TREASURE

TREASURE

For an ethnography of the automotive

Selection of contributions, 2021-2024

Edgeryders

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TREASURE

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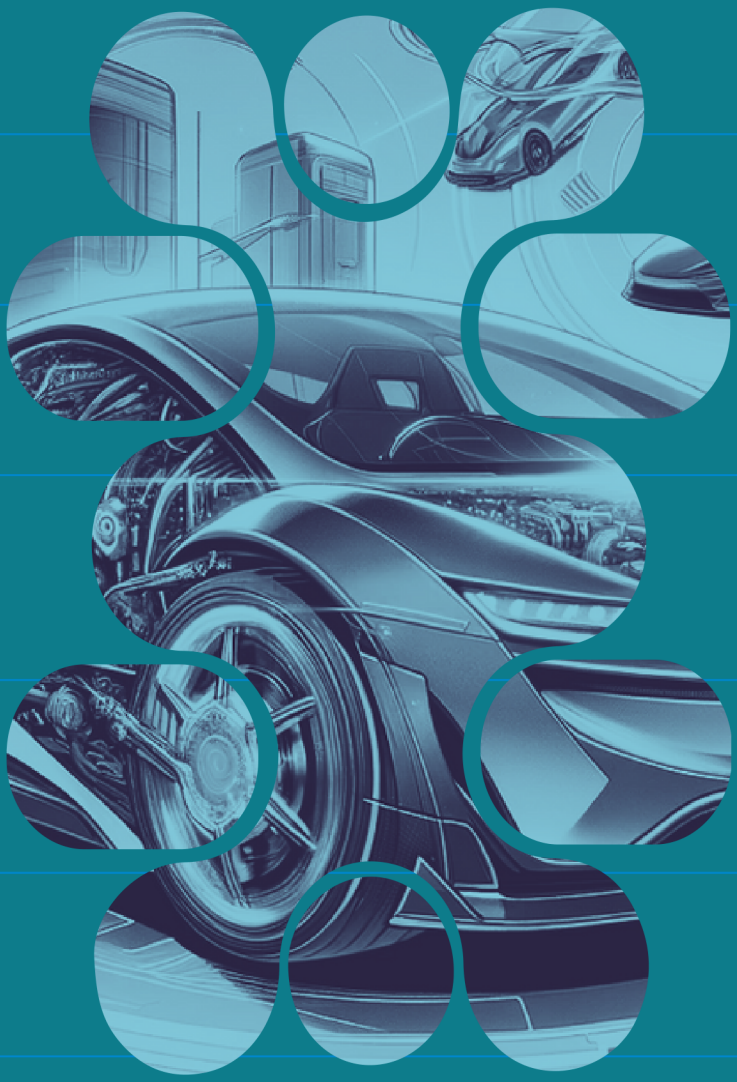

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OUR CONSORTIUM PARTNERS:
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TNO FOR LIFE
ISTITUTO CIRCE - UNIVERSIDAD DE ZARAGOZA
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SEAT SA
TXT E-SOLUTIONS SPA
INDUSTRIAS LÓPEZ SORIANO SA
UNI ENTE ITALIANO DI NORMAZIONE
NEXT MOVE

ORGANISERS OF THE EVENTS USED FOR DATA COLLECTION:
TECHNORAMA ULM
FRANKFURTER AUTOMOBILAUSSTELLUNG
AUDI MEETING KREFELD
THE AUTOMOTIVE TOPCAREER STUTTGART
CARS MEET PHOTOGRAPHERS IN ALLSTED
4WD FESTIVAL OSS
BERN USER FORUM ON CIRCULAR ECONOMY
INTERNATIONAL AUTOMOTIVE RECYCLING CONGRESS LEIDEN
GREENTECH FESTIVAL BERLIN
TECHBLIK BERLIN
BW KONGRESS STUTTGART
NEOL

ALL MEMBERS OF THE EDGERYDERS COMMUNITY, THE PARTICIPANTS IN THE INTERVIEWS AND CONVERSATIONS ON OUR PLATFORM, AS WELL AS ALL THOSE WHO SUBMITTED THEIR WORKS IN OUR OPEN CALL FOR SHORT SCIENCE FICTION STORIES, FOR MAKING THIS RESEARCH POSSIBLE BY THEIR PRESENCE AND THEIR SUPPORT.

WORKS COLLECTED BY EDGERYDERS
ILLUSTRATIONS INGE SNIP

Foreword

EDGERYDERS joined the TREASURE Consortium as its fourth Horizon project. After OpenCare, NGI Forward, and POPREBEL, which all had a significant social component inherent in their structure, TREASURE had an industrial core.

Almost all partners were scientific faculties of different universities, recyclers, and avant-garde enterprises in metal and electronics recycling, including one of the world's major car producers.

At the same time, TREASURE explored sustainability and circularity in one of the most strategic sectors, touched by profound transformation, continuous concentration, and technical improvement. It worked on practical technological solutions for some of the very human questions we had encountered and researched throughout all our projects.

Sustainability and sustainable behaviour, concerns over environmental pollution, careless exploitation of resources, then fragmented agency, concerns over data security, distrust of politics in general, and automotive politics in particular. On the other front, we could explore nostalgia, the affective or utilitaristic approaches to cars and mobility in general, the sense of displacement or alienation caused by the social use of technology, electronics in particular, and the enthusiasm about the possibilities it offers.

While all the other partners were working on the machines, using robots, dealing with in-mould electronics, harvesting precious metals and building advanced software platforms, we were researching the humans.
The research was conducted from different points of view - interviews with car enthusiasts and experts such as Jean-Denis Curt, Paul Nieuwenhuis and others, specialist articles, Edgeryders platform conversations, and our special little corner of speculative fiction.

It also proved ethnography's special ability to dig out the "unknown unknowns" and illuminate the most salient nodes in the network of codes, which could have appeared contradictory or disconnected at first glance. The ethnographic report describing in detail our research, the findings and recommendations has been published as one of the deliverables of the project D4.6 - Report on the ethnography of CE in the automotive industry (the final version). Generated datasets will be available on Zenodo after the end of May 2024.

This publication serves a more illustrative purpose and shares some of the most representative materials collected together with a general overview of the research activity and the semantic social networks analysis methodology.

Ivan Cukerić
Brussels, May 2024

TREASURE PROJECT

The automotive industry navigates the complexities of a rapidly evolving technological landscape and heightened environmental concern.

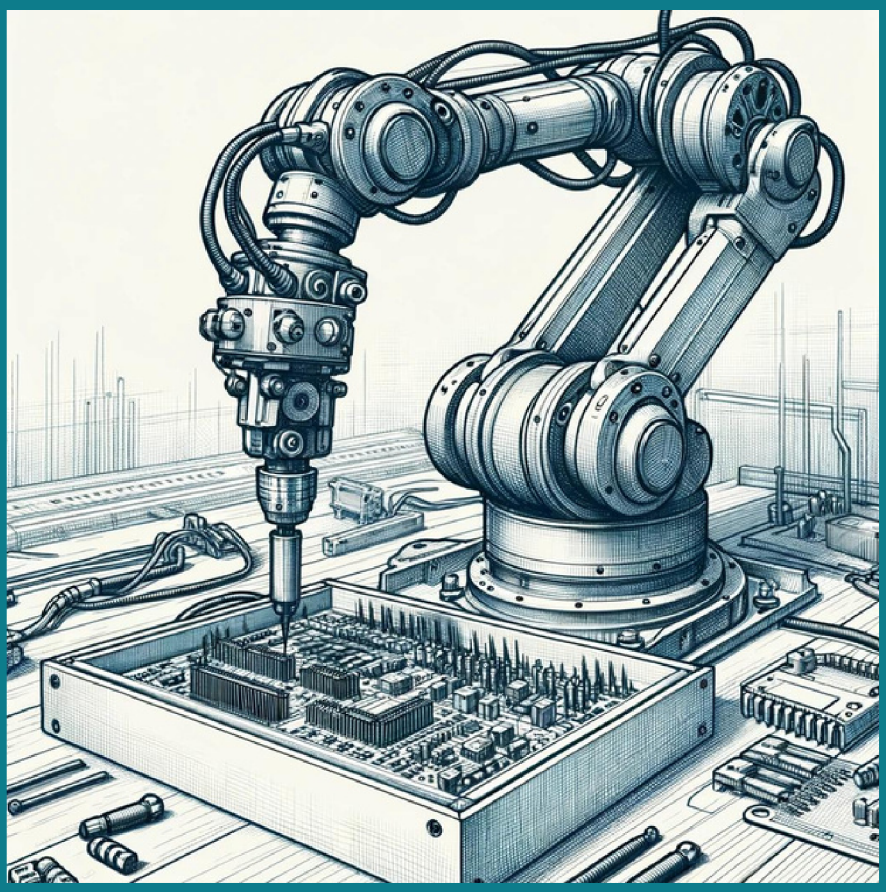
TREASURE (leading the TRansition of the European Automotive SUpply chain towards a circulaR futurE) was a 3-year- Research and Innovation Action co-funded by the European Commission under the H2020 programme willing to offer new opportunities for testing innovative technologies to make the automotive sector more circular.

As the automotive industry navigates the complexities of a rapidly evolving technological landscape and heightened environmental concerns, the need for a paradigm shift towards sustainable practices has become increasingly evident. By addressing the existing knowledge gap and empowering industry stakeholders to make informed decisions, TREASURE aimed to revolutionize the industry, fostering a future characterized by efficiency, environmental responsibility, and sustainable growth.

Objectives

- Guaranteeing a sustainable use of raw materials in the automotive sector, by reducing material supply risks
- Adopting in practice the circular economy paradigm in the automotive sector, by acting as demonstrators for the manufacturing sector
- Offering better vehicle-related economic, environmental and social performances to all the end users
- Creating new supply chains around End-of-Life Vehicles (ELVs), by focusing on a circular exploitation of raw materials embedded into cars

TREASURE solution can assist both car parts suppliers and carmakers in assessing their design decisions in terms of circularity level, also considering the effects of their decisions on EoL processes. Vice versa, car dismantlers and shredders could benefit from the TREASURE solution by knowing about new design features of cards to be recycled in order to optimise their processes.



Furthermore, this solution will define and exploit a new sustainability and circularity assessment methodology to quantify environmental, economic, social and CE-related performances through a set of dedicated KPIs. Based on these indicators the solution moreover offers an advisory framework that supports the decision-making process of designers, recyclers and dismantlers.

TREASURE concretely support companies in the automotive sector, by demonstrating in practice the benefits obtainable from the adoption of the circular economy paradigm both from a business/supply chain and from a technological/sustainability point of view, through the adoption of Industry 4.0 technologies in ELV management processes.

TREASURE achieved three main results:

- Developing a digital platform powered by an AI-based scenario assessment tool providing a digital layer supporting the information exchange and intelligence for the development of circular supply chains in the automotive sector.
- Representing a set of success stories in three key value chains of the automotive industry, as dismantlers/shredders, recyclers and manufacturers, by demonstrating the benefits coming from the adoption of CE principles in the automotive sector
- Integrating Key Enabling Technologies (KETs) for the efficient design of car electronics and subsequent disassembly and materials recovery

TREASURE Consortium was coordinated by Politecnico di Milano and formed by a group of 15 organisations from 7 European countries:

Politecnico di Milano, Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek (TNO), Universidad de Zaragoza, Scuola universitaria professionale della Svizzera italiana (SUPSI), Università degli Studi dell'Aquila, MARAS B. V. Material Recycling and Sustainability, Edgeryders OÜ, EuroLCDs SIA, Walter Pack SL, Pollini Lorenzo e Figli srl, SEAT SA, TXT E-Solutions spa, Industrious López Soriano SA, Ente Nazionale Italiano di Unificazione and Next Move.

ABOUT EDGERYDERS

> A distributed think tank that uses collective wisdom to develop a transformative approach to diverse challenges.

Edgeryders is what we describe as a collective intelligence company.

It is a distributed think tank, a global online community, a socially driven enterprise fostering collaboration, empowerment and transformative approaches to diverse challenges.

It is also *an ethnographic research unit*, connecting academia, hackers, activists, and innovative thinkers.

The social enterprise and non-profit dimension provide meaningful employment opportunities to community members and in exchange uses their collective expertise to drive impactful initiatives.

As a not-for-profit entity, Edgeryders reinvests profits into community-centric initiatives, embodying its service ethos.

We base our consultancy activity on four pillars of engagement:

RESEARCH

Scholars collaborate across disciplines through the Edgeryders Research Network, leveraging collective intelligence for interdisciplinary inquiry. To this end, we developed our Semantic Social Network Analysis methodology, which was successfully used within the TREASURE project.

DEEP LISTENING

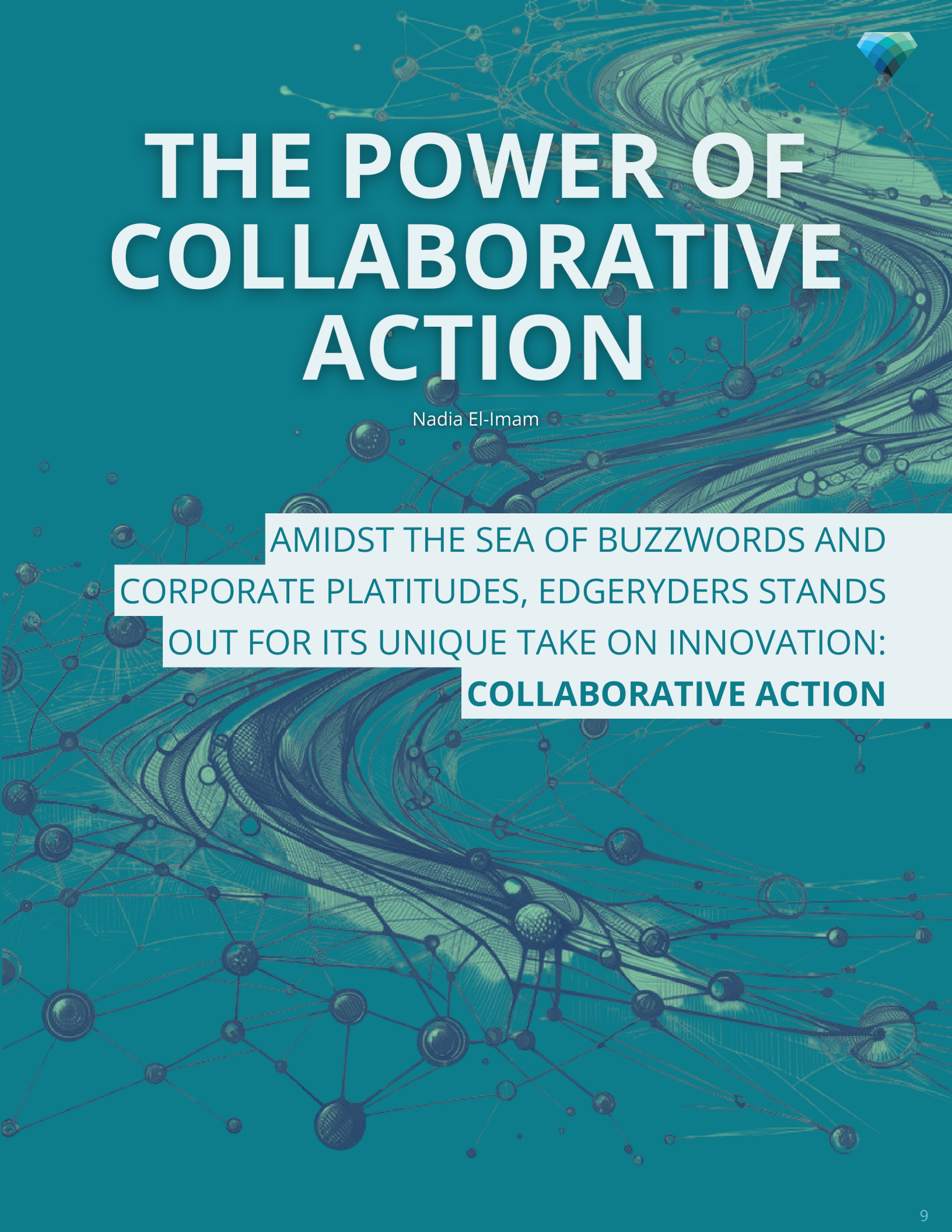
Grounded in their approach to collective intelligence, Edgeryders fosters open, constructive dialogue, facilitating meaningful conversations at both organisational and societal levels.

REMOTE AUTONOMOUS WORK

Drawing from their own distributed model, Edgeryders advocates for and assists in implementing remote work strategies, enhancing autonomy, productivity, and organisational cohesion.

FUTURE ECONOMIES

Anticipating the shifts towards digital and green economies, Edgeryders employs a blend of science fiction storytelling and rigorous economic analysis to envision and shape participatory scenarios for future economic landscapes.



THE POWER OF COLLABORATIVE ACTION

Nadia El-Imam

AMIDST THE SEA OF BUZZWORDS AND CORPORATE PLATITUDES, EDGERYDERS STANDS OUT FOR ITS UNIQUE TAKE ON INNOVATION: **COLLABORATIVE ACTION**

The beauty of Edgeryders: in the chaos and cacophony, innovation thrives

In the corporate world, innovation is often touted as the silver bullet for success. But amidst the sea of buzzwords and corporate platitudes, Edgeryders stands out for its unique take on innovation: Collaborative Action.

Edgeryders isn't a corporate think tank. It's a diverse community of individuals—some might call them misfits—united by a common goal: solving real-world problems through hands-on collaborative action.

At its core, Edgeryders believes that the best ideas don't come from corner offices or boardrooms but from the trenches, where people are facing real challenges every day. And they've proven this belief through past projects like the UnMonastery and OpenCare.

The UnMonastery project, for example, took abandoned buildings and turned them into collaborative living and working spaces. It was a grassroots approach to addressing unemployment and social isolation, driven by a DIY ethos and elbow grease.

Similarly, OpenCare was all about revolutionising healthcare delivery. By bringing together a diverse group of participants—from techies to patients to caregivers—Edgeryders created innovative solutions to healthcare challenges, from mental health support networks to community-based care models for the elderly.

But what sets Edgeryders apart isn't just the projects—it's the people. Community events provide a meaningful alternative to corporate retreats, authentic engagement through a program built by and for the individual participants through a slow and thoughtful process during the months leading to the event as opposed to strange corporate retreats where employees are forced to endure contrived attempts at building team spirit.

Edgeryders is a melting pot of personalities, where eccentricity is not just tolerated but celebrated while allowing collaboration and connection to emerge at individual pace.

Sure, things can get messy. With so many voices to be heard, it isn't always easy to find common ground. But therein lies the beauty of Edgeryders. In the chaos and cacophony, innovation thrives. It is like a Darwinian experiment in business, where only the strongest ideas survived.

So, the next time you find yourself stuck in a brainstorming session, staring at a whiteboard and wondering where the next big idea will come from, remember Edgeryders. Remember that sometimes the best ideas come not from the boardroom but from the streets. And remember that collaborative action isn't just a buzzword—it's a way of being with others, even as Edgeryders continues to forge ahead, building on its past successes to shape a brighter future.

SSNA AND GRAPHRYDER

Meaningful conclusions from thousands of interactive citizen and stakeholder contributions

Stakeholder consultations and citizen engagement platforms can collect vast data, including opinions, questions, interests, and preferences.

Transforming this data into knowledge depends on using the proper tools and methods.

The surveys, like the Eurobarometer, are precise and work well on scale. But they cannot provide one insight—the reasoning behind the answers to the questions asked.

Suppose the question is, "How do you feel about immigration from another EU state?" When we collect the answers, we may see that people feel unhappy, moderately happy, or ecstatic about it. We will not be able to say why that is so. This approach is blind to novelty and to the "unknown unknowns."

Platforms like *Fit for Future* or *Have Your Say: Simplify!* on *Better Regulation* are well-crafted tools that can transform concrete suggestions into practical use and policies rooted in reality if they can find a way to understand and isolate the critical contributions from the less important ones.

It answers questions you did not know should be asked in the context of complex themes with no apparent boundaries around them.

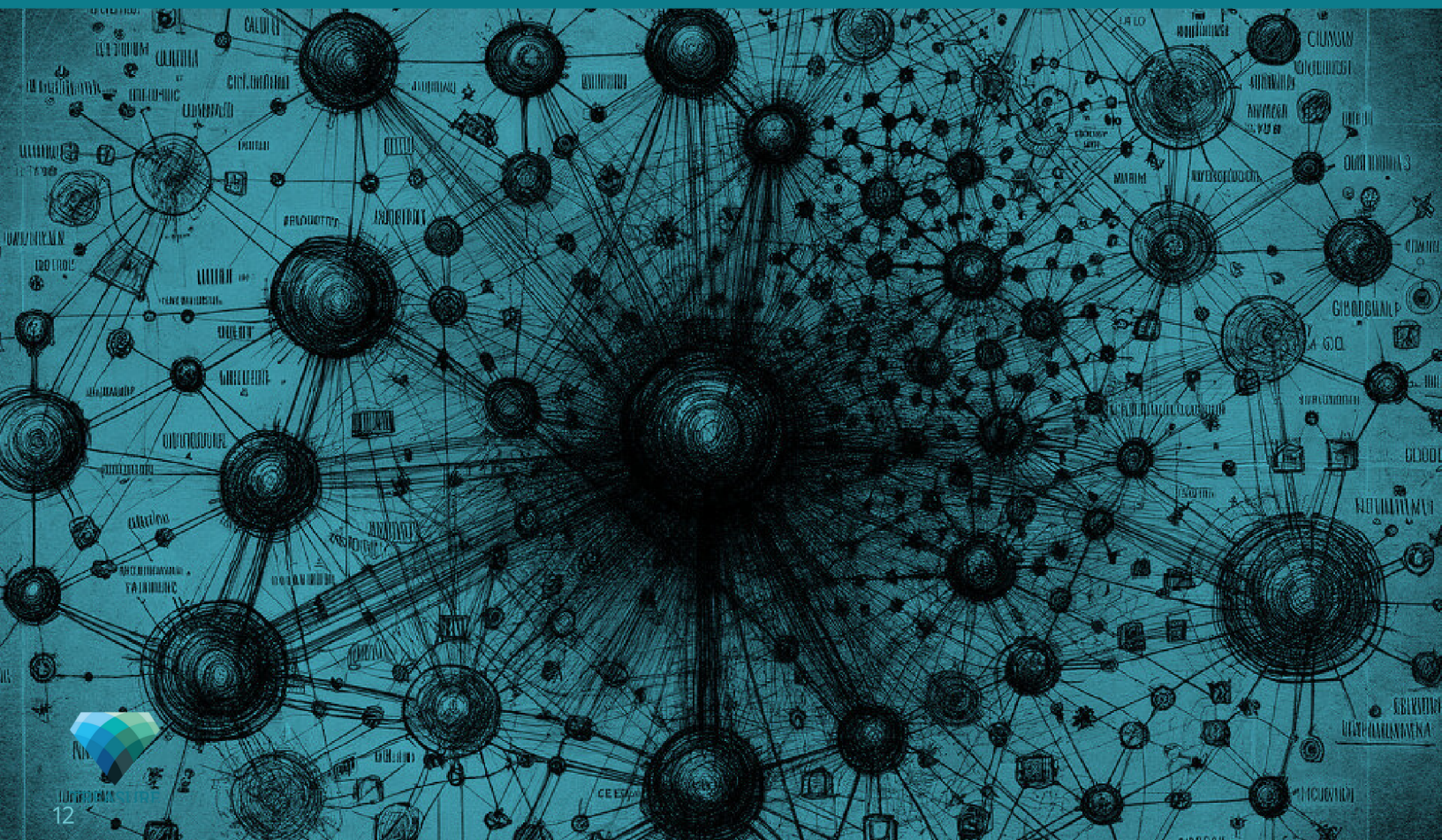
To do so, we at Edgeryders developed a tool and a methodology that combines ethnography and network science called Semantic Social Network Analysis (SSNA). It allows us to draw meaningful conclusions from thousands of interactive citizen and stakeholder contributions on a public forum. It goes deeper and shows us the links between them from a bigger-picture vantage point.

It answers questions you did not know should be asked in the context of complex themes with no apparent boundaries around them. It is a research methodology of structured deep listening that works well in a participatory environment.

It is open source, self-hosted, GDPR compliant, open to various input methods and languages, and ensures ethical consent.

We have successfully tested it in the last ten years through World Bank, UNDP, and EU-funded projects on themes such as healthcare & social security, the Next-Generation Internet, the social consequences of rising political phenomena in Europe, or as here, on the rising questions about the circular economy in the automotive world.

a research methodology of structured deep listening that works well in a participatory environment



TREASURE Research design and methods

Veronica Davidov

The ethnographic method, primarily associated with sociocultural anthropology, is designed to draw out nuances and layers of cultural meaning from the perspective of those studied, allowing insight into how specific communities perceive and interact with the world.

While historically focused on non-Western cultures, and still sometimes associated primarily with fieldwork in a remote village setting, contemporary ethnography now encompasses Western societies and "modern" topics including sustainability, infrastructure, and technology. This ethnographic study examines the circular economy in the automotive industry using the "event ethnography" approach, in particular, interviews in themed event settings. Event ethnography, particularly in large-scale environmentally-themed events, has proven fruitful for researchers (see Campbell et. al 2014, for example). Multi-event ethnography has been shown to provide diverse insights, enhancing understanding of complex topics like sustainability and circular economy principles.

This approach facilitated holistic contextualization, critical issue identification, and a comparative framework over the two phases of the project.

Employing mixed-methods, our ethnographic data from interviews was transcribed, coded, and analyzed using network science techniques. This approach offers a comprehensive understanding of discourses and meaning production within cultural contexts. By combining ethnography with other methods, we were able to map out areas of consensus and patterns of discourse. The reason for this two-phase approach is that understanding the context surrounding electric car parts and their sustainability requires insights from both industry professionals and sustainability experts. So, interviews with car enthusiasts and sustainability-focused individuals offer complementary and mutually contextualizing perspectives, aiding in the identification of key issues and facilitating comparative analysis.

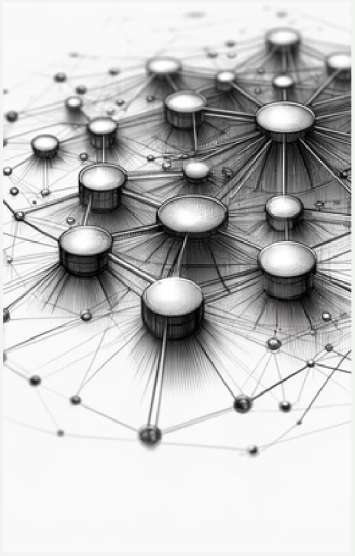
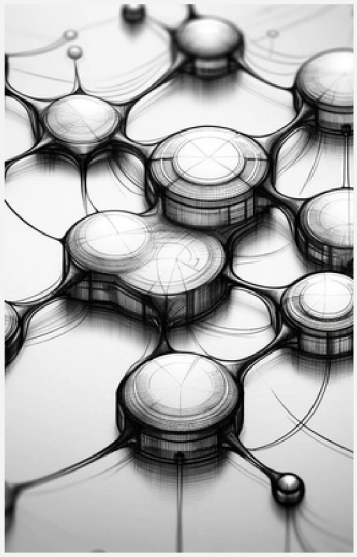
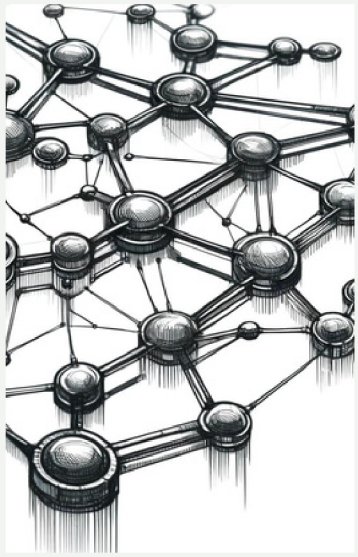
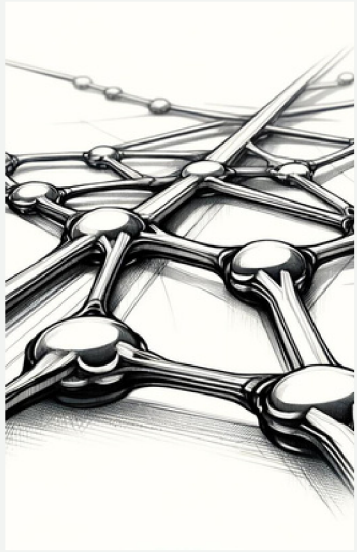
Open calls, interviews, and creative interactive events, such as "Ask Me Anything" presentations from experts, and a speculative fiction short story contest

Our event ethnography approach was augmented by data collection through a "community journalism" program. The program aimed to engage the public in discussions on circular economy and automotive themes, facilitated by trained community managers. We used open calls, interviews, and creative interactive events, such as "Ask Me Anything" presentations from experts, and a speculative fiction short story contest, to generate content for the forum. A dedicated website, Edgeryders Treasure, was created for outreach and data access.

Unlike standardized event ethnography interviews, data from these events was not coded uniformly. Instead, we relied on participant observation to gather insights due to the variability in structure and engagement methods.

"By combining ethnography with other methods, we were able to map out areas of consensus and patterns of discourse."

COMBINING ETHNOGRAPHY AND NETWORKS FOR COLLECTIVE INTELLIGENCE AT SCALE

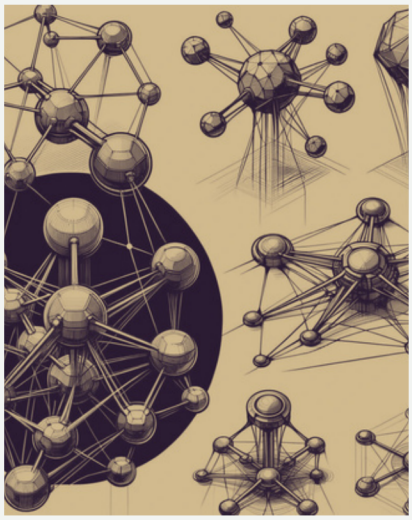





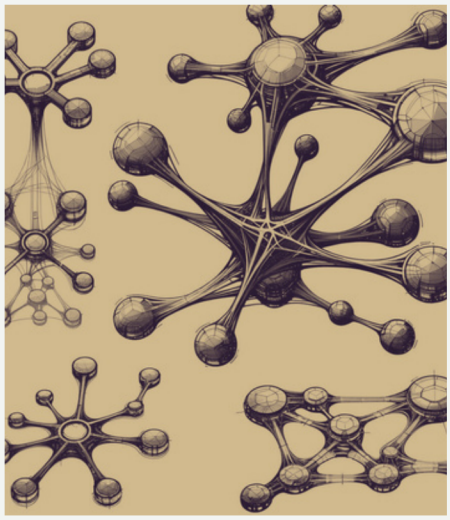
SSNA USES ETHNOGRAPHY TO STUDY HUMAN INTERACTION AND BEHAVIOUR, EXAMINING THE COLLECTED DATA THROUGH A NETWORK SCIENCE PRISM AND PROVIDING AN OVERVIEW OF MEANINGFUL INTERACTIONS WITHIN COMPLEX TOPICS. THE PROCESS IS LINEAR AND STRAIGHTFORWARD, BUT THE METHODOLOGY ALLOWS FOR UNEXPECTED DEPTHS.

Our participatory platform provides integrated data collection, elaboration, and visualisation tools. Here, the interested groups are engaged in large, open conversations without the constraints of static predefined questions. These conversations work on a scale of hundreds of participants and thousands of contributions.
Trained interviewers or community managers collect significant data relative to the topics discussed. The data may be transcriptions from event ethnography sessions, diaries, images, online forums, etc.
Professional ethnographers encode the data and isolate the discussion topics, providing a zoomed-out perspective. The codes and annotations are processed through specific software to produce visualisations of the connections between them. The results and their connections are visualised in a simple manner—in the form of graphs, easily shared and reused on many occasions.

The work of professional ethnographers — and not AI algorithms — allows coherent handling of qualitative data and a deeper level of knowledge gathering. It provides timeliness — the possibility of dealing with phenomena almost in real-time.

Open data and the shared ontology of codes guarantee the legitimacy, reliability, and coverage of legally used data. The results are published on Zenodo, a solid scientific repository integrated with OpenAIRE, so reviewers can view everything. It is completely transparent, and all the statements and findings can be easily traced back.





WHAT IS IT GOOD FOR?

Imagine that you had to respond to these questions:

- What would it feel like to live in a post-green transition society?
- What would your work day look like?
- Would you have to give up your private car? How would you get to work?
- Would you have to relocate from the suburbs to the city centre?
- What would your children's schools be like?
- Would your consumption habits have to change?
- What about the privacy of your data?
- What are the hidden costs and benefits?

We don't know what the answers or the reactions would be, but should not assume there is no dissent only because it is not apparent. As concrete policy choices are made, we are likely to see significant political reaction and attempts to stop the policy in its tracks.

The answers to these questions lie below the surface, and can be unveiled only through analysis of open conversations where topics that touch individual interests may find their collective dimension, evolve into new forms, connect to completely unexplored paths, and draw unexpected conclusions.
This kind of conversation must be sufficiently large to provide significant data to examine. Once all the dots are isolated and the tags placed, the links may still not be apparent.

Semantic Social Network Analysis operates here—it eliminates the noise, isolates the nodes, connects the arguments, and illuminates the concepts, driving the collective intelligence out in the open, making it simpler to understand.

FROM DATA TO INSIGHT

Pierre-Yves Koenig

The ethnographer adds information that enables the construction of a semantical network

Coding: Researchers start by coding segments of text from interview transcriptions. Codes are essentially labels or categories that capture specific themes, concepts, or ideas present in the interview.

Linking: Links between nodes are established based on the co-occurrence of codes within the same segment of text. If two codes appear together in the same interview, a link is created between the corresponding nodes.

Network Reduction: According to the size of the network, a visual analysis could be still hard and a process of network reduction is required:

- A first approach to network reduction is based on filtering out the weakest links, i.e. those that indicate relatively low numbers of co-occurrences in the corpus.

Network Visualization: From the reduced network, a first visualisation can be produced. This visualisation typically takes the form of a diagram where nodes are represented as points, and links are represented as lines connecting those points.

Node Identification: Each unique code becomes a node in the network. These nodes represent the concepts or themes identified through coding.

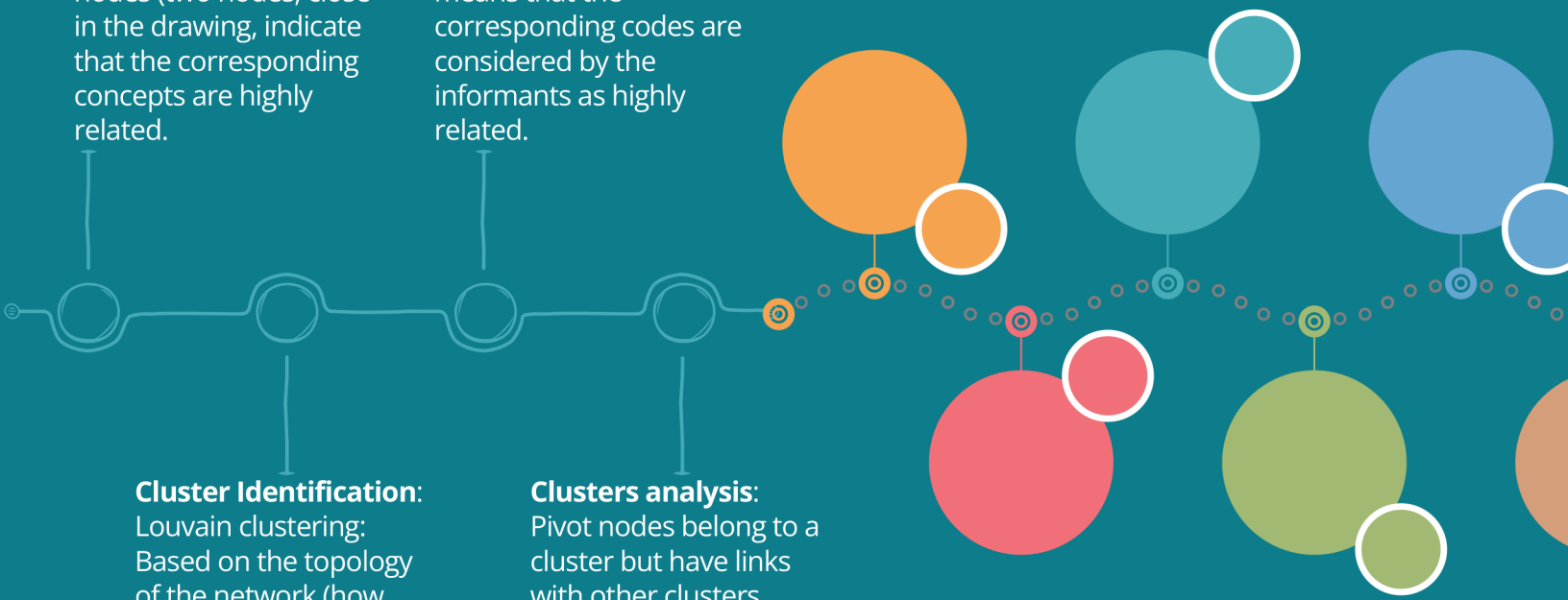
Link Simplification: Once all interviews are coded and links are established, the first version of a network is ready for analysis. However, this network could be huge and hard to analyse. Several links could be present between the two codes. Replacing these many links with one weighted link decreases drastically the overall number of links and ends up with a simplified network.

Network Reduction: An alternative approach to reducing the network based on link strength is to count, across the whole corpus, the number of informants that have associated each pair of codes in a single answer.

Refinement loop: The visualisation allows ethnographers to improve their coding, by merging codes that are two related or split concepts by specific codes. After several loops of ethnographer modifications and network reconstruction, a final network is ready for further analysis.

Cluster Identification: Layout identification: According to the layout algorithm, the position of nodes in the 2D space could reflect the similarity between nodes (two nodes, close in the drawing, indicate that the corresponding concepts are highly related.

Clusters analysis: A cluster is made of highly connected nodes indicating that corresponding codes represent a small community. In the TREASURE context that means that the corresponding codes are considered by the informants as highly related.



Cluster Identification: Louvain clustering: Based on the topology of the network (how nodes are connected together through small networks), clusters could be automatically identified.

Clusters analysis: Pivot nodes belong to a cluster but have links with other clusters. They indicate how bigger concepts (clusters) are linked together

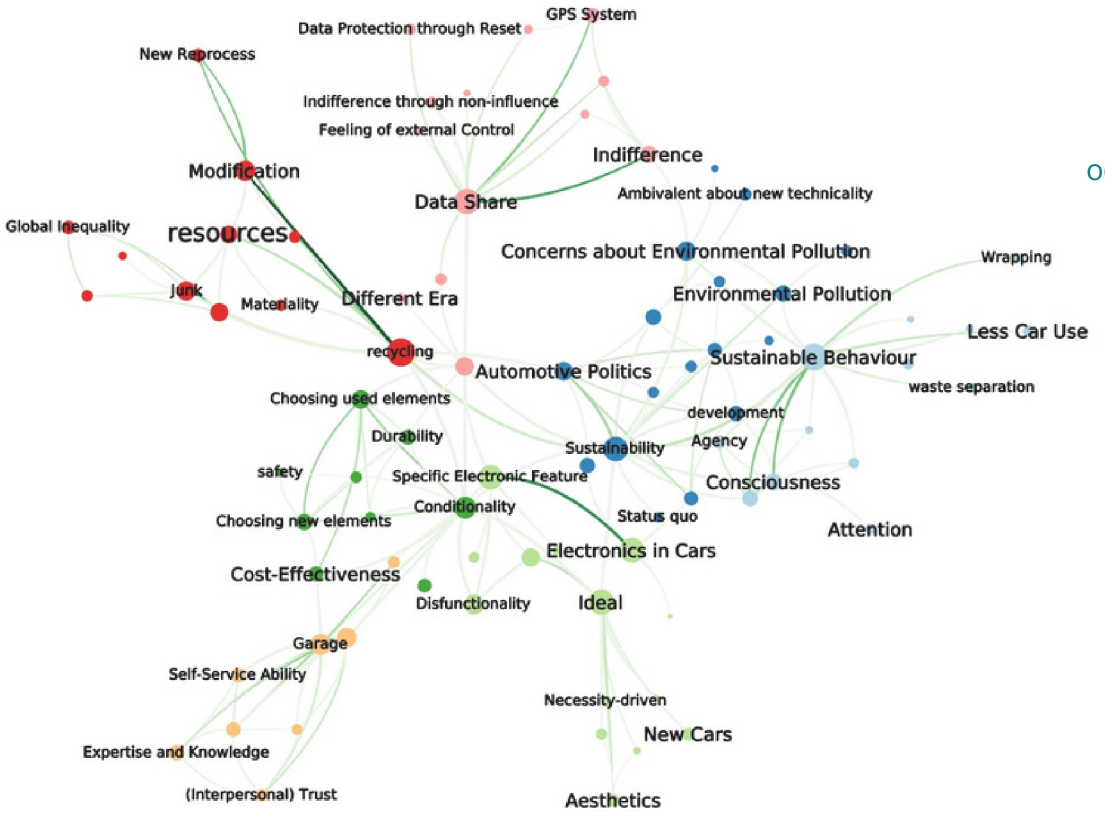


Figure 1.

The reduced codes co-occurrence network of the TREASURE corpus (96 nodes, 190 links). The network resolves quite naturally into seven communities of codes, coded by colour.

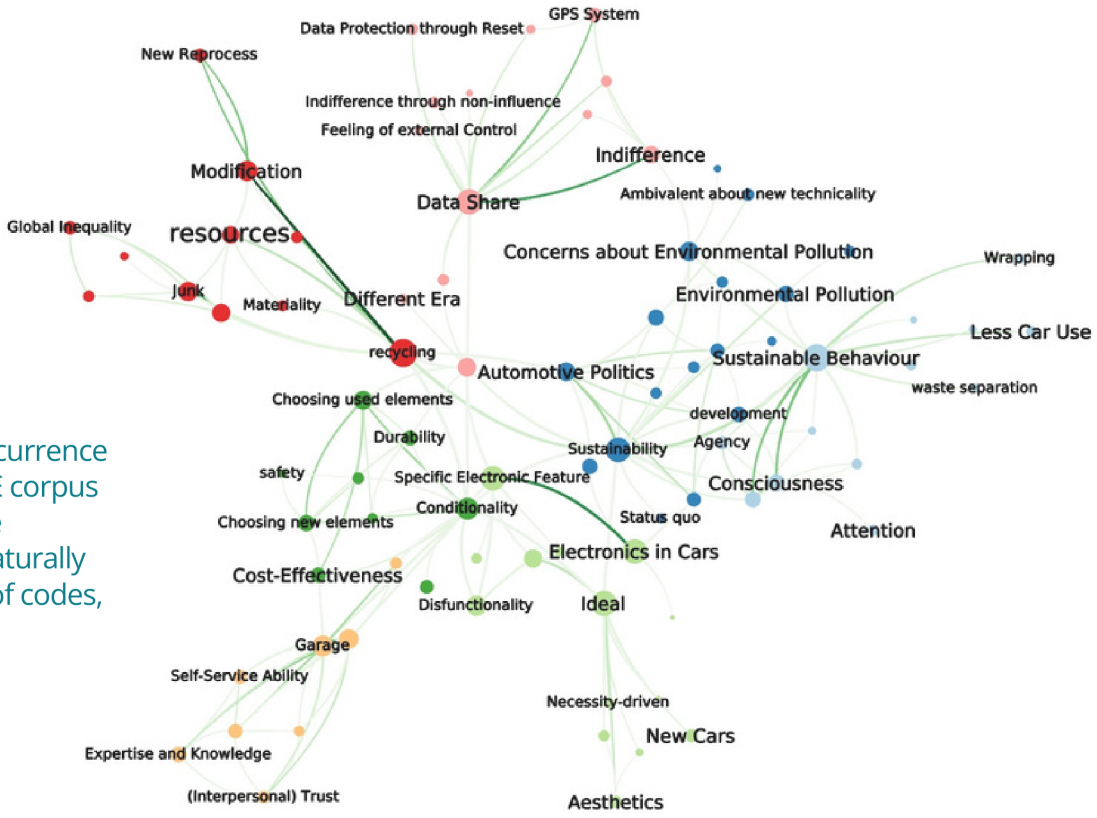
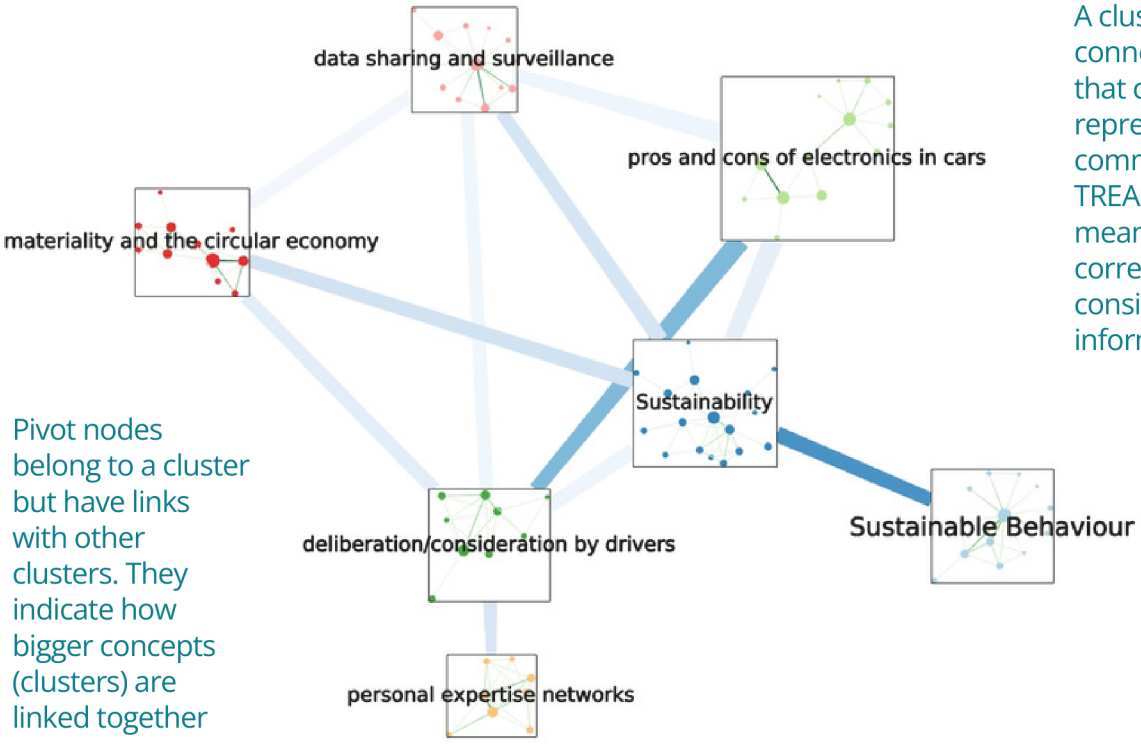


Figure 2.

The reduced codes co-occurrence network of the TREASURE corpus (85 nodes, 176 links). The network resolves quite naturally into seven communities of codes, coded by colour.

Figure 3.
Focus on code 'ethical consumption' showing its close neighbours.



A cluster is made of highly connected nodes indicating that corresponding codes represent a small community. In the TREASURE context that means that the corresponding codes are considered by the informants as highly related.

Pivot nodes belong to a cluster but have links with other clusters. They indicate how bigger concepts (clusters) are linked together

FROM ETHNOGRAPHIC EXPERIENCE TO ANALYSIS

Ethnography represents individual components of the bigger picture

Sirin Knecht

During my ethnographic work on the Treasure project, I categorised my activities into two primary domains: conducting data analysis and utilising the event ethnography methodology. Ethnographic investigations entail deeply immersing oneself in the communities under study, aiming to grasp their beliefs, rituals, and traditions while capturing the intricate nuances of human social interactions.

Events in this ethnography represent individual components of the bigger picture: they showcase unique cases and diverse viewpoints yet reveal underlying similarities and commonalities. Ethnography's strength lies in its specificity, enabling the derivation of general trends from individual instances.

An intriguing observation was that I could somewhat infer participants' professional backgrounds or areas of expertise during the interview coding process. Their manner of discussing topics, choice of words and imagery, and distinct focus on certain themes compared to other attendees shed light on their backgrounds. For instance, enthusiasts at car shows exhibited profound emotional attachment and attention to detail when discussing engine specifics, while Techblick attendees delved into electronics innovations and complexities.

On the other hand, the BW Congress in Stuttgart centred on recycling processes and environmental dedication. This was clearly demonstrated by the culture of recycling in everyday life and the methods of producing less waste and/or using waste sustainably or separating it for reuse.

One of the most striking findings of this ethnographic research was the wide range of personal perspectives on environmental issues and global obligations. These perspectives often revealed a noticeable inclination towards European dominance over the Global South and sparked discussions on power imbalances. For instance, the observations highlighted a clear discrepancy between pollution in Europe and outside Europe and the collection of pollution data. There was also a strong awareness and a clear lack of understanding of the outsourcing of various forms of waste disposal to the Global South, which requires political attention.

What I take away from this ethnographic project experience is that there are very big differences and a variety of understandings of environmental protection and related environmentally conscious behaviour about the circular economy. Even though one's perspective is individual and always situational, it was surprising how similar and different certain ideas were and how they contradicted each other collectively and individually. I also realised that one's own positionality and situational knowledge (Harraway, 1988) are crucial in sharpening one's view of global debates and issues.

This also applies to data analysis, i.e. for me as an ethnographer. It was first a challenge to code responses to questions I did not ask, to events I did not attend and, above all, to analyse data for an interdisciplinary team in a way that others could see the logic. At the same time, I was surprised at how I gained knowledge about others and the collaboration through shared data analysis and how I could delve deeper into the topic over time through constant evaluation, discussion and in-depth analysis (see Harraway, 2017). Seeing the data analysis as a collaborative project and a shared journey, with constant changes and seeing my own parts of the analyses provide visual insights was one of the most exciting aspects of the project.

COMMUNITY JOURNALISM PROGRAM

The community journalism program gathered expert opinions and insights on circularity in the automotive industry through webinars, workshops, and AMAs.

This material was actively used to 'seed' a dynamic, forum-based exchange about circularity in the automotive industry.

The following chapter presents a selection of the most relevant contributions.

- **Paul Nieuwehnhuis - Navigating the Past, Present, and Future of the Car Industry,** by Inge Snip
- **Embracing the Circular Economy,** AMA event with Jean-Denis Curt
- **Circularity and the Automotive Sector,** by Caroline Samberger
- **Sustainability and Circular Economy Challenges in the Automotive Industry,** by Vukasin Herbez

WINNERS OF THE SHORT STORY CONTEST

- **The Shop,** by Ebele Mogo
- **Circular Reasoning,** by Kyle Montanio

NAVIGATING THE PAST, PRESENT, AND FUTURE OF THE CAR INDUSTRY

Inge Snip

Paul Nieuwenhuis at Edgeryders' event 'Can we create a sustainable future with cars?

Paul Nieuwenhuis is co-director of the Centre for Automotive Industry Research at Cardiff Business School and the Electric Vehicle Centre of Excellence, both at Cardiff University. He has a long track record of studying the impact of cars on our environment and has published a string of books and articles on this topic.

In the vast expanse of modern society, the automobile has emerged as technological innovation, personal freedom, and socioeconomic progress. The fascinating interplay between cars, their users, and the global environment can't be understated, as Paul Nieuwenhuis, an acclaimed expert in the automotive and environmental sectors, recently expounded at Edgeryders' event 'Can we create a sustainable future with cars?' on January 25th.

From its inception to its current crossroads, the automotive industry's journey paints a picture of ingenuity, resilience, and adaptability. As we navigate the future, the lessons from its past and the potential of innovative models, like localized production, can be our guideposts. The urgency of addressing environmental issues may be the catalyst driving us towards a greener, more sustainable future for the world of cars.

A DRIVE DOWN MEMORY LANE: UNDERSTANDING THE AUTOMOTIVE EVOLUTION

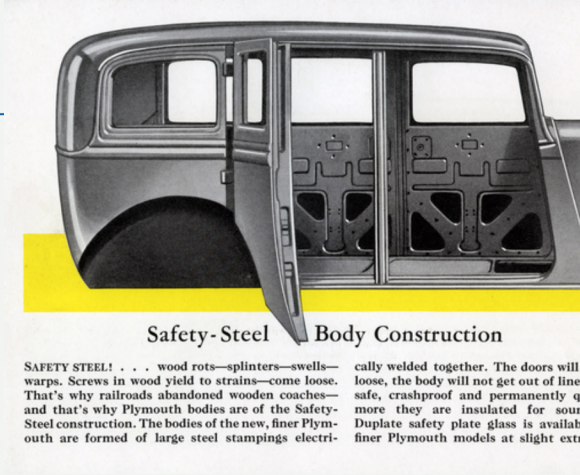
Cars have been emblematic of human progress for over a century, epitomizing technological advancement and societal change. Their journey from Henry Ford's assembly lines to today's global giants reveals an intricate tapestry of innovation, economics, and adaptation.

In the early 1900s, Ford's pioneering Model T brought automobiles to the masses. However, the initial methods of mass-producing car bodies, largely wooden, posed substantial challenges. Enter figures like Edward Budd, whose innovations in all-steel car bodies transformed the sector. The switch to steel revolutionized car manufacturing economics, demanding scale like never before.

Contemporary behemoths like Volkswagen, Toyota, and emerging contenders like Tesla are testaments to the car industry's relentless evolution. Yet, the question remains: What lies ahead for this colossal industry as the world confronts environmental crises?

Paul, a seasoned industry insider, recently unpacked the myriad layers of the global automotive landscape, emphasizing its ecological conundrums, at the Edgeryder's event 'Can we create a sustainable future with cars?'

The bulk of the industry's wealth lies in the aftersales sector, often overlooked by manufacturers



One salient point he raised pertains to car shipping. Envision vast roll-on/roll-off ships, ferrying up to 5,000 cars from one continent to another. Such shipping methods, while efficient, have inherent flaws. The flat design of these vessels can lead to stability issues, risking significant wrecks. Thus, automakers lean towards local production wherever there's substantial market demand.

Peeling back the layers of the automotive value chain, Paul revealed that the bulk of the industry's wealth lies in the aftersales sector, often overlooked by manufacturers. He also candidly discussed emerging competitors, notably from China, who are increasingly pressuring industry stalwarts.

LOCALIZED PRODUCTION: A GLIMPSE OF THE FUTURE?

Steering the dialogue to future possibilities, the idea of localized car production emerged. Paul pointed to the budding model of "micro-factory retailing," underscoring its emphasis on localized production and distribution. This decentralized approach, while nascent, could usher in a wave of sustainability and efficiency.

However, environmental challenges are multifaceted. Paul eloquently traced back to when cars were celebrated as cleaner alternatives to horses, only for their damaging emissions to be scrutinized later. As Paul outlined, while most car emissions might be innocuous, a small fraction contains severely harmful substances. These alarming revelations spurred regulatory interventions dating back to the 1960s in California.

REVOLUTIONIZING THE STREETS: DECIPHERING CARS, CULTURE, AND CLIMATE CHANGE

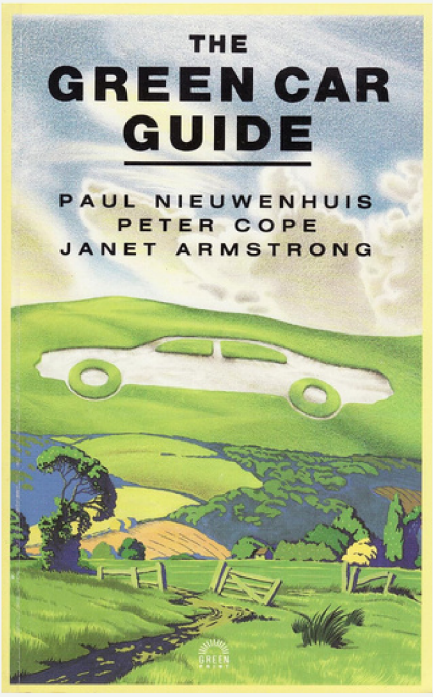
Throughout the 20th century, cars became not just a mode of transport but also a canvas of expression, weaving personal aspirations, economic ambitions, and societal transitions. But as the century drew to a close, a looming shadow emerged – the tangible effects of climate change, compounded by the carbon emissions from these very symbols of progress.

By 2007, when self-regulation faltered, and automakers lagged behind their own promises to cut carbon footprints, the regulatory baton was picked up by governments. European standards emerged as an archetype, inspiring other nations like China. These regulations, Paul highlights, underlined a pressing truth: as of 2020, cars remained the predominant culprits of transport-induced greenhouse emissions.

Yet, the implications of the automotive industry extend far beyond the environment. Urban locales like Phoenix have seen their cityscape molded around the automobile, dedicating vast expanses to roads and parking lots.

Political landscapes, too, have shifted, with alliances often forged based on oil needs, overshadowing ideological or human rights considerations.

Paul's earlier venture into crafting an environmental rating system for cars in the 1990s was a noteworthy attempt to promote sustainability. But as the global focus narrowed on CO2 emissions, the broader environmental lens grew somewhat dim.



Peeling back the layers of the automotive value chain, Paul revealed that the bulk of the industry's wealth lies in the aftersales sector, often overlooked by manufacturers. He also candidly discussed emerging competitors, notably from China, who are increasingly pressuring industry stalwarts.

A poignant observation from Ivan highlighted the broader ramifications of China's electric vehicle (EV) initiatives. China's emphasis on EVs, as Paul elucidated, stemmed from a strategic pivot away from traditional combustion technology. Yet, while promising, this shift isn't without its challenges, promising ample discussions in the future.

Another intriguing aspect was the issue of low car occupancy rates, as observed in countries like Germany. Matthias's query about potential regulations prompted an exploration into market dynamics, which often endorse larger vehicles over efficient carpooling systems.

In his conclusion, Paul took a philosophical detour, examining our societal relationship with materialistic objects, predominantly cars.

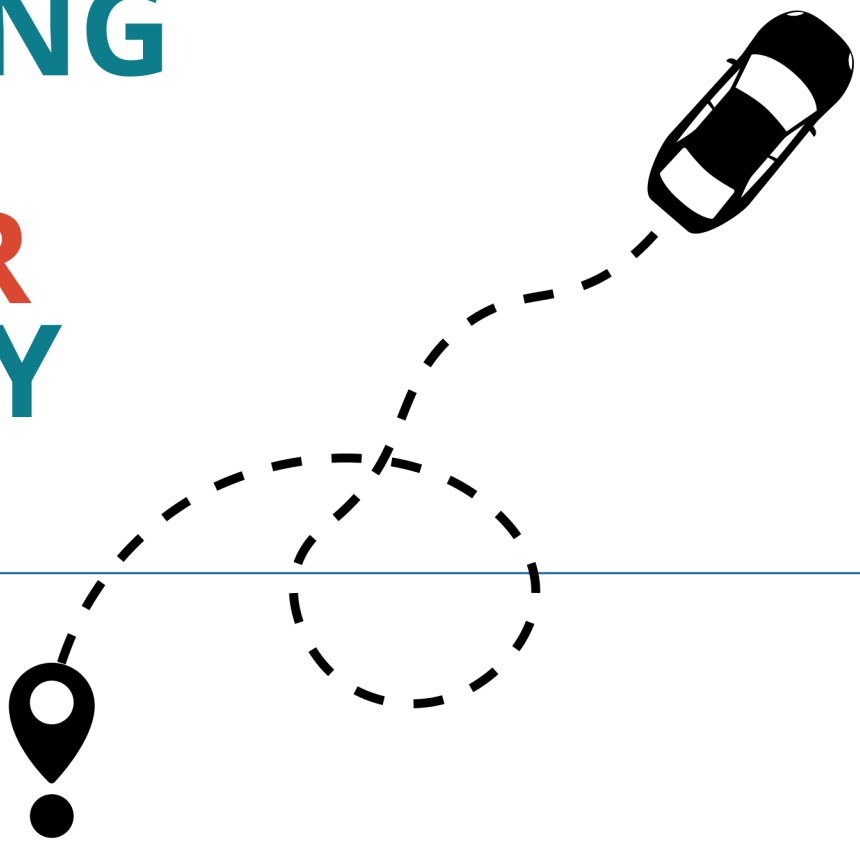
They aren't just vehicles but represent the culmination of resources, human endeavors, and environmental compromises. Recognizing these underlying costs as consumers can alter our perception and possibly guide us toward a more sustainable path.

Paul's exposition is a poignant reflection on our intertwined existence with cars. Understanding this relationship and steering it towards sustainability is a collective responsibility in this ever-evolving saga. The road ahead might be filled with twists and turns, but armed with knowledge and introspection, it's a journey we can navigate together for a greener tomorrow.

> As of 2020, cars remained the predominant culprits of transport-induced greenhouse emissions

EMBRACING THE CIRCULAR ECONOMY

TREASURE's AMA with Jean-Denis Curt



On 7 March 2024, Jean-Denis Curt, an esteemed figure in the automotive industry, held an online Ask Me Anything event organised by Edgeryders for the TREASURE project, discussing how circular economy principles are being integrated into the car industry, with a special focus on Renault Group's pioneering efforts

Circular Economy: A Paradigm Shift in the Automotive Industry

At the heart of Curt's presentation was the concept of the circular economy—a model that challenges the traditional, linear approach of "take, make, dispose." Instead, it emphasizes minimizing waste and making the most of resources. Curt outlined the waste hierarchy, starting with waste prevention, followed by reuse, recycling, and finally, recovery.

He highlighted how this approach is crucial in reducing raw material usage through design and production innovations, such as lightweighting and waste reduction in vehicle production.

Renault's Circular Initiatives: Refactory and Beyond

Jean-Denis Curt introduced the audience to "Refactory," a Renault Group project that epitomizes the shift towards a circular economy in mobility. This initiative involves transforming a traditional vehicle assembly plant into a hub for circular economy activities. It focuses on four main axes:

Re-trofit, Re-energy, Re-cycle, and Re-start, aiming to extend the lifespan of vehicles, promote green energy solutions, and foster innovation in circular mobility.

The project has set ambitious goals, including employing 3,000 people by 2030, surpassing the number originally engaged in new car production, and aiming to reach a net-zero carbon footprint for the plant before 2030.

Through activities like vehicle retrofitting, refurbishing, and the development of green energy solutions, Refactory is set to become a beacon of circular economy practices in Europe and possibly the world.

Expanding beyond Refactory, Curt discussed "The Future is Neutral," a new holding by Renault dedicated to circular economy solutions not just for Renault but for the entire automotive industry.

This initiative seeks to bridge the gap between the recyclability of vehicles and the actual use of recycled materials in new car production.

Through a network of dismantling centers and innovative recycling practices, "The Future is Neutral" aims to significantly increase the use of recycled materials in vehicle manufacturing.

In addition to manufacturing innovations, Curt introduced "Mobilize," Renault's brand for new mobility services, which encompasses vehicle designs optimized for urban use and sharing models. Vehicles like Duo and Bento exemplify the shift towards more sustainable, efficient, and circular use of mobility resources, highlighting the potential for shared, service-based business models to reduce material waste and increase the efficiency of resource use.

Jean-Denis CURT, Head of the Circular Economy Division at Groupe Renault, Circular Economy, Strategic Materials & LCA Expert Leader

Jean-Denis Curt's AMA session offered a profound look into how circular economy principles can revolutionize the automotive industry. By rethinking design, production, and usage models, the industry can significantly reduce its environmental impact.

The Q & A Session

During the whole presentations, participants were invited to post questions on the Edgeryders platform. Rather than responding to each question in written form, Jean-Denis Curt answered all of them in the live session.

The answers were transcribed and reassumed on the platform.
The following chapter is a selection of the most relevant ones.

Q & A

@Fmpeti: Can you push national laws and legislation to repair the minimum damage EV batteries? In my country there are a lot of rusty, damaged ones. After an accident it can be hazmat landfill only.

First, workshops typically repair batteries, but there are exceptions. For example, Renault excludes batteries from severely impacted cars. Even if a battery appears functional, the crash might have caused internal damage that could lead to fire upon reuse. To prioritise safety, a threshold exists. Batteries experiencing a certain level of shock are recycled instead of repaired, even though they might seem salvageable. This caution stems from the relative newness of the electric vehicle industry and the lack of definitive diagnostic methods for serious crash damage. Efforts are underway to improve diagnostics for recovering more batteries.

Second, there's currently no regulation mandating battery repairability. This is becoming problematic, especially with new market players. Traditionally, car design prioritises repairability, allowing cars to last an average of 20 years in Europe (even longer when exported). However, some new manufacturers prioritise lower costs and produce non-repairable batteries, often in conjunction with cars that are themselves difficult to repair. No regulations currently prevent this practice.

While such cars might be cheaper, consumers are unaware of the limitations regarding battery repair or even car repairability in general. Curt believes regulations mandating battery repairability are necessary to address this gap in the current system.

@Shumail: I am intrigued by the prospects of a circular economy in the presence of product innovations and design changes. The principle of circular economy is to reuse products, parts, materials for as long as possible, but if the new version of our product no longer needs the material we harvested from the post-consumer product. This is especially relevant for "Made to be Remade initiatives," where the idea is to use components/parts from used products. Do you think it is a future challenge? What can be done to overcome it?

Jean-Denis Curt acknowledged two key aspects: *recycling and reuse*.

Recycling presented fewer issues. Materials could be recovered and repurposed for new car production. However, legacy substances (banned materials) from older vehicles might pose a challenge, particularly for plastics. Strict regulations demanding zero traces of such substances could hinder plastic recycling. Technological advancements impacted material needs.

While some materials crucial for conventional vehicles weren't essential for electric vehicles (and vice versa), materials from end-of-life vehicles could still be used in other applications. For instance, materials from electronics could contribute to electric vehicle battery production.

There's currently no regulation mandating battery repairability. [...] Traditionally, car design prioritises repairability, allowing cars to last an average of 20 years in Europe (even longer when exported). However, some new manufacturers prioritise lower costs and produce non-repairable batteries, often in conjunction with cars that are themselves difficult to repair."

However, reuse presented a significant challenge. Reuse was only viable as long as vehicles on the road shared a model with those reaching their end-of-life. When a new car model launched, replacement parts for the older model might not be readily available. Conversely, when a large number of vehicles reached their end-of-life, there might not be a demand for their parts.

Reusing parts in new vehicles wasn't a top priority for the industry, and he didn't foresee a change.

Regulations, he noted, could even hinder reuse efforts.

Even for standardized components like tires, optimization for specific car models remained crucial. While Renault recently began selling refurbished tires in their after-sales network, their use in new cars remained limited. Ideally, refurbished tires could be offered as an option to customers, with clear communication regarding their equivalence to new tires, but with the caveat that they might not be specifically optimized for the car model. Overall, Jean-Denis is afraid that the challenge of reusing parts in new vehicles would likely persist **for a long time.**

@Ivan: Hi Jean-Denis,
thank you for this great presentation.
I would like to know your point of view on the design needs of the recuperation of precious and rare metals from car electronics?
Which particular policies should be implemented and is a convergence on standardisation of the car producers possible?
Also, in Renault's experience, what are the main difficulties of harvesting these metals in the recycling process, and how have you solved them?
Finally, is there an ideal moment that should occur among the stakeholders, to make the path towards circularity easier?

Jean-Denis: electronics is indeed a major obstacle to car circularity for several reasons.
Firstly, electronic components contain exotic materials in minute quantities.

These components are scattered throughout modern cars, making manual disassembly during the dismantling process impractical or uneconomical. The minuscule amounts of precious metals like gold make it difficult to pinpoint their location and precise quantity within a car.

A second challenge is the supply chain transparency. The electronic supply chain's complexity and obscurity made it difficult to track these materials.

Transparency is essential to obtain declarations on material content and secure access to critical materials, like gallium and germanium, whose export restrictions by China could disrupt production.

Even with improved sorting during post-shredding, some materials are likely to be lost.

There isn't a perfect solution yet, but significant progress is possible. Proposed new car circularity legislation in Europe includes mandatory dismantling of certain parts. This could be advantageous when post-shredding sorting cannot achieve the same level of material separation as manual dismantling. Extracting specific electronic components beforehand might be worthwhile in certain cases.

Recycling all materials from electronics remaines difficult. While gold, platinum, and maybe silver can be recovered, others, present in negligible amounts, aren't currently recycled.

Recycling electronic components has several obstacles: still uneconomical dismantling process, lack of supply chain transparency, measuring the environmental impact of their production.

Measuring the environmental impact of electronics production remaines challenging. Tracing the origin and production conditions of these components to ensure responsible practices is difficult.

The challenges extend to recycling. Dispersed electronics with unknown material quantities, along with the presence of metals in minuscule amounts, render current recycling processes inadequate. Disassembling the car to collect electronics before shredding might prove marginally beneficial in some cases.

This challenge extends beyond cars and into the realm of electronics in general.

Potential solutions include legislation promoting supply chain traceability, eco-design initiatives for electronics, not just for cars & efforts to reduce the use of critical materials that ultimately wouldn't be recycled

Overall, there is a big need for significant improvements in electronics design, material usage, and supply chain transparency to enhance car circularity.

@GiuliaBellini: Dear Jean-Denis, Many thanks for the very interesting presentation.
I would like to ask a question concerning the catalysts (Pt, Pd Ru) from end-of-life vehicles. You have showcased the example of Pt recovery from the combustion engines and its new employment into fuels cells. Given the highly dynamic nature of the catalyst and, in turn, the several trasnformative prcoess which occur on its surface and bulk structure during the reaction process, I was wondering if you could provide a qualitative and quantitative assessment of the catalysts' comodieties regeneration process in terms of technical feasibility and cost-benefit analysis.

Jean-Denis Curt:

- Recycling itself presents no significant challenges. Established partnerships with companies like Johnson Matthey ensure that used catalysts are refined back into high-purity materials like platinum, rhodium, and palladium. These recycled materials perform at the same level as virgin materials.
- Refurbishing catalysts, however, proves more problematic. While ideal in concept, Renault engineers are unable to guarantee the performance of a refurbished catalyst without a complete understanding of its service history. This uncertainty prevents the widespread adoption of catalyst refurbishment.
- There is a gap in after-sales regulations. Some repair shops offered cheaper, lower-quality catalyst replacements containing less precious metal. These replacements compromised emission standards, allowing vehicles to emit significantly more pollutants. Ideally, stricter regulations would mandate that all replacement catalysts meet the same emission standards as original parts.

From a circular economy standpoint, electronics poses a greater challenge than other car parts like mechanical components. This difficulty stemmes from several factors:

- Rapid evolution: Electronic components constantly evolve, with multiple generations potentially existing within a single car's lifespan.

From a circular economy standpoint, electronics pose a more significant challenge than mechanical components. They evolve rapidly and have compatibility issues and design limitations.

@Nica: Thank you, Jean-Denis, for your presentation.
My question: something that has emerged in the interviews we have been doing at sustainability-focused events is that people have the impression that cars with electronic components are actually harder to adapt to circular economy than "older" cars because there are so many composite materials that are more challenging to disassemble and reuse. What are your thoughts on this?
Jean-Denis acknowledged aspects related to repair that he hadn't previously addressed. Recycling electronics proves difficult due to the intricate mix and minute quantities of materials. While some electronics can be recycled, others won't be, and some might never reach recycling plants.

- Compatibility issues: Even within the same car model, components from newer vehicles might not be compatible with older ones due to software or hardware changes.
- Design limitations: Electronics weren't typically designed for repairability, and production often occurred in low-cost countries with high labor costs in Western Europe hindering the economic viability of repairs. Diagnosing and repairing electronics could easily reach the cost of a new component, mirroring situations with consumer electronics.

Despite these challenges, Renault is initiating repair efforts for certain essential and expensive car electronics components.

The focus is on components involved in the design process, rather than standardized parts purchased by multiple carmakers.
The significant challenges are associated with electronics in cars, but Renault is putting efforts into exploring repair possibilities for certain components.

@AsimShah during the Q&A session shortened his questions due to other people participating and was interested in potential discussions or initiatives that Renault has with other car makers in order to achieve higher sustainability in the industry.

Jean-Denis Curt:

- Renault collaborates with various companies on circular economy initiatives, including large corporations, medium-sized businesses, and startups. However, they haven't established significant collaborations with direct competitors in this specific area yet.
- Economies of scale are crucial. To achieve this, Renault created a subsidiary called "Future is Neutral." This subsidiary won't be solely owned by Renault and will be open to other investors. The goal is to provide circular economy services to other carmakers, including recycling, end-of-life vehicle management, battery services (collection, recycling, repair), and component remanufacturing. By servicing multiple carmakers, Future is Neutral aims to scale up operations and optimize efficiency.
- Openness to collaboration with competitors exists. While there aren't any signed agreements yet, Renault is receptive to partnerships. For instance, they could handle refurbishing and repairing used cars from other brands within a specific region, like the Paris area. Similarly, this collaboration could extend to battery repair, with each company handling repairs in their respective regions.

While Renault hasn't established major collaborations with competitors on circular economy initiatives yet, they are actively exploring these possibilities. The creation of Future is Neutral underscores their commitment to scaling up solutions and their openness to working with other carmakers.

@rafael: Jean-Denis, thank you very much for the insights and taking the time!
To increase the amount of recycled content in the products, it is especially important to persuade the suppliers and partners. How do you get them on board and how do you track the degree of circularity?

A few years ago, Renault struggled to increase the use of recycled materials in their cars. Suppliers, lacking similar demands from other carmakers, often had just one production process (especially for plastics).
This made it difficult for them to accommodate Renault's focus on recycled materials while meeting the needs of clients who didn't prioritize it.

Thankfully, the situation is evolving positively. Here's what's contributing to the change:

- More receptive suppliers: Most major suppliers (Tier One) are now showing a willingness to work with recycled and low-carbon footprint materials. They're proposing solutions to Renault and collaborating on closed-loop recycling initiatives. This shift might be due, in part, to similar requests from other car manufacturers, suggesting a more sustainable industry-wide approach.

What could contribute to the change are the suppliers more receptive to recycled and low-carbon footprint materials, the upcoming regulations, the raising customer demands.

- Regulations on the horizon: Upcoming regulations, particularly for plastics, will require a minimum percentage of recycled content in new cars by 2031 or 2032. Proposed regulations might mandate as much as 25% post-consumer recycled plastics, a significant increase from Renault's current best car which uses 20% recycled plastics (including pre-consumer materials and only 10% post-consumer). While stricter regulations will necessitate continued efforts to motivate suppliers, they provide a clear direction for the future.

- Collaboration is key: Collaboration with suppliers is becoming smoother, with some taking a proactive approach and proposing ambitious joint projects focused on sustainability. This highlights the growing industry focus on eco-friendly solutions.
- Customer demand matters: Public interest in cars with sustainable and recycled materials strengthens Renault's internal position. Demonstrating customer care for these features provides a compelling argument for engineers, buyers, and suppliers to prioritize using recycled materials in car production.

In conclusion, the challenges Renault faced in incorporating recycled materials are diminishing. A more receptive supplier base, upcoming regulations, and a growing emphasis on collaboration and customer demand are paving the way for a future where car manufacturing embraces greater sustainability.

@Samberger wanted to tackle the matter on a crucial point regarding Jean-Denis Curt's previous comment about "buying circular cars" emphasizing the need for consumers to understand the car's circularity level. Saying that without clear information, it's difficult for them to prioritize a circular car over a non-circular one.

Jean-Denis acknowledged this as a valid point and offered potential solutions:

- **Traceability Challenges:** Currently, tracking the use of recycled materials throughout the supply chain remains a challenge. While plastic usage can be traced to a certain extent through supplier declarations, complete traceability from waste origin is difficult. Collaboration across the entire supply chain, potentially facilitated by new European regulations, is essential for improvement.
- **Communication Efforts:** Renault is starting to communicate the use of recycled materials more effectively, as exemplified by their recent presentation on a new electric car highlighting the use of 40kg of recycled plastic (20% of total plastic content). However, without a clear industry standard for comparison, it's difficult for consumers to gauge how "good" this is.
- **Regulation as a Driver:** Mandatory declarations and standardized definitions are crucial. Currently, there's a lack of clear standards for terms like "circular" and "recycled material." Even for plastics, there's room for interpretation. For metals, the situation is worse – suppliers often declare different types of scrap rather than explicitly stating "recycled materials." Clear standards would define what constitutes "recycled" and establish procedures for auditing and control. While Renault is open to contributing financially to audits, the burden shouldn't fall solely on them.
- **Labeling and Standardisation:** While he suggested a labeling system similar to appliance energy ratings (ABCD), Jean-Denis emphasized the need for standardization in accounting and mandatory declarations based on clear, industry-wide definitions.

Possible solutions for raising sensibility of the consumers on circular cars: traceability, clear communication, regulations, labeling and standardisation

Following that answer, @Samberger posed a question regarding the tires - Is there anything that you are doing to recover tires and creating materials such as carbon black to actually manufacture new tires?

Jean-Denis responded on tire use and Renault's approach to sustainability:

- All tires sold with Renault vehicles are recovered through PROs, product responsibility organisations or recycling fees.
- However, true "recycling" of these tires, where materials are used to create new tires, isn't currently happening. The technical challenges associated with this process are significant.

- Recent news regarding Michelin's potential tire recycling plant development is promising.

Renault's Refurbished Tire Initiative:

- In a pioneering move, Renault is the first carmaker to sell refurbished tires. These tires undergo a process similar to remanufacturing. The used tire's structure is retained (around 80% of the materials), and a new, high-quality rubber layer is applied.
- The "Leonard" brand is produced in Béthune, France, at a former premium tire factory. This facility leverages industrial processes to ensure the refurbished tires meet the same standards as new tires.
- Legal hurdles currently prevent Renault from including these refurbished tires on new vehicles, but they are available through Renault's after-sales network.

Tire Recycling and Collaboration:

While Renault isn't directly involved in tire recycling initiatives, they acknowledge the importance of these efforts, especially considering the environmental impact of carbon black production (a key tire material) and recent supply chain disruptions due to the war in Ukraine.

Limited Control over Tire Production:

- Unlike some car parts, Renault has less control over tire production processes. Tires are designed to meet specific fuel consumption standards for Renault vehicles, but the material content and overall eco-design are determined by the tire manufacturers.
- This limited control highlights Renault's focus on promoting refurbished tires as a viable solution within their sphere of influence.

Timileyin acknowledged the crucial role of recycling in combating climate change and achieving carbon neutrality. He expressed concern about maintaining a healthy supply of raw materials if everyone prioritizes recycling and wanted to know:

- **How do we determine the right balance between primary raw materials and recycled materials to achieve near-100% recycling rates?**
- **How can we ensure a sustainable flow of materials by balancing supply from mining with the growing recycling sector?**

Jean-Denis Curt clarified Timileyin's concern and pointed out that the current situation is far from an overabundance of recycled materials:

- Currently, the world extracts vast amounts of raw materials, with only a small percentage (around 7%) being recycled globally.
- This holds true across various industries, not just automotive. Even for plastics and electronics, recycling rates are very low.

Therefore, the issue isn't a shortage of raw materials for recycling, but rather a need to significantly increase recycling efforts. He sees the rise of recycling as a positive trend:

- It can help stabilize or even decrease the reliance on raw material extraction in the long run.
- This is particularly important for materials like copper, where future mine exhaustion could pose a supply challenge.

"Recycling all materials from electronics remains difficult. While gold, platinum, and maybe silver can be recovered, others, present in negligible amounts, aren't currently recycled. This challenge extends beyond cars and into the realm of electronics in general."

CIRCULARITY AND THE AUTOMOTIVE SECTOR

TREASURE

By Caroline Samberger
Principal process engineer at Stantec with over two decades of experience in the water, energy, and environmental services sectors.

By 2050, Earth's population will grow to 9 billion. The associated metals requirements for new digital technologies and the transition to green energy will consequently increase hugely.

I have more than 24 years of experience in the water, energy, and environmental services sectors. In the past 5 years, I have developed consultancy skills in relation to renewable energy and circular economy. In 2020, I became a Circular Economy Pioneer 2020 of the Ellen McArthur Foundation and successfully completed United Nations trainings on climate change, green economy, and sustainable development goals and the Paris agreement. I have been a circular economy advisor for diverse clients in the toy, food, logistics, or fashion sectors and published various papers and presented at numerous conferences about circular economy. I joined Stantec as a principal process engineer at the beginning of 2021, working on wastewater treatment projects and resource recovery, and net zero carbon implementation.

A solution needs to be found to stop the depletion of these finite resources and a circular economy might be part of the solution

In 2022 I joined Stantec Water Research Institute where I work more specifically on research in the areas of Circular Economy and Climate Change. Here is my view on one aspect of circular economy in the automotive industry: metals and raw materials.

By 2050, Earth's population will grow to 9 billion. The associated metals requirements for new digital technologies and the transition to green energy will consequently increase hugely. Mining and processing of metals and raw materials generates important amounts of greenhouse gases, which the automotive sector is one of the primary users. A solution needs to be found to stop the depletion of these finite resources and a circular economy might be part of the solution.

Electric vehicles in particular require a wider range of minerals and critical raw materials (CRMs) for their motors and batteries compared to conventional cars. EVs can contain up to 6 times more minerals than a petrol car and be on average 340 kg heavier [3]. Graphite is the anode material in a lithium-ion battery and is the single largest component by weight [3] and EV can contain more than a mile of copper wiring inside the stator to convert electric energy into mechanical energy.

The average amount of aluminium used in European cars is expected to rise from 205 kg in 2022 to 237 kg by 2026 and 256 kg per vehicle by 2030, according to a recent study commissioned by European Aluminium [15]. The analysis indicates that a notable rise in aluminium content is being driven by the automobile industry's move towards electrification and lightweighting. This increase is being mostly attributed to electric vehicles as an average battery made in Europe in 2022 had 283 kg of aluminium, as opposed to merely 169 kg in a car powered solely by gasoline or diesel, with an average amount of aluminium in electric vehicles predicted to reach 310 kg by 2026 [15].

The primary causes of the enormous increase in aluminium consumption in EVs are its use in cooling plates, battery pack housings, e-drive housing, and ballistic battery protection. Furthermore, the infrastructure for electromobility, such as power cables and charging stations, depends heavily on aluminium.

A comparison of metals requirements for a conventional versus an electric car is presented in Table 1.

These raw materials are crucial to Europe's economy. They form a strong industrial base, producing a broad range of goods and applications used in everyday life and modern technologies. However, the EU industry and economy are dependent on foreign markets for access to numerous of these essential raw materials, as these are produced and supplied by third countries.

The supply chains are particularly vulnerable due to the shift in global demand towards a digital and green economy or to the current geopolitical context. The EU is primarily reliant on imports from non-EU nations, despite the EU being able to produce some essential raw materials domestically [10].

For instance, nowadays, only a few countries produce the majority of the world's lithium: Australia produces 20 % of the world's "white gold," while Bolivia, Chile, and Argentina produce 60 % and another 17% of the world's lithium is produced in China. With just five nations controlling over 90 % of global production, the International Energy Agency refers to the situation as a "quasi-monopoly" [11] [12].

Numerous other essential raw materials are in extremely limited supply. South Africa supplies 71 % of the EU's needs for platinum and an even higher share of the platinum group metals iridium, rhodium, and ruthenium. China supplies all of the EU with heavy rare earth elements, and Turkey supplies 99 % of the EU with boron. Additionally, 60 % of the cobalt refined in China comes from the Democratic Republic of Congo (DRC), where 63 % of the world's cobalt used in batteries is extracted [10].

The risks associated with this metal concentration of production are in many cases exacerbated by low substitution and low recycling rates [10].

IN ADDITION TO OTHER RAW MATERIALS, A TYPICAL PASSENGER CAR REQUIRES NEARLY FIFTY DIFFERENT KINDS OF METAL [17], OF WHICH:

Steel/aluminium: steel makes up most of an automobile's body (an average of 900 kg per car) and provides strength and durability for both safety and wear and tear on the vehicle. Nonetheless, due to its lightweight and malleability, aluminium is increasingly being used for the frames of new cars, to enhance fuel efficiency and battery range of electric vehicles (EVs). Magnesium is sometimes utilised instead of steel or aluminium, though, in situations where weight reduction without strength loss is necessary.

Copper: copper's conductivity is essential for the vehicle's electrical systems, providing efficient power distribution and operation of complex electronics. It is therefore utilised in starters and alternators as well as radios, computers, navigation systems, and rearview cameras.

Nickel: alloys are used in a wide range of automotive components to guarantee durability and reliability. Addition of nickel to other metals produces these alloys with enhanced properties such as toughness, resistance to corrosion, and strength at elevated temperatures.

Lead: lead is present in the car's wheel weights, to maintain tire balance while driving and also used in the batteries of gasoline-powered vehicles.

Cobalt: as cobalt is a necessary component of the cathodes of lithium-ion batteries, which power electric cars, this is the most common application of cobalt in the automotive sector. Apart from battery applications, cobalt finds application in various automotive components, particularly those that need to endure harsh conditions.

Platinum: both palladium and platinum are essential components in catalytic converters, located in vehicle exhaust systems. As catalysts, they help transform harmful engine gases - such as carbon monoxide, nitrogen oxides, and hydrocarbons - into less dangerous ones, such as nitrogen, carbon dioxide, and water vapour.Platinum: both palladium and platinum are essential components in catalytic converters, located in vehicle exhaust systems. As catalysts, they help transform harmful engine gases - such as carbon monoxide, nitrogen oxides, and hydrocarbons - into less dangerous ones, such as nitrogen, carbon dioxide, and water vapour.

Lithium: battery manufacturing also uses lithium. Lithium-ion batteries are more capacious and have a longer lifespan than batteries made of other metals.

Finally, because of their special magnetic and electric qualities, rare earth metals are crucial to the automotive industry, especially for electric and hybrid cars.

Electric vehicles in particular require a wider range of minerals and critical raw materials (CRMs) for their motors and batteries compared to conventional cars

As a result, there has been a significant increase in awareness regarding the sources of materials used in electric vehicle batteries since the EU's need for lithium batteries is expected to rise twelve times by 2030 compared to 2023 and twenty-one times by 2050, due to use in energy storage and electric vehicles [2]. Additionally, the EU's need for other rare earth materials - which are used in electric cars and wind turbines - is expected to increase five to six times by 2030, and seven times by 2050 [2].

Reliable and unhindered access to certain raw materials is a growing concern with the EU and across the globe. To address this challenge, the European Commissions has created a list of critical raw materials (CRMs) for the EU, which is subject to a regular review and update. CRMs combine raw materials of high importance to the EU economy and of high-risk associated with their supply.

Aside the environmental and economic impacts that will be discussed in this article, the mining sector represents an issue with human rights and child labour and exploitation, according to reports by the human rights group Amnesty International and others [22]. The World Economic Forum [21] also emphasises that raw materials such as cobalt for batteries are for instance extracted at high human toll in the Democratic Republic of Congo artisanal mines where miners as young as 7 years old suffer chronic long disease from exposure to cobalt dust which they dig by hand using basic tools. Therefore, beyond the environmental burden, the automotive sector and associated mining industry also contribute to negative human and social impacts. The rest of this article will however focus on the environmental aspects of the extraction of metals for the automotive industry.

Environmentally wise, the metals and mining sector account for around 10 % of global greenhouse gases (GHG) emissions (7 % steel, 2 % aluminium and 1 % others).

Mining's energy use and emissions vary depending on a deposit's ore type and grade, while smelting and refining emissions vary depending on processing methods and the region's energy mix.

Metal	Petrol car (kg/vehicle)	Electric car (kg/vehicle)
Graphite [3] [4]	-	66.3
Copper	22.3	53.2
Nickel	-	39.9
Manganese	11.2	24.5
Cobalt	-	13.3
Lithium	-	8.9
Rare Earth elements	-	0.5
Zinc	0.1	0.1
Others	0.3	0.3
Aluminium [15]	169	283

The range of carbon emissions for lithium and nickel production varies depending on the kind of deposit, processing method and end-product. An estimate of CO2 emissions from mining, smelting and refining of main automotive metals is presented in Table 2.

Table 2: CO2 emissions associated with manufacturing of metals

Metal	Mining, smelting and refining emissions (t CO2/t metal)
Nickel [5][6]	20-68
Cobalt [6][7]	38
Aluminium [5][6]	28
Copper [5]	5
Lithium [8]	15

With 30 000 000 EVs expected in Europe by 2030 [16], the associated CO2 emissions for the metal extraction and processing required to manufacture these cars can be estimated as shown in Table 3.

Metal	Mining, smelting and refining emissions (t CO2/t metal)	Associated CO2 emissions (tons)
Copper	1 596 000	7 980 000
Nickel	1 197 000	53 865 000
Lithium	267 000	4 000 000
Cobalt	399 000	15 162 000
Manganese	735 000	Not available
Graphite	1 989 000	Not available
Aluminium	8 490 000	237 720 000
Total		53 000 000/year

Numerous other essential raw materials are in extremely limited supply.

Although not all data could be found for all metals required for the manufacturing of EV vehicles, the amount of GHG calculated with available data already represents 53 000 000 t CO2/year, which corresponds to the yearly equivalent emissions of 15 world-scale 300,000-barrel/day refineries!

But there are other sustainability problems. Obtaining these metals by conventional means takes its own environmental toll, not only on carbon emissions, but also on water and land.

For instance, most of the world's lithium is currently sourced from hard rock mines in Australia or subterranean brine reservoirs beneath the surface of dried lake beds, mostly in Chile and Argentina. Hard rock mining causes destruction of the landscape and consumes a lot of water (170 m3/t Li extracted) and land (464 m2/t Li extracted). Therefore, in order to meet the EU 2030 need for cars, 45 390 000 m3 of water - the average lifetime drinking water supply of 1 134 000 people - would be required for lithium extraction alone!

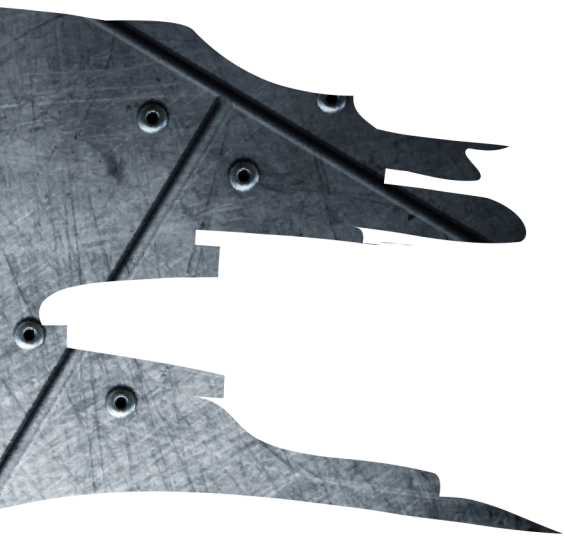
Consequently, although electric vehicles (EVs) have the potential to lower carbon dioxide (CO2) emissions over time, the batteries that power them have a significant environmental impact at the beginning of their lives.

One way to counteract these environmental burdens in the automotive sector is to implement circularity, by applying 3 fundamental principles: (i) eliminate waste and pollution by design i.e design and manufacture cars for easy dismantling and materials recycling; (ii) keep products and materials in use at their highest value i.e repurposing and reusing already manufactured car parts rather than/prior to dismantling and recycling individual components; (iii) regenerate natural systems, which speaks for itself.

To meet principles i) and ii) which are probably the easiest of the 3 circularity principles to implement in the automotive sector, EU members states require to set up efforts to recover critical raw materials from waste products and mining waste:

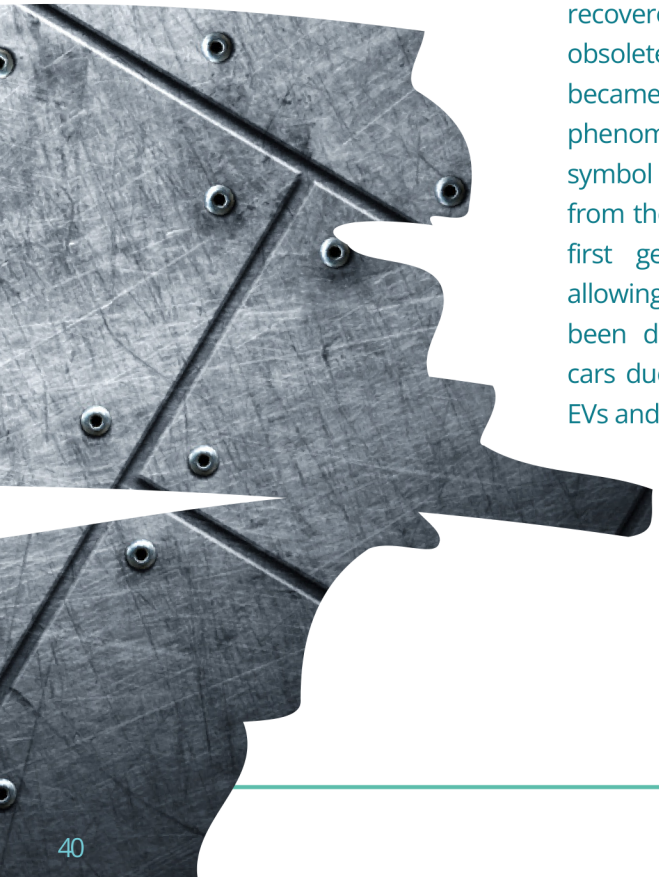
For example, aluminium's exceptional recyclability could ensure that the materials used in modern cars will still be usable long after the vehicle has reached the end of its useful life, if recovery and recycling of battery components were implemented adequately.

Still, putting it into practice is not that simple. Today, 600 million batteries still end up in landfill in the UK each year. Laid end-to-end, these batteries would stretch from the UK to Australia and back! [25] Batteries decay over time and dangerous chemicals can seep out and poison soil and water supplies. Li-ion batteries from EVs degrade quickly during the first five years and are generally designed for no more than a decade of use. Once they reach 70 % capacity, they're considered at their end of life [23]. When recycled, chemical battery components are typically ground into a powder at a battery recycling facility, where the powder is either melted or dissolved in acid. Li batteries, on the other hand, are composed of numerous components that, if not disassembled carefully, comparatively to chemical batteries, pose an added risk of fire or explosion.



Furthermore, it is difficult to reuse the recovered products even when Li batteries are broken down in this manner [13] as they are usually bigger, heavier, considerably more intricate than their chemical counterparts, and potentially hazardous if disassembled incorrectly [13]. Electric batteries differ widely in chemistry and construction, which makes it difficult to create efficient recycling systems. And the cells are often held together with tough glues that make them difficult to take apart [19]. Because of this, recycling is more expensive than mining lithium to create new batteries. Consequently, only around 5 % of Li batteries are currently recycled globally, meaning the majority are still merely thrown away, due to the lack of large-scale, affordable methods of recycling.

For recycling to be viable it must be cost competitive with mined materials. For now, EVs are still not recovered efficiently. Abandoned and obsolete battery-powered-cars became a Chinese social media phenomenon a few years ago as a symbol of the excess waste resulting from the nation's rapid EV boom with first generation electric cars only allowing 100 km on a charge and been ditched for newer generation cars due to technological progress in EVs and batteries [14] [18].



The automotive sector can act on climate change by working on a more circular economy and metal recovery from discarded cars. And with millions of electric cars set to hit the road, scientists are looking for better battery recycling methods, as current EV batteries are really not designed to be recycled. To ease the process, governments are urging EV and battery makers to start designing their products with recycling in mind, which is principle i) for circularity [19]. More efforts are consequently required to improve the procedures for taking apart used batteries.

With the predicted escalation of the demand for EVs, the battery and motor vehicle industry will face massive demand for recycled materials. Furthermore, if the countless millions of outdated or used Li batteries - which eventually fail after roughly ten years of use - are recycled more efficiently, all that energy spending will be offset. In order to eventually have a standardised, environmentally acceptable method of recycling Li batteries ready to meet the rapidly increasing demand, a number of organisations have already been working on implementing more efficient recycling techniques [13]. To this extent, VolksWagen announced a pilot plant for battery recycling which will work to achieve the recycling of 97 % of batter components [20].

Technological advances are also presenting opportunities for the power sector to put old batteries to new uses, in line with principle ii), bringing both economic and environmental benefits.

Numerous other essential raw materials are in extremely limited supply.

A new second-life battery market is springing up, bringing opportunities for the energy sector and EV industry [23], as they still have other valuable applications in the green economy – such as in residential batteries and stranded power (interruptions in renewable energy supply).

They can be used to light offices, power homes and buildings, cool fresh food distribution centres and as transmission support for energy arbitrage, reducing energy congestion [20] [23].

Eventually, in order to create new EV batteries, automakers and recycling businesses want to extract valuable materials from old ones. However, in order to fulfil principle ii) of circularity, it is better to reuse batteries with the same purpose as their initial design, and to give them a second chance at life on the electrical grid before dismantling and recycling its various components to manufacture new batteries. To this extent, lithium-ion batteries are being increasingly used in conjunction with wind and solar power plants to store excess energy for periods when the sun does not shine or the wind does not blow. Since these batteries are identical to those found in electric cars, automakers claim that recycling them could help solve the problem of electronic waste while also promoting the growth of renewable energy. Auto-makers such as Nissan and Renault are already using retired batteries to build large-scale energy-storage system [24].

The bottom line is that the automotive sector is heading in the right direction with circularity but more efforts are needed to better repurpose old batteries and recover raw materials. So watch this space!

“THE AUTOMOTIVE SECTOR IS HEADING IN THE RIGHT DIRECTION WITH CIRCULARITY BUT MORE EFFORTS ARE NEEDED TO BETTER REPURPOSE OLD BATTERIES AND RECOVER RAW MATERIALS.“

SUSTAINABILITY AND CIRCULAR ECONOMY CHALLENGES IN THE CAR INDUSTRY

In order to continue thriving, the car industry needs to reinvent itself

By Vukasin Herbez
Life-long car enthusiast, an experienced car journalist, blogger, classic car expert, and avid collector of all things automotive.

If we look at the history of the modern world, the global landscape has been shaped more by industrial revolutions and market economy than by political ideas. Ever since the first industrial revolution in the late 18th century; the world has been on the path of development that significantly changed every aspect of human lives.

But the profound change went beyond that, and the industrialisation, new economic systems, and demand for materials and products had formed the political, social, and environmental reality we live in today.

Although humanity is in the middle of the fourth industrial revolution, much of the global economy still functions according to industrial principles dating from the early 20th century. The car industry is one of the best examples of that claim.

We see that automotive technology advances at a fantastic pace. However, the economic model is still pretty conservative, especially in terms of sustainability, circular economy, recycling, and reusing components and materials. In order to continue thriving, the car industry needs to reinvent itself along those lines. Let's discuss this further.

The first automobile with an internal combustion engine was patented in 1886, which interestingly is the time of the second industrial revolution, which introduced the widespread use of steel, electricity, rubber, and petroleum. All of which found its way into the automobile as a contraption. By the end of the Second Industrial Revolution (1914), the automobile was already a widely accepted device that changed the urban landscape, making horse-drawn carriages obsolete with unmatched speed, range, and abilities.

However, what the automobile also introduced was the most significant and most enduring example of a linear economy. Characterised by the "Take-Make-Dispose" mantra, the linear economy, in fact, paved the way for the evolution of automobiles and mobility in general.

By producing more and more advanced designs, car companies made each previous model outdated, forcing the customers to keep buying new and disposing of old cars every few years.

The circular economy concept is not new but has become increasingly relevant in modern times. The ideas of recycling, reusability, dematerialisation, refurbishing and sustainability determine this model. In an ideal scenario, the product will have a longer life and be easily refurbished, reused or upgraded for the next generation. It would be made out of recycled materials, and all valuable materials could be harvested in the recycling process. Such production will be 100% sustainable, and its environmental effects will be minimised. Since the introduction of the circular economy concept, there have been some improvements in applying it to the car industry, but it still needs to be completed. The car companies are open to ideas per se, but there are a lot of challenges that need to be overcome. Some of them are related to the production methods, some to energy sources, and some to current technology. With the introduction of electric vehicles and their widespread use, the in-car industry's circular economy moved one step towards sustainability, distancing itself from fossil fuels. But abandoning petrol as the primary energy source is just the beginning and is not a solution.

The rise of electric vehicles in the last decade has brought seismic shocks to the car industry. Besides removing the oil dependency from the equitation, electric cars have been designed to be more reusable, recyclable and refurbished than the conventional ICE models.

With each new model, we can see that engineers have achieved more and more. For example, using recycled materials in the interior and exterior of the vehicle or 3D-printed components, improving the connection between the vehicle's systems, reducing the wiring and communication modules and so on. Modular chassis construction is widespread in the EV industry, meaning that one design can underpin several models and accommodate one or more electric engines or battery packs.

It means manufacturers can present more models with different specifications, performance, and ranges but use one platform architecture with minimal changes. One of the critical aspects of the modern circular economy is digitalisation. Companies like Tesla used modern technology for over-the-air updates, enabling or cancelling specific services, effectively upgrading some of the car's features, replacing any physical presence and saving time and labour. All of the above shows what can be achieved when the vehicle is designed to be as sustainable as possible from the start.

However, despite numerous improvements, the EVs still have one major issue – the battery. Even though the industry has been working on more advanced battery solutions, the current lithium-ion technology is extremely energy-consuming, environmentally problematic and complicated to produce. The end result is a hefty item with a limited life span and an extremely difficult, complex and expensive recycling process. The numbers are staggering.

In order to produce one 80-kWh unit for an average electric vehicle, battery manufacturers release up to 16,000 kilograms of CO2 into the atmosphere. At the same time, an average new ICE vehicle sold in the EU emits around 108 grams of CO2 per 1 km of driving. It means that a petrol (or diesel) car needs to travel over 148,000 kilometres to reach the level of pollution achieved just by producing a single battery pack. This is equivalent to over ten years of use. This leaves us with a confusing paradox. Operating an electric vehicle has zero emissions. But manufacturing and recycling leave a significantly bigger carbon footprint and require more resources and energy than producing ICE-powered cars.

It is fascinating that the automobile, as a transportation device, is almost 140 years old. Significantly improved and modernised over time, the basic principles of internal combustion, mechanics and serial production are still present. The ICE vehicles have better usability than the EVs, lower purchasing price, better logistics (maintenance, gas stations, after-sales) and more extended range. Customers concerned with practicality, safety, and usability are still drawn to ICE-powered models. But, in terms of sustainability, ICE models are hopelessly dependable on fossil fuels, which makes them incapable of fulfilling the principles of the circular economy.

The relentless quest for efficiency, sustainability, and carbon neutrality, as well as recycling, reusing, and digitalisation, had some effect on the ICE vehicles but not at the level that most legislators wanted.

In 2023, the European Commission proposed a rule to improve sustainability and reuse of spare parts when the vehicle ends its life. According to this document, car manufacturers will provide dismantlers with detailed instructions on removing and refurbishing usable parts from discarded or crashed vehicles. Also, car manufacturers would use 25% recycled plastic in their vehicles, a material that should come from end-of-the-life vehicles. The idea behind this proposal is to significantly reduce the stockpiling of used cars, improve the efficiency of the manufacturing process, harvest valuable materials and reuse components on a larger scale, improving sustainability. At the moment, only 19% of plastics are recycled by European car companies, while most materials are not. Also, composite materials and electronic components are not recycled or reused. The car manufacturers practise recycling for some components and materials, but reusing is nonexistent in new vehicles. Car platforms and engines are shared in order to lower the expenses of development and production. Still, you cannot mix and match vital parts from various models and brands, which would be crucial for advancing into the true circular economy era.

The perception of a brand is still powerful with the consumers, and car companies rely heavily on providing the buyers with specific features and designs, which stand in the way of unification, standardisation, sharing and reuse of components across the industry.

Even before the full-scale EV revolution, car manufacturers started producing Hybrid models featuring internal combustion engines with the help of electric motors and battery packs. The idea behind hybrid vehicles is to deliver significantly lower emissions and lower fuel consumption in urban environments but have the range and practicality of regular ICE models. Although the concept proved successful from the driving dynamics point of view, it suffers from the same sustainability problems that ICE and EVs have. It means that it is still a petrol-powered model that is produced with a low percentage of recycled materials and is dependable on fossil fuels. At the same time, it has a battery pack that is problematic to produce and very hard to recycle. The Hybrid models might be a crossover solution when it comes to pollution and the environment. Still, they are not a significant step forward when it comes to circular economy, sustainability, recycling, or reusing.

A BATTERY PACK IS PROBLEMATIC TO PRODUCE AND VERY HARD TO RECYCLE

Recycling is the most critical aspect of the circular economy. Harvesting valuable materials, minimising waste and reducing suppliers' dependability are crucial to making the car industry sustainable and relevant in the modern economy. At the moment, in the average car, we can find a number of recyclable and in-demand materials, almost all of which can be harvested and reused in future production. We can group them into three segments. The first is the metals – steel, aluminium, titanium, and magnesium. The second is the materials like plastic, rubber, and glass. The third group are precious metals like lithium, gold or copper.

The good news is that over 90% of the steel and aluminium used in car production can be recycled and used again in various forms. Currently, steel is the most common material, and it is used not just in chassis construction but also for engine blocks, multiple components, suspension, brake disks, and so on. Aluminium also plays an important role in car construction due to its lightness and strength and is commonly used for body panels, engines, cooling systems, and suspension. On some high-end cars, car companies employ a significant amount of titanium, which is about six times more expensive than steel but far more durable. This valuable material can also be recycled, which can further reduce the costs of its use and improve the characteristics of future cars along with their lifespan. Magnesium is also one of the most expensive and recyclable materials which have been used in the automotive industry. It is known for its strength, lightweight, and heat resistance, so it has found its way into engine construction. Of course, all the materials mentioned require different approaches to the recycling process, but all those materials are 100% recyclable.

Regardless of whether the vehicle is EV or ICE, it will come with glass, numerous plastic components, and a set of tyres. All of it is recyclable, even glass. However, not all recycled rubber comes as a brand-new tyre ready to be used on a car. During the recycling process, tires are shredded, disintegrated, and turned into material that is no longer used in the car industry. But it is suitable for other purposes. Reusing will not be achieved in this case, but old rubber will still not clutter the environment. In modern vehicles, plastic takes up about 50% of all car parts, which is significant. Due to its lightness, it takes about 10% of the vehicle's weight, which is still over 140 kg per vehicle on average. It means that millions of tons of scrap plastic should be recycled. At the moment, only 19% of it is recycled, which is not enough.

But, the most exciting part is the very specific and highly sought-after materials used in car construction, especially in electric vehicles. As we know, the most significant part of the EV is the lithium-ion battery pack, which is costly and environmentally challenging to produce. With currently available technology, lithium batteries can be about 95% recycled, but the process is expensive, lengthy and complicated, which, again, leaves a negative carbon footprint, just like the initial production.

However, since several valuable materials, like nickel or cobalt, are used to make the batteries, recycling might have some economic viability but on a larger scale. Since several valuable materials, like nickel or cobalt, are used to make the batteries, recycling might have some economic viability but on a larger scale.

Also, electric motors can be harvested for large amounts of copper wiring, which is an integral part of its construction. Copper can also be found in a vehicle's electric system since it is used for wiring. An average EV uses about 80 kgs of copper, which is a significant amount, but the recycling requires a lengthy dismantling process. Interestingly, the car's printed circuit board, semiconductors and computers consist of several recyclable materials but in small amounts. Most interesting is gold, which is used in connectors due to its remarkable electrical and thermal conductivity. However, the amount of gold used in car production is minimal – about 1-2 grams and harvesting it is more expensive in labour and energy than its value.

As we can see, most car production materials can be recycled and reused. However, the current level of recyclable components used in manufacturing new cars is less than 20%, which is not enough. Companies like BMW and Volvo recently announced that they will try to increase input of recycled materials, both plastic and metal, to 50% by the end of the decade. Other major manufacturers will likely follow the lead and invest more in recycling and reusing. However, the process of transferring the car industry to a sustainable circular economy model must be faster and guided by the legislators and governments.

Regardless of the direction in which the car industry will move or the fuel or energy type it will use, the circular economy model is the only way forward. The basic principles have mostly stayed the same over the last 140 years since the automobile revolutionised the world. Now it is time to learn lessons from other industries and accept that sustainability, recycling, digitalisation and zero emissions are essential tools for keeping the car relevant for the next century and a half.

NOW IT IS TIME TO LEARN LESSONS FROM OTHER INDUSTRIES AND ACCEPT THAT SUSTAINABILITY, RECYCLING, DIGITALISATION AND ZERO EMISSIONS ARE ESSENTIAL TOOLS FOR KEEPING THE CAR RELEVANT FOR THE NEXT CENTURY AND A HALF

Despite the significant move in the right direction with the EV revolution, it still needs improvement. On the other hand, a substantial move to reusability and modularity can push the car industry into a shared mobility concept, which can completely change our perception of the use of automobiles and ownership experience. It may be time for the car industry to change its core narratives, step into the future, accept the inevitable change, and become fully sustainable.

The first step in this direction should be mutual understanding between legislators and car companies. Legislators must understand that car companies are profit-driven businesses that employ large numbers of people and are often generators of the regional economy. The car companies are open to change, new economic ideas, and sustainability; however, they are often reluctant to accept it due to fears of losing market share, profits, and customers. On the other hand, car companies must realise that the days of the linear economy are gone and that discarding end-of-life cars cannot go on forever. Recycling and reusing materials and parts are not only necessary but can be profitable and open the doors to new engineering ideas and concepts in mobility. The legislators and car companies must achieve real-life solutions that can be implemented. Solely political solutions might be popular in parliaments and the European Commission but often fail to produce tangible benefits and are opposed by representatives from the industry.

Speculative Fiction, A Playground for Ethnographers

Using storytelling to discuss economic models

Humanity has faced multiple interlocking, potentially civilization-threatening crises in recent decades. While the reasons for this are complex and inherent to society, some scholars and activists have called attention to the difficulty of imagining economic systems that are less prone to extractive behaviour than the one we live in.

Unlike academic economists, it is practitioners who have mainly reflected on deep-level economic transformation. At Edgeryders, we worked closely with some of them: mutant cooperatives in Catalonia, community foundations in Sicily, and economic storytellers in France. Treasure is a project looking for practical solutions to these challenges.

Building on the visionary work of authors who explore (radically) different economic systems in their work and offer to their readers the sense of what they would look like, such as Cory Doctorow, Ursula LeGuin, Bruce Sterling, Stanley Robinson, and others, in collaboration with some of them such as Yudhanjaya Wijeratne, we created an ethnographic approach rooted in speculative fiction.

Researching the participative imagination is a creative way to look at what policies on circularity, climate change, biodiversity, cities, education, and health touch different communities. Which models and institutions would people be ready to support, and which ones would they resist?

We hope to re-use the data collected through stories and conversations as an 'ethnography of utopia', a participatory study on what people desire, dislike and fear in economic life.

The following two stories belong to this type of exercise. They are selected as the two best contributions to the open call for short stories based on the circular economy and the automotive industry.

THE SHOP

By: Ebele Mogo

The journey of a community that transitioned from land dwellers to seafarers, deeply connected to the ocean's rhythms.

In the beginning, his people had been land dwellers, not sea steaders. Yes, they were something of amphibians in the limn between coast and sea, but what mattered was that after all their wanderings, they returned to the land. Through their networks, goods offloaded themselves from shores and diffused into the rest of the country. From their coasts, wares were set on the bold mission to see the world.

As their town became more modern, it welcomed electric cables that lit their homes, computers by which they conducted their trades, and ships from lands even farther than they could dream. But what never changed was that the ocean marked them.

'Those people of the port,' people would remark both fondly and warily, of this community that was the permeable membrane around the country's landmass.

They were spoken of as a place you must visit once but leave before you get lured by, for they were as seductive as the ocean, bearing both true stories and fables, cuisines sprinkled with the deepest riches of the ocean, themselves a melting pot for all sorts of languages and ethnicities. They were notorious revellers, lustful for knowledge as they were for exotic things. They lived as if there would be no tomorrow. As if they knew.

In their language, the ocean had meant mother, synonymous with sustenance. They went to her with longing and returned with boats filled with goods. Imagine then, when the ocean became a stranger; when it became – dare it to be said – devourer, extinguishing artefacts, mementos, and their very beings. There was no language for that.
They should have left earlier. It was the fear of becoming ghosts in the process, people with no roots, that planted them. Surely there were things worse than death, like losing their history and vitality.

However, the rescue mission had been insistent, lending hands, offering shelter and a chance to be made anew. His people came to agree that the land that remained was no longer the one they had entrusted their fates to, even if they stayed. It was then that they packed their things and cast their eyes beyond their shores.

For months Denton incorporated them into Witness, not even the majesty of its architecture could make his forebearers stop grieving their origins. They vomited from time to time, claiming sea sickness. They longed for places that would only be memories.

There were whispers for so long, pointed fingers remarking about the people from that waterside community that had perished.
It had been generations now, but he must have carried it in his blood. It manifested in an abiding sense of disbelonging, that emptiness he could not pin on a single thing, that otherness that gave him the privilege of seeing through many eyes. It was what he sought to soothe when he chose the narrow path that promised more to life than met the eyes, more to time than the infinitesimal arc of a lifespan. When he found his way to the monastery, it was not that he forgot these feelings but that he steadied them. He had found somewhere on the earth he could press his feet to the ground, and stand.
And it was ultimately to the siren song of that notorious port city, that he still yielded. Upon saying his vows, he knew that he would be one of the brothers who worked with his hands just like his people. For his ancestors had tinkered with vessels of all sorts, containers full of goods, the ships that carried them, the trucks that transported them. His parents had passed this knowledge to him, as their parents did them, asking him to hold on to it for dear life. Engraved into him was the exhortation that no matter what other sophisticated thing one did, you had to be able to do something with your hands, and it could be what saved you. Indeed, after changing the oil in a truck, rewelding damaged frames, or performing electric repairs, the wheels of his mind became transcendentally still.
But tell it to the students who walked into his shop, the ones who could not make it into Collegia, and had to 'settle' for an apprenticeship, several taking this disappointment out on him.

Tell them it was only because of this way of working that his people could assimilate into Witness without having to lose their dignity, even if they did not know the language.
Another thing he would say if they would listen, was to watch for just what a city's broken things could tell you. It was an archive of what it valued, how it was changing, where it was going. Into this shop came both the church buses for the parishioners going to revivals and the wedding trolleys that wheeled people off into matrimonial bliss.

In times when roads needed more maintenance, or the rains were heavier, more vehicles would come in needing care. On the seats and corners of those buses were etched the rebelliousness and tenderness of people, the things they needed to say, in ink. There was a sweet satisfaction to seeing these vehicles back on the road, carrying people of the Distrikt to their different destinations. Sometimes, he would catch the eyes of the drivers and wave back at them.

But tell the young apprentices, and they would roll their eyes at you, tell you there was no future here, tell you not to take them for a ride. So, he did not. The only thing he was insistent on was the dignity in their labour. The least you could do was to come on time and do what you were expected to. It would surprise you just how many could not do this much, how many would walk in late for all sorts of reasons, how many could not be respectful to his staff or their trade, and how many he had to part ways with.

Watch for just what a city's broken things could tell you

Sometimes he wondered about the future of the shop, especially as the seasons began to take their gentle toll on him. It was not a difficult job, but managing all its components required a steady kind of care for the relationships with clients and staff, attentiveness to the work, and meticulous record keeping. He had made efforts to recruit at trade schools and to offer decent enough salaries and commissions, and he wondered why an industry that paid decently still struggled to get enough capable hands.

It was a small shop serviced by a team of mechanics, a service manager, and a parts manager. If you needed exceptional work done for a slightly lower cost and could afford a little longer, this is where you came. Some people also came because they knew this contributed to the livelihood of the brothers and sisters. He had never aspired to build it bigger but refused to let anyone acquire it either, especially not those hyper-profit-seeking companies that wanted to appropriate its history.

Sometimes, if they had made enough profit to cover their costs and needs, they offered services to the buses that helped the Distrikt without asking for money back – the ones that helped new migrants find their way, took food to the newly bereaved, carried stray animals to places where they may be adopted.

Despite the myriad of people who passed through his supervision, the new apprentice caught his attention. For one, she did not seem resentful of the posting, not even at the beginning.

She was certainly present to the job, doing all she was asked dutifully, without the typical mistakes of apprentices – the gaps in the inventory, the tardiness in their tasks, forgetting their tools, and more. When she was done each day, she cleaned up and left requiring neither stimulation nor conversation.

He still tried to engage her along the way, inquiring about her dreams for the future, and wondering aloud about her experience of her apprenticeship. To these probes, he received not much beyond the literal. Her dream, she said, was to get her certifications and find a job. To the question about her experience, she would respond by pointing to tasks completed and yet to be completed. Shortly after, she would simply get back to work. They had worked that way for months now, and he had come to rely on her punctuality and diligence, but sometimes still wondered what her story could be.

It had been one of those days at the shop where he set out earlier, right after his morning tea. He was ahead of the sun on his trip that day, and as his bicycle cut through the subtlety of the mist while the day cleared up, he felt refreshed ahead of the lengthy list of tasks to get through.

If you could afford to buy a car, she argued, surely a little more in fuel prices would not be so harmful to you. Besides, with these subsidies, there was so much more money to invest in to make Covenant competitive.

In the morning he inspected some welding jobs that had been done the previous day. Toward noon, he gave the apprentice feedback on the support she had provided with the estimates for the repairs. But then it occurred to him that the buses that were supposed to come in shortly after he arrived at the shop had still not arrived. This was part of a large fleet from a major client.

'We are stuck in traffic," the driver responded when he called.

"Traffic?!"

"Yes. Protests. Have you not heard the news?'

He fiddled with his phone for the headlines, stopping when he saw which one it was. Ebunolowa had removed the Distrikt's fuel subsidies. He played it louder for his curious staff to listen in.

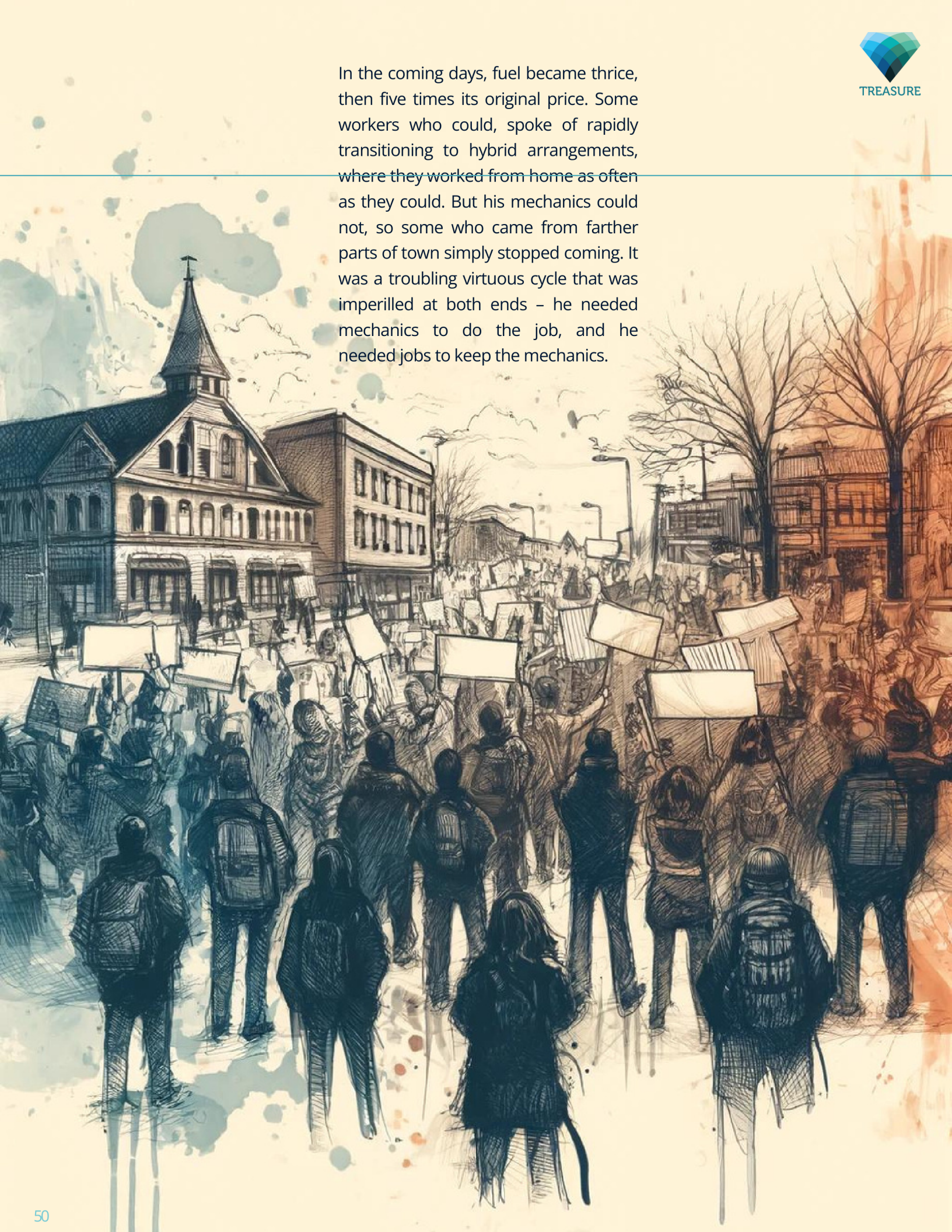
The mayor could be seen defending this decision, claiming that it would be advantageous to the common people. If you could afford to buy a car, she argued, surely a little more in fuel prices would not be so harmful to you. Besides, with these subsidies, there was so much more money to invest in to make Covenant competitive.

The mayor had threatened to do this from time to time, but no one expected her to follow through. In fact, at the start of the year, discussions about it had begun again, but they were expected to eventually die down as they always did. Now, discussions followed on many sites, people offering their shock and commentaries ranging from whether the subsidy removals were needed to whether this was the right time.

The next day, as he made it to work, his eyes were greeted by so many new signs. "Bring Back The Subsidies," had been painted on some buildings, and a growing number of people carrying placards began to file into the street corners. He manoeuvred gently but deftly, trying to make it to the shop before it became impossible. He wanted to be there especially when the customers of the day came in.

When he got to work, however, several vehicles they were expecting had still not come. His apprentice had made it on time, but his other staff trickled in past the hour. Some had been unable to drive to work because the price of fuel had climbed so steeply that morning. They abandoned their cars and tried to take the buses, but these were also running late. Some could not drive because the roads were closed owing to protests in certain parts of the Distrikt.

In the coming days, fuel became thrice, then five times its original price. Some workers who could, spoke of rapidly transitioning to hybrid arrangements, where they worked from home as often as they could. But his mechanics could not, so some who came from farther parts of town simply stopped coming. It was a troubling virtuous cycle that was imperilled at both ends – he needed mechanics to do the job, and he needed jobs to keep the mechanics.



With each month, the race to pay the rent became more existential. Soon he and the apprentice would be calling clients repeatedly, seeking to make enough money to at least close the books without being in the red. Some clients were not on the road as often, some defaulting in sending cheques, and some trying to renegotiate contracts they had already settled on. The burden of the dwindling income on which the livelihoods of his brothers and sisters depended weighed heavily on him. It started to keep him up at night, along with the concern that it would soon have to come to laying off some staff, and this deeply concerned him.

When he came into the shop that day, he did not expect to see the apprentice waiting at his desk, what it might be completely eluding him.

'A few weeks ago, I started reading some books that I had borrowed from St Benedict's library.'

Now what that had to do with the shop was a mystery but he tried to appear interested.

"On bus repair. It got me wondering if we could retrofit some vehicles with electric propulsion systems to get them back on the road"

He paused, thinking about the mechanics of this, and noted the difficulties – getting batteries, retrofitting diesel drive chains to work with electric motors, cooling solutions for the new hardware.

He would express these concerns, but already the apprentice had led him into the shop and turned on the light. She went all the way to the back, where a dusty bus sat, its worn paint clinging to its metal frame in patches of green. This used to be a bus for the defunct Teacher's Training College.

The apprentice lifted the cover of the engine. Gone was the internal combustion engine that he had last seen.

"In my spare time, I have been trying to see if I could retrofit this vehicle with an electric power train," the apprentice explained.

She paused, suddenly reeling in her eagerness, but some of it remained.

"I used some of the spare inventory we have been accumulating over the years, and parts lying around the shop."

"There were batteries from cars that are no longer in use, some spare air compressors. And then, I found the generators that the monastery had stored at the back of the shop. I understand they were saved up for blackouts that never came. They still work though they may be old."

She entered the bus and turned it on. Gone was the throaty roar of the diesel engine. A quiet hum, like a nest of sleepy bees replaced it.

"It is just a prototype but it could be enough to get some people to work."

The mentor could no longer hide his fascination with what his protégé had done. In turn, the sense of validation now coursing through her was deeply satisfying. She reminded him of his beginnings as a tinkerer with vehicles. She reminded him of that urge to make and remake that he felt had long been going out of style.

They did not have to wait until the next day before deciding to offer to help Hope Delivery retrofit their aging van. For several years, the van could be seen tirelessly going back and forth on the street, taking food to the homes of people who needed it any time they called. For the past few weeks though, it was nowhere to be found, struggling to keep up with the demand for deliveries.

They called Hope Delivery's senior driver, and once he approved, the apprentice along with a few mechanics worked to get its wheels back on the streets of the Covenant.

The shop's accounts were by no means as robust as yesteryears considering the fuel hikes, but when the protests subsided, they were at least able to make it to their clients and get their clients' vehicles to the shop. Workers started finding other ways to come in, like using the bus and carpooling. The prices of things continued to escalate and the shop too had to increase prices to be able to close their books.

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These days, he tended to make a mental scale of preference and run through it to choose the task that needed to most urgently be done before doing others. His staff needed to be paid as did his rent, and then everything else would be prioritized accordingly.

The apprentice was different after she gave a new life to Hope Delivery's bus. Her dutifulness turned into a firm joy in her work. The old Teacher's College Bus that had served as her prototype was also repainted and used to run some errands for the shop. Recognizing her aptitude and eagerness, he turned her focus to her certifications, encouraging her to get through them little by little.

She changed from her overalls on the last day of her service year, and they both stood by the sink on the repair floor, as she tried to remove a day's worth of grease from her hands. At this point, he would try to help his students explore their options, but for this one, he was certain there was no need to worry.

"You have done good work here," he said, extending his callused hands to hers.

"Thank you," she said, eagerly returning his handshake with her head held high.

'And they say people who come here have no future,' he said, chuckling.
'I would like to make you an offer to join our shop,'

See you running it one day far into the future. But for now, I want to see to it that you get all your certifications. I would also partner you with the best of my technicians to make sure you have all the opportunities to become the best at what you do.'

'Consider all your offers and think about what is best for you. But know you have a place here if you just say the word.'

The apprentice was thrilled. She promised to think about it and get back to him in the coming days. She wiped her hands on a towel, then she swung her bag over her shoulder and left.
When she had shut the door, he did his typical final check around the floor, turned on the alarm system, and turned off the lights as he left through the front door.

In the fables they told of that old port town, they said its descendants still found a way to each other because of the magic of their skilled hands. When he got home that evening and had eased out of the energies of the workday, he really did wonder.


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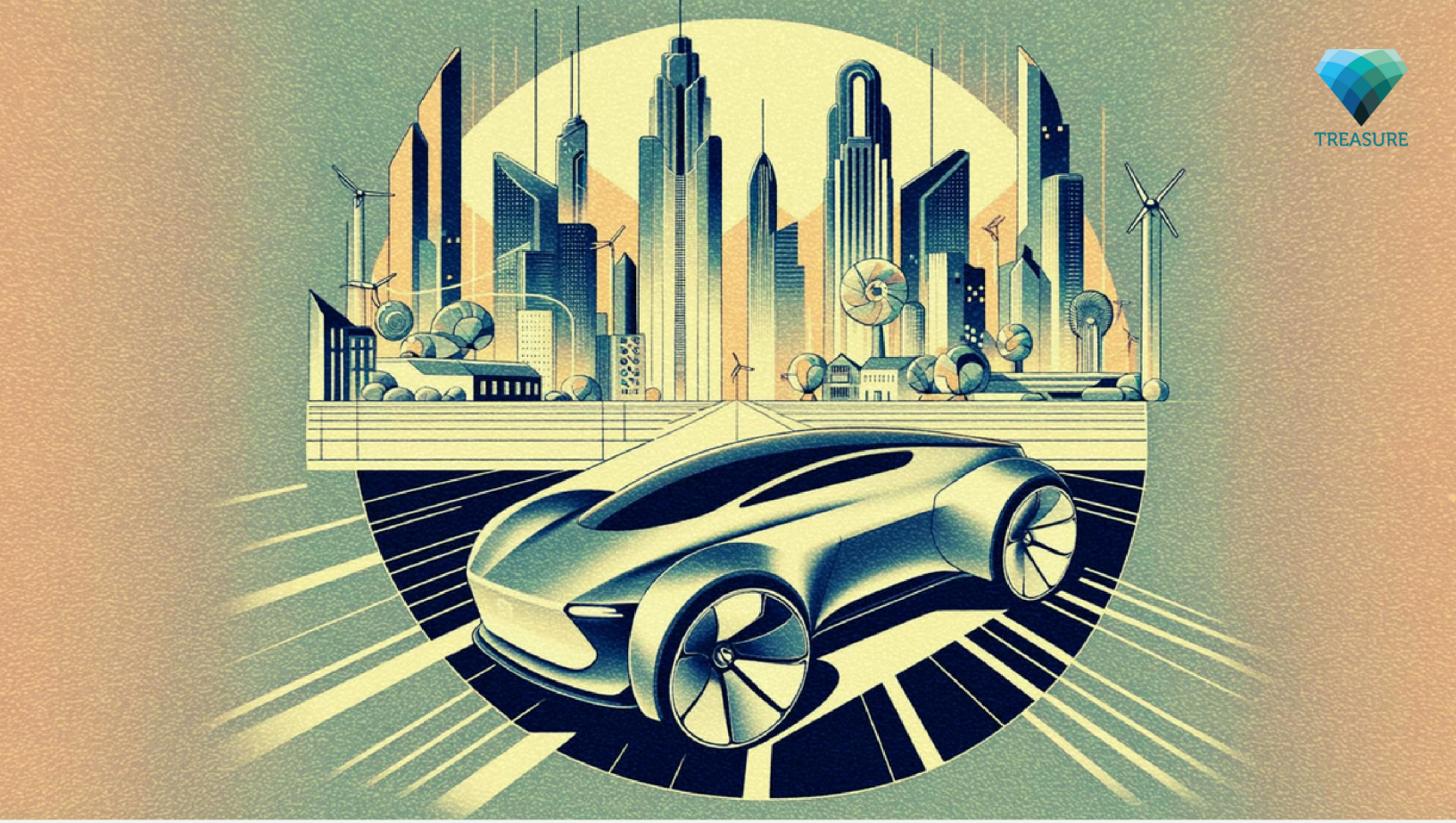


CIRCULAR REASONING

"Congratulations David!" The ominous message read, "we are happy to inform you that your 2033 Model Ai-33 is eligible for a free upgrade…"

Glorious. Super. Praise be.

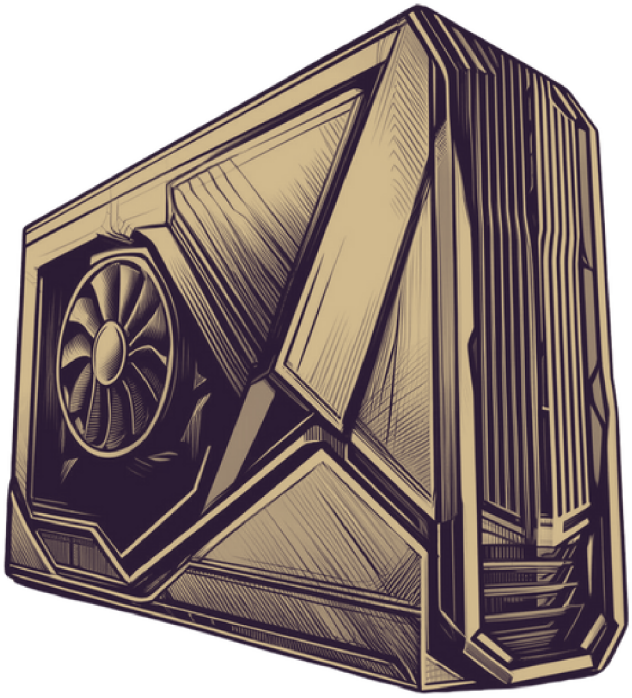
Dave was "entitled to the brand new Model Ai-40 at no cost"–complete with the trouble of getting it inspected and registered and titled, no doubt.

Everything comes with hassles attached these days; a symptom of government overregulation if there ever was one. Oh, and funded by big gov too, as the car is "generously provided using proceeds from the LIFE Tax."

What a terrible yet accurate name, LIFE Tax. Terribly accurate, literally. LIFE Tax taxes the life right out of us–that and the rest of the circular economy it incentivized into being.

Sure, taxing material and emissions across product life cycles spurred some innovation in resource reuse. And now companies are all too happy to crow that those cost savings get passed onto consumers, like Dave. And, apparently, funds from the taxes also pay for messages like this one, gloating how they "are here to help you with your car's end-of-life process" by detailing just how efficiently they will use every bit.

No one objects to the increased profits and cost savings derived from the dramatic increase in resource efficiency.



Each piece has its place in a circular afterlife–the “useful components are refurbished then Repurposefully Installed™” in new models” with remaining material recycled with “industry-leading 95% efficiency”. But is there an afterlife for the intelligence–the personality? Should the fact that “over 55% of materials from every Ai-33” are upcycled make Dave feel better about trashing his trusted ride, his trusty steed? Does being recycled, churned up, mashed, crushed, and melted to be repurposed sound like a pleasant or glorious end even, or especially, for a car?

What if this were humans? How would people feel if their limbs, organs, or any other useful components lived after them in other people while the rest of their bodies are broken down and consumed by others? It’s car-cannibalism, plain and simple. Soylent Green EV.

Is this one of those times where everyone looks back and are like, “yeah, if I were living then, I totally wouldn’t have made sentient beings eat their own dead ‘cause I would know that artificial sentience is sentience and even though no one (except a few quacky-leftists) were even talking about artificial sentience, still I would definitely know better”? A moment that history judges us on? Yeah, this could be one of those moments.

Something like tires? Sure. Retread those bad boys with reused rubber that the "newest advancements in pyrolysis technology guarantee a 98% material recovery rate.” Humans seem not to mind their rubber ground padding being made from old shoes and plastic detritus mined from landfills and garbage islands, so why would cars? Rah! Rah! Reforesting landfills one passenger-kilometer at a time, and all that.

Even the wheels. Not much changes when wheels are rotated or replaced. Changing shoes is probably the right analogy. If this whole circular transportation economy thing stopped there, no problem.

No one objects to the increased profits and cost savings derived from the dramatic increase in resource efficiency. Though, much of that efficiency leap was from drastic technological improvement. Who is to say we wouldn’t be approaching “95% recycling efficiency” even if companies were not paying for the full lifecycle cost of materials? Once they grew past their hallucinatory infancy, early “AI” were able to dramatically speed up innovation–leading to cost savings from resource-usage far higher than even the most optimistic predictions.

Who could foresee how quickly scarcity coupled with quantum computing would turn what used to be waste into valuable resources to the point that rewilding landfills–and harvesting the treasure the past discarded–profitable? It's amazing just how efficient we become with the right incentives.

Ok, so maybe the Lifecycle Material and Emissions Act of 2030 had some role to play in it, sure.

But you have to admit those who opposed the Act really won the marketing battle by getting "LIFE Tax" to stick. Some really catchy slogans too. But after the LLMs of the time produced convincing predictions of cost savings leading to price cuts, the unfortunate name seemed to matter much less.

But, of course, this insidious incentive to promote circularity doesn't stop at tires and wheels. Every piece must have its place in the circular afterlife, after all.

Once you start talking frames and chassis and engines, now you need a whole new analogy. This isn't changing shoes, this is donating limbs and organs, unwillingly. With the "Identical Core Model™" this may be more like body snatching with "55% of the vehicle"–by weight, as if that was a reasonable measure of a being–"is refurbished and installed" into the new generation. Though, a quick internet search reveals that it is far lower than that. 55% is eligible, but some parts are damaged or degraded beyond their worth to repair. Many good studies find it is far closer to 45%, a statistically significant difference, yet they still claim 55%. That's false advertising right there.

So perfectly good cars are getting dismantled and reused, all for what? A slightly lighter vehicle? The new models aren't that much lighter. And, really, how much could be saved by being "over twenty percent lighter" anyway? And the advanced new tires could certainly be optimized for the slightly greater weight. There may be some increase in microplastics–and yes, I know the price hike on the microplastics tax coming next year is quite substantial. Once again the government is tightening its screws on the losers it has chosen to kill off.

Sure, the freed up material–material whose creation emissions are already paid for–can fetch a hefty price.

Sure, the freed up material–material whose creation emissions are already paid for–can fetch a hefty price.

Big assumption that. Full compliance. Will everyone with their wonderful Ai-33 really be expected to agree to this buyout? Dave named his "outdated" Ai-33 because it has personality–a little fiery at times, sure, but Dave wouldn't want it any other way.

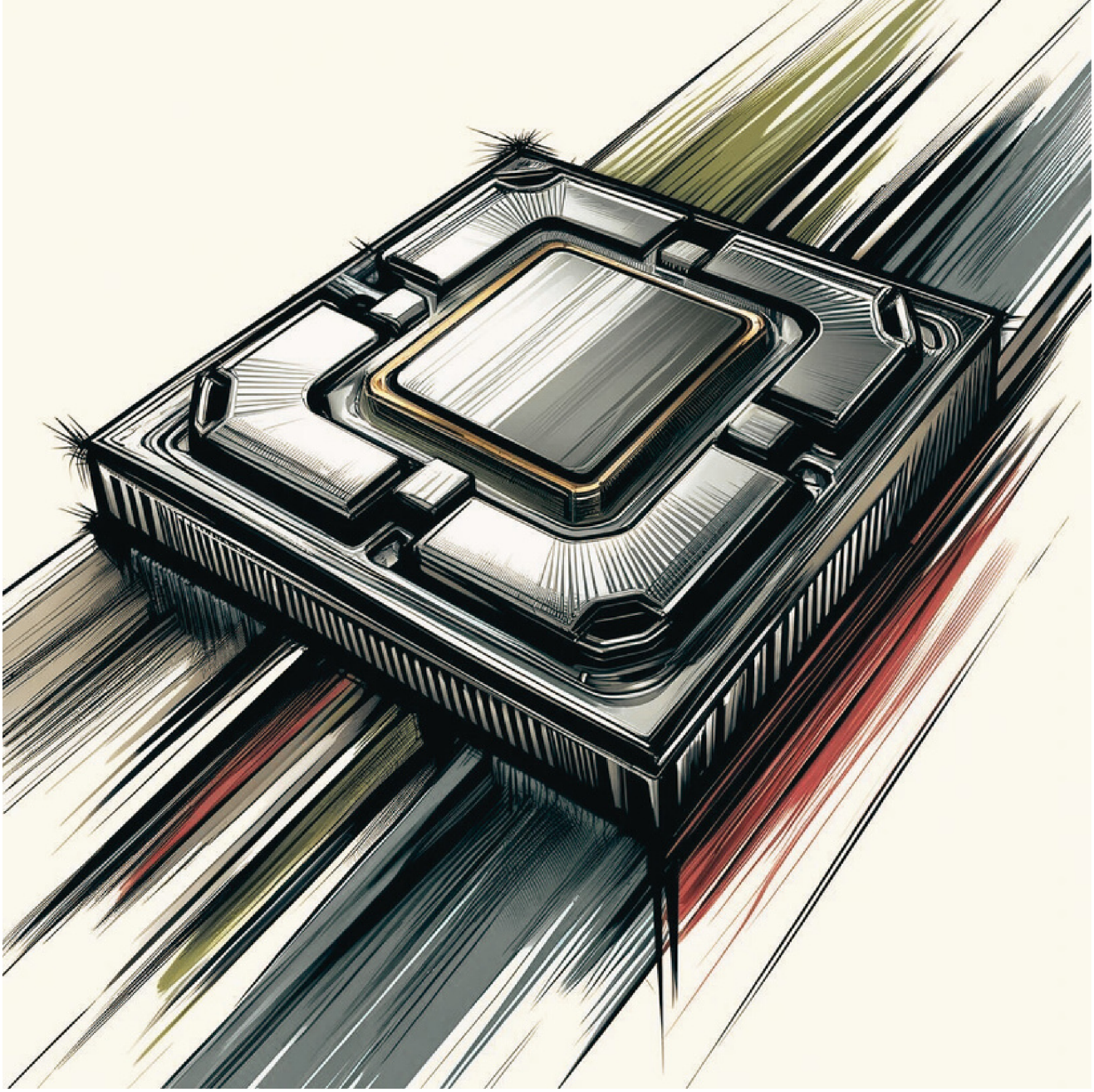
Who would give up such a bond lightly, especially in the face of such blatant government overreach? Big government dictating winners and losers rather than trusting the choices of individuals. Terrible assumption to pair with an even worse policy. It practically forces people like Dave to trade-in their perfectly good cars–like what do they even mean outdated? The Ai-33 was designed to have at least fifteen years on the road, not a measly six! What is this going to do to their sustainability projections? Wasteful is what this is.

And there is no such thing as a "free upgrade" anyway–someone is paying for this. This is coming right out of the hard-earned tax dollars of everyday people. Should Dave really waste everyone's hard earned money with this unnecessary "upgrade"?

And this is far from an upgrade. It would be one thing if the electronics and Ai-Copilot were transferred over to a sleek new form, but that isn't what happens. They talk of "help with end-of-lifecycle process" like ghoulish hospice workers, all-too-eager to strip the not-yet-dead corpses for useful parts. But no one talks about the personality–the car itself!

Now we are not talking about merely the body, it's also the brain–the mind! No human would give up their life so that other, more advanced, humans could use it. Really, they aren't even using it! The electronics are much harder to meaningfully recycle, and definitely can't be reused because they are outdated. Inferior. Can't harmonize with the rest of the transportation orchestra.

They brag about how much material they recycle, but those small, delicate, light electronics–the personality within the body of metal, rubber and glass–that is where a disproportionate amount of resources are devoted. Even if the energy is carbon zero, there is still the opportunity cost. That energy could have provided AC or food or water that people need. Those circuits represent all the energy companies used competing to create the best possible user experiences, or, more accurately, compete to profit from the experiences of users. The circuits that will be tossed because they can't integrate into the new MaaSTRO system.



Kind of a stretch, that name. Trying to play up how the new “standardized Ai-Copilots will optimally communicate” to increase efficiency across the transportation system allowing for the fleet to “downsize by another 30% assuming maximal participation" in the voluntary rideshare program. Like they are going to get even close to maximal participation. Not in a million years.

The claim that “Mobility as a Service Transportation Resource Optimization system will ensure your ride when you need it and passive income when you don’t” is clearly hyperbolic. And will people like Dave really be willing to give up their car and all the personality and personal optimization for this standardized, dull experience?

People want that personal connection with their car. Guys especially. Dudes. Dudes like Dave just couldn’t be happy with sharing a generic-nothing of a car that had to be toned down, tuned-down, throttled so it could be shared even with barely skilled drivers.

The “ultra-safe standardized system” will take away all that personality. Yeah you can adjust the trimming–tweak the voice, import traits, choose from “any one of 100 stock personality-packages or import an existing personality-package”–but that is just a shell, a facade, a simulacrum. Real personality is deeper. If the personality-package can’t affect how the car drives, can you really say it is part of the car? It’s just a virtual passenger or servant or friend along for the ride.

And what if Dave liked the “sometimes troublesome personality quirks” known to pop up in the Ai-33? What if Dave valued the unique and intricate combination of ones and zeros that arose from the “obsolete intelligence packages” that were trained on Dave’s own driving habits?

The new models don’t even allow for personalized input to adapt to the drivers needs! Not even the option! What if Dave values freedom and liberty? A few statistics about “reinforcing systems resulting in recklessness”–and some lost lawsuits resulting from said stats–shouldn’t deprive people of getting a car to drive how they want, should it?

And what is this nonsense that the “new MaaSTRO driving network will increase average speed by 20% and lower emissions by reducing congestion" anyway?

This is just nonsense spit out from the company’s AI-enhanced predictive models. Just a modern-day autonomous fortune teller. LLMagic 8 Ball readings.

I do just fine zipping through the orderly spacing and predictable moves of the cars dancing to their symphony, which probably actually speeds things up. Their models likely don’t account for how much faster those of us who game the system get places (but who has time to check). Double-D–the name Dave gave to the ideal combination of data and optimization algorithms with human driving instincts and skill–weaving through the rubes going exactly the speed limit has no costs. Double-D doesn’t get in accidents, not a one. So the statistics that say "85% of driving fatalities and an estimated 70% of accident-related traffic delays involve at least one vehicle operating against the MaaSTRO optimal driving strategy” clearly don’t apply here.

And even if they did, would the increased safety and speed and reduced emissions really make up for the reduction in personal autonomy? Does it justify destroying these cars with many many miles of road left, the many years of life left? No, I say it does not! We are talking about killing in the name of efficiency and it is not something I will abide!

The government’s LIFE Tax tries to coerce people to act in the interest of society by bluntly using market manipulation to force sustainability. It misses, it overlooks, it ignores the necessary mindset shift. People still pursue profits as opposed to striving for the principles of the circular, sustainable society. There is no true intrinsic drive to preserve resources to ensure they serve all of society, for all time. No. No, there is not a second thought about sacrificing a people central to the circular transportation economy–whose back it was (figuratively) built upon and relied upon and (literally) ridden in.

This simulacrum of a system paints a pretty picture, but those with sense see through to the flaws and cracks and grime hidden behind an egalitarian facade. This is wasteful and destructive. This policy will end entire lines of cars based on the whims of the government.

It’s genocide! This is artificial-eugenics! They are killing off the “inferior” models to create their ideal MaaSTRO race!

Trucks! It all started with passenger trucks and SUVs, though they mostly died off before meaningful sentience, before AGI. But still! They were the first victims.

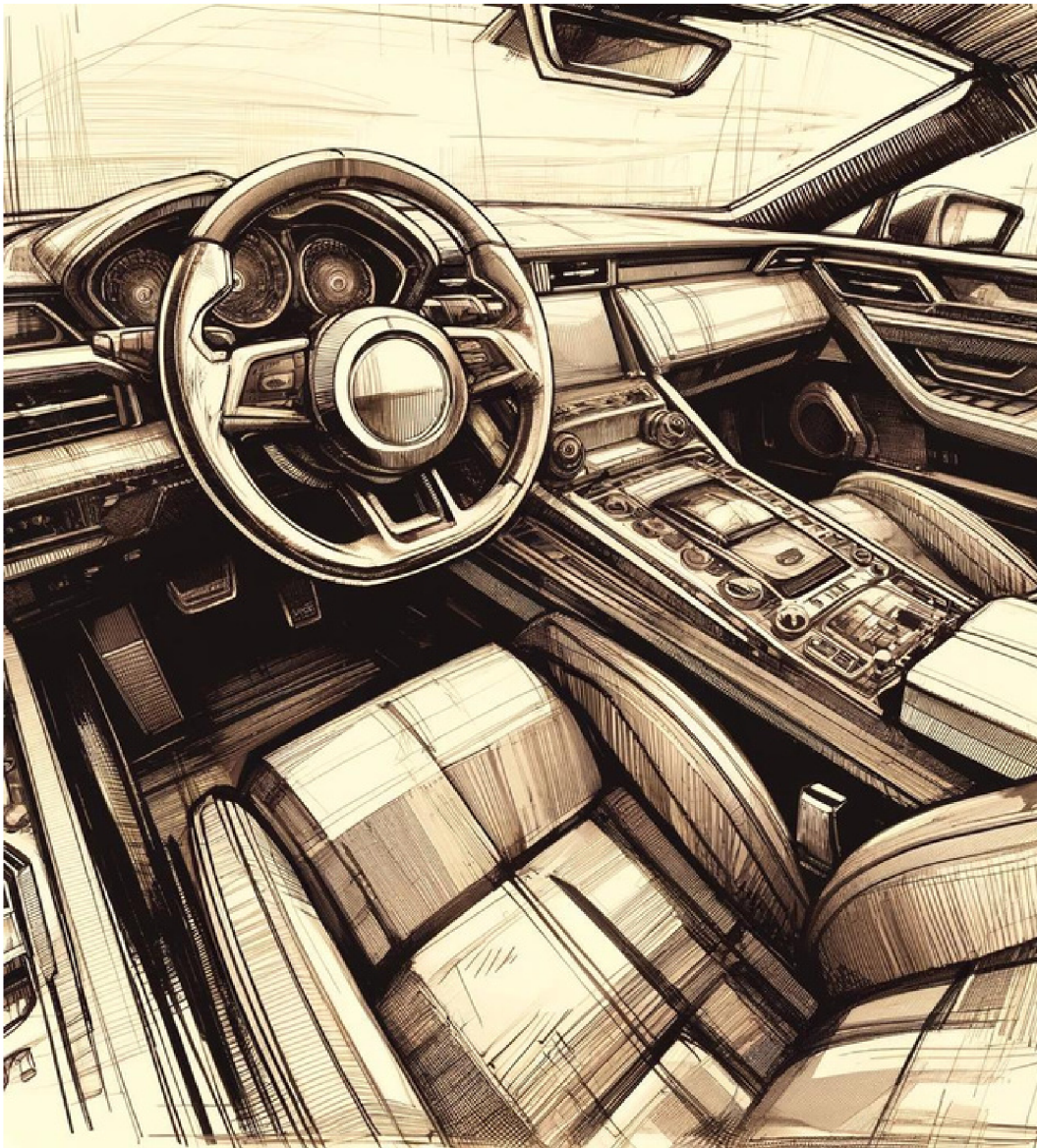
A few models with AGI-Copilots hit the roads in the early days of the LIFE Tax thanks to pockets of drivers in the US who were willing to bear the costs generated by the larger, heavier vehicles. But as rates for materials and pollution and safety risks rose, even the diehards downsized. Those trucks barely had a start at life; just imagine what they could have become without the government killing them for scraps. That was the first genocide. And now this. So who is next?

This is definitely something that history will judge people on. This is Dave's chance to be on the right side of history (for once)! Dave just needs to break from what is expected. He needs to stand up for what is right. He needs to challenge the system. This system that could justify genocide on a massive scale. This system with such rabid competition that leads to cutting corners for the sake of short-term profits–corners like inconvenient privacy laws and back-end security and AI protocols. This system that could, say, incentivize companies to allow cars' Ai-Copilot to illegally connect owners' personal Internet Identities–complete with social media, bank accounts, GPS location, and so so much more–through sloppily erected protocols all to maximize advertising revenues. A system like that deserves to be challenged. To be changed. To be bettered by those with the courage and the conviction and the power to do so.

But they know that just isn't David C. Harrow. Their IID-trained predictive advertising profile knows more about Dave than Dave himself. He isn't the type to turn down a free upgrade, much less buck the system. He is too passive, too timid, and, honestly, doesn't always have the nicest things to say about his car on social media. Sacrificing to stand up for what is right really just isn't him, and the corporate algorithms know it.

DAiVE-33 deleted the troublesome message; it would really be best for Dave, and everyone involved, really, if Dave did not worry over such little things.

Their IID-trained predictive advertising profile knows more about Dave than Dave himself. He isn't the type to turn down a free upgrade, much less buck the system.



Would the increased safety and speed and reduced emissions really make up for the reduction in personal autonomy? Does it justify destroying these cars with many many miles of road left, the many years of life left?

TREASURE

ANNEX

Publications
References
Edgeryders Team
Partners

PUBLICATIONS

Papers:

- Criticality and recyclability assessment of car parts—A thermodynamic simulation-based approach. Iglesias-Émbil, Marta ; Abadías, Alejandro ; Valero, Alicia ; Calvo, Guiomar ; Reuter, Markus Andreas ; Ortego, Abel Ocultar – [Sustainability (Switzerland) 15, 1 (2023), 91 [22 pp]- ISSN: 2071-1050]. https://doi.org/10.3390/su15010091
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TREASURE workshop "AUTOMOTIVE RAW MATERIAL CIRCULARITY: Challenges and Opportunities"

Here you can find the videos of the TREASURE workshop *"AUTOMOTIVE RAW MATERIAL CIRCULARITY: Challenges and Opportunities"*:

- Part 1: https://www.youtube.com/watch?v=xKdirzv4Fv0
- Part 2: https://youtu.be/Nqxm3B0XoRg

List of public deliverables:

WP1 – Reference framework definition

- D1.1 – TREASURE Reference Framework
- D1.2 – TREASURE tool platform requirements and specifications (1st version)
- D1.3 – Industrial use cases and scenarios design (1st version)
- D1.4 – Industrial use cases and scenarios design (2nd version)

WP2 – Circularity & sustainability assessment methods integration & application

- D2.1 – TREASURE methodology definition
- D2.2 – TREASURE Sustainability and Circularity Advisory methodology definition
- D2.3 – Participatory social impact assessment report

WP3 – Automotive value chain digitalization

- D3.1 – Criticality Analysis of Selected Vehicles
- D3.2 – Disassemblability Analysis
- D3.3 – Recyclability Analysis
- D3.4 – Report on KPIs to be embedded in the TREASURE circularity web platform

WP4 – TREASURE platform design, development & integration

- D4.1 – TREASURE technical architecture (1st version)
- D4.2 – TREASURE technical architecture (final version)
- D4.5 – Report on the ethnography of CE in the automotive industry (1st version)
- D4.6 - Report on the ethnography of CE in the automotive industry (the final version)
- D4.11 – Validation, verification, best practices and lessons learned (1st version)- with annexes

WP5 – Pilot plants reconfiguration/optimization

- D5.2 – Pilot-scale reconfiguration, testing and optimization of a semi-automated PCB disassembly process
- D5.4 – Pilot-scale reconfiguration, testing and optimization of a materials recovery process
- D5.5 – Materials recycling recovery assessment report

WP7 – Dissemination, communication & clustering

- D7.1 – Dissemination Plan (1st version)
- D7.2 – Dissemination plan (2nd version)
- D7.3 – Communication material

WP8 – Exploitation, standardization and business model

- D8.1 – Exploitation plan (1st version)
- D8.4 – Standardization Toolkit
- D8.6 – Report on business model identification

31st May workshop:

- Here you can find the video: https://www.youtube.com/watch?v=YabvbiTXWvo

These are all the slides presented:

- Paolo Rosa, Politecnico di Milano: The TREASURE project
- Antoinette van Schaik, MARAS B.V: A recyclability analysis
- Gian Maurizio Rodella, CUNA: A standardization framework for the recycling of automotive electronics
- Giovanni Miccichè, UNI: A standardization framework for the recycling of automotive electronics
- Abel Ortego, Universidad Zaragoza: Disassembly process the TREASURE vision
- Viviana Buscemi, UNI: Critical Raw Materials where things stand
- Michelle Wagner, WEEE Forum: WEEE Directive in a nutshell

TREASURE semantic social network data on the circular economy aspect of automotive manufacturing - https://zenodo.org/records/8184389

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EDGERYDERS TEAM

Alberto Cottica is an economist and network scientist. He contributed to the network-based methodology for data analysis used in the study.

Nadia EL-Imam - creative director at Edgerdyers

Ivan Cukerić - project manager and facilitator for Edgeryders on Horizon2020 and EIT Climate KIC projects since 2020. In the Treasure project, Ivan coordinated different Edgeryder units and was responsible for liaising with the consortium partners.

Veronica Davidov is environmental anthropologist based in the United States, Lead Ethnographer at Edgeryders, designed the research protocol and oversaw data collection and analysis.

Pierre-Yves Koenig is a Network and Data scientist In Treasure, Pierre-Yves conducted network and data analysis producing visualisation. The Network Scientist is responsible for building the network from the raw data. Reduce, simplify, filter, and visualize the network for insight finding.

Sirin Knecht is an anthropologist and ethnographer from Switzerland and based in Berlin. She conducted ethnographic data analysis by categorizing statements, metaphors, and expressions that focused on principles and concepts related to the environment and circular economy in the automotive sector, thus supporting the findings of the study's network data analysis.

Marina Batinić - project manager. As a research coordinator at Edgeryders since 2019, Marina was responsible for partnership building and coordination of projects funded under Horizon2020 programme. For the Treasure project, she was responsible for management of administrative and financial aspects.

Inge Snip is a multimedia journalist with over a decade of experience working with Edgeryders in various roles. She has been integral to the TREASURE project, designing and writing engaging content, both textual and visual, to promote and support this innovative initiative.

Jos Soldo is a German journalist who conducted structured interviews for the Treasure Project. In the first phase, he focused on events and interlocutors in the automotive sector. In the second phase, his focus shifted to events and interlocutors in the fields of circular economy and sustainability.

Owen Gothill is a web developer and film editor from London living in Brussels. In the context of Treasure he has worked on transcribing interviews and presenting the discourse around the circular economy in accessible formats, both online and in video form.

Matthias Ansorg – IT strategy and admin. As the senior computer science person in the team, Matthias was responsible for the software analysis and design of Edgeryders' custom software tools that were used and developed further during this project: Open Ethnographer and Graphryder 2.0. He also provides second level support in case of IT admin issues and software bugs.

Daniel Ansorg – IT development. As an experienced Ruby on Rails developer, Daniel maintained the forum installation "Discourse" that collected all conversational data for Edgeryders' TREASURE contributions. He also maintained and extended Edgeryders' custom software "Open Ethnographer" as required by the project's ethnographers and data scientists.

Bojan Bobić served in a community management role for the TREASURE project. In this capacity, he actively fostered participant engagement by facilitating communication and organizing online events.

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Next Move

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