The Future of Interiors

Uf Ultrafabrics®

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1. Executive Summary

Car Design News (CDN), in collaboration with Ultrafabrics®, has researched and produced this unique business intelligence report on The Future of Interiors. The report identifies how wider trends in mobility, technology and sustainability are transforming vehicle interiors and redefining the use of textiles, fabrics and other materials in automotive interior design, surfaces and functionality.

Interiors are the next frontier for innovation within car design, shaped by a new wave of tech-savvy, ethically minded consumers. Indeed, as OEMs move towards shared platforms, the interior presents the chance to express the values of a brand and its points of difference from rivals through material choice, UX/UI, smart surfaces and multi-modal interiors.

Further, the development of connected, autonomous, shared and electric vehicles will open the doors to radical new interior forms, particularly in the arena of fully autonomous transport.

The binding thread running through the report is sustainability, which will continue to be the dominant trend in interior materials, especially as greater scrutiny is placed on the use of plastics and leather. For example, materials for carpets, seat fabrics and foam, headliners and door panels will need to be considered with sustainability and new regulations in mind. This will open opportunities to explore new, lighter materials, recycled secondary materials and blends of ‘virgin’ materials, such as natural fibres and plant-based composites.

Demand for luxury fabrics will also propel market growth owing to a steady move towards ‘premiumisation’ across OEM brands and model segments. When paired with emerging demand for premium vehicles in the developing world, we are likely to see very strong growth in the automotive fabric market over the next decade.

Sustainability the Dominant Trend

Our research confirmed environmental considerations to be the top issue currently for vehicle interiors. Regulations are increasingly compelling OEMs and suppliers to shift to recycled and sustainable materials. Meanwhile, more environmentally aware consumers are rejecting plastics and leather. OEMs are therefore keen to promote their eco-credentials especially for interiors, which are particularly visible to consumers. Consequently, interior materials are a key area of focus for designers including for carpets, seat fabrics, seat foam, headliners and door panels.

Premiumisation of Interiors

One of the major factors driving the rising value of fabric per vehicle is the competition among OEMs to raise the bar in vehicle interiors across all segments, from entry level to premium segments, meaning that there will be increased demand for more luxurious fabrics. Owing to premiumisation, we estimate that the average value of upholstery fabric fitted to vehicle interiors will rise by 37% from an estimated $255 in 2020 to $349 in 2030.

Automotive Fabric Market Growth

We forecast that the global automotive upholstery fabric market, which was worth an estimated $19.6 billion in 2020, will increase by 125% in size to $44.1 billion in 2030. This is due to two major factors: firstly, global vehicle sales volume growth mainly from emerging markets, and secondly, the average value of automotive fabric fitted to each vehicle.

Interiors as Differentiators

As OEMs increasingly share vehicle platforms, manufacturers will put more emphasis on interiors to differentiate brands, including through materials, aesthetics, UX and technology. This can often mean a move to lighter, cleaner looking materials and interiors. OEMs are using the transition to EVs as an opportunity to re-brand and break new ground away from legacy ICE vehicles.

CASE Technologies and Design Freedom

Connected, Autonomous, Shared and Electric (CASE) vehicles will undoubtedly transform interior design, but it's clear that of those four trends, electrification will arrive fastest. EVs create an opportunity to differentiate interior space, surfaces and fabrics from conventional ICE vehicles. Furthermore, eco-conscious consumers are more likely to purchase EVs, which naturally increase expectations for sustainable features, including for interiors. When shared and autonomous vehicles become mainstream, they will profoundly change the purpose of the interior space as drivers experience the vehicles more as passengers. As many autonomous concepts show, designers will look to radical and bold new designs including for surfaces, fabrics and materials.

New Materials

The sustainability trend creates a multitude of opportunities to develop and implement new options, including recycled secondary materials and blends of new 'virgin' material, natural fibres, plant-based materials and composites. Nanomaterials are also being developed improving antimicrobial qualities, durability, strength and weight.

New Manufacturing Processes

Manufacturers are deploying 3D printing, laser cutting, laser etching and electro welding for new fabric effects such as perforations, stitching effects and embossing. These tools create new surface textures, decorative elements and individuality to fabrics and materials.

Smart Surfaces

Another area of potential growth is in fabrics and surfaces that integrate interactive sensors, controls, infotainment and other technology such as driver monitoring systems (DMS), which incorporate haptic feedback. Such technology will change the functionality and further increase the value of such surfaces.

Lightweighting

To meet emission regulations, OEMs and suppliers are looking to interiors in particular to save weight, as engineers have found it efficient to save weight with such non-structural components. Seating fabrics, foams and carpets are key areas of focus for lightweighting.

Evolving Ownership Models

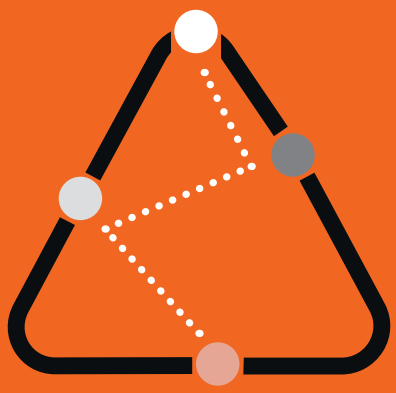
Consumers are increasingly leasing vehicles and may in future turn to ‘subscription’ models. In such scenarios, consumers ‘rent’ vehicles more in the way that they might a mobile phone, which they regularly swap and update. That allows them to opt for higher specification trim levels and interiors than many would if purchasing the car outright. If the occupants are users not buyers, there is more of a need for interiors with more durable, easily cleaned surfaces and fabrics suited to returning vehicles to other users.

Multi-Functional Interiors

As vehicles become multi-modal with functionality beyond mere A-to-B transport, the interior becomes a multifunctional space for a mobile virtual office workspace, meeting and socialising space. This fundamentally changes how consumers use, perceive and experience interiors and in part explains why there is a trend to make the interior feel more like ‘home’.

Interiors are the New Frontier

Consumers appear to be more conservative when it comes to vehicles exteriors, but are more willing to be adventurous and express their individuality within the relative safe and private space of a vehicle interior. For OEMs, designers and suppliers vehicle interiors present significant scope and opportunity to differentiate one vehicle from another.



2. Research Mission

2.1 Aims & Objectives

The purpose of the research is to provide Ultrafabrics®, the fabric supplier industry and wider automotive supply chain with insight into the most important themes, challenges and opportunities developing within vehicle interiors today and in the future. Ultimately, the research aims to inform the automotive supply chain and wider industry as to the direction of travel, and to provide thought leadership on The Future of Interiors.

2.2 Methodology

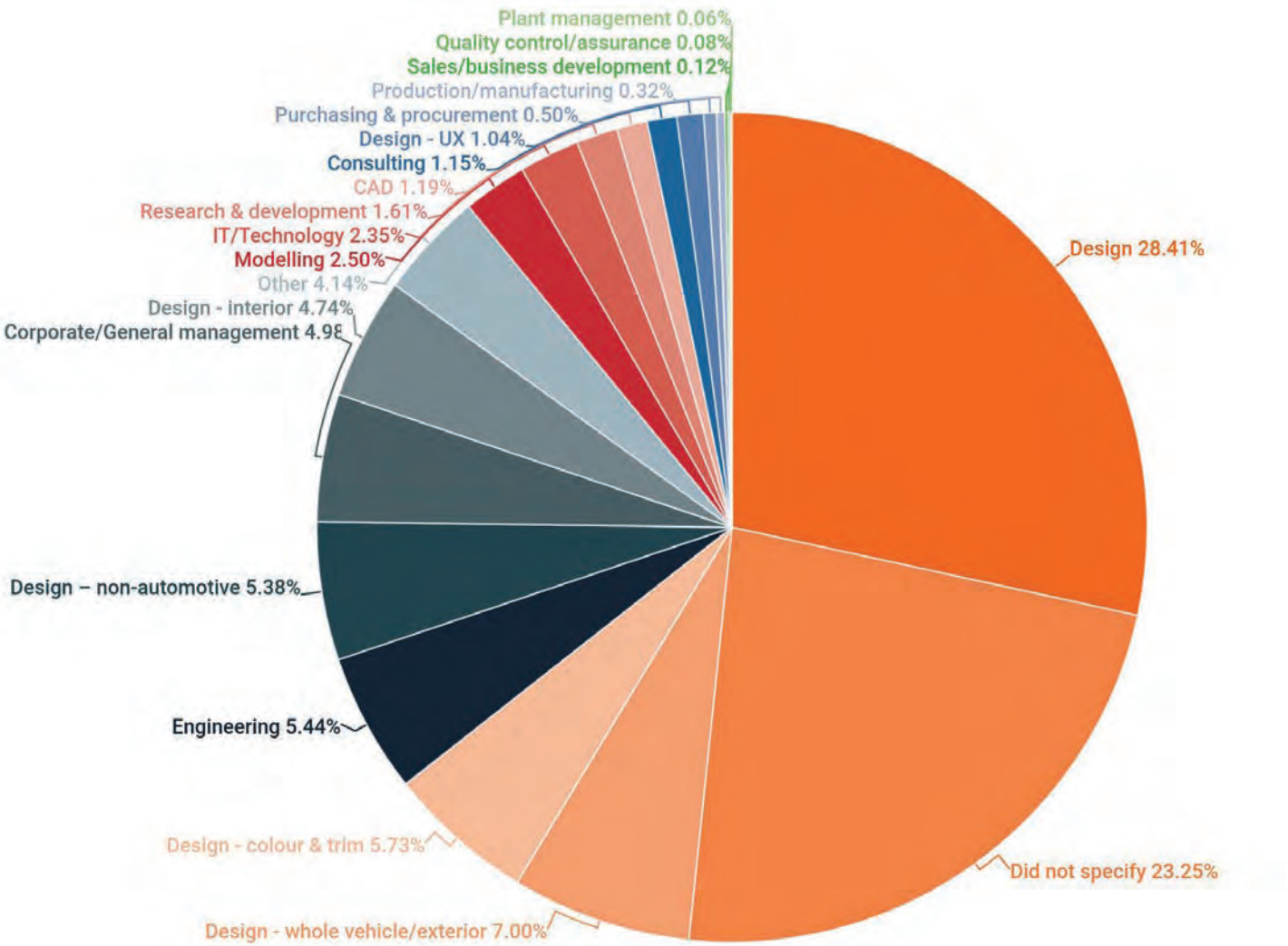
This business intelligence report uses a mixture of quantitative and qualitative research, trend analysis, forecasting and case studies.

- *Car Design News* in-house experts were consulted from both CDN's business intelligence and editorial team, leveraging their knowledge and coverage of vehicle interiors blended with wider automotive industry insight and trend analysis.
- Secondary research, which includes industry insight, market forecast data, trend analysis, case studies, materials research and evaluation of the broader future direction of the industry over a short-, medium- and longer-term forecast horizon.
- Primary research from an exclusive survey questionnaire that leverages the global *Car Design News* subscriber database, through newsletters, website and select social media, drawing in expert insight on the changing use of materials.

2.3 Survey Design

The survey was sent to 17,838 registered users of the *Car Design News* database. These were specifically targeted at car designers and also relevant automotive industry professionals with a strong involvement and knowledge of interior car design and materials choice.

Table 2.1 Job Functions of Those Surveyed



There were four email campaigns on 21st April, 28th April, 5th May and 12th May 2021.

In the first survey campaign on 21st April, to encourage participation, for the first 50 respondents a $50 Amazon voucher (or equivalent in local currency) was offered.

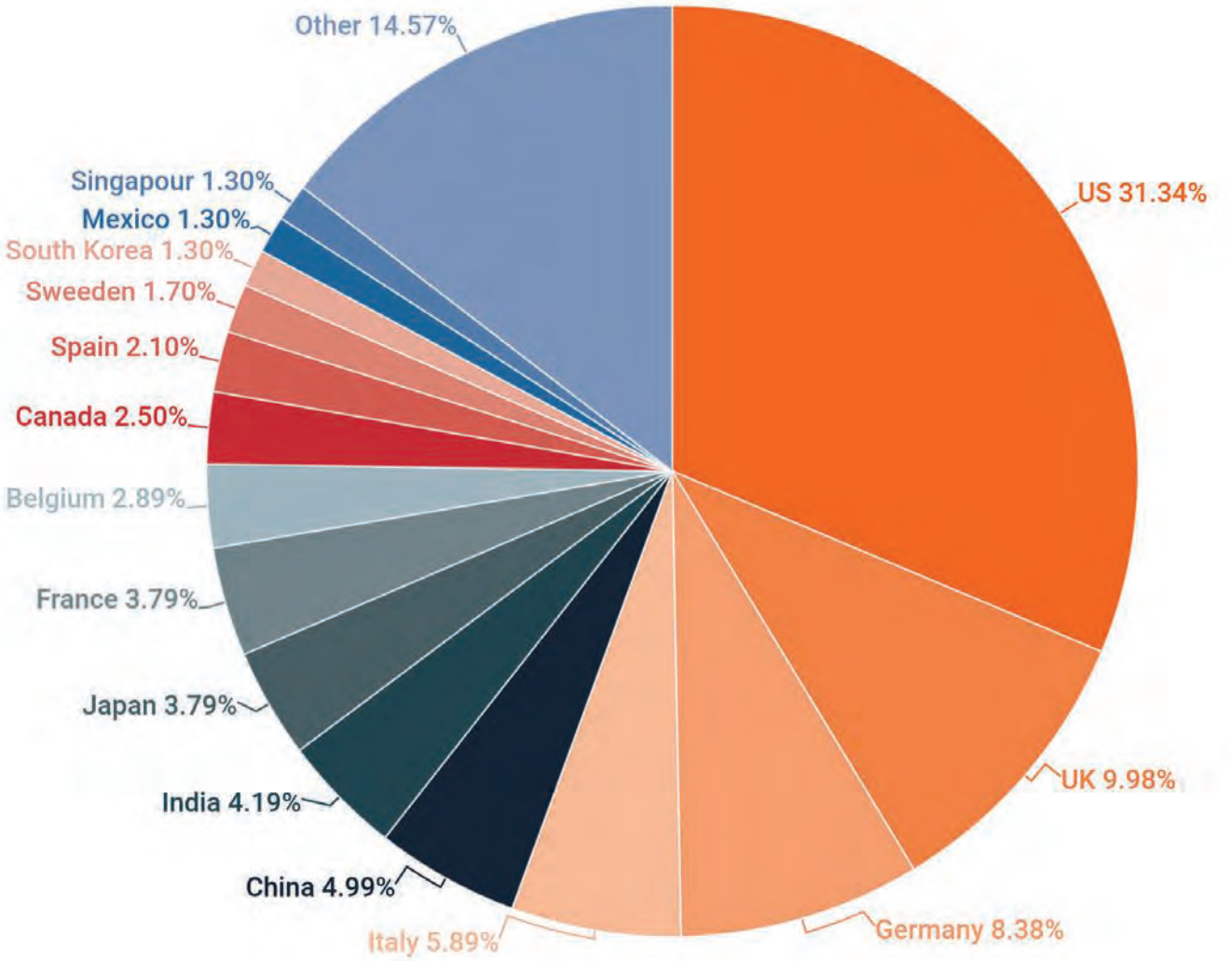
For the subsequent three email campaigns, for all participants, a free executive summary of the research findings was offered upon completion of the research.

2.4 Survey Responses

We received 239 responses which equates to a 1.3% response rate, which is in line with most comparable surveys. Given the number of responses this sample size can be considered statistically significant.

The geographic spread of respondents, although biased slightly towards English-speaking western markets, is largely representative of the global industry as the leading countries who responded are in line with the major vehicle markets of North America, Europe and Asia.

Figure 2.1 Geographic Spread of Survey Respondents (%)



Source: CDN, Automotive from Ultima Media

Furthermore, the survey can also be considered robust because the survey made it compulsory for all 15 questions to be answered fully, which resulted in fully complete surveys rather than patchy and incomplete responses. Survey respondents took it seriously by having to answer all the questions. See the Appendix for the full survey results.

3. Evolving & New Uses for Vehicles

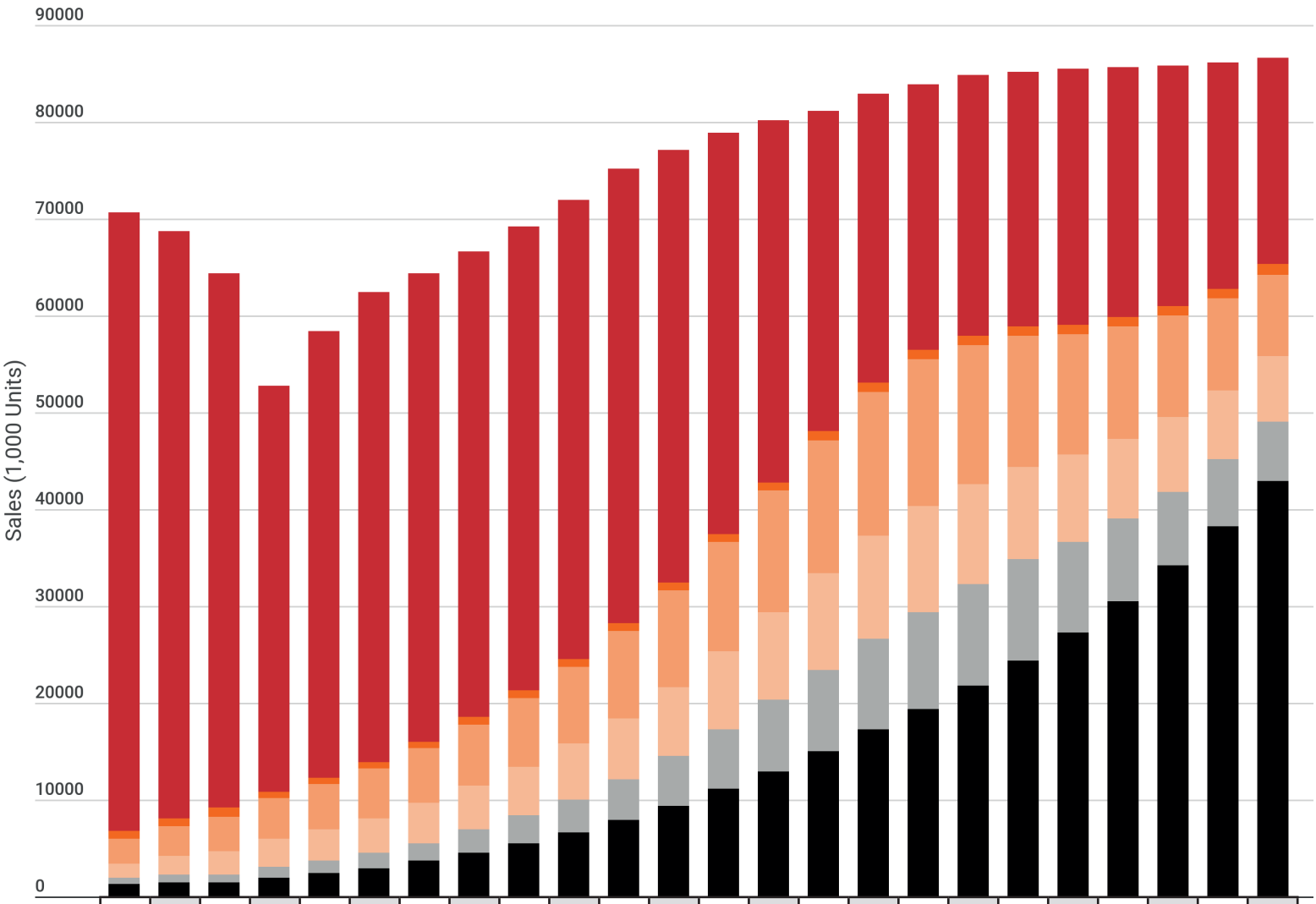
3.1 CASE Trends Driving Industry Transformation

The next decade looks certain to be the most transformative in the history of the automotive industry.

The ongoing megatrends including connectivity, autonomy, shared mobility and electrification (CASE) will profoundly change how vehicles are used, owned and driven – and consequently how they are designed, especially so for interiors. However, partly as a result of the pandemic, as well as accelerating focus and regulations on mitigating the climate crisis, consumers and OEMs have pushed the electrification trend to the top of the agenda, whilst manufacturers' investment and development of autonomous vehicles and shared mobility have slowed.

Mini Vision Urbanaut Concept Autonomous EV Creating A 'Third Living Space'

Figure 3.1 Global Passenger Vehicle Powertrain Forecast 2017-2030 (1,000 Units)



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
EV	1300	1500	1500	1950	2399	2926	3658	4572	5532	6639	7900	9401	11093	12979	15056	17314	19392	21719	24325	27244	30514	34175	38276	42869
PHEV	650	750	750	1050	1260	1537	1875	2288	2791	3405	4155	5069	6184	7420	8385	9224	9962	10460	10460	9414	8472	7625	6863	6176
HEV	1500	2000	2500	3000	3300	3630	4066	4553	5100	5712	6397	7165	8025	8988	9887	10677	10891	10346	9622	8949	8322	7740	7198	6694
MHEV	2500	3000	3500	4200	4620	5082	5692	6375	7140	7997	8956	10031	11235	12583	13841	14948	15247	14485	13471	12528	11526	10489	9440	8496
NGV + FCV	800	850	900	630	693	714	728	743	757	773	788	804	820	836	853	870	888	905	923	942	961	980	999	1019
Pure ICE	63950	60580	55200	41952	46147	48455	48309	48116	47875	47445	46970	44622	41498	37348	33128	29815	27430	26881	26344	26344	25817	24784	23297	21433

Source: CDN, Automotive from Ultima Media

3.2 The Shift Towards EVs and its Impact on Vehicle Interiors and Materials

3.2.1 Electrification as a Differentiator

The shift to electrification presents an opportunity for OEMs to re-brand and differentiate their vehicles from legacy internal combustion engine-based (ICE) technology and establish a fresh design language and new paradigm. It is a rebranding exercise that is even evident In the way that OEMs are redesigning logos, including GM, Volkswagen, Kia and Peugeot, to mark a clear break between the ICE era and electrification.

Buick Elektra EV Concept

3.2 The Shift Towards EVs And How It Will Impact And Redefine Vehicle Interiors And Materials

3.2.1 Electrification as a Differentiator

The shift to electrification presents an opportunity for OEMs to re-brand and differentiate their vehicles from legacy internal combustion engine-based (ICE) technology and establish a fresh design language. It is a rebranding exercise that is even evident in the way that OEMs are redesigning logos, including GM, Volkswagen, Kia and Peugeot, which all mark a clear break between the ICE era and electrification.

Survey Question:

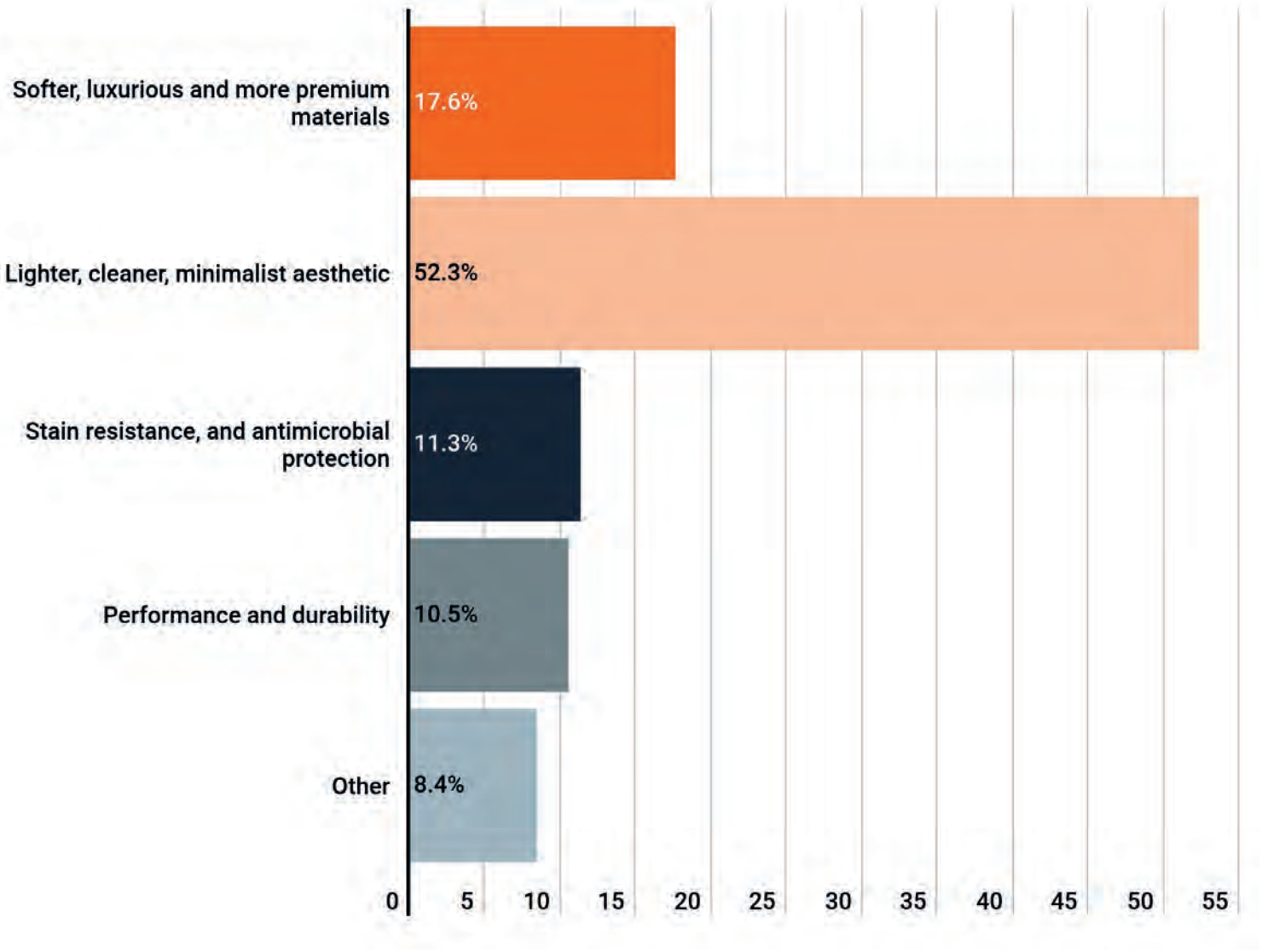
Does electrification provides an opportunity for differentiation?

52.3% agreed EVs will mean a “lighter, cleaner, minimalist aesthetic”

17.6% agreed EVs would lead to “softer, luxurious and more premium materials”.

Figure 3.2 Survey: Electrification

The shift to electric vehicles presents an opportunity for automotive OEMs to differentiate and sets a design language with distinctive interiors. Interiors could take precedence over exteriors. If this happens, what do you feel will be the most important factor in this design?



For interior design, this shift has been evident in design themes featuring a lighter, cleaner, minimalist and futuristic aesthetic. A good example of this trend has been the Tesla Model 3 monochrome white and black minimalist interior, which very clearly set it apart from the physical switchgear, knobs and levers of ICE vehicles and other legacy OEMs. **See Figure 3.3**

Figure 3.3 Tesla Model 3 with Monochrome Interior

EVs fundamentally change the driving experience. For example, electric powertrains make very little noise compared to ICE vehicles and driving an EV has been likened to 'sailing'. This relative silence brings other sources of noise vibration and harshness (NVH) to the fore. Consequently, tyre noise, soundproofing material and soft, plush, sound-absorbing surfaces will all become more important in an electric-only future.

3.2.2 Electrification: Exterior Freedom Drives Interiors

EVs fundamentally change the design possibilities around the classic traditional 3-box architecture of legacy ICE vehicles. As a consequence, the interior is not as constrained by the engine, exhaust, gearbox and transmission tunnel that would otherwise intrude into the cabin space.

Many designers are exploiting this design freedom on EVs, specifically those with purpose-designed platforms. For example, more EVs feature a low, flat floor, which has been used to create a traditionally Scandinavian living room feel, opening the space to maximise interior space. Examples of this approach in recent concept cars include the MINi Vision Urbanaut: Concept, and Audi AI:ME.

This approach has also been true of Volvo Cars, which has used the transition to EVs as an opportunity to integrate design heritage from parallel industries, such as furniture design, interior design and architecture incorporating the Scandinavian philosophy around living spaces.

We expect that this trend to accelerate. In the longer term, for example, once EVs are entirely powered from renewable sources, with battery costs and range less important factors, aerodynamics could become much less important, leading to a fundamental redefinition of interiors. In this way, interiors could determine much more of the exterior design. A good example is legendary ex-BMW designer Chris Bangle's REDSPACE EV concept, in which the interior practicality overrides normal exterior considerations such as aerodynamics and aesthetics.

> "This is the first really major change that the industry is having to embrace, which affects all of us at once"
>
> **Mike Simco,** VP Design General Motors on the significance of EVs.

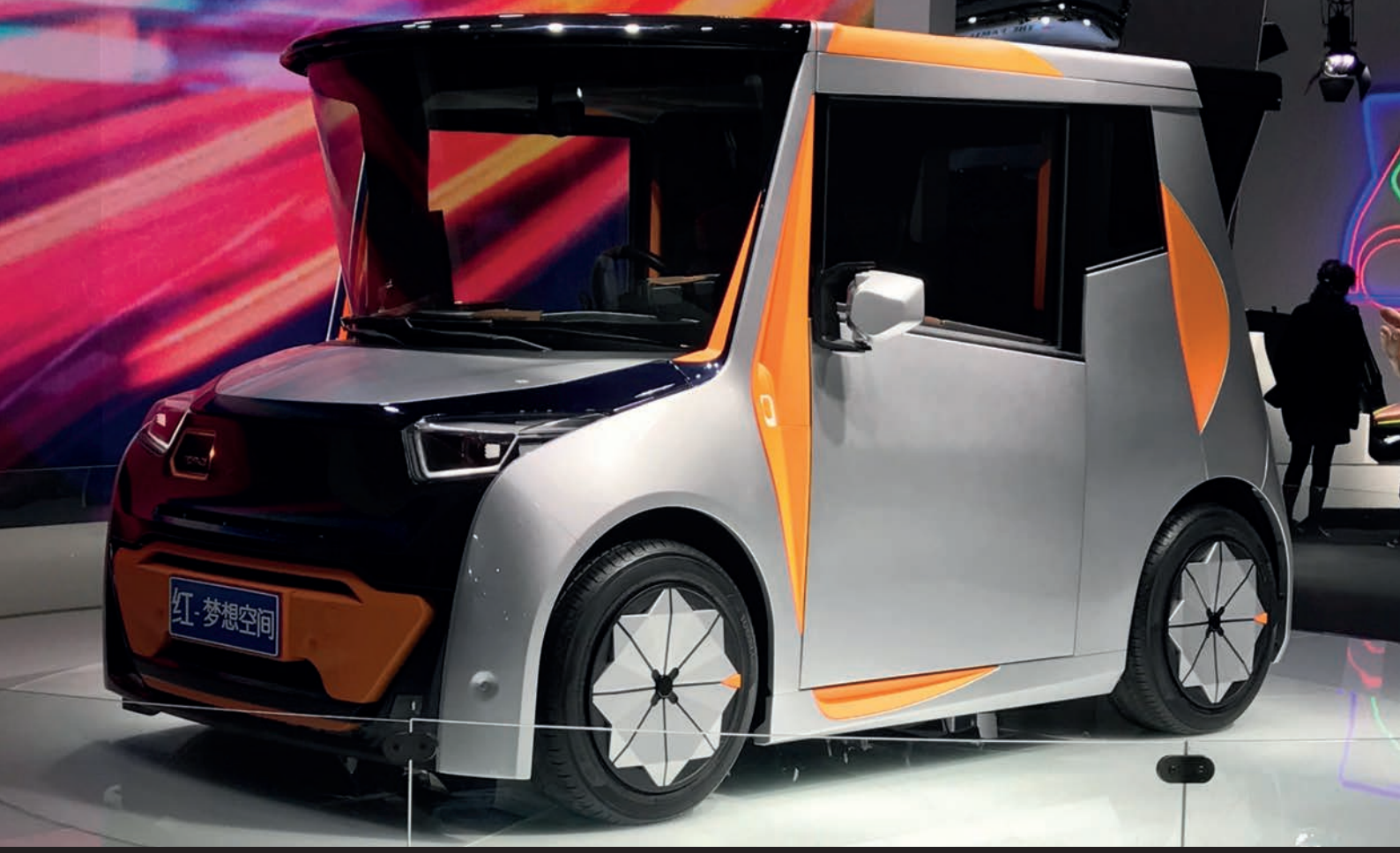


Figure 3.4 REDSPACE EV Concept Design Where Interior is More Important than Exterior

3.3 How Will Autonomy, Shared Mobility and Connectivity Impact Interiors and Materials?

3.3.1 Connectivity

With increasing connectivity features, vehicles are likely to continue to shift from being single modes of transport to increasingly multimodal mobile and virtual offices, meeting and leisure spaces – sometimes described as a 'rolling wi-fi hotspot'. As users spend more time in cars and across more functions, it is likely to change interiors further and place even more focus on materials.

OEMs are increasingly fitting vehicles with more advanced connectivity, not just in futuristic concepts but also relatively entry-level models such as:

Honda E, Honda Jazz, Hyundai i30.

Honda E with Advanced Connectivity

Survey Question:

What will become the most popular use for vehicle interiors?

37.2%
"Multimodal virtual, mobile office"

27.2%
"Ride sharing"

18.4%
"Lounge / family area"

Figure 3.5 Survey: Changing Modes

Vehicles are likely to shift from A to B modes of transport to places where users spend much more time in cars. This could radically change the design of the interior. What do you think will become the most popular use for vehicle interiors?

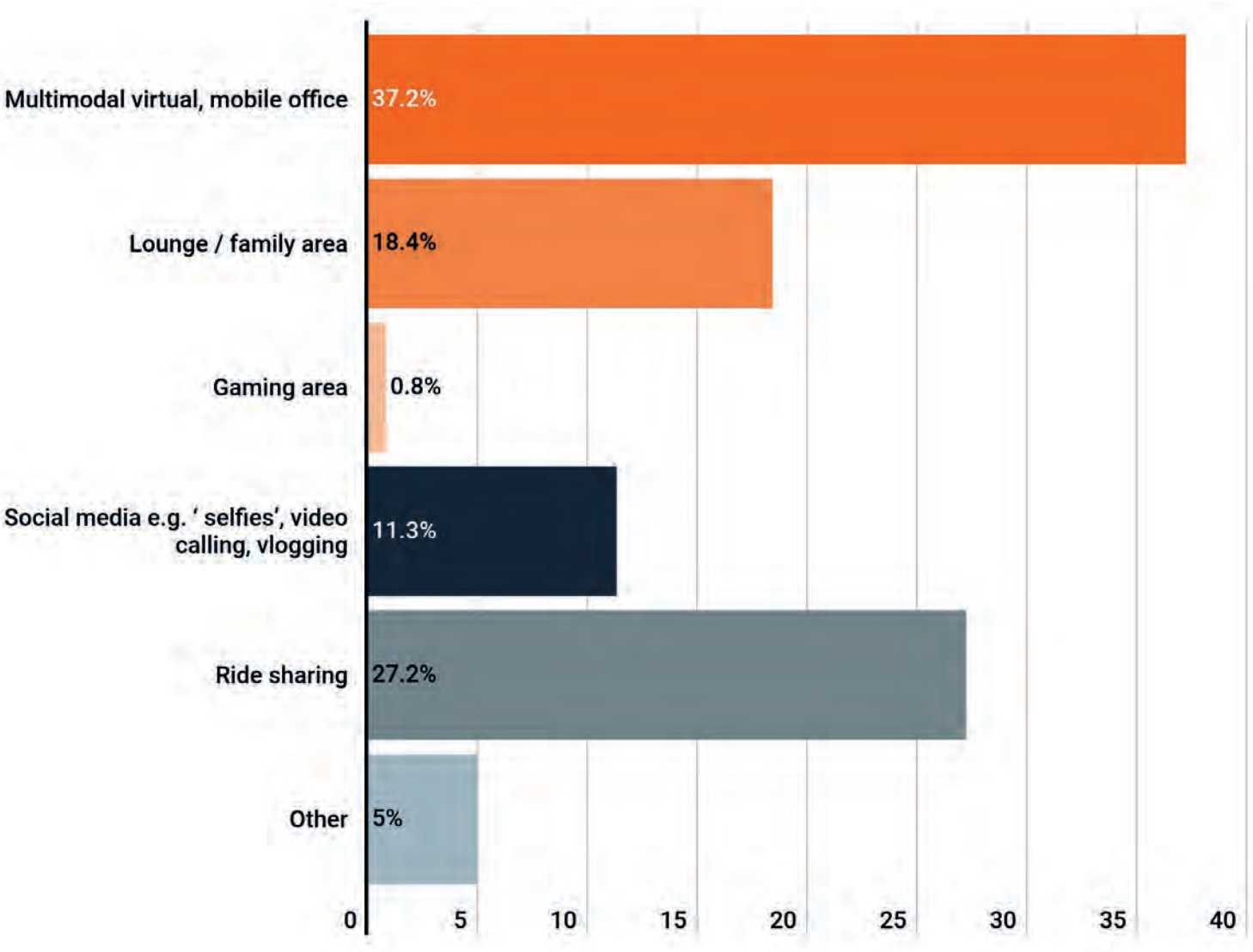


Figure 3.6 Sony Vision S Concept with Advanced Connectivity

3.3.2 Autonomy

Autonomous driving fundamentally changes the role of the occupants from drivers to passengers and may ultimately have the most significant impact on automotive interior design and materials. It will change how the occupants perceive and use the space, as well as increasing the perception of vibration, noise and harshness (NVH). As vehicle autonomy increases, interior comfort levels will become a key determinant and differentiator. Already, designers have started to experiment with the use of ambient lighting and noise-cancelling technology.

As vehicles become more autonomous, occupants are also likely to want more space to move around whilst they're not driving. To allow more space, designers have investigated retractable steering wheels and adaptive seat positioning such as fold-away rear seating and a swivelling front passenger seat.

As most autonomous vehicles are also likely to be autonomous electric vehicles (AEVs), this would take these trends further, as the relative silence and smooth acceleration of an EV differentiates the interior experience even more to legacy ICE vehicles.

However, only Level 1 and 2 autonomy (which include driver assistance technology) are currently available on production vehicles, while any wider adoption of level 3, 4 and up to 5 (fully autonomous) vehicles are still a long way off. High levels of autonomy are unlikely to be common before 2030-2035 at the earliest because of the cost, computing power required, traffic regulations and consumer acceptance of self-driving vehicles.

Future examples of how autonomous vehicles might look include the

Mercedes-Benz F105 Concept, Hyundai Prophecy Concept, MINi Vision Urbanaut Concept, Buick Elektra: Concept, Bentley EXP-100 GT Concept, Infiniti QX Inspiration Concept and YFAI XiM20 Concept.

Hyundai 45 EV Concept

Survey Question:

How important will interior materials be in autonomous vehicles?

41.8% "Extremely important"

41.4% "Very Important"

13.4% "Moderately important"

Figure 3.7 Survey: Autonomy

Autonomy changes how occupants perceive and use a vehicle interior. Passenger comfort levels will become a key determinant in the success of these vehicles. In addition to the use of ambient lighting, noise-cancelling technology and seat positioning, how important will interior materials be in autonomous vehicles?

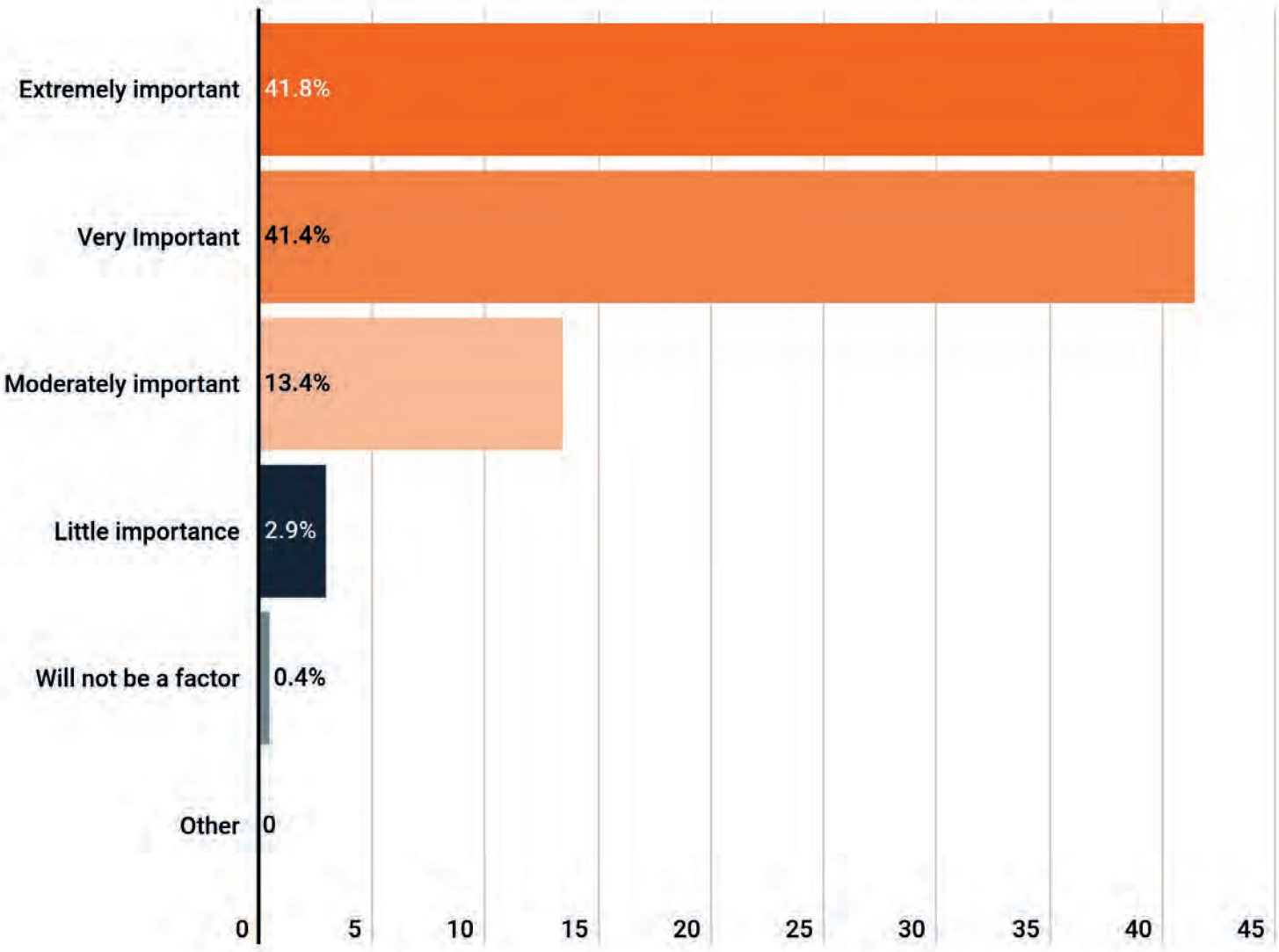


Figure 3.8 Infiniti QX Inspiration Autonomous Vehicle Concept

3.3.3 Shared Mobility

On-demand mobility, whether through shared mobility or ride hailing, is another factor that would fundamentally change relationships between cars and consumers, and with that interior design and material considerations.

The requirements and considerations for space, functionality and comfort change when the purchaser or owner of a vehicle is longer the (only) end user. For example, most shared mobility business models would lead to a significant increase in vehicle usage, with cars becoming assets to maximise much in the same as mass transport by plane, rail or bus. That changes the role of equipment like seating, which has an increased need for materials that offer durability, stain resistance and antimicrobial protection.

Occupants' expectations of vehicle interiors also change when they are not the owner and instead share the vehicle. Seat spacing, privacy screens and hygiene standards become more relevant in a shared space. Such features require surfaces and fabrics that are highly resistant to dirt and damage, but also maintain a premium appearance, as customers still expect high levels of service, comfort and technology.

Examples include

YFAI XiM20 Concept, Renault MORPHOZ concept, Audi AI:ME concept and Fiat Centoventi concept.

Survey Question:

How will shared mobility impact interior materials?

32.2% "It will make some more basic"

20.5% "Slightly more luxurious"

Figure 3.9 Survey: Shared Mobility

Shared mobility increases vehicle usage as with mass transportation such as airline, rail and bus seating. Expectations of the interior are likely to change in a shared space. Will this result in surfaces and fabrics needing to be more luxurious or more basic?

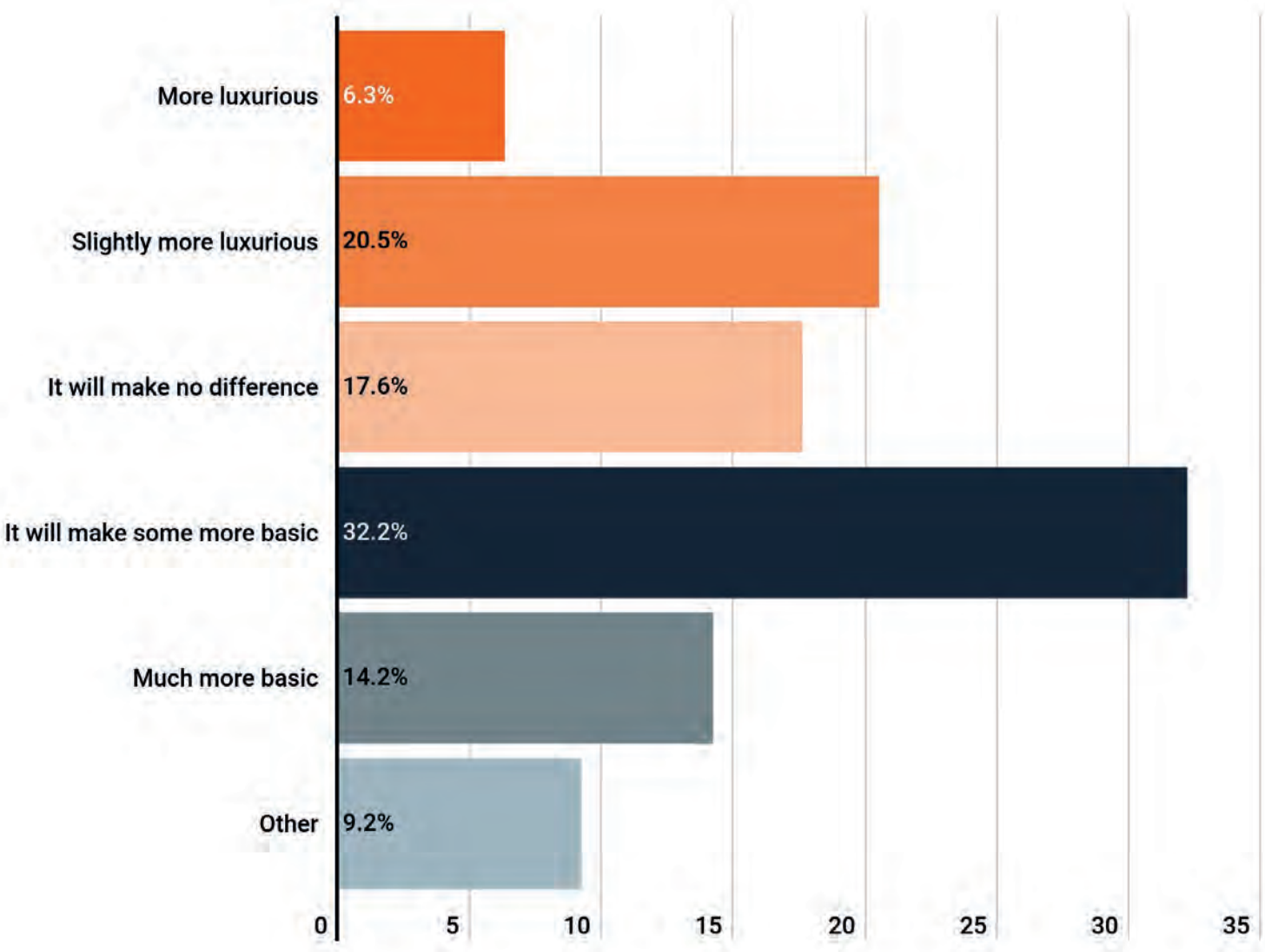


Figure 3.10 YFAI XiM20 Autonomous Shared Mobility Concept

3.4 Evolving Ownership Models

3.4.1 Increasing Leasing

In many major and developing vehicle markets, outright vehicle ownership has been declining as a share of the market compared to leasing, which has risen further thanks in part to low financing costs. As leasing becomes more widespread, one consequence is that consumers opt for more premium interior trim levels and luxurious materials than if they had purchased the vehicle outright. The usage model profoundly changes, as consumers see vehicles less as their own and more as disposable consumer goods that are replaced and upgraded every two years, much like a mobile phone on a new contract.

3.4.2 Subscription Models

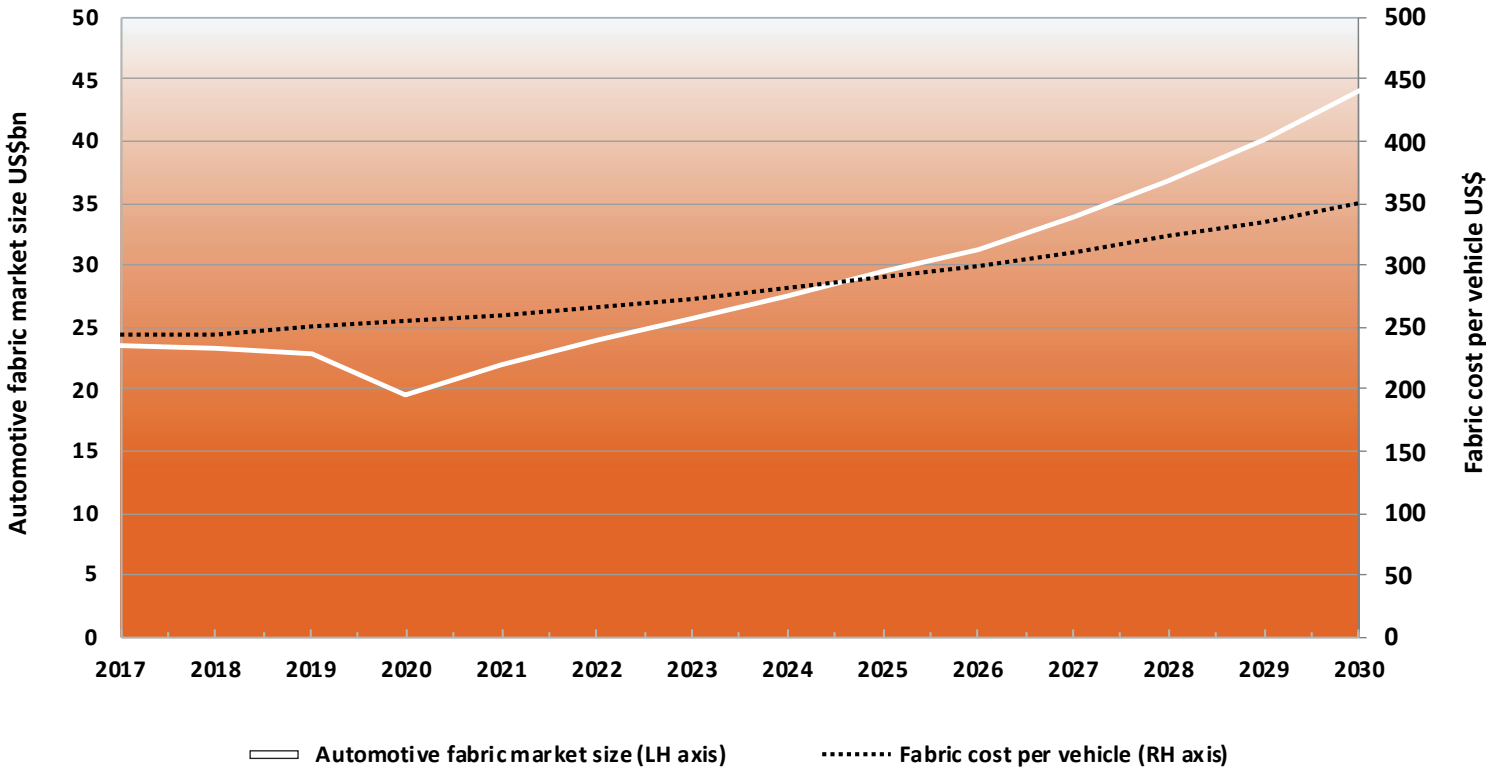
Many OEMs are now launching subscription services that take this product rental approach even further. The subscription package often combines the vehicle lease, maintenance and insurance to one simple monthly payment. In this model, vehicles can be returned and changed with much more flexibility than a usual fixed term lease. In such a context, the expectations and needs for interiors will likely shift to an even more premium trim levels as occupants and passengers become users rather than owners.

4. Market Development of Interior Materials

4.1 Market Definition

The definition of automotive upholstery fabrics varies considerably. For the purposes of this forecast, we define it as including the surface materials covering seats, door trims, instrument panels, centre consoles and headliners, but not including carpets. The definition includes all vehicle types and segments, including both passenger vehicles and commercial vehicles.

Figure 4.1 Global Automotive Upholstery Fabric Market Forecast 2017-2030 (Market Size $bn, Fabric Cost Per Vehicle $)



Source: CDN, Automotive from Ultima Media

4.2 Interior Materials Market Analysis

The global automotive upholstery fabric market is valued at $19.6 billion in 2020. However, this figure was clearly lower than normal values as a result of significantly reduced vehicle demand in the wake of the Covid-19 pandemic.

In 2021, we expect a strong rebound in vehicles sales, but it will still take around two years to recover to pre-pandemic levels across global markets, including harder-hit markets in Europe and India, for example. After this recovery phase, we expect global sales volumes from 2023 and beyond to be driven largely by strong demand growth in emerging markets in Asia and particularly China.

We expect the automotive upholstery fabric market to grow strongly as well, expanding at a compound annual growth rate of 8.4% over the next decade and more than doubling from 2020 levels to reach $44.1 billion in 2030. It is not only the recovery and growing global vehicle demand that will drive this increase, but we also expect the average value of automotive fabric fitted to each vehicle to increase as a result of the following main factors:

- Increasing Sales volume: After the Covid recovery phase, global vehicle sales volumes will gradually recover and from 2025 onwards will start to increase strongly thanks to emerging market growth in Asia and China.
- Premiumisation: The arms race to raise the bar in vehicle interiors across all model segments means that there will be increased demand for more luxurious premium fabrics. The average value of fabric fitted to vehicles will rise from an estimated $255 in 2020 to $349 in 2030. **See Figure 4.1**
- Leasing and subscriptions: Consumers continue to shift to leasing, with more OEMs also encouraging full subscription models. For interiors, this means that consumers are increasingly choosing higher specification trim levels and interiors than they would have done if purchasing the car outright.
- Sustainability: OEMs and suppliers are under pressure from regulation to shift to recycled and sustainable materials. Consumers are increasingly aware of environmental factors around materials, in particular plastics, and are expecting more environmentally friendly interiors. OEMs are keen to promote their eco-credentials especially for interiors, which are highly visible to consumers.
- Interiors as differentiators: As OEMs use more shared vehicle platforms, car designers are turning increasingly to vehicle interiors and UX to differentiate across model segments as well as brands. This trend will also grow especially as OEMs roll out more EVs and later autonomous vehicles, which provide even more opportunity to use interiors to differentiate from legacy ICE vehicles.

5. Sustainability

Survey results clearly demonstrate that the dominant trend in automotive interiors is towards sustainable materials.

Sustainability will have a profound impact on the choice of materials and fabrics in interiors. From a regulatory, manufacturing and consumer viewpoint, the direction of travel is clearly towards more sustainable materials; the question is how fast it will happen, and what are the sacrifices on aesthetics, performance and price that OEMs, suppliers and consumers are willing to make.

Survey Question:

Is the shift to sustainable materials genuinely achievable or greenwashing?

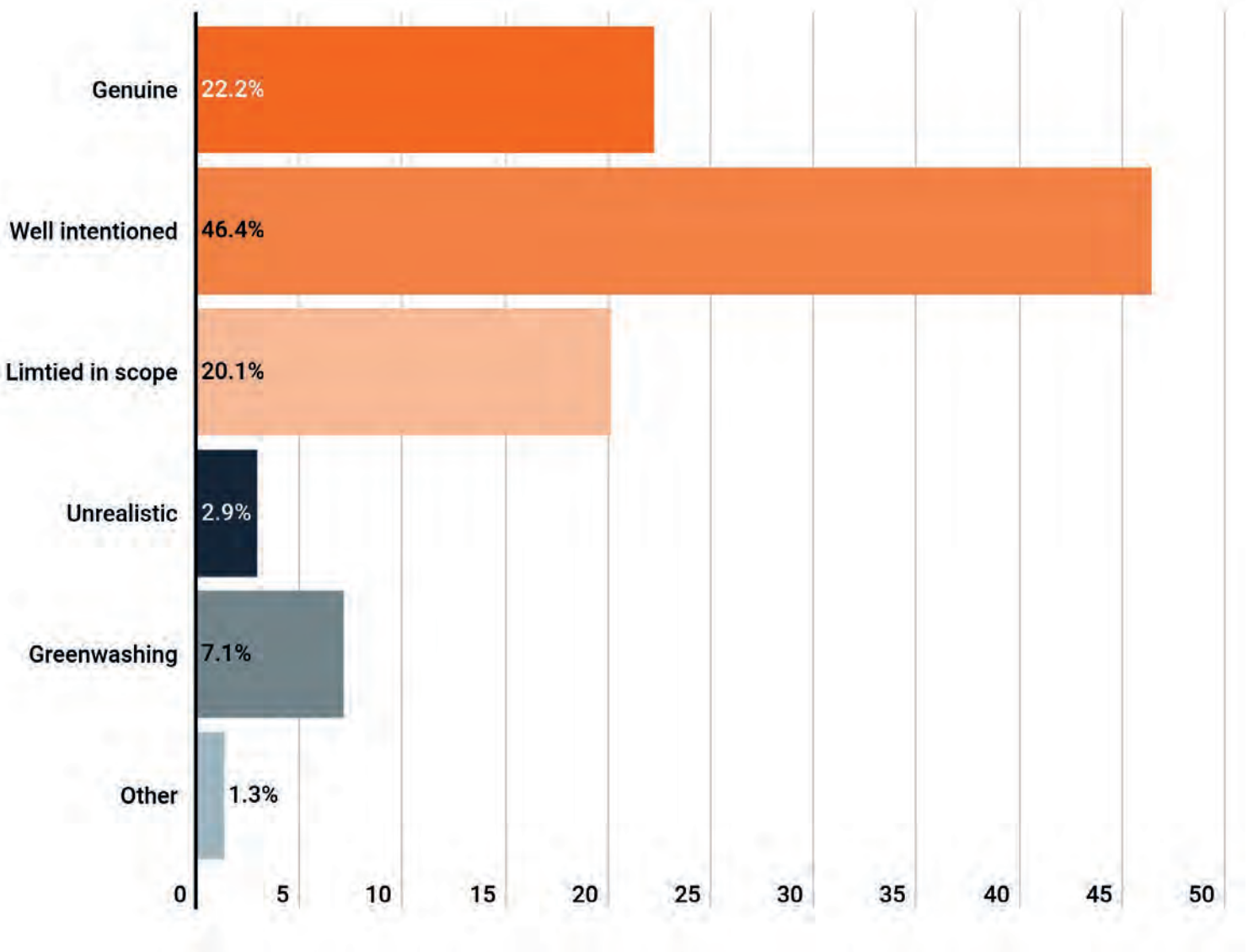
46.4%
"Well intentioned"

22.2%
"Genuine"

68%
had a positive view

Figure 5.1 Survey: Sustainability

Increasing environmental concerns are shifting vehicle interiors towards recycled secondary materials and naturally sourced renewable materials. Are these aspirations genuinely achievable or greenwashing?



Survey Question:

With the growing ethical movement against leather and the favouring of naturally sourced materials, is this trend likely to continue?

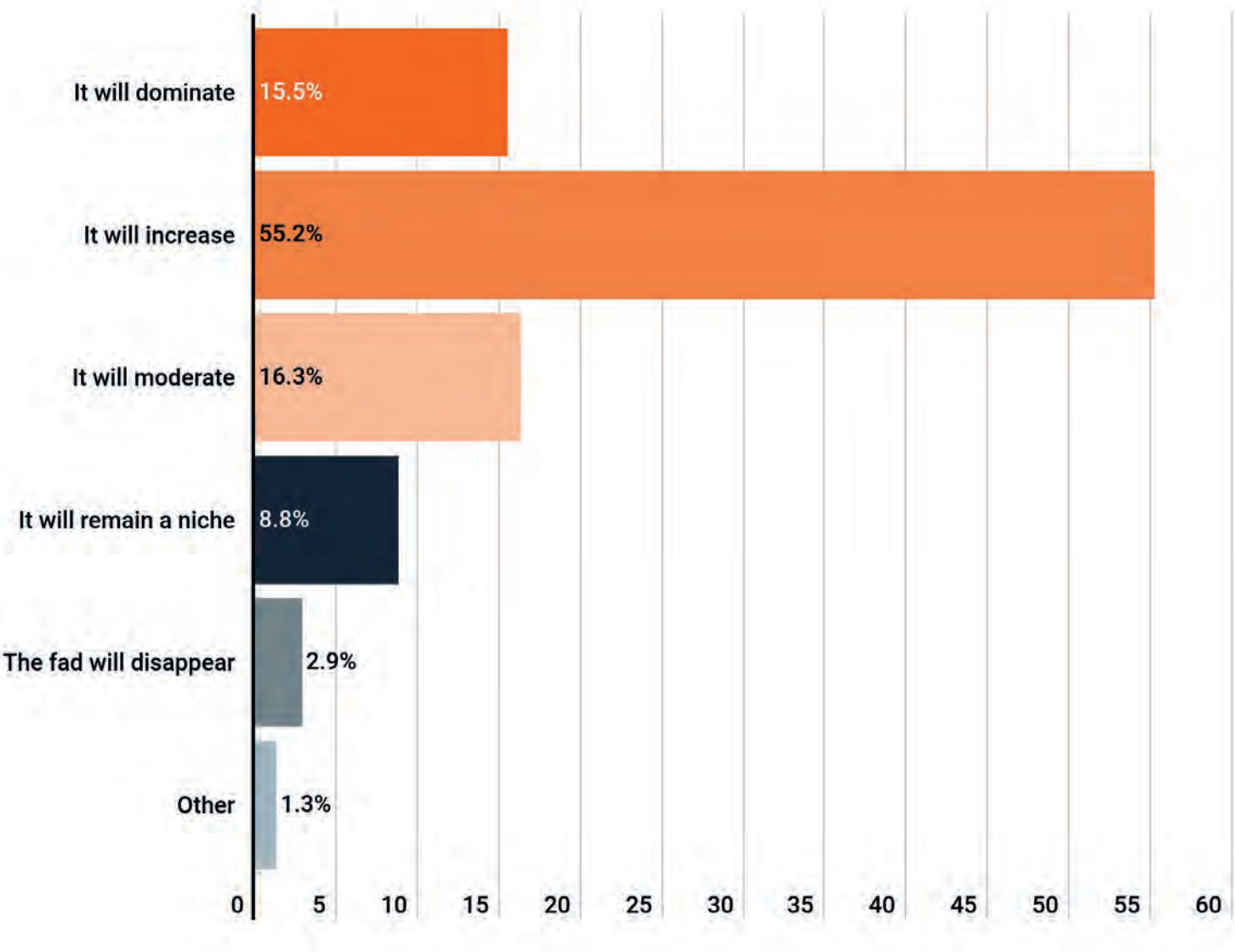
55.2%
"Increase"

15.5%
"Dominate"

70%
of respondents believe ethical materials will play a larger role in automotive interiors.

Figure 5.2 Survey: Ethical Materials

With the growing ethical movement against leather and the favouring of naturally sourced materials, is this trend likely to continue?



Survey Question:

What will OEMs be willing to change in interior designs to achieve sustainability?

45.2%
"A fair amount"

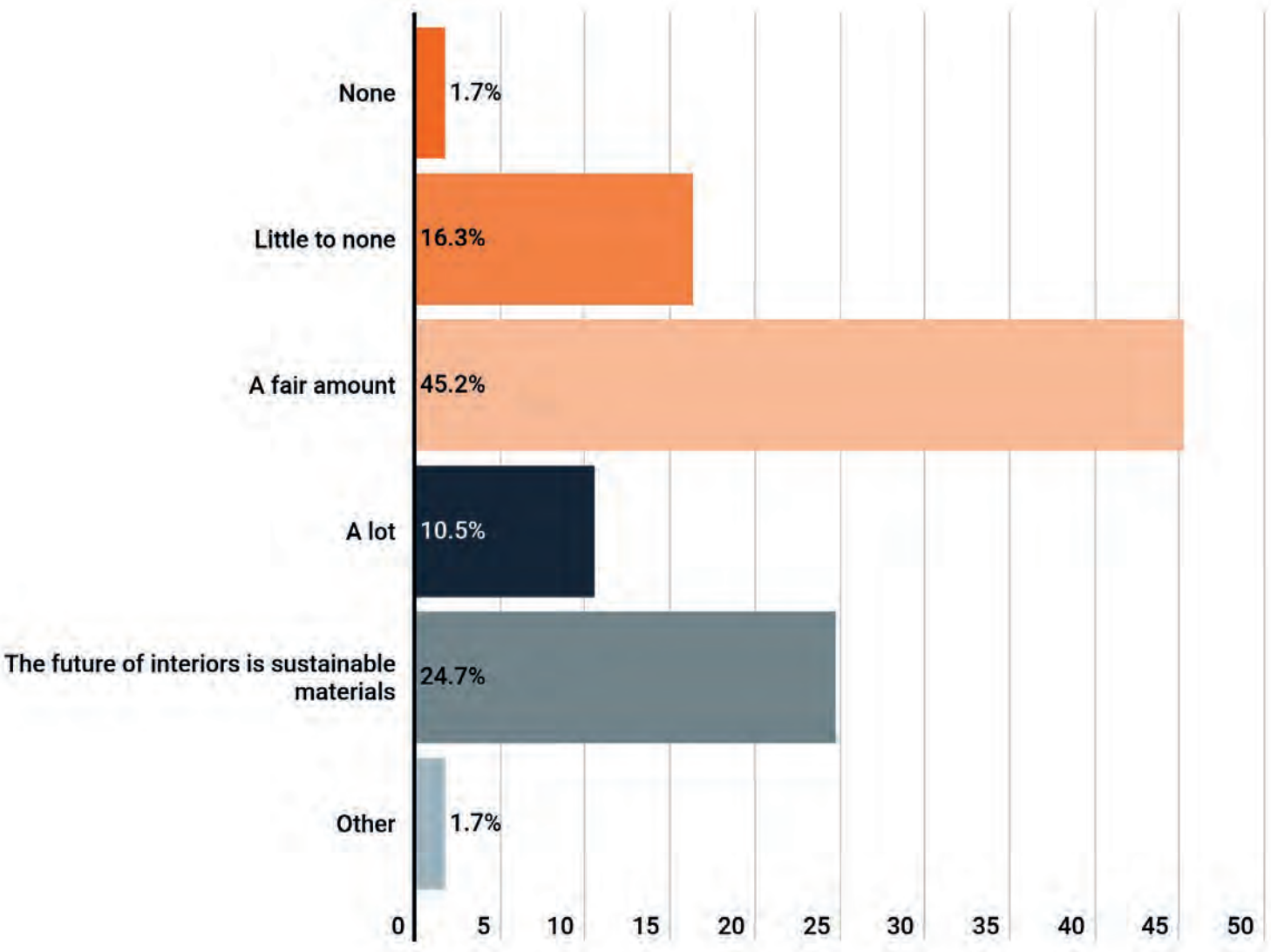
10.5%
"A lot"

24.7%
agreed that "The future of interiors is sustainable materials"

80%
believe that OEMs will be willing to change interior designs significantly to achieve sustainability.

Figure 5.3 Survey: Paying The Price

The need to go green comes at a cost. To what degree do you think automotive OEMs will be willing to change designs to have more sustainable products?



However, beyond the marketing hype and environmentally friendly terminology, the definitions of **sustainability** and **recyclability** are often mis-used, misunderstood and used interchangeably. These terms should be clarified to understand the key differences within the context of vehicle interiors.

5.1 Sustainability

Recycling is not always sustainability. Sustainability refers to whether a material can be produced indefinitely from a source which can be replenished without any loss of quality or significant depletion of natural resources or impact upon the environment. Good examples would be wood from trees or any plant-based products. Advocates of real leather claim it is sustainable as it's from a natural replenishable source. However, leather production also requires many toxic chemicals to manufacture. Furthermore, cows produce methane which is a potent greenhouse gas. True sustainability is a very high bar to reach, as each stage in the production process has to be neutral both in terms of natural resource and carbon emissions neutral.

Table 5.1 Examples of Sustainable Interior Materials

OEM	Material name	Made from	Application
Bentley EXP 100 GT Concept	Vegaa	A vegan leather made from grape skins, seeds and stalks	Seating
Bentley		Veneers from timber felled 5,300 years ago	Dashboards
BMW i3	Kenaf	Natural plant fibre kenaf plant	Instrument panel, door trim
BMW i3		Eucalyptus wood	Dashboard panelling
BMW i3		Wool	Seats
Mercedes S-Class		Natural fibre microsandwich	Door trims, backrests, rear shelf
Mercedes	Karuun	A compressed timber product made from sustainably harvested rattan	Floors, dashboard trim
Polestar	Bcomp	Flax -based composite	Interior panel
Polestar	Cork-based vinyl	Inspired by technical fabrics for camping and adventure gear.	Seat inserts
Range Rover Evoque	Tencel Lyocell	Eucalyptus Melange tree wood fibres	Interior upholstery
Toyota		Glycol from renewable sugar cane rather than glycol derived from petroleum	Seat cushions
Porsche Taycan	Mirum	Plant-based vegan leather	Interior trim
VW ID. Roomzz, VW ID. Space Vizzion Concepts	Nuuwai	Apple skin made into leather	Seats
Volvo XC60	Bcomp	Flax -based composite	Interior panel

Source: CDN, Automotive from Ultima Media

As can be seen from **Table 5.1,** there are currently few examples of genuinely sustainable materials used in vehicle interiors. There are various barriers to adoption, including cost, performance, durability and aesthetics, which in many cases struggle to compete against established synthetic, non-sustainable materials. These barriers will gradually be overcome, but it will take time.
We currently see the penetration rate of truly sustainability materials in interiors at a very low level, representing around 2% in 2020 and set to increase gradually to around 20% by 2030 as technological advances close the gap and consumer acceptance grows for these alternative materials..

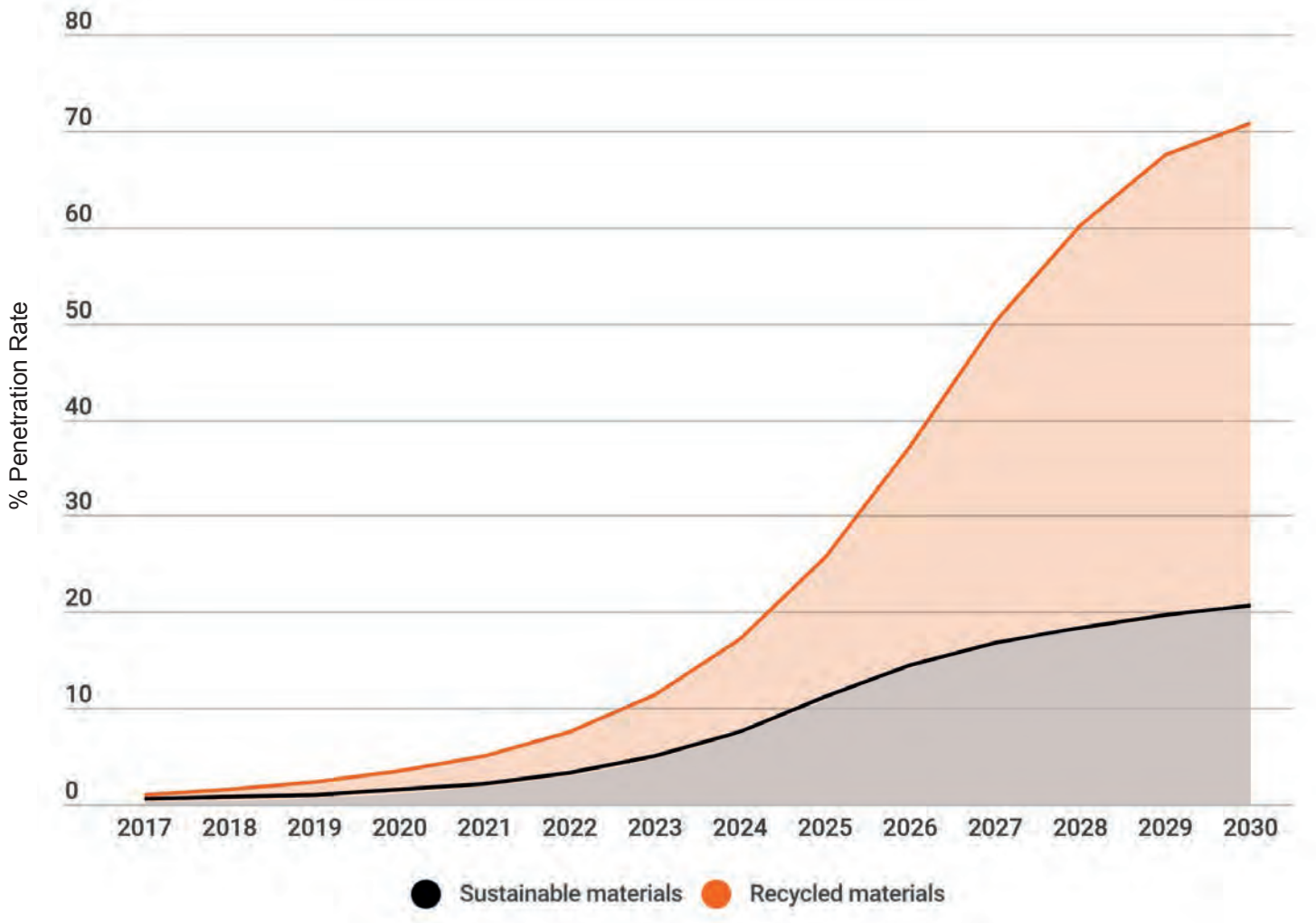
Technical hurdles and challenges around consumer acceptance of truly sustainable materials will likely mean that the penetration rate of sustainable materials in interiors will be considerably lower than recycled materials. **See Figure 5.1**

Nonetheless, we do see diverging penetration rates for sustainable materials according to vehicle segments. For entry-level segments, the interior materials currently used are low cost and margins are so slim that it would be unviable to introduce high levels of sustainable materials for these vehicles. However, in the premium segment vehicle margins are higher, allowing much more scope to introduce sustainable materials.

A question for designers is whether consumer's environmental awareness will consistently remain strong enough for them to accept sustainable materials that may have inferior durability, aesthetics or tactile qualities. One approach to this is by making sustainable materials synonymous with 'premium'. For example, Polestar has tried to position its sustainable interiors as a new and guilt-free sense of luxury. This is a huge technical challenge but also an opportunity.

Note also in **Figure 5.1** the likely trajectory for recycled materials. It is a much more realistic option for suppliers to integrate partially or fully recycled materials into the product mix, and we expect this uptake to grow strongly over the next decade, before starting to plateau by 2030, as the practical limits are reached for integrating recycled materials. See section 5.2 below that explains those limitations.

Figure 5.4 Rates of Sustainable vs Recycled Materials Used in Vehicle Interiors 2020-2030 (% penetration rate)



Source: CDN, Automotive from Ultima Media

5.2 Recyclability

Recycling refers to whether it can be reused a number of times to extend the life of that material. This greatly reduces the environmental footprint of the original material's manufacture, but it does not eradicate it completely. Most recycling can only be achieved a few times before there is a loss of quality or until it becomes more difficult to recycle. To maintain quality, new products often have to blend new material with recycled content, so rarely are new products made from 100% recycled material.

It is generally easier to introduce sustainable recycled materials into non-structural components such as interior surfaces and fabrics, which is partly why we ultimately expect a higher uptake of recycled materials in vehicle interiors over the next decade **(see Figure 5.1).** However, as Toyota has commented, one of the main challenges in developing such materials is that recycled materials are usually of a lower quality. Once again, the question for designers is whether consumers' environmental awareness will consistently remain strong enough for them to accept recycled materials that may have inferior performance characteristics. To implement recycled materials widely, suppliers must find ways to meet stringent technical specifications whilst also meeting consumer expectations – or perhaps even exceeding expectations and making recycled materials synonymous with 'premium'.

5.3 Example Interiors Using Recycled Materials

Increasing environmental concerns are leading OEMs to experiment with materials from primary plastics and recycled secondary materials. Examples include **Jeep Grand Wagoneer, Polestar Precept Concept, Mercedes Benz Vision EQS Concept**, Volkswagen ID Space Vizzion Concept.

There are many examples of recycled materials in interiors as shown in **Table 5.2.**

This strong shift to recycled materials is confirmed in the survey, in which more than 80% of respondents said that OEMs would be willing to change interior designs significantly to achieve sustainability. That included 45.2% selecting “A fair amount”, 10.5% choosing “A lot” and 24.7% stating “The future of interiors is sustainable materials”.

Figure 5.3 Survey: Paying The Price

The need to go green comes at a cost. To what degree do you think automotive OEMs will be willing to change designs to have more sustainable products?

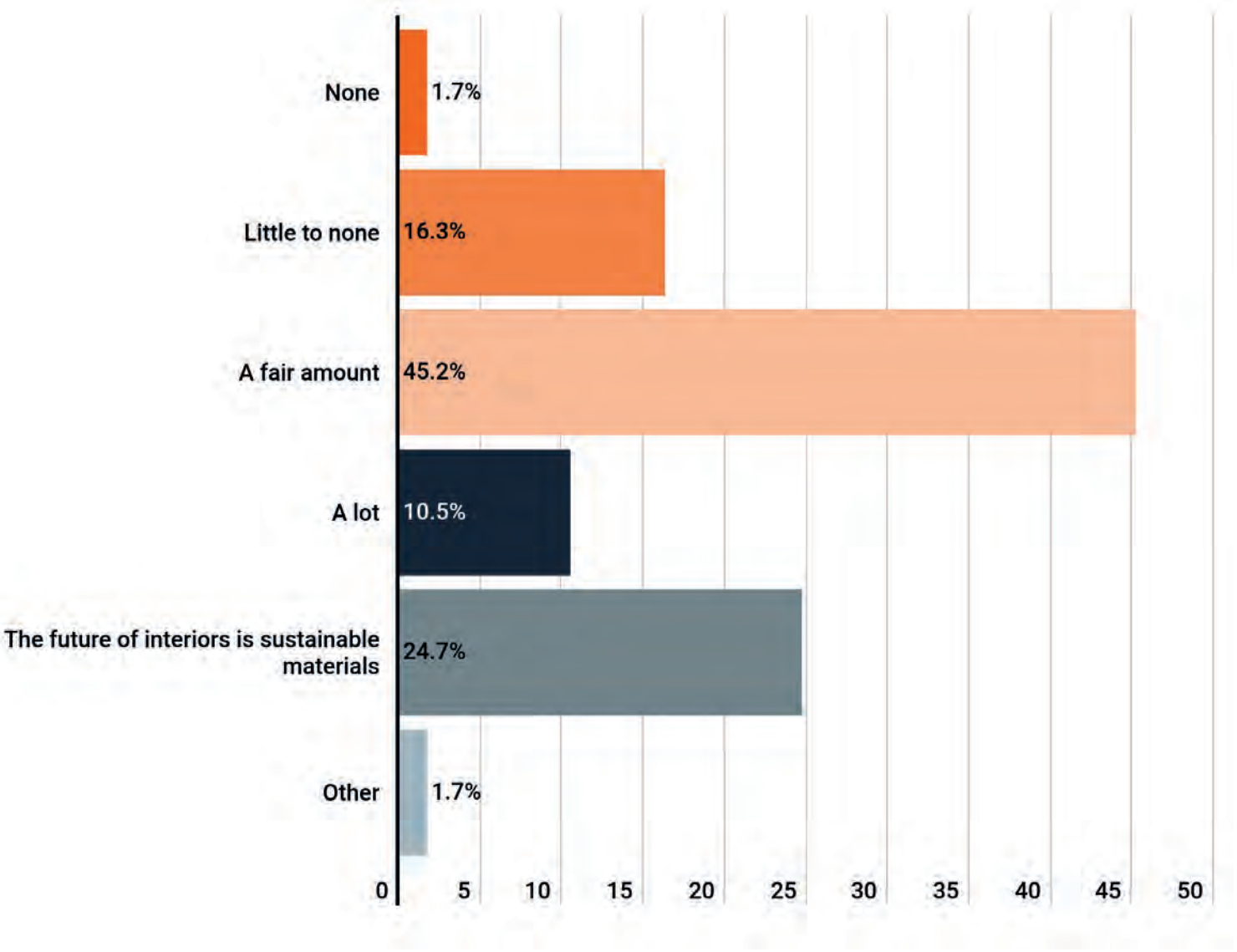


Table 5.2 Examples of Recycled Materials In Interiors

OEM Group	Material	Made from	Application
Audi A3		Recycled plastic PET bottles	Seats, Carpets
Audi Q4 e-Tron		Recycled plastic	Seats
Audi e-Tron GT	Econyl	Recycled fishing nets	Carpets
Corvette C8 Stingray	Dinamica	Recycled polyester from PET bottles, T-shirts	
Ford EcoSport		Recycled plastic bottles	Carpets
Fisker Ocean		Recycled fishing nets	Carpets
Hyundai Ioniq EV		Recycled plastic combined with powdered wood and volcanic stone	Support pillar covering
JLR next gen cars	Econyl	Regenerated nylon from landfill, clothing, fishing nets	Trim, floor mats
Jeep Grand Wagoneer, Land Rover Defender	Dinamica	Recycled polyester from PET bottles, T-shirts	Seats
Range Rover Evoque, Jaguar I-PACE	Kvadrat	Blend of wool and suede made from recycled plastic bottles	Seats
Lynk & Co.	Econyl	Regenerated nylon from landfill, fishing nets	Trim, floor mats
Mercedes A-class, C-class, EQC 400, Vision EQS, AMG GT, Maybach S 650, AVTR concept	Dinamica	Recycled polyester microfibre from PET bottles, T-shirts	Seats, trim, steering wheel
Mercedes EQS	Econyl	Regenerated nylon from landfill, fishing nets	Floor mats
Mercedes EQS		Recycled plastic	Cable ducts
Polestar	Ecoalf	Made from recycled fishing nets	Carpets
Renault Zoe	Filatures du Parc	Recycled seat belts, textiles, PET bottles	Seat fabric
Skoda Scala		Recycled PET bottles	Carpets
Porsche Taycan	Mirum	Plant-based vegan leather	Interior trim
Volvo XC60	Ecoalf	Recycled from fishing nets	Carpets
VW ID.3, ID.4, Audi Q2, Porsche Taycan	Dinamica	Recycled polyester from PET bottles, t-shirts	Seats

Source: CDN, Automotive from Ultima Media

Figure 5.6 Polestar Precept Using Recycled Materials & Natural Composites

At a high level, regulations and wider environmental targets are driving all industries to reduce energy use in manufacturing. For the automotive industry specifically, end-of-vehicle life (EVL) regulations are further encouraging the trend towards recyclability in vehicles and individual components, along with growing consumer awareness and ethical concerns.

For example, EU Directive 2000/53/EC from 1 January 2015 means that manufacturers are obliged to produce components which allow 95% of the components to be recyclability at the end of the vehicle's life, 85% from the materials of which they are made, and the remaining 10% to produce energy. That means in practice that virtually every component in a vehicle must be recoverable and recyclable to some degree. However, some countries such as the US and many smaller national markets have relatively little or no EVL regulation. **See Table 5.3.**

Table 5.3 Summary of End of Vehicle Life Recycling Regulations in Leading Markets

Country	Subject	Recycling Target	Regulatory Act
UN	Recyclability of motor vehicles		UN R133
EU	Recycling end-of-life vehicles	Reuse + Recovery: 95 % Reuse + Recycle: 85 %	Directive 2000/53/EC and Commission Decision 2005/293/EC, which sets rules on monitoring the reuse/recovery or recycling for end-of-life vehicles Directive 2005/64/EC of the European Parliament and of the Council
	Recyclability (M1, N1 category)		
US	There is currently no specific federal law governing extended producer responsibility (EPR) in the United States.		However, there are indirect regulations such as the Resource Conservation Recovery Act and the Clean Air Act. There are some patchy state level regulations. But, the emphasis is on voluntary 'product stewardship' by all stakeholders in the value chain
China	Recovery of automobile products	Possibility 95% (material recycling of 85% or more)	National Development and Reform Commission (NDRC) (2006) Technical policy for the recovery and utilization of automobile products.
	Requirements for the use of prohibited hazardous substances on automobiles		GB/T 30512-2014 CNCA-C11-001:2014
South Korea	Recycling of vehicles	Material & energy recovery: 95 %	Act on Resource Circulation of Electrical and Electronic Equipment and Vehicles (Korea RoHS)
	Requirement for the recycling of end-of-life vehicles and material bans		Pres Ordinance 27049 MOE Notification 2015-145
Japan	Recycling of vehicles	70%	2002 ELV Recycling Law

Source: CDN, Automotive from Ultima Media

5.4 Ethical Materials

As consumer become more aware, ethical concerns are also shifting consumer choices regarding interiors. For example, there is a growing ethical movement, particularly among younger consumers, against leather. Leather's environmental impact and links to animal cruelty is reducing its use as an interior material. Despite the leather industry's attempt to position the material as a sustainable material, advances in imitation or faux-leather increasingly offer viable substitutes for real leather. For many consumers, the ethical advantages of synthetic substitutes are increasingly outweighing their own environmental impacts, which are not always seen as sustainable given their material inputs.

Despite its environmental flaws, the vegan trend has gained traction and has resulted in a shift towards wood, plant-based fibres and other naturally sourced materials. These materials are evident in examples including the **BMW 3 Series, Fiat 500 Hybrid, Range Rover Evoque, Mini Hatchback, Polestar 2, Tesla Model 3 and Model X, Renault Clio, Dacia Sandero, SsangYong Tivoli** and **Suzuki S-Cross.**

> **Vegan leather is full of plastic"**
>
> **SangYup Lee,** Head of Hyundai Global Design Centre

Figure 5.8 Tesla Model X Vegan Interior

Survey Question:

Will the trend to ethical materials will continue?

70%

believe ethical materials will play a substantially greater role, of which

52.2%

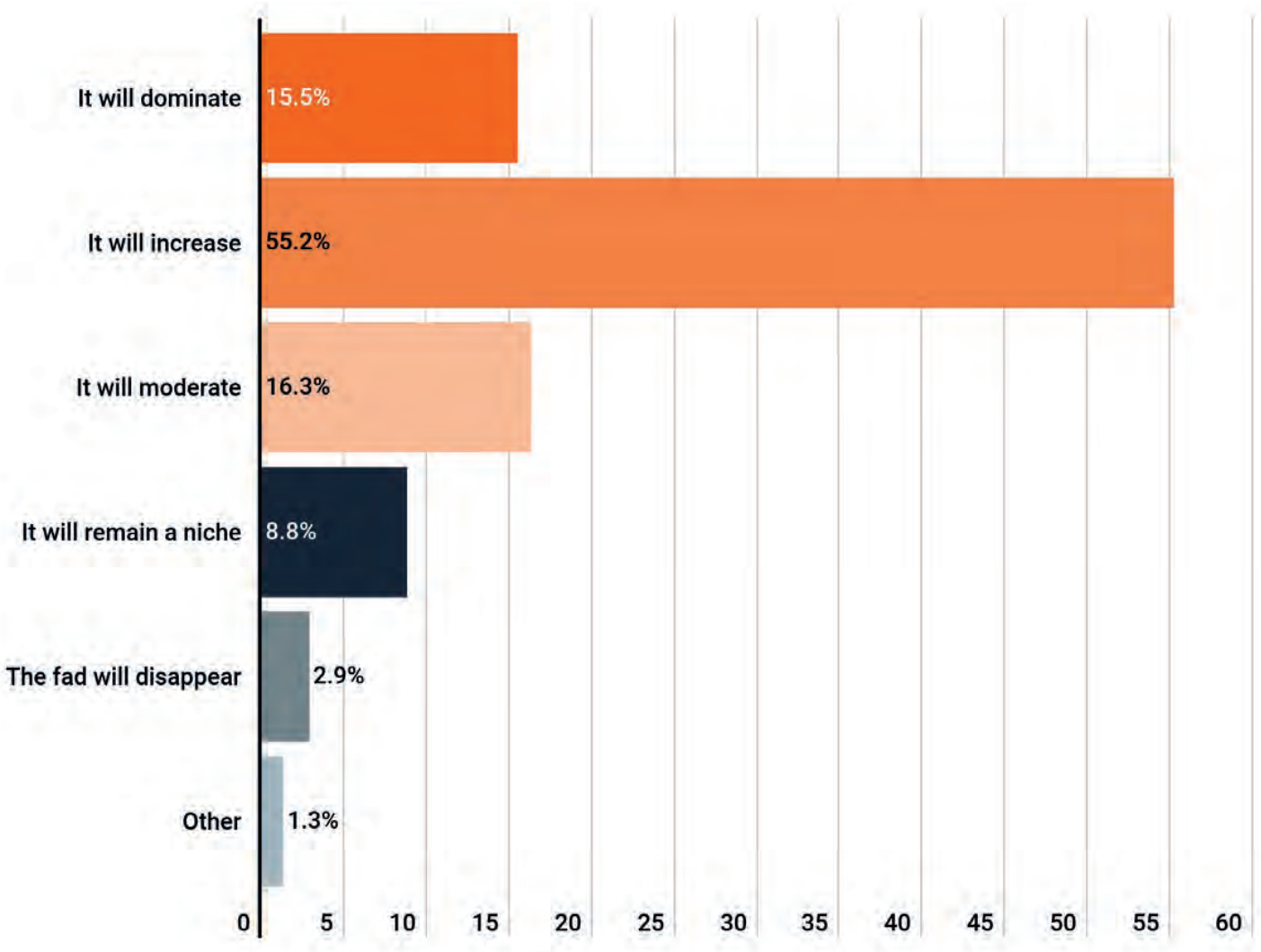
ethical materials will “Increase”

15.5%

ethical materials will “Dominate”.

Figure 5.7 Survey Question 6: Ethical Materials

With the growing ethical movement against leather and the favouring of naturally sourced materials, is this trend likely to continue?



6. Other Factors Driving Interior Trends

6.1 Factors Driving Market Development in Textiles: Emissions Regulations, Safety and Consumer Trends

6.1.1 Emissions Regulations

Governments around the world are tightening vehicle emissions regulations, led in particular by the European Union and China. However, other regions are following suit; even in the US, which had been behind the curve in federal emission regulations, corporate average fuel economy (CAFE) standards look set to tighten in line with ambitious policies to tackle climate change from the new administration of Joe Biden.

6.1.2 Lightweighting

The emissions regulations are compelling OEMs to save vehicle weight to reduce vehicle emissions, as vehicle weight directly increases emissions. This is especially true for non-structural components such as seating, fabrics, and electronics, where there are easier weight gains to be made. For example, an OEM implementing lightweight seats is illustrated by the BMW 6 Series Coupe as shown in **Figure 6.1**,

Survey responses also point to lightweighting being a factor in interior design.

But there is an important distinction to be made between ICE vehicles and EVs when it comes to lightweighting. This lightweighting trend to reduce vehicle weight is particularly true for ICE-based vehicles, for which OEMs are being compelled to meet increasingly stringent emission targets.

Reducing weight is also an important consideration for electric vehicles as OEMs try to keep weights down to allow greater driving range, compensate for the heavy weight of electric vehicle batteries as well as to simplify manufacturing processes.

However, for electric vehicles the factors around lightweighting are more nuanced. Whilst weight reduction is a factor in driving range, electric vehicles do not have to meet emission targets, as regulators generally classify them as zero emission. Furthermore, technology such as regenerative braking systems have made EV weight less of a factor, thanks to it allowing vehicles to deploy as much as 90% or more of the energy that would otherwise be lost when decelerating the vehicle.

Thanks to the size of batteries, electric vehicles are already typically 200kg (440 pounds) heavier than an equivalent ICE vehicle. As battery prices fall, it will become much more cost effective to fit a larger battery than invest in expensive lightweight materials, which can considerably impact on margins. For example, the expensive carbon fibre chassis of the BMW i3 EV made sense to reduce weight when battery prices were high. Today, with lower battery prices and greater range, BMW has switched to using conventional steel on the successor i2 EV. This is a good example of lightweighting becoming less of an issue as vehicle fleets electrify.

Figure 6.1 BMW 6 Series Coupe With Lightweight Seats

6.1.3 Interior Safety Regulations

There are growing technical regulations for materials used in vehicles interiors, for example abrasion resistance, VOC (volatile organic compound) emissions, flame retardancy and the 'processability' of the material.

Throughout every part of the supply chain, automotive fabric manufacturers must comply with a complicated regulatory framework of product safety standards, manufacturing processes and disposal methods, whilst also trying to protect margins and retain profitability.

For example, European fabric manufacturers have to conform to product safety regulations on flammability, toxicity and recyclability. The energy used during manufacture needs to be in part derived from renewable energy while OEMs need to follow pollution regulations regarding waste byproducts. New materials need to conform to specific regulations within each country. Imported materials also need to comply with ethical standards on child labour.

In some parts of Asia Pacific and China, there has been a weaker regulatory framework for fabric and materials, which has contributed to lower manufacturing costs in many instances compared to Europe, North America or Japan. However, this lighter regulation and low-cost outlook is changing especially in China, where safety and environmental standards are rising. In time, we expect standards will align more closely around the world in major automotive markets, and the cost differential will diminish and create a more level playing field where competition is based more upon productivity and technology than low-cost materials and manufacturing.

Rising vehicle safety regulations around the world are also increasing the requirement for fitment of airbags and seatbelts in new vehicles. Although not upholstery, fabrics used in airbags and seatbelts do use specialist textiles and fabrics in their manufacture. For these applications, OEMs are therefore selecting fabrics such as nylon and velour because of their high strength-to-weight ratio.

Table 6.1 Summary of Interior Safety Regulations In Leading Markets

Country	Item	Subject	Regulatory Act
UN	Technical	Seating	UN R17
	Safety	Requirement for interior fittings	UN R21
	Safety	Head restraints (headrests)	UN R25
	Technical	Seats of large passenger vehicles	UN R80
	Technical	Fire resistance of interior materials	UN R116
	Safety	Burning behaviour of materials used in the interior	UN R118
US	Safety	Instruments panels, Interior compartment doors, Seat backs, sun visors & armrests	FMVSS No. 201
	Safety	Occupant protection in upper interior head impact for passenger cars, trucks, buses and multipurpose passenger vehicles.	FMVSS No. 201U
	Safety	Flammability of interior materials	FMVSS No. 302
	Safety	Seating Systems	FMVSS No. 207
EU	Safety 12A	Interior fittings (M1 category)	Regulation (EC) No 2019 / 2144 UN R21
	Safety 15A	Seats, their anchorages and any head restraints (M, N category)	Regulation (EC) No 2019 / 2144 UN R17
	Safety 38A	Head restraints (headrests), whether or not incorporated in vehicle seats (M1 category)	Regulation (EC) No 2019 / 2144 UN R25
	Technical 15B	Seats of large passenger vehicles (M2, M3 category)	Regulation (EC) No 2019 / 2144 UN R80
	Technical 51A	Burning behaviour of materials used in the interior construction of certain categories of motor vehicles (M3 category)	Regulation (EC) No 2019 / 2144 UN R118
China	Safety	Requirement for interior fittings GB 11552	GB 11552-2009
	Safety	Geometric requirements for seats (seat cushion depth / width)	GB 7258-2017 / XG1-2019 Chapter 4.4.2.2 / 4.4.2.3 / 11.6.2
	Safety	Flammability of interior materials for buses	GB 38262-2019 GB 15083-2019 GB 11550-2009 GB 13057-2014 GB 8410-2006 CNCA-C11-12:2014
	Safety	Requirement for CCC certification of seats and head restraints	
	Safety	Requirement for CCC certification flammability of automotive interior materials	GB 8410-2006 CNCA-C11-09:2014 (abolished)
	Technical	A zero-VOC emissions policy	

India	Safety	Requirement for interior fittings	IS-15223:2002
	Safety	Requirement for seats and seat anchorages	IS-15546:2005
South Korea	Safety	Requirement for flammability of interior materials	KMVSS Art 95 (2015)
	Safety	Requirement for interior fittings – instrumental panel	KMVSS Art 88 (2016)
	Safety	Requirement for interior fittings – backrest	KMVSS Art 98 (2016)
	Safety	Requirement for interior fittings – armrest	KMVSS Art 100 (2016)
	Safety	Requirement for head restraints	KMVSS Art 26 (2012)
			KMVSS Art 99 (2012)
	Safety	Requirement for seats / seat anchorage	KMVSS Art 97 (2016)
Japan	Safety	Requirement for interior fittings	TRIAS 20-R021-01 Harmonised with UN R21
	Safety	Application of UN ECE-R 21 (interior fittings of vehicles)	TRIAS 20-J028-02 (dashboard)
	Safety	Requirement for head restraints	TRIAS 22(4)-J034R025-01 Harmonised with UN R25
	Safety	Testing of seats and seat anchorages	TRIAS 22-R017(1)-01 (2011) Harmonised with UN R17
	Safety	Testing of flame-resistant interior materials	TRIAS 20-J027-01´(2012)
Brazil	Safety	Flammability of interior materials	CONTRAN 498 / 2014
	Safety	Requirement for interior fittings,	CONTRAN 531 / 2015
			CONTRAN 468 / 2013 (amended by CONTRAN 642 / 16)
	Safety	Requirement for seat anchoring: Seat strength	CONTRAN 518 / 2015
			CONTRAN 416 / 2012 (M2)
	Safety	Strength of seats and their anchorages (large passenger vehicles)	Resolution CONTRAN 463 / 73
			Resolution CONTRAN 406 / 12 (M2 only)
	Technical	Fire resistance of interior materials	CONTRAN 545 / 2015
			CONTRAN 498 / 2014

Israel	Safety	Flammability of interior materials or burning behaviour of materials used in the interior construction (M, N category)	(EC) No 661 / 2009 ECE118 FMVSS 302 amended by (EU) No 2019 / 543
GCC	Safety	Flammability of interior materials and testing methods	GSO 98:1988
	Mixed	Car upholstery Testing methods of fabric for car seats	GSO 279:2005**
	Mixed	Car upholstery Fabric for car seats	GSO 280:2005**
ASEAN	Technical	Seats	(planned for adoption under ASEAN MRA) UN R17
	Technical	Head restraints	(planned for adoption under ASEAN MRA) Un R25

Source: ACEA, NHTSA, EU, Automotive from Ultima Media

6.2 Consumer Trends

6.2.1 Comfort & Cocooning

Consumers are increasingly evaluating the driving and passenger experience with their comfort level in mind. Occupants spend an increasing amount of time in their vehicles and so a smooth comfortable ride is not only desirable to reduce fatigue on longer journeys, but is also synonymous with premium luxury vehicles. One of the key differentiators between the interior of an entry level and premium segment vehicle is comfort. OEMs are increasingly raising the bar, which means that even entry level vehicles today offer similar levels of ride quality, comfort and luxury that were only available in premium segments a few decades ago.

This trend towards comfort is not only evident in terms of the mechanics of tyre choice and suspension design, but also more specifically for interiors in terms of soundproofing material, carpets, seat foam padding and tactile, soft-touch plush fabrics which cosset the occupants in a protective bubble.

Consumers are increasingly using their vehicles as a safety shield to protect them from the outside world by enhancing interior air quality, acoustics, vibration, and in terms of hygiene, especially during the Covid-19 pandemic.

For example, Geely has implemented an intelligent air-purification system with advanced self-cleaning materials in its Icon SUV. Hyundai Motor Group are developing Ultraviolet-C sterilisation antimicrobial lights to reduce the risk of viruses.

The trend goes beyond mere comfort and speaks to wider societal changes and a need to feel protected, safe and to cosset the occupants from the harshness of the outside world.

Vehicles with a cocoon or sanctuary theme include:

Audi AI:ME Concept, Lincoln Corsair, Geely Icon SUV, DS Lounge Aero Sport Concept and Tata Sierra Concept.

Survey Question:

What material attribute is most important to health and wellness?

40.2%

"Overall comfort"

33.5%

"Enhancing interior air quality, low VOCs"

15.9%

"Safeguarding against germs"

Figure 6.15 Survey: Cocooning

Consumers are increasingly using their vehicles as a safety shield, protector and mobile bubble. What material attribute do you think is most important to health and wellness?

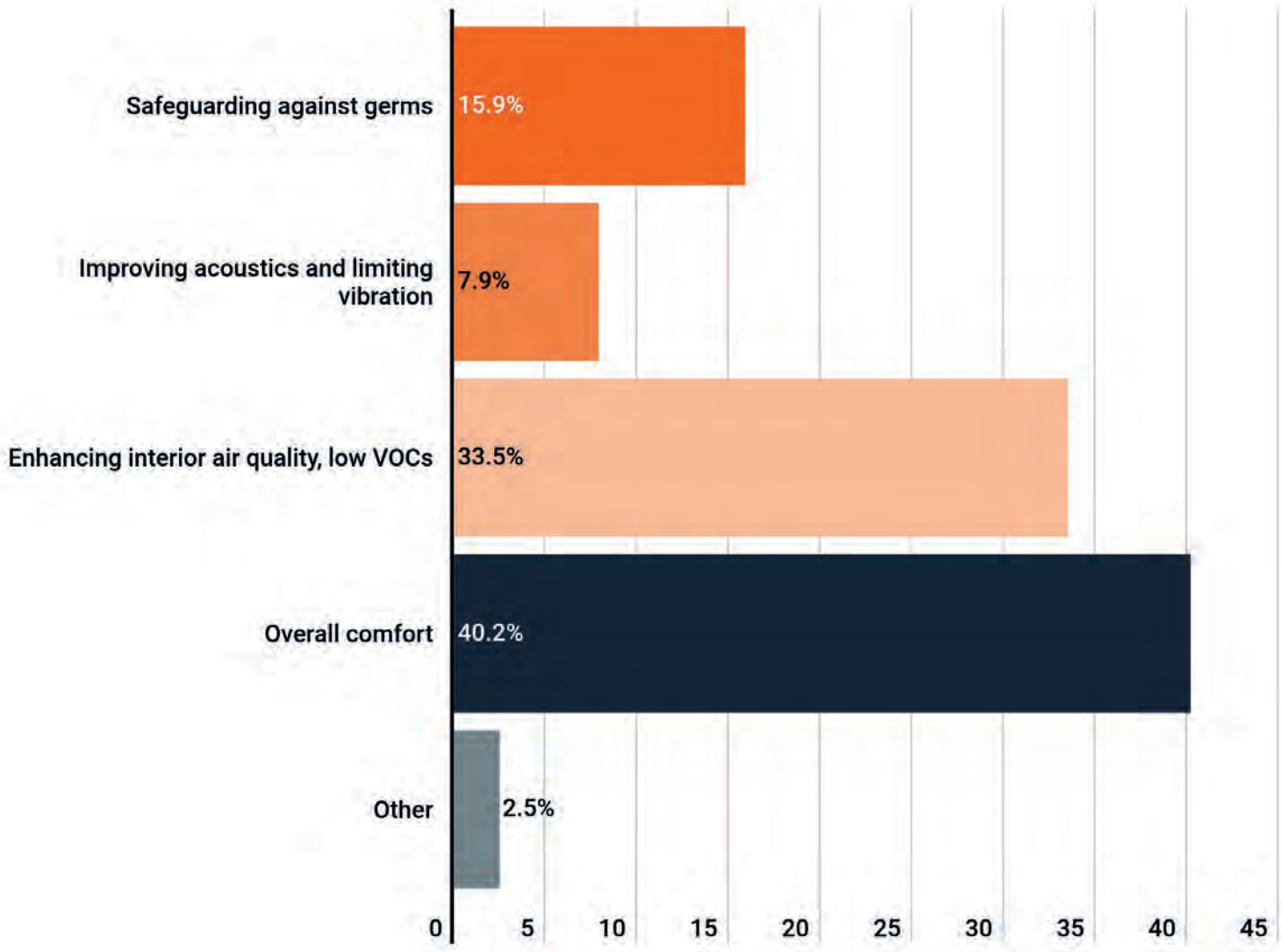


Figure 6.3 Audi AI:ME Cocooning Occupants From The City Streets

6.2.2 Interiors as an Experience and Differentiator

Vehicle Interiors are growing ever more important in vehicle design, especially in terms of the emotional, comfort and technology experience they offer. In many ways, interiors are potentially becoming even more important than exteriors in terms of factors influencing final purchase decisions.

As vehicle platforms are increasingly shared, interiors are one of the remaining areas where designers can create a brand 'experience' and differentiate their design identity, brand values and competitive positioning through materials, aesthetics and features. Some designers have intentionally created the impression of a first-class rail cabin or premium airline seat.

Above: Figure 6.4 Hyundai 45 EV Concept With Unique Cabin Experience

Examples include

DS Aero Lounge Concept, Hyundai 45 EV concept, GAC Entranze Concept, YFAI XiM20; Concept and BMW iX.

Above: Figure 6.5 GAC Entranze Concept With Dramatic Entry & Exit Experience

Figure 6.6 DS Aero Lounge Sport Concept With Aviation Inspired Airline Seats

6.2.3 Premiumisation

There is increasing premiumisation across all vehicle segments with ever higher quality materials, surfaces and luxury fabrics with soft-touch contact points.

While this trend towards premium offers higher profit potential, it also reflects a challenge for OEMs to differentiate interior design. Increasingly, OEMs are fitting even entry-level vehicles (at least at the highest trim levels) with interiors which were only recently considered as premium. How then should OEMs differentiate mid-segment or lower premium segment vehicles?

The answer is an increasing arms race across interior features and materials that continues to increase the premium experience across all model segments. There is especially pressure on mid-to-higher range models to include features that entry-level models usually can't match, such as panoramic roofs and luxury fabrics. However, the line between the interior features on an entry-level model and more expensive ones is increasingly blurring.

Examples of entry-level vehicles with a premium interior include

Peugeot 208 / 2008. Skoda Enyaq IV, Nio EC6, Geometry A and Fisker Ocean Concept.

Figure 6.7 Peugeot 208 / 2008 With Upscale Premium Interior

High-end, artisan fabrics are one key way that higher end vehicles can offer a markedly different experience compared to entry-level vehicles, which cannot compete with handmade upholstery and craftmanship. It is also often the case that premiumisation, sustainability and ethical concerns go hand in hand – especially where there are the margins to do so.

Figure 6.8 Bentley Luxury Concept Interior Featuring Vegea Vegan Leather

6.2.4 Whiter, Lighter Interiors

Linking in with the premiumisation trend, there is a growth in the use of whites and light greys. Once deemed impractical as it would show dirt and marks, advances in faux leather and other materials mean that such colours are no longer just for premium vehicles. These upscale interiors not only make the interior feel lighter, airier and larger, but also more premium, even if fitted to mid-segment vehicles. Tesla is a prime example of an OEM tapping into this trend. Other examples include the **Hyundai 45 Concept, GAC Entranze Concept, Geometry A, Nissan IMK Concept, Fisker Ocean Concept, Mercedes Benz Vision EQS Concept and Mercedes Maybach Concept**

Figure 6.9 Mercedes Maybach Ultimate Luxury Concept with White Interior

6.2.5 Panoramic Glass Roofs

The trend for more light also extends to increasing glass area and incorporating panoramic glass roof panels. Sometimes referred to as a moonroof or skylight, these are often expensive for OEMs to fit as standard on premium models, but are increasingly becoming standard or optional extras on low to mid segments. However, panoramic glass roofs do greatly enhance the interior lighting. Examples include the **Jeep Grand Wagoneer, Lincoln Corsair, Nio EC6, Polestar Precept Concept, MINi Vision Urbanaut Concept, Audi A!:ME Concept, Fisker Ocean Concept, GAC Entranze Concept, Lexus LF-Z Electrified Concept and Tata Sierra Concept.**

Figure 6.10 Jeep Grand Wagoneer With Full Length Panoramic Glass 'Moonroof'

6.2.6 A 'Third Living Space'

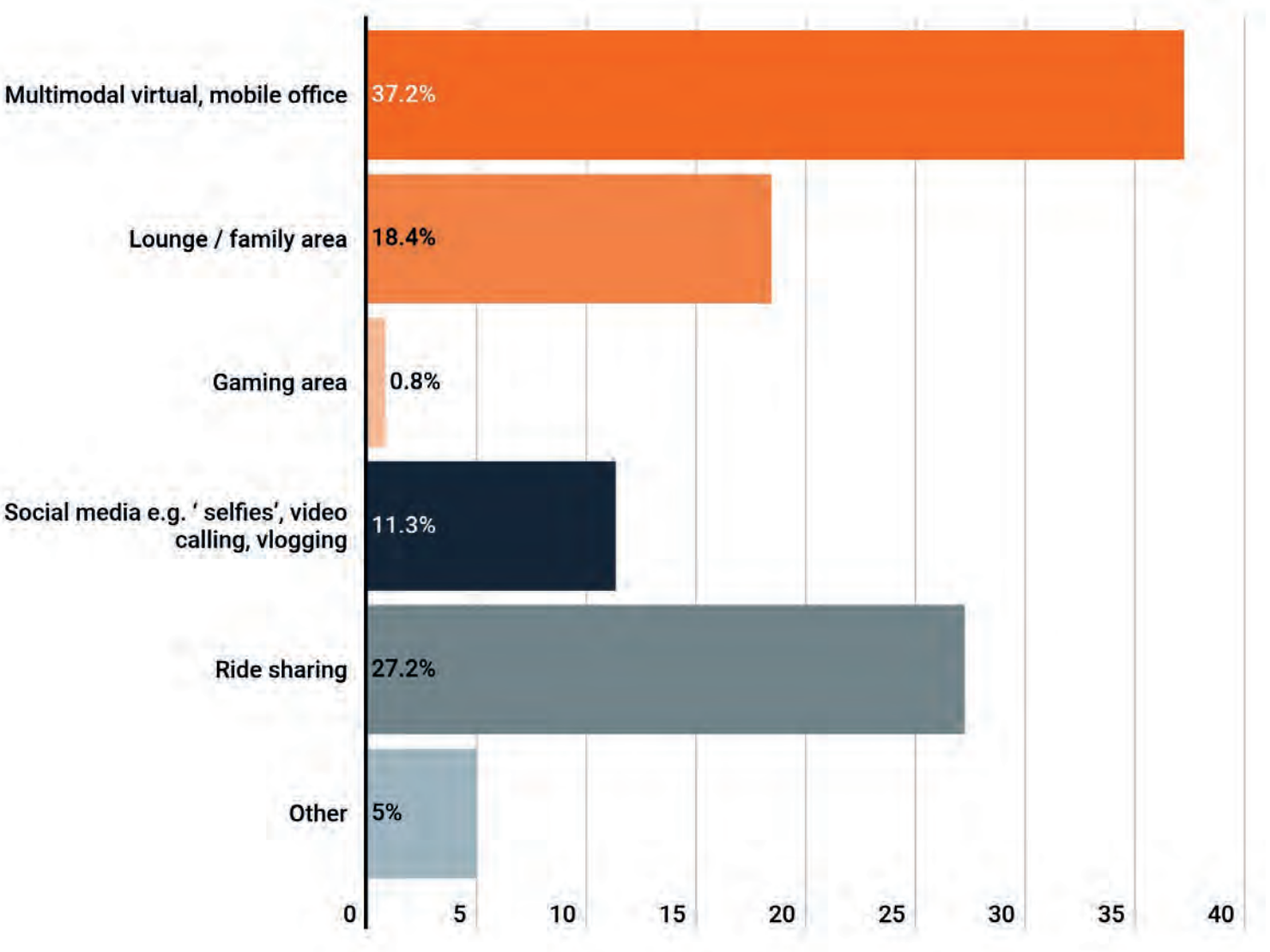
Vehicle interiors are increasingly designed to be a comfortable, third living space, deploying natural and luxurious materials to create a welcoming homely lounge feeling with the emotional aesthetics of home. Increasingly, emotions play a larger factor in how consumers experience interiors as a personal and family space.

We are already seeing that the extra cabin space achievable with EVs combined with the flat floor and more design freedom are already allowing more flexibility in cabin design and seating configuration.

The survey results reinforced the trend toward expanding work and living spaces in vehicles. The question on changing modes asked what would become the most popular use for vehicles. Replies were strongly in favour of "Multimodal virtual, mobile office", followed by "Ride sharing" and "Lounge / family area".

Figure 6.11 Survey: Changing Modes

Vehicles are likely to shift from A to B modes of transport to places where users spend much more time in cars. This could radically change the design of the interior. What do you think will become the most popular use for vehicle interiors?



This trend is only set to solidify as semi-autonomous and fully autonomous vehicles become mainstream, and the vehicle cabin becomes a place for family and friends to interact, socialise and have fun. The feeling and touch will become more important for vehicle interiors to make cars more human. And while technology and digital interfaces are at the centre of interior design changes, the rise of the living space in a vehicle will also bring with it desires for hiding and disabling some electronics and connectivity features, if not even to remove some altogether to reclaim the balance between work, social and family life **(see the following section 6.2.10 on 'Digital Detox').**

Examples include

MINI Vision Urbanaut Concept, Audi AI:ME Concept, DS Aero Lounge Sport Concept, Tata Sierra Concept, Nissan IMK Concept, and Infiniti QX Inspiration Concept.

Figure 6.12 MINI Vision Urbanaut Concept Autonomous EV Creating A 'Third Living Space'

6.2.7 Scandi Minimalism

‘Scandi minimalism’ refers to an uncluttered, simple, comfortable, livable interior, without unnecessary decoration, detail or distractions. The origins of this trend derives from Scandinavian architecture and its influences on the region’s OEMs, primarily Volvo Cars. Such design influences are evident widely across the interiors of the Geely group, which owns Volvo, Polestar and Lynk & Co.

However, the ‘Scandi’ trend is being felt much more widely and many vehicles are now including these design sensibilities in interior and material choices.

Figure 6.13 Volvo S90 With ‘Scandi’ Minimalist Interior

Examples include

Volvo S90, Tata Sierra Concept, Audi AI:ME, Nissan IMK Concept and Buick Elektra Concept

Figure 6.14 Tata Sierra Concept With ‘Scandi’ Minimalist Interior

6.2.8 Health and Wellbeing

Driver and occupant health and wellbeing is a broad topic that includes everything from hygiene, to interior air quality, lighting advances and driver monitoring systems (DMS).

Driver monitoring systems, for example, can have sensors embedded into the surfaces and fabrics, measuring vital signs, alertness levels, movement and providing feedback alerts to the occupants, adjusting heating and lighting accordingly. Examples of vehicles with advanced driver monitoring systems include most BMW models since 2019 with the optional Live Cockpit Professional, and the Ford Mustang Mach-E and Ford F-150, as part of their Seeing Machines Driver Monitoring Systems. (DMS)

Furthermore, car air-filtering systems have been a growing area of focus for OEMs, especially in high pollution countries such as China and India. The coronavirus pandemic has clearly given a new impetus to such technologies in terms of warding off the virus and other pathogens.

In 2020, Geely launched its Health Car Programme alongside the launch of the **Geely Icon SUV** to demonstrate its range of vehicle technologies focused on enhancing occupant wellbeing. These included:

- Intelligent air-purification system with N95 certification (keeping 95% of airborne particles 0.3 microns outside the vehicle, which is broadly considered equivalent to a medical grade mask.)
- Micro-positive cabin-pressure technology to restrict contaminants from entering the vehicle and removing them if they do.
- Self-cleaning materials for frequently used contact points such as handles and buttons.

To support this point, in **Survey: Cocooning**, “Overall comfort” dominated the replies to this survey question with 40.2% of responses. “Enhancing interior air quality, low VOCs” accounted for 33.5%. Only 15.9% selected “Safeguarding against germs” which could be viewed as surprising in the context of the current Covid pandemic.

Figure 6.15 Survey: Cocooning

Consumers are increasingly using their vehicles as a safety shield, protector and mobile bubble. What material attribute do you think is most important to health and wellness?

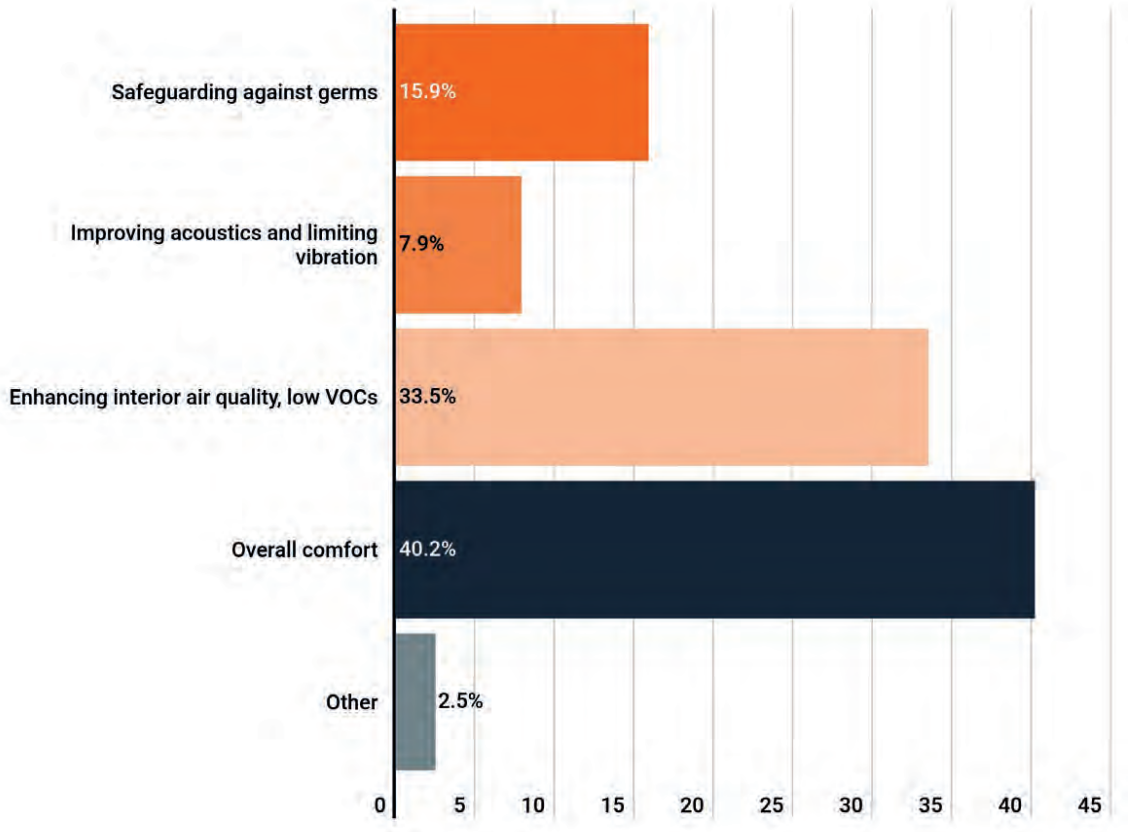


Figure 6.16 Geely Icon SUV With Technologies to Enhance Occupant Wellbeing

6.2.9 Digitalisation, Consumer Tech & UX

One of the strongest interior trends is the digitalisation of user experience, and a veritable arms race in the size and number of touchscreen displays, infotainment systems and human machine interfaces (HMI) functions such as AI voice activation, functional surfaces, connectivity and V2X technology connecting vehicles to surrounding infrastructure. The rise in such technology is having profound impacts on interior design and material choices and costs.

For example, as touchscreens become ever larger, there are questions as to whether LCD touchscreens will be a transitional technology, with the head up display (HUD) and windscreen integrated with augmented reality effectively becoming a large touchscreen. The dashboard of the Mercedes-Benz EQS effectively revealed a continuous touchscreen across the width of the interior.

Other examples of this use of touchscreens include

Jeep Grand Wagoneer, Maybach S-Class, Honda E, Cadillac Escalade, Byton M-Byte, Tesla Model S, and Sony Vision S concept.

Figure 6.17 Mercedes EQS With Full Width Touchscreen

Consumer tech companies such as **Apple, Samsung, Alphabet (Google), Microsoft, Amazon** and **Sony** are having a growing influence on vehicle software and UX in terms of making vehicles 'smartphones on wheels'. This convergence of vehicle interior and big tech is likely to continue to shape vehicle design, architecture and the overall interior branding. Examples include **Volvo** cars who now collaborate closely with Google on operating system and UX design.

6.2.10 Digital Detox

The trend towards hyper-connected interiors also has an opposing trend. Some consumers appear to find the relentless digitalisation of interiors with ubiquitous screens and technology overwhelming.

The reaction to that is a ‘digital detox’ trend towards a cleaner, minimalist aesthetic, removing unnecessary visual distractions and ‘visual noise’. That detox can also include removing audio noise with noise cancelling technology to make the interior a more tranquil, calm place, like a sanctuary.

The EV driving experience further compounds this trend as EVs are also very quiet, effortless and likened to sailing or flying. Rather than seeing interior as a place to multitask across work and communication, more designers are putting mindfulness at the centre of UX and interior design. This has certainly been the aim for French premium brand **DS** according to Thomas Bouveret, head of interior design, for example through the brand’s airliner inspired **DS Aero Lounge concept**. But is it realistic to ‘digitally detox’ given the countervailing trend created by the growth in digital screens, infotainment and connectivity?

There is a likely to be a divergence with some OEMs (and consumers) embracing maximum digitalisation while others opt for a digital detox. Increasingly, interior designers are looking for a happy medium where the technology is tastefully integrated with the interior but is not dominating, and where touchscreens can be turned off or even packed away out of sight when not required, allowing the consumer to choose the level of visual stimulation they want.

Examples of vehicles aiming for the digital detox include

Tata Sierra Concept, DS Aero Lounge Sport Concept, MINI Vision Urbanaut Concept, Audi AI:ME Concept.

Figure 6.18 DS Aero Lounge Sport Concept With Digital Detox

Figure 6.19 Tata Sierra Concept With Digital Detox

6.2.11 Ambient Lighting

The interior experience is fundamentally underpinned by lighting. Car designers use advanced lighting not only for brand communication and aesthetics, but also to control mood and emotion, for example with adaptive LED. Lighting also provide alerts and communicate warnings when necessary, for example as part of driver monitoring systems. While most lighting systems are fixed from purchase, vehicle owners and users can customise and personalise ambient lighting to suit their tastes and mood.

Examples of highly customisable and adaptive lighting include

Peugeot 208/2008, Volkswagen ID.3/ID.4/Space Vizzion Concept, Geometry A, Audi AI:ME Concept, Fiat Centoventi Concept, Mercedes Benz Vision EQS Concept, Karma SC1 Vision and SC2 Concept, Mercedes Maybach S-Class, Hyundai Prophecy Concept and Lexus LF-Z Concept.

Figure 6.20 Volkswagen ID Space Vizzion Concept With Ambient Lighting

6.2.12 Regional Differences

As OEMs increasingly move to global vehicle platforms and vehicle models to reduce cost and achieve economies of scale, vehicle designers must account for many regional differences in consumer tastes, preferences and regulatory requirements. There are exceptions to the rule of course, but Asian markets, notably China, continue to see more of an emphasis on interior technologies including an arms race in connectivity, infotainment and features, including increasingly large and ubiquitous touchscreens. For European markets, there is still interest in UX technology of course, as we have shown with Mercedes and Tesla, but in some cases there is more emphasis on tasteful integration, and with slightly more emphasis on the utility and practicality of interiors.

Why is this important for interiors and materials? This feeds into the technological divergence are noticing in interiors. Will there be increasing focus and emphasis on technology with the touchscreens put upfront, or will the technology be more tastefully and seamlessly integrated, hidden away, downplayed, minimised or even removed to cater to more of the digital detox and cocooning / sanctuary trends? And this factors into how the dashboard and controls are designed and the choice of materials, surfaces and fabrics sit within that overall design philosophy.

Survey Question:

Will vehicle design become more globalised or regionalised?

48.5%
"More regional variation"

16.2%
"Slightly more globalisation"

27.6%
"Slightly more regionalisation"

12.6%
"Much more globalisation"

indicating that only

28.7%

believed there will be more globalisation of vehicle design.

Figure 6.21 Survey: Modularisation

As the industry moves to global vehicle platforms and vehicle models, will interiors become more standardised globally or will there be more regional divergence due to cultural differences and local consumer tastes?

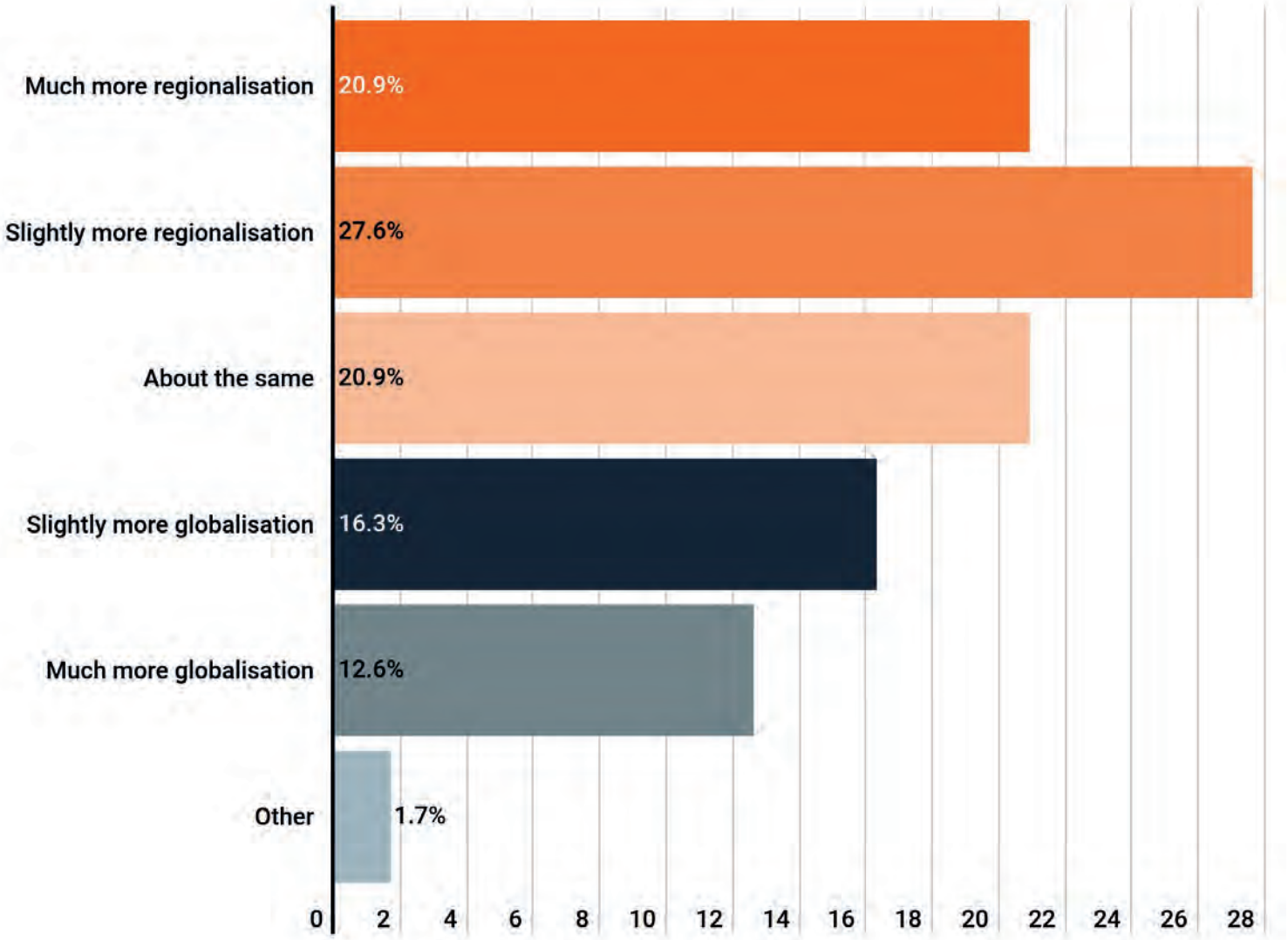
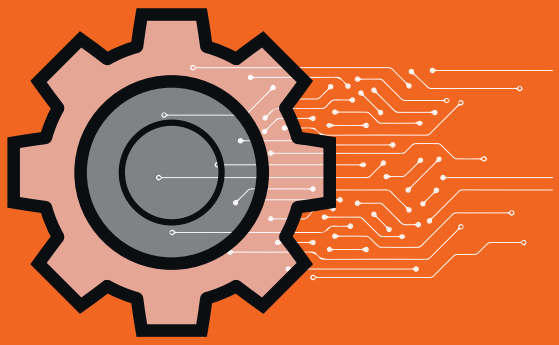


Figure 6.22 Byton M-Byte With a Strong Emphasis on Technology



7. Technology Changing Interior Design & Materials

7.1 How New Fabrics and Surfaces Allow Designers to Find New Uses

Beyond the shift to sustainability, there are a range of new materials, advanced manufacturing processes and cutting-edge technologies that are becoming available to interior designers.

Taking advantage of these technical advances will significantly impact the choice of surfaces and selection of fabrics in particular and these will potentially transform the interior experience for the occupants.

7.1.1 Smart Surfaces

For future interiors, digital capabilities will increasingly transcend mechanical buttons and provide the opportunity for virtually all surfaces to become smart and connected. Surfaces are seamlessly blending with haptic controls to become interactive smart surfaces enhancing UX and HMI through integration of touch sensitive and gesture controls. This trend has implications for the fabric market as well, as such surfaces can include fabrics using conductive inks applied using digital ink printing. Graphene is also likely to be needed for the sensors integrated within the fabrics to create smart surfaces.

However, this technology is likely to be reserved for more upmarket segments where there is a need to differentiate premium interiors from entry level models and where margins are higher to allow more expensive materials.

Survey Question:

What is Premium?

33.5%

associated premium with “Advanced interactive and smart surfaces.”

Figure 7.1 Survey: What is Premium?

With the trend in automotive OEMs using ever higher quality materials, surfaces and luxury fabrics at the very high end of vehicles, what phrase below do you think best describes this “new” premium?

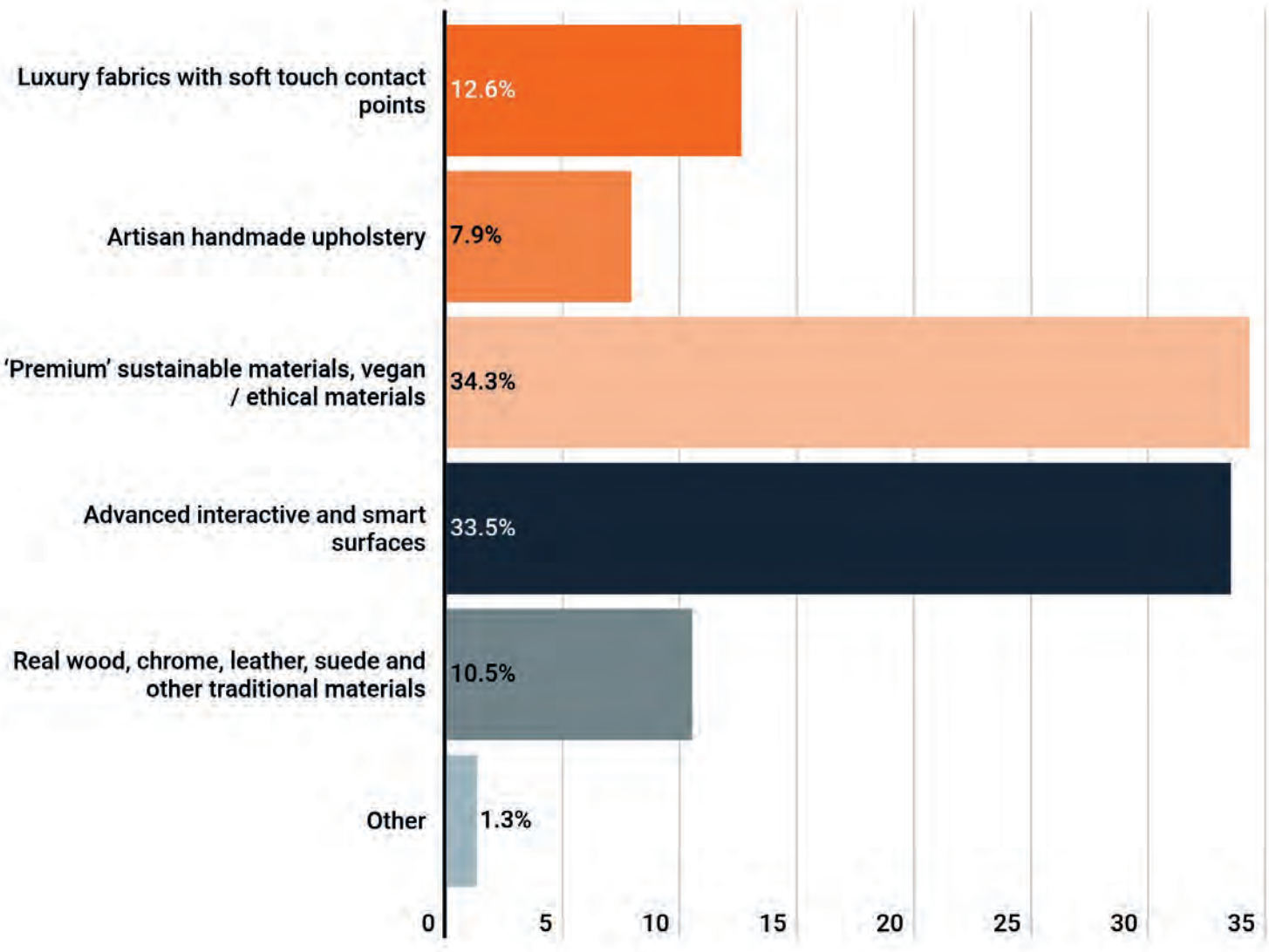
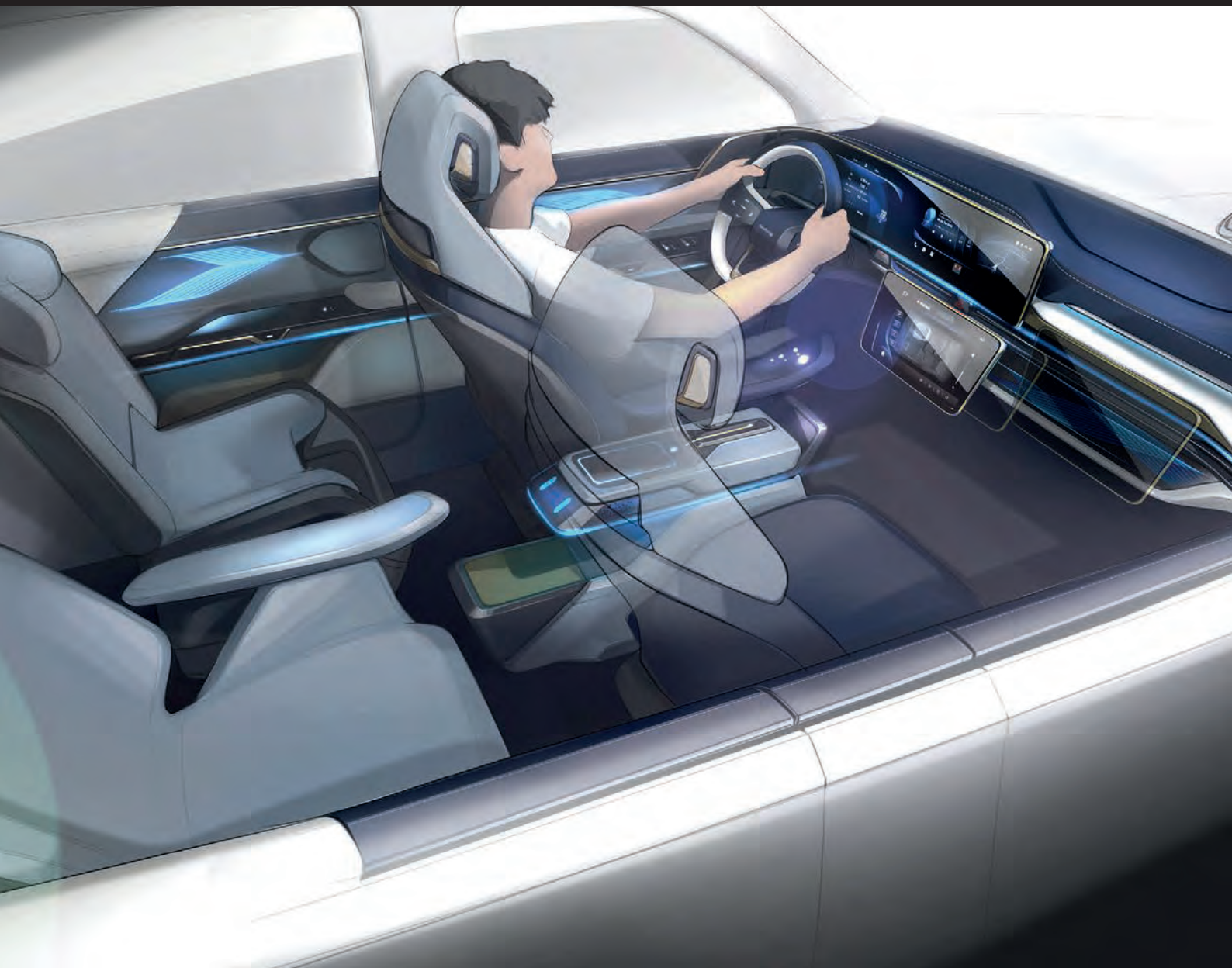


Figure 7.2 Yanfeng XiM21 Concept with Smart Surfaces



7.1.2 Haptic Surfaces

While the clean aesthetics of smooth surfaces is attractive, the disadvantage of touchscreens is that they do not provide the sensory feedback of a mechanical button, switch or lever. Haptic feedback provides a physical vibration, just like on a smartphone, to indicate that a touchscreen control has been operated. This is important to allow the safe control of buttons and controls whilst retaining smooth surfaces.

Another factor is that as technology levels escalate, there is a real risk that the driver or occupants experience sensory overload and are overwhelmed by information. One of the solutions to this is to reduce that information to a simpler sensation that can be communicated by a more intuitive and instinctive touch or vibration, and this is where more advanced forms of haptics come into play. For example, a Driver Monitoring System (DMS) may notice the driver falling asleep, and instead of an audible alarm, could rouse the driver with a subtle vibration of the seat. Or conversely a stressed driver could be relaxed with a vibrating and heated seat massage. A Lane Departure Warning System (LDWS) could notify the driver of a danger by vibrating the steering wheel.

The objective is to employ more of the human senses than only sight and sound and to make the Human Machine Interface (HMI) a more Intuitive, interactive and immersive interior experience.

Figure 7.3 Mercedes-Benz EQS Concept With Haptic Surfaces

7.1.3 Smart Integration

Vehicle design teams are not the only ones looking at how sustainable materials and new technologies can enhance interiors and UX. Designers at Tier-1 suppliers are increasingly offering smart integration, helping to change business models from that of suppliers of seats or components, to providing fully integrated modules and product lines. Examples such as Grupo Antolin and Faurecia's Cockpit of the Future integrates full product lines into one holistic interior design package to fit into vehicles. In such cases, OEM may not be fully aware of what technologies a supplier may have available and what combinations are possible. The design philosophy and technology can more fully integrated making for a seamless driver experience. For example, if the driver monitoring system senses that the driver is losing consciousness, the system can respond in various ways, such as by blowing air from a vent, releasing a fragrance, vibrating the seat, and even having haptic feedback all facilitate a holistic system response.

Figure 7.4 Faurecia Integrated Interior

7.1.4 Antimicrobial Materials & Technologies

The numerous touchpoints in a vehicle provide the ideal opportunity to be exposed to bacteria and viruses and this is particularly so given the expected increase in ride sharing and shared mobility. Of course, the Covid-19 pandemic has bought put hygiene and surfaces further into focus. As such, OEMs are accelerating the rollout of antimicrobial materials in interiors.

One solution is to use metals such as silver and copper as they naturally have antimicrobial properties. Another solution it to apply antimicrobial coatings on surfaces that incorporate nanoparticles of silver, copper, zinc oxide or titanium oxide and embedded into the seat fabrics and other surfaces. Other suppliers are also developing natural antimicrobial polymers.

But the potential goes beyond antimicrobial materials. Hyundai Motor Group is developing Ultraviolet-C sterilisation antimicrobial lights. However, because they are dangerous to human skin they would be embedded out of sight into air filtration systems, or only activated when the vehicle is empty. And Geely have implemented self -cleaning materials in its Icon SUV. **See Figure 7.4.**

Survey responses reinforced the importance of hygiene, as “Overall comfort” dominated the replies, followed by “Enhancing interior air quality, low VOCs”. Only 15.9% selected “Safeguarding against germs” which could be viewed as surprising in the context of the pandemic.

Figure 7.5 Survey: Cocooning?

Consumers are increasingly using their vehicles as a safety shield, protector and mobile bubble. What material attribute do you think is most important to health and wellness?

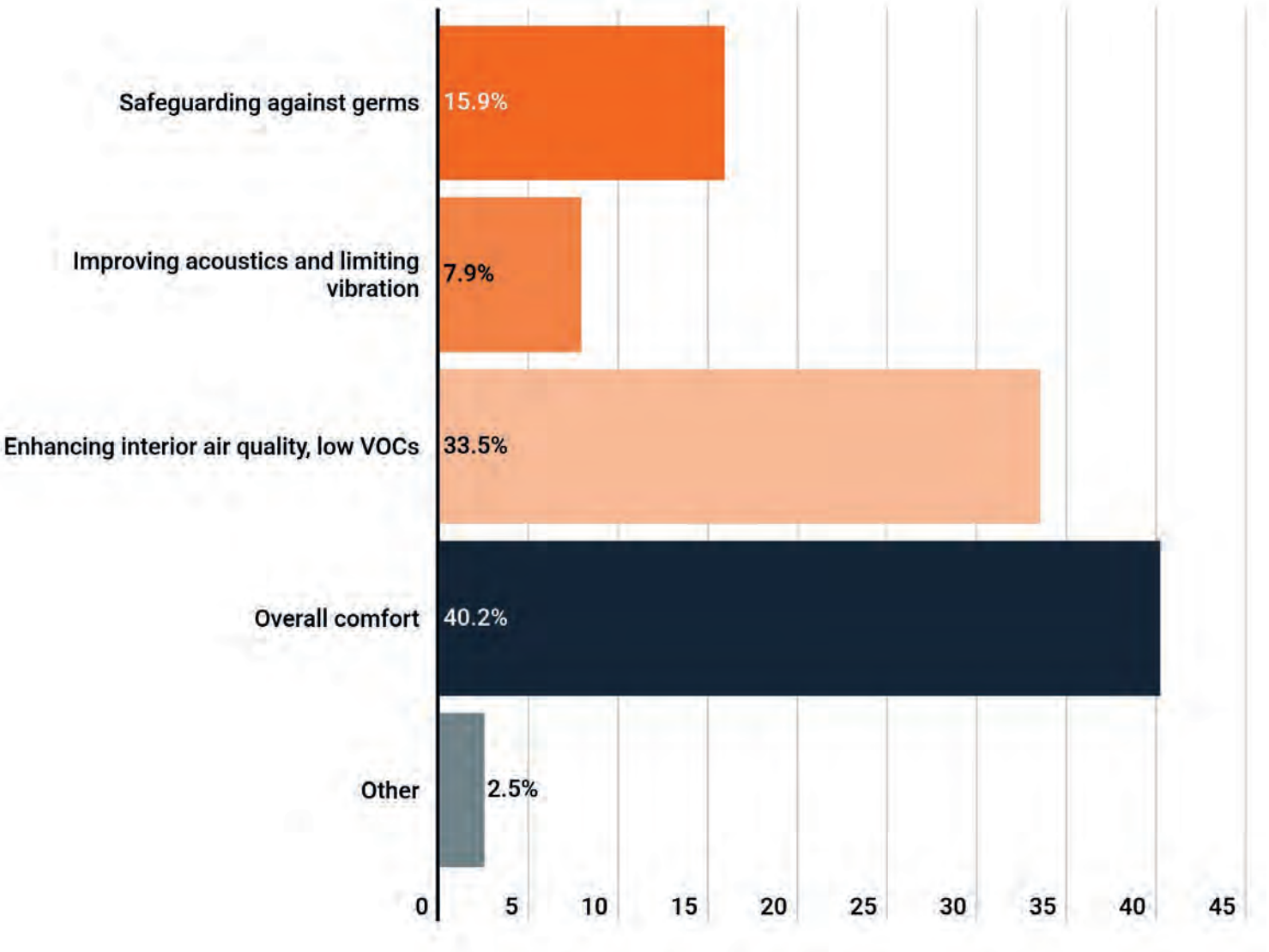


Figure 7.6 Geely Icon SUV with Self Cleaning Materials

7.1.5 Digitalisation of Colour, Materials and Fabrics

Manufacturers are increasingly using advanced manufacturing techniques such as laser cutting, laser etching, electro welding and 3D printing to create new surfaces and fabric effects without stitching, as well as to create perforations, stitching effects and embossing to create a new surface texture, touch and feel.

For example, Dinamica, which is part of Sage Automotive Interiors (a division of Asahi Kasei), is digitally printed with conductive electrical ink to produce a smart surface. Furthermore, materials are being developing that embedding sensors for measuring occupant wellbeing, such as heart rate, and even what nutrients you need.

These advanced manufacturing techniques can also reduce manufacturing costs, add design flexibility and allow a higher level of customisation and much quicker changes in design.

In particular, manufacturers are developing 3D printing and additive manufacturing techniques. For example, Yanfeng is using the technology to develop interior components in both polymers and metals.

Respondents confirmed this trend in the survey, in which “3D printing” was cited as the most important manufacturing technique for the future of interiors, followed by “Laser cutting, laser etching.”

Figure 7.8 Maserati MC20 with Laser Etched Alcantara Seating

Figure 7.7 Survey: New Materials

Many automotive OEMs are using advanced post manufacturing techniques to create a new texture, touch and feel for interiors. Which do you feel is the most important for the future of interiors?

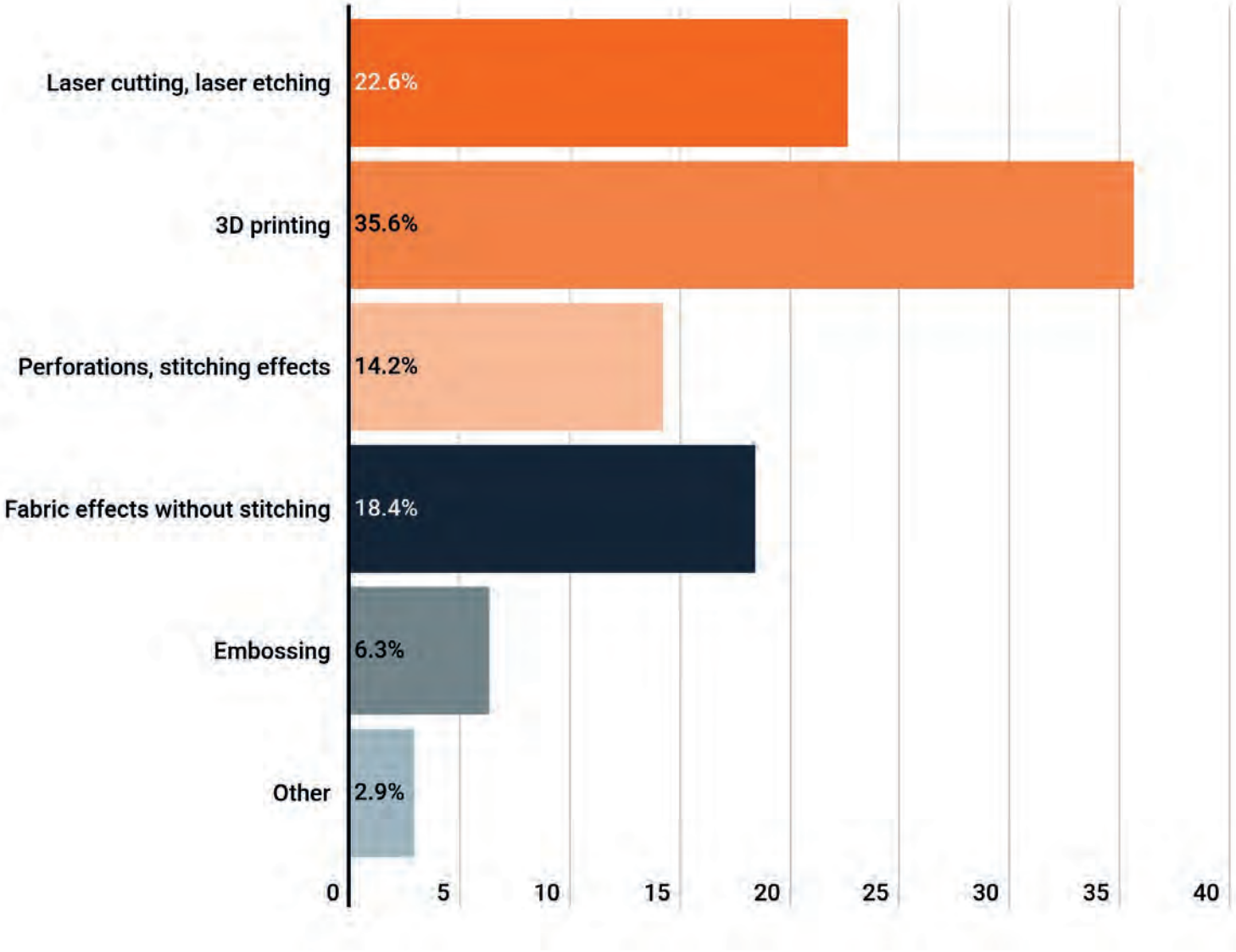


Figure 7.9 Lightyear One Solar Powered EV Concept Contains More than 60 3D Printed Interior Parts

7.1.7 Materials Choice Criteria

And while the following materials are not new, there is growing interest in incorporating natural sustainable materials in vehicle interiors, such as wool, hemp, flax, jute, ramie, kenaf, bamboo and pineapple leaf-based materials.

As the environmental agenda increases, the criteria for materials choice will inevitably evolve. Of course, cost remains paramount in materials choice, but newer factors will come into play around performance and durability. For example, the trend to lightweighting favours lighter materials and many sustainable, naturally derived materials are often lighter than their synthetic equivalents.

7.1.8 Nanomaterials

As mentioned previously nanomaterials are used in antimicrobial materials, but nanomaterials also have other key advantages.

Nanomaterials are being developed for a range of components and materials which are lighter and stronger and lighter which is important in the context of the lightweighting trend to improve fuel efficiency and help meet ICE emission targets and also in improving EV range.

Compared to nanomaterials, conventional fabrics are inferior in terms of properties such as protection from dust and dirt, ventilation, durability, wear and tear, and fire retardancy. Nanomaterials therefore have real potential to offer superior materials to address these issues.

8. Recommendations

8.1 Strategic Takeaways and Recommendations on Material Use and Investments

Sustainability. The dominant trend towards sustainability is a huge business opportunity for fabric manufacturers and material suppliers. Whether that is with partially or fully recycled materials, more ethically sourced materials or truly sustainable natural and plant-based materials, the regulatory frameworks and consumer trajectory is clear. Likewise, consumer awareness of vehicles' environmental footprint is growing steadily as climate change moves up the agenda. Investments in recycled and sustainable materials would achieve great demand from tier suppliers and OEMs alike.

Premiumisation. While there will always be intense financial pressures to keep costs down to maintain slim vehicle margins, the overall trend within interior fabrics is actually upwards in price towards quality. This demonstrates the increasing importance that car designers, OEMs and consumers place on the interior as a part of the experience – and perhaps above all – a pivotal selling point of the vehicle. We expect automotive upholstery fabric value per vehicle to rise from an average of $255 in 2020 to $349 in 2030. This creates opportunities to develop and bring to market more premium, soft touch fabrics and materials.

Automotive Fabric Market Growth. With a global automotive upholstery market size expected to increase from $19.6 billion in 2020 to $44.1 billion in 2030, this provides significant organic growth opportunities but also a huge upside potential in new markets and in new regions such as in the emerging markets of India, China and other Asian markets.

Interiors As Differentiators. Material and fabric suppliers can exploit this trend for differentiation by developing unique fabrics and materials for interiors to be different and to stand out from the rest in a crowded market place. This could be achieved in a number of ways by developing new aesthetic themes using new materials, processes, textures and colours.

CASE Technologies Allow Design Freedom. The coming disruptive transformation to EVs is a certainty, with connected, shared and autonomous vehicles likely to follow albeit at a later date. Interior designers and fabric manufacturers should see these as massive opportunities to gain competitive advantage by re-thinking interiors for how interior spaces will be used differently in future. This could manifest itself with new cabin layouts, new seating configurations, new surfaces, new aesthetics, new materials and profoundly new interior experiences.

New Materials. OEMs are considering many new interior materials, ranging from natural plant-based fibres, to composites or blends of all the above in partially recycled materials. There is nanotechnology, and the range of new materials available to designers revolutionising the antimicrobial qualities, durability, strength and weight of materials.

New Manufacturing Processes. To remain distinctive and competitive, material suppliers should explore advanced new 3D printing, laser cutting, laser etching and electro-welding techniques. This will allow them to develop the capabilities for new fabric effects such as perforations, stitching effects and embossing, to create unique surface textures, decorative elements, individuality and to explore the potential for adding value to fabrics and materials.

Smart Surfaces. The integration of surfaces, fabrics, and materials with electronic sensor technologies with embedded switches and controls present a major are of growth potential for fabric suppliers. Although such smart surfaces will initially be in premium segments at first as an upmarket differentiator, over time these smart surfaces will trickle down to mainstream vehicles and the mass market.

Lightweighting. Non-structural components in interiors such as surfaces and fabrics are key areas for potential weight saving. Fabric suppliers who develop more lightweight fabrics and materials will fare well in comparison to their competitors when seating tier suppliers compare fabric weights.

Evolving Ownership Models. The trend to leasing and subscription models is leading to consumers selecting more upmarket but also more durable and easily cleanable surfaces that are better suited to passing on to another user. Therefore, suppliers who can develop fabrics that can simultaneously achieve those contradictory material qualities – of being perceived to be more upmarket and yet also more durable – will prosper.

Multi-Functional Interiors. As vehicles become mobile virtual office workspace, meeting spaces, social and family areas that are evocative of home, suppliers need to cater to this evolving need for materials, namely homely, functional and yet desirably upmarket surfaces.

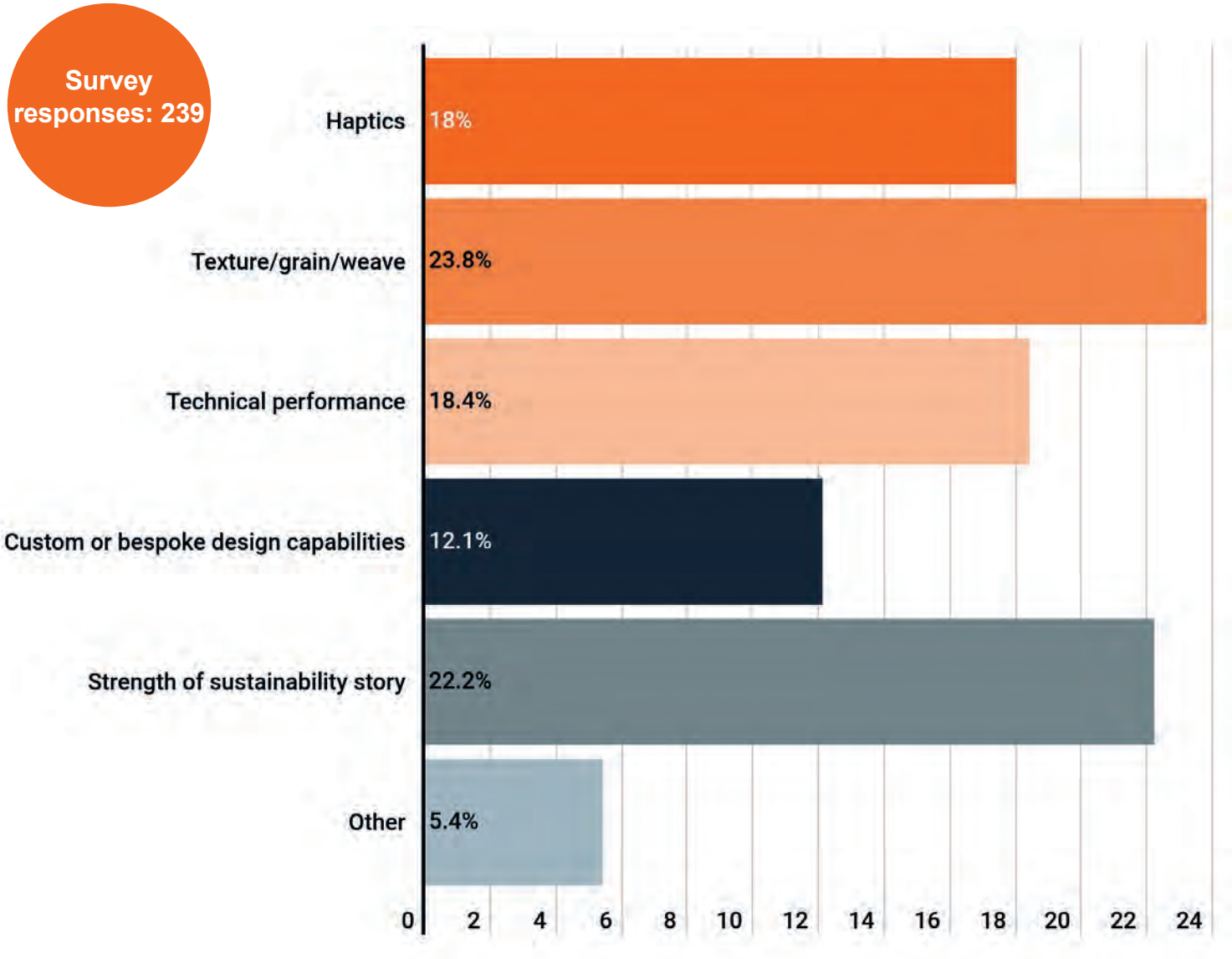
Interiors are the New Frontier. To achieve brand differentiation, and respond to consumers desire for individuality, interior designers must constantly push the envelope. Fabric suppliers that succeed will be those that invest in and capitalise on this trend with new colour palettes, aesthetics, materials, textures and technologies that create innovative and imaginative interior experiences. That is The Future of Interiors.

Appendix: Survey Results

We asked 15 survey questions as follows with the following 239 individual responses –

Survey Question 1: Choosing Surface Materials

Currently which factors do you think are the most important for automotive OEMs when choosing a surface material?



Responses to this question were quite evenly spread, with no clear single answer. However, the leading answer with 23.8% of responses was for **“Texture / Grain / Weave”**, followed by 22.2% of responses with **“Strength of Sustainability Story”**, indicating that if the material can be shown to be genuinely sustainable then OEMs are more likely to select it.

There were only 5.4% selecting **“Other”** and those 13 responses to this were as follows -

“balance between the appearance and the cost”

“Sustainable construction”

“recyclability”

“Illumination (mood and functional) And Tech”

“Sustainable materials”

“Tradition”

”Cost”

”All of the above”

”Appearance! Colour”

”The possibility to integrate function”

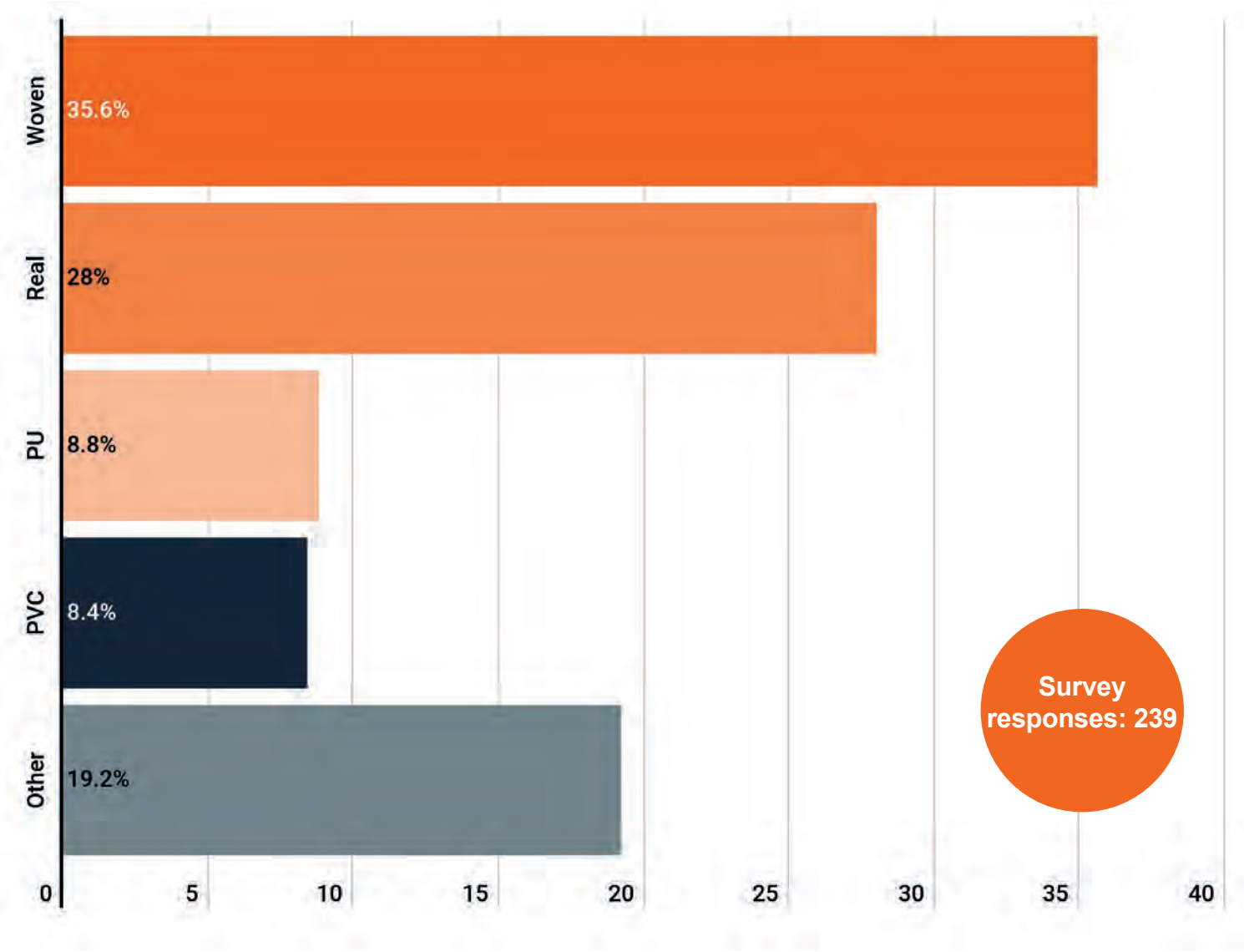
”Novelty - impact and appearance”

“Cost”

“Natural decoration with a natural touch”

Survey Question 2: Material Types

Are there any specific material types that you expect to see automotive OEMs increase use of in vehicle interiors?



The responses to this question very clearly indicated a preference for **"Woven"** with 35.6% of responses followed by **"Real"** with 28.0% of responses.

Notably with this survey question, there was an unusually strong and varied response to **"Other"** with 19.2% selecting this option. Of those 46 responses sustainability, recycling and eco materials featured very strongly

"Recycled / Repurposed Hybrids"
"Composites"
"Smart materials"
"Biopolymers"
"MMC and memory materials"
"Microfiber"
"Glass"
"Alcantara"
"Plush"
"Natural / Organic / Renewable / Recycled"
"Recycled"
"Knit"
"biomass or recycle materials"
"Flyknit/ Leather alternatives"
"recycled plastics"
"Sustainable"

“eLeather”

“Glass”

“3D printed parts”

“Plant/Bio-based materials”

“Glass”

“various recycle (mechanical, chemical, PCR, PIR)”

“PA6”

“Light weight”

“Light transmissive materials”

“Bio”

“Circular Approach”

“Sustainable”

“Mycellium-biocomposite”

“Sustainable”

“Ethical”

“Renewable”

“Vegetal leather”

“organic.. non animal”

“Fabrics from Outdoor clothing for open top cars”

“a wholesale shift away from single use plastics”

“Any sustainable material or vegan”

“Eco materials”

“Recycled plastics”

“Recycled materials”

“Herbal, eco-friendly fabrics or leather”

“sustainable materials/ natural materials”

“no woven”

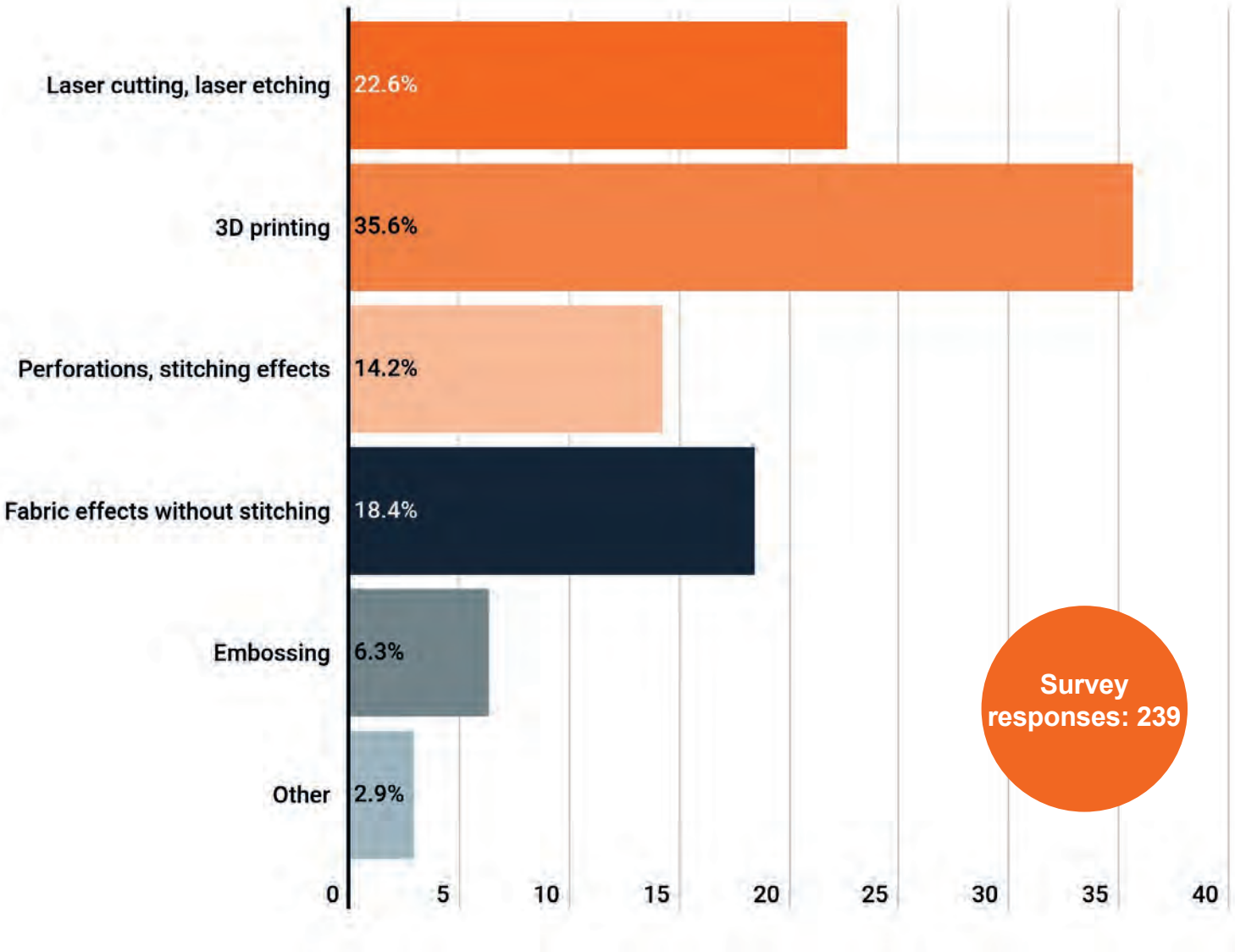
“Man-made”

“mono materials”

“Suede”

Survey Question 3: New Materials

Many automotive OEMs are using advanced post manufacturing techniques to create a new texture, touch and feel for interiors. Which do you feel is the most important for the future of interiors?



"3D printing" dominated the answers to this question with 35.6% of responses.
"Laser cutting, laser etching" followed with 22.6% of responses.

For the **"Other"** responses, only 3%, chose this option and had the following 7 responses -

"The texture of the material itself"

"Smart surfaces that respond to touch"

"printing"

"will depend on brand"

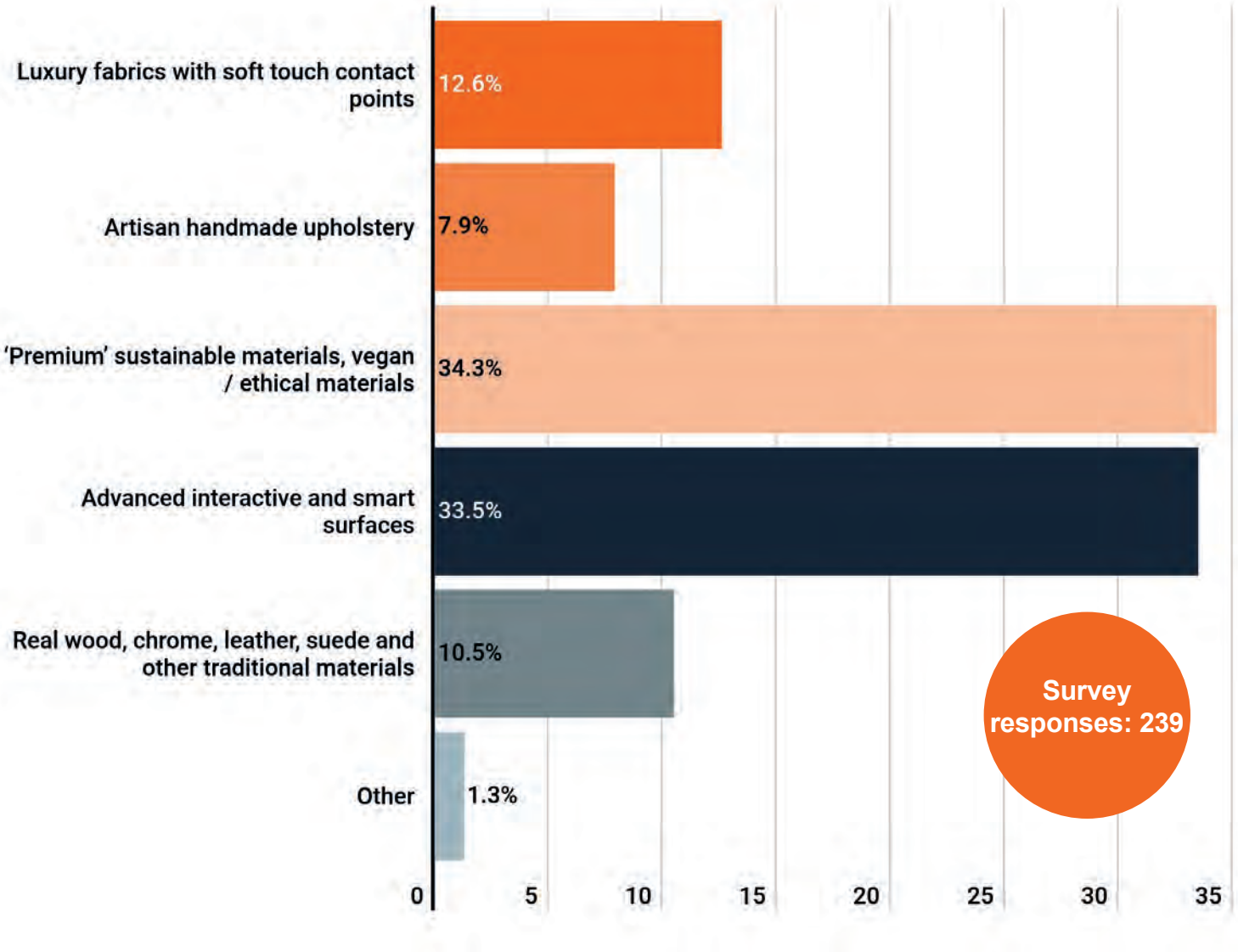
"Lightweight and sustainable"

"3D knitting"

"Including lighting"

Survey Question 4: What is Premium?

With the trend in automotive OEMs using ever higher quality materials, surfaces and luxury fabrics at the very high end of vehicles, what phrase below do you think best describes this “new” premium?



The response to this question was dominated by two answers almost equally. **“Premium sustainable materials, vegan / ethical materials”** had 34.3% of the responses. **“Advanced interactive and smart surfaces”** gained 33.5% of the replies. Both illustrating a powerful movement towards premium sustainable materials in parallel to the shift to smart fabrics.

The **“Other”** response accounted for only 1.3% of replies and 3 answers as follows -

“Renewable materials”

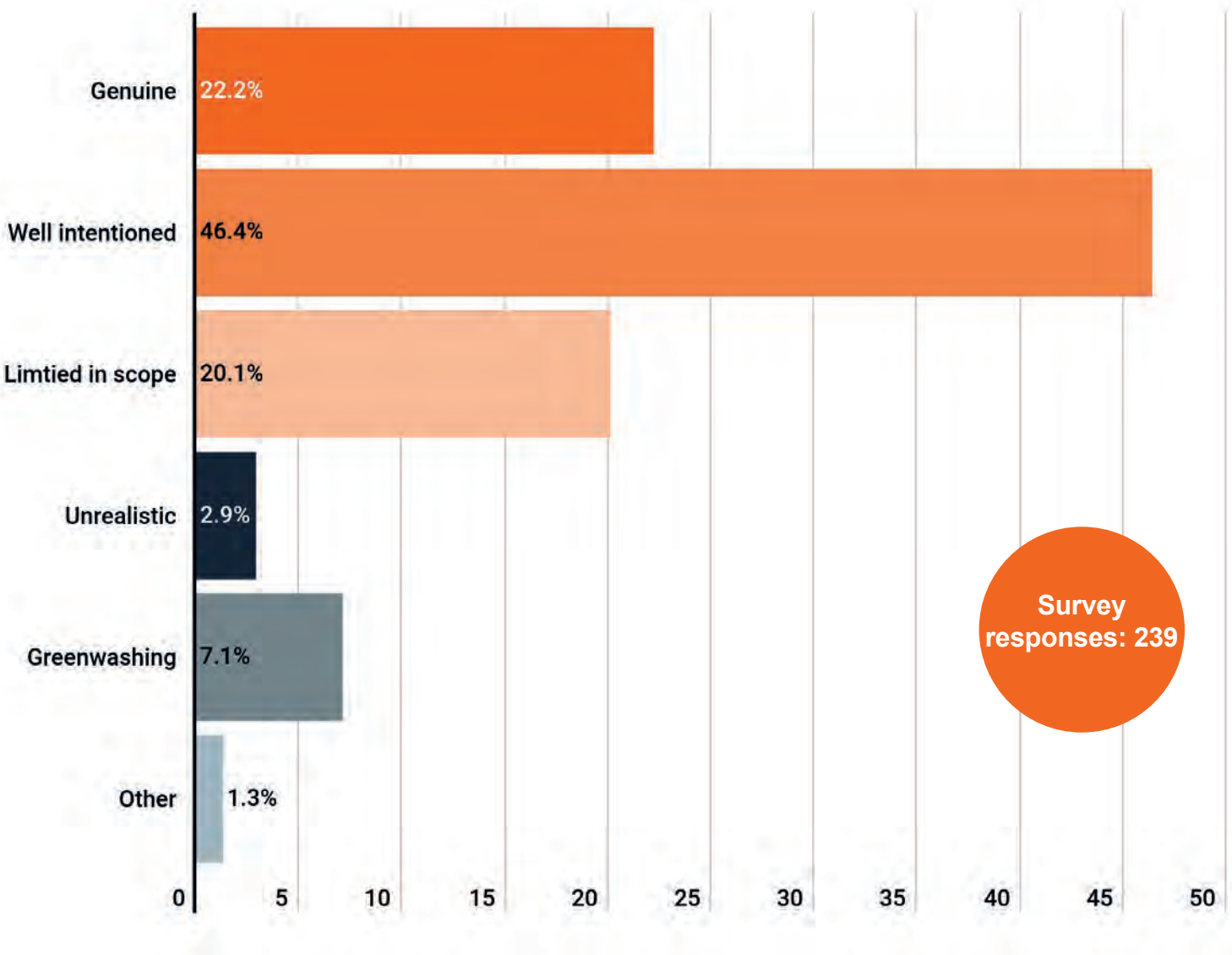
“Depends on the brand strategy”

“Premium is individual, unique”

Sustainability

Survey Question 5: Sustainability

Increasing environmental concerns are shifting vehicle interiors towards recycled secondary materials and naturally sourced renewable materials. Are these aspirations genuinely achievable or greenwashing?



Overwhelmingly, the responses to this question indicated that the shift to sustainable materials was either **"Well intentioned"** with 46.4% of responses and **"Genuine"** with 22.2%. Therefore over 68% believe it is well intentioned or genuine.

Notably only 7.1% believed that the shift to sustainable materials amounts to **"Greenwashing"**

"Other" accounted for only 1.3% of replies with 3 responses -

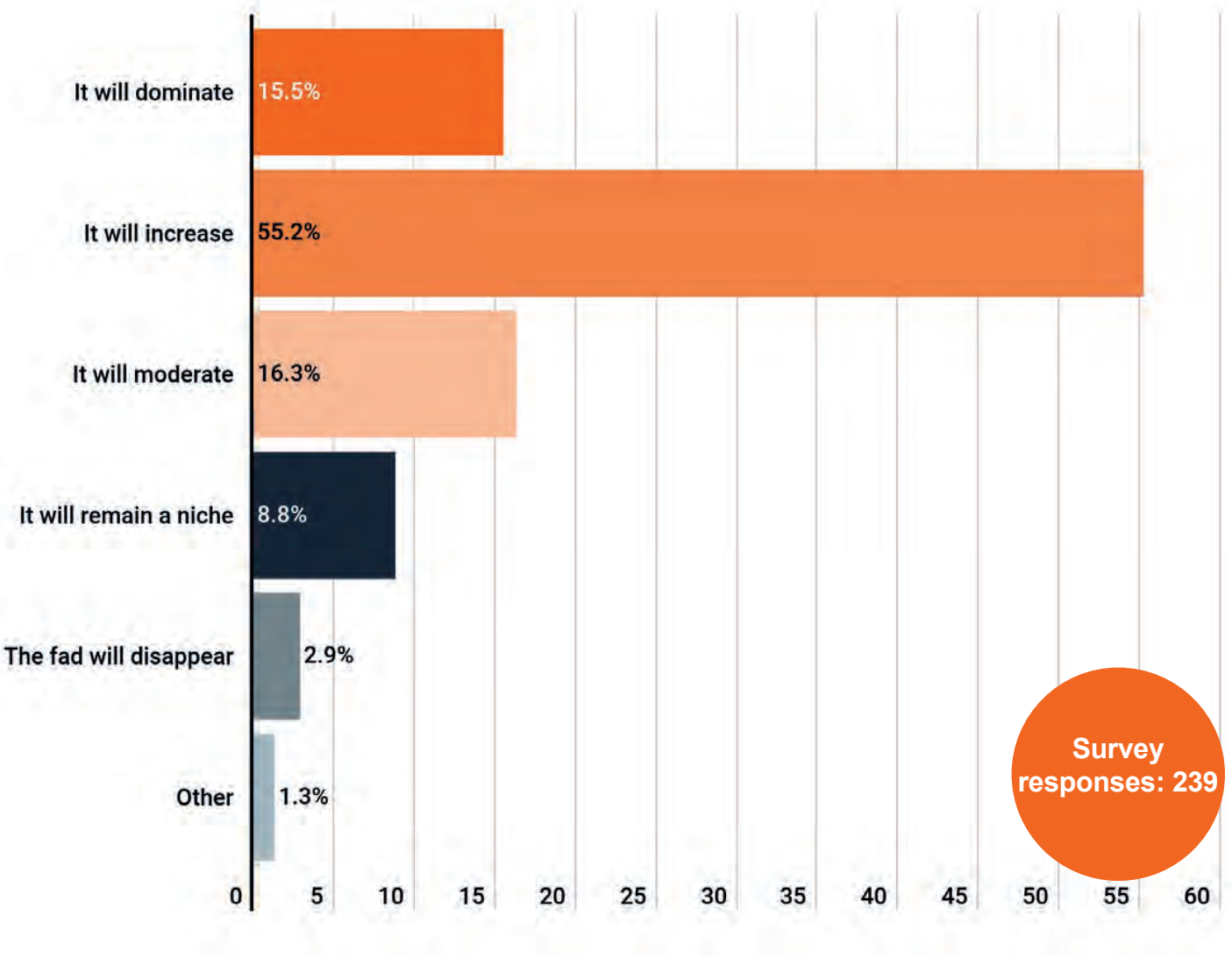
"Achievable but costly"

"At the moment, hard to say"

"well intentioned, but over publicised for PR"

Survey Question 6: Ethical Materials

With the growing ethical movement against leather and the favouring of naturally sourced materials, is this trend likely to continue?



55.2% of replies indicated that ethical materials will **"Increase"** and 15.5% believe it will "**Dominate".** Combined this means that a compelling 70% of respondents believe ethical materials will increase or dominate.

"Other" accounted for only 1.3% and 3 responses as follows -

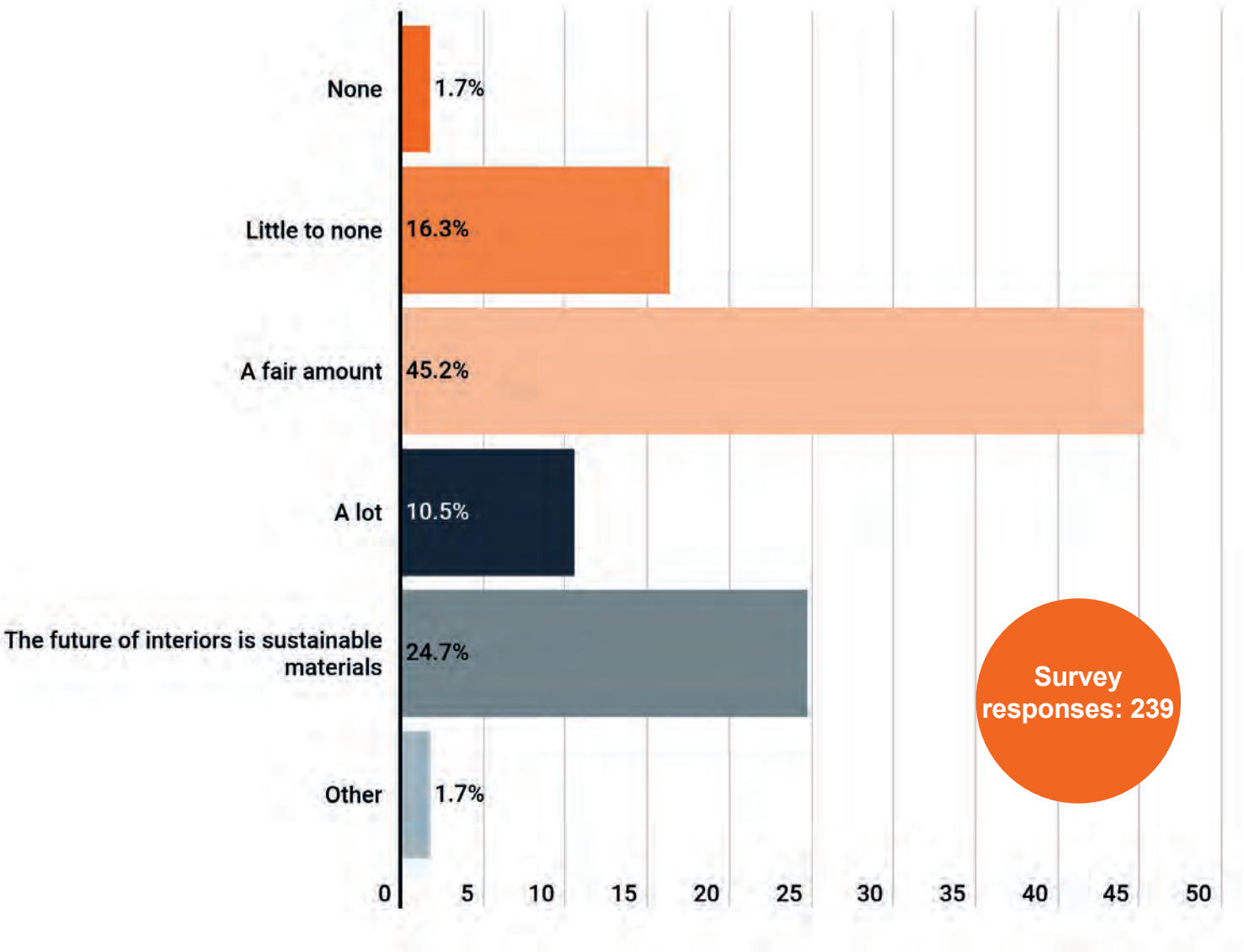
"It will continue but is greenwashing"

"we'll go back to leather"

"meaning change"

Survey Question 7: Paying The Price

The need to go green comes at a cost. To what degree do you think automotive OEMs will be willing to change designs to have more sustainable products?



The responses to this overwhelmingly indicate that OEMs will be willing to change interior designs to achieve sustainability. 45.2% selected **"A fair amount"**, 10.5% chose **"A lot"** and 24.7% agreed with the statement **"The future of interiors is sustainable materials".** Combined this means that over 80% believe that OEMs will be willing to change designs significantly.

"Other" accounted for only 1.7% and 4 responses as follows –

"If the customer demands it, OEM's have no choice"

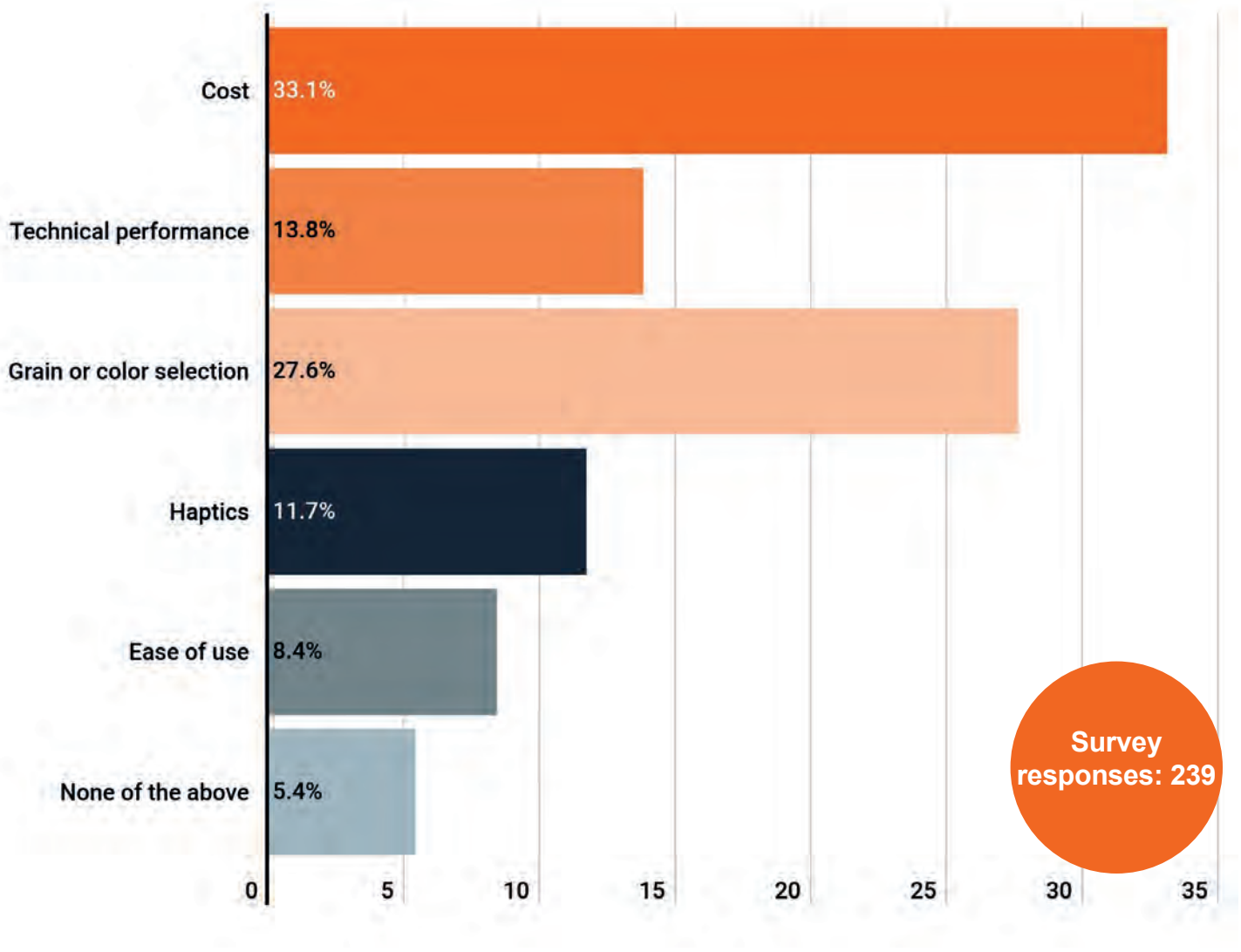
"customers and government will determine"

"OEMs, fair to little. High-end luxury OEMs, a lot"

"catch22 - all down to economy of scale"

Survey Question 8: Compromise

What do you think automotive OEMS will be willing to compromise for a sustainable product?



"Cost" was selected as the leading factor with 33.1% of responses, followed by **"Grain or colour selection"** with 27.6% of responses.

"Other" was selected by 5.4% of respondents with 13 responses as follows. Notably only 3 of these replies (1.3%) indicated that OEMs would not be willing to compromise -

"wealthy will pay more for clear conscience"

"Material cost around the cabin for touch points"

"OEMs have nothing to compromise"

"OEMs will continue to Demand and cost reductions"

"It will change technology, how to make and sell"

"Longevity"

"sustainable materials friendly geometry"

"Customisable-made to order at a higher price"

"brand image"

"Willing? Nothing"

"COST, but this would change on a longer run"

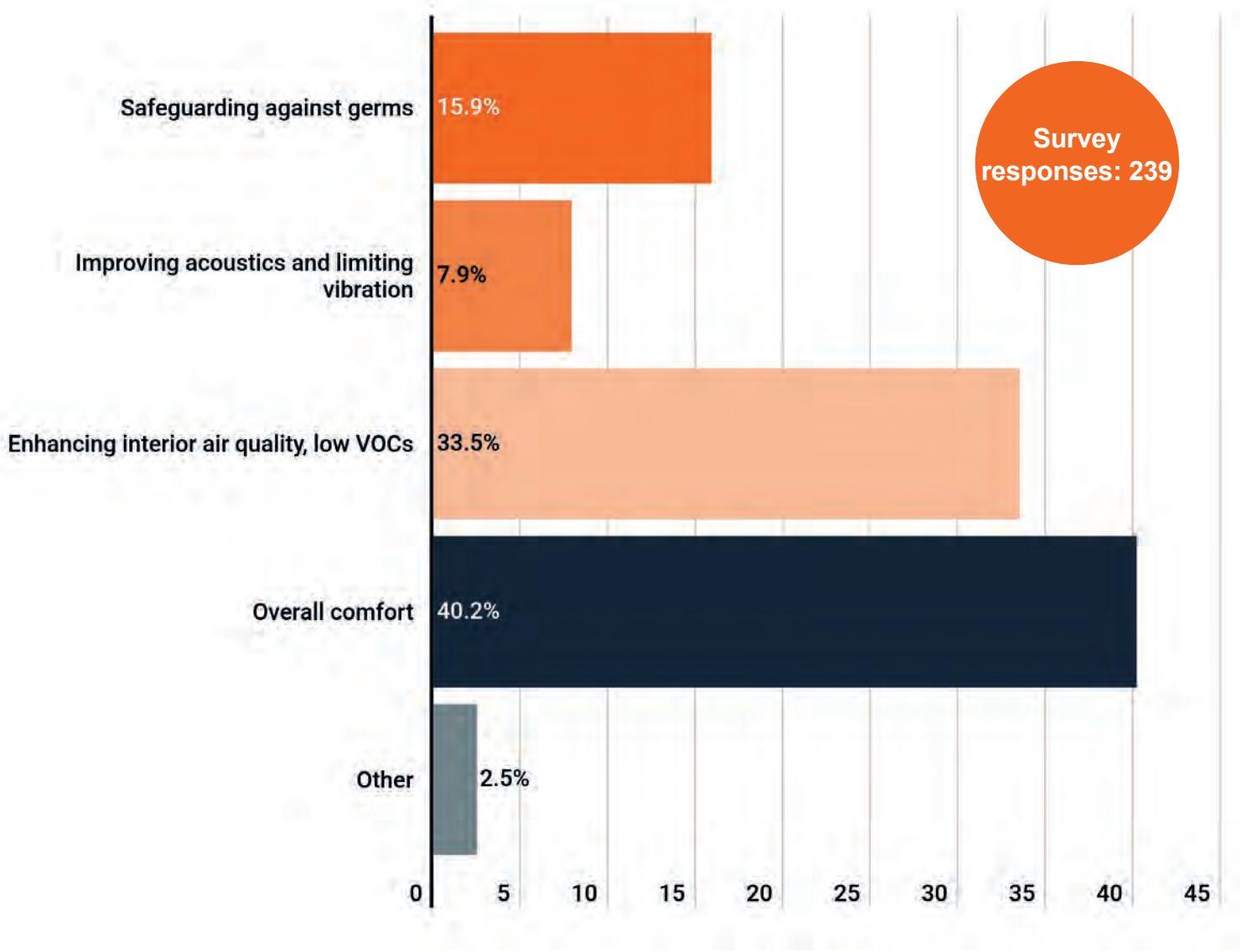
"None"

"No compromise"

Technology Changing Design

Survey Question 9: Cocooning

Consumers are increasingly using their vehicles as a safety shield, protector and mobile bubble. What material attribute do you think is most important to health and wellness?



"Overall comfort" dominated the replies to this survey question with 40.2% of responses. **"Enhancing interior air quality, low VOCs"** accounted for 33.5%. Only 15.9% selected **"Safeguarding against germs"** which could be viewed as surprising in the context of the current Covid pandemic.

"Other" responses were only 2.5% and had 6 responses as follows -

"privacy and virtual and physical safety"

"All of the above, more durable exterior"

"Balance between comfort and precision"

"Ease of outside visibility"

"Self-cleaning materials"

"Cleanability"

Survey Question 10: Customisation/Personalisation

This survey question gave the respondents the opportunity to comment with open-ended responses to the question **"Vehicles are highly mass-produced, yet more than ever consumers want to feel that their vehicle is customised and personalised to them. List (3) key issues you see restricting more customisation of interiors"**

The overwhelming response to this survey question was **"Cost" / "price"** which was mentioned 168 times. In fact, four separate respondents chose to state in all three comment boxes **"cost"**, **"cost"** and **"cost".** The comments clearly indicate that cost, complexity and the limits of an automated mass production process as the key barriers to vehicle customisation and personalisaiton.

Other key words that featured strongly in the responses included -

"material" mentioned 38 times
"complexity" mentioned 30 times
"manufacturing" mentioned 26 times
"production" mentioned 25 times
"design" mentioned 24 times
"colour" mentioned 17 times
"safety" mentioned 15 times
"consumer" mentioned 14 times
"mass production" mentioned 13 times
"regulation" mentioned 10 times

Table A.1 Full Results of Survey Question 10

#	Comment 1	Comment 2	Comment 3	Other comments
1	mass production	costs	increase in production time	
2	possibilities have no limit	demands can be absurd with bad taste hampering brand image	slowing down of manufacturing because of special jobs?	
3	safety requirements	cost (competitive MSRP)	production process (current)	
4	Government regulations, especially those regarding placement of seats and types of controls	Limited availability of autonomous driving systems, with these systems in place, vehicles will be much more configurable.	Cost of technology and materials	
5	Cost	Complexity	Confusion	
6	Cost	Production time	Limits of manufacturing	
7	Cost	Flexible manufacturing (or lack of)	Stubborn OEMs	
8	Structure	Ergonomics	Durability	Production management and lead times

9	Lack of Imagination and vision	Reluctant to consider tailoring as it complicates manufacturing. Manufacturing set up for standardised production techniques	Cost - reluctance from manufacturing and customer. Manufacturer won't pay extra if customer demands cheapest price. Market dependent and customisation could be a key brand deferential	
10	Cost	Practicality	Inability to please everyone.	
11	Colour	Layout	Purpose	
12	seats	wheel	controls	
13	electronics, infotainment systems	young designers without any vision	cost	
14	Logistics	Consistency of quality control	Cost	
15	Functionality	Safety	Cost	
16	Cost	Sustainability	Causes/movements	
17	colour	type of materials	recycled	
18	cost	limited	interrupt mass production	
19	cost	regulation	safety	
20	Higher Cost			None Other- Those Who Can Afford The Added Cost Would Probably Go For It
21	Resourcing of unique materials	Costing of vast amounts of colours, trims and finishes	Bottom dollar costs to the consumer.	
22	Cost	Process	Image	
23	price	logistics	quality	
24	Texture	Secondary finishes	sustainability	
25	Lack of modular interfaces	No ability to plug personal phones/ tablets into infotainment systems	Cockpit Environment linked to mood	Voice over air interface for HMI control
26	Cost	Volume	Supply chain support	
27	the design element of the interior	materials of the trims	the size and position of the screen	
28	safety regulations	cost	production complexity	
29	Cost of Materials	Lead Times	Lack of modular lines in mass production lines	Artisan shortages
30	Seat	Decoration part	Injection part	
31	Advanced manufacturing processes	Sourcing in limited quantities	Testing of multitude of new materials	

32	High labour cost	Low turnaround	Meeting customer requests/ wants	
33	Tooling cost	Stock	Infrastructure	
34	high volume economy of scale	legislation and safety issues	lack of personalisation solutions from suppliers	
35	Uniqueness	New colour developments	use of new technologies and materials	
36	costs	very different targets		
37	safety	cost	complexity	
38	Cost issue	OEM hardly supported	Complicated	
39				no issues
40	cost	sustainability	design	
41	cost	real materials		
42	Limited appeal of bold colour choices	focus on market as a whole, not specific consumer	cost restrictions	
43	Cost	Ease-of-replacement	Display causing distraction	
44	cost	scalability	environmental impact	
45	Die cost	Safety reg	Mindset	
46	Cost reduction	Excessive endurance	Past marketing methods	
47	shape	aerodynamics	catering for large demographics	
48	Price	Logistic	Traditional industry	
49	cost	speed	uniqueness	OEM not set up for customisation
50	Trend Turn-over rate	Perceived Style or Theme	Tech outdating and Feature Fads	
51	Interior materials	Component layout(dashboard, controls, buttons)	Development speed and shorter life cycle of cars	
52	Manufacturing Process	Cost	Materials Sourcing	
53				This statement is not true. Customisation is niche and for aftermarket
54	Additive Manufacturing advancements not quick enough	Multi material parts	Costs	Safety concerns
55	price	high volume manufacturing	lack of digitization	
56	Interactive and smart surfaces	Increasing safety regulations	infotainment systems	
57	Cost	Production Issues	Lead Times	

58	cost	production	too much customization	
59	Cost	Number of choices	Limited materials	
60	less differentiation	low product power	no more brand identity	
61	Designed for fixing parts	Design that does not assume custom	Classification of non-customised and possible	
62	Cost	Mindset of OEM's - too many options	Technology to solve customization	
63	ergonomics	finishes	materials	number of customizable pieces
64	reflexions	material temp attributes	patching...push to reduce patches	
65	texture	durability	inflexibility	
66	Difficult to cater to individual taste	Inventory cost due to stocking material variant	Mass production difficulty whilst catering to produce for personalised choice	
67	Cost	Trend	Regulations	
68	cost	cost	cost	
69	Cost	Cost	Cost	
70	cost	production limitations	comfortability	
71	Lighting	User Interface	CMF	
72	Cost	Mass manufacturing	Carry-over parts	US specific: almost no one custom orders cars - the dealer picks cars and limits what is available to consumers.
73	Old school management mentality	Tooling investments	Clever design solutions	Rolls Royce is almost 80 % bespoke!!
74	proliferation of part numbers	availability of raw goods	Lack of interest due to ride sharing	
75	Cost	Technical restraints	Ergonomics	
76	Modifying desired interior may affect the quality intended to provide	May alter the existing look and feel of vehicle	Serious concern with the energy put towards the change is big compared	
77	chain of industrialisation	liability risks	spare logistics	
78	seat	door panels	ceiling	
79	Number of variants per platform	High costs	regulations by law	
80	More Electronics	No guidelines to DIY	We don't have speciality customisation centres for interiors	
81	cost	cost	cost	

82	modular			
83	Complexity Issues	Cost	Plant size restrictions	
84	cost	productivity	stock management	
85	Cost	Lack of equipment to allow customisation	Mass produced doesn't lend well to customisation	
86	If marketing says no, then it's no	Qty of options to be kept at a minimum	Limited to a set of options (packages)	
87	limited form factors (geometry)	limited digital contents expandability		
88	sustainability	complexity		
89	Cost	scale	Materials	
90	Car dealership system in the US, they sell preselected cars	high cost of personalisations (always as extras)	introducing innovative materials in OEM process	
91	cost	manufacturing complexity	maintaining quality	
92	concern about BoM at OEMs	distribution and retail system restraints	inflexible mfg environments unable to customize JIT	
93	part numbers and labour	testing and specifications	complexity of elements	room for mistakes
94	Cost	Performance	Warranty replacements	
95	Seat Material	Interior colour layout	Customized gadgets	
96	Customer demand	Too much choice	Simplicity	
97	Price	Production Flexibility	Communication to buyer	
98	Parts complexity	Labour hours to build customized parts	Cost	
99	cost	time	specialty	
100	Cost	Manufacturing Methods	Material type	
101	Labour costs	An easy custom ordering process and short wait times for finished product	Availability of materials	
102	Cost	Priority	Complexity	
103	Cost	Unrealistic requests	Requests in poor taste	
104	Cost	Complexity	Resale	
105	high price	limited choices	safety issue	
106	productivity	cost		
107	Cost	Sustainability	Manufacturing	

108	Standardisation of regional needs to global anatomy. E.g 95% male mannequin to 5% female to defines ergonomic zones. Doesn't leave designers any opportunity to use arm rests and consoles in variable ways.	Cost cutting and carry over strategies.	Reduction in complexity e.g. decor trims add possibility of differentiation and customisation. But complexity reduction for standard components reduces the possibility of creating multiple trim options.	
109	Availability of choices	Cost	Time	
110	car sharing	cost reduction	safe against germs	
111	complexity	cost	regulations	
112	cost	lack of modularity in design		
113	Cost	Time	Variety	
114	Safety standards	Cost of interchangeable parts	Risk to launch and produce	
115	Increased cost in making customised components	Increase in CO2 in transporting customised parts from manufacturing site	Each custom part may need new strategy for recycling/ reuse	
116	Custom to me when it is shared	Resale value	scalability and profitability to the OEM	Will customer even want to customise?
117	High cost	Parts are limited (availability)	Low quality parts	
118	tech integration	supply chain	n/a	
119	Communication between customers and designers	Cost	Increased delivery timelines	
120	Cost of multiple parts	New car inventory cost	Dealer attitude	
121	production cost of lower numbers of individual components	complications in logistics, in-plant as well as sales channel	resale value	
122	Cost	Complexity	Limitation of materials	
123	logistic	unflexible industrial process	validation	
124	change of system	design	technologies	
125	Costs	Care	Market research	
126	Mass Production	Cost	Logistics	

127	Limited seat and IP colour combination options	Limited material selections	option to go bespoke	
128	Variant proliferation	Resale values resulting from “strange” combinations	“Too much choice” overload	
129	Cost	Standardised architectures	Inventory	
130	Resale-value	UI of choosing customisation		
131	last longer vehicles	less sales	lower costs request	
132	Reuse of existing parts bins- one interior for multiple vehicles	Cost cutting and not designing in customisation early on	Limited mindset that consumers don’t REALLY care about customisation	
133	complex component attachment.	complexity of the component.	range and costs of what can be offered.	
134	Time to produce	Cost	Choice	Of course, with the new tech these things are greatly reduced. Perhaps, it is just as much an issue of ‘want to’ and service coordination as anything else.
135	Cost	Mass production	Company own standard requirements	
136	Unique Design details	Harmonious interior that matches to the vehicle grade , sport, entry, mid, premium	Clear communication to end consumer about added value of interior materials - hang tags, QR codes, Sales education and communication to customers	Mini does this.
137	Options that are not ‘bundled’	Ability for consumer to pay for ‘green’ material option	OEM not comfortable of performance of ‘new’ materials	
138	government regulation	one size fits all	cost	
139	Cost	Manufacturing	Time	
140	cost	options quantity	more brands need to be involved	
141	cost	manufacturing complexity	technical limitations/restrictions	

142	Paint to sample. The fact that material and colour is so limited that it's often hard to find colours as "down the fairway" as navy blue is evidence of how archaic the industry is. The restricting issue is the paradigm that the management team is stuck in. It's very difficult to accept the risk of innovation when decisions are always reached by committee.	Another key issue is the distance from designers and decision makers from their consumers. And especially the early adopters in the space. Surveying inside the industry is evidence of this. Product creation teams need to be better connected to the consumers and influencers in the space and then empowered to act on those insights.	"Try it." If you think of Harley Earl and the beginning of modern automotive styling there's a good blueprint there. Creating one off personalised custom vehicles for influential drivers. It wasn't democratic. If I were leading an OEM I would create the best product creation/customization team in the world. We would take our mass-produced goods and create artwork in collaboration with influencers that would make a Singer Porsche look bland. North stars.	"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete. "B. Fuller.
143	Issue 1, lack of interior materials that transmit light	Issue 2, lack of OEM level and supplier relationships do to pandemic	Education of OEM and suppliers of what is available	Zoom meetings don't work for this, face to face interaction is always best when that is possible.
144	Brand Identity	Dictated Theme	out of the box complexity	
145	Cost	Complexity	Logistics	
146	Customization opportunity disguised as overall trims	Time and cost setbacks for economy vehicles	Increasing regulations	
147	cost	complexity on the assembly line	material supply	
148	Quality requirements	Cost	Assembly complexity	
149	cost	limits resale of vehicle	Limited interest - i.e. niche sales tool	
150	sustainability trend	cost	assembly processes involved	
151	Standardisation of production methods	Internal struggles/ lack of agile	Not being consumer focussed	
152	manufacturing	cost	development time	
153	cost	production complexity		
154	common parts across model ranges	cost of customising parts	ease of providing service	
155	Cost	Time	Qualified employees	
156	Cost	Slow Digitalization Pace	Conservative management	

157	Type of Material	Cost	Availability	
158	Cost	Manufacturing		
159	Suppliers	Cost	Material availability	
160	Material availability	New uses of interiors	Environmental factors	
161	Cost	Cost	Cost	
162	Cost	Inventory	Individual maintenance	sourcing and suppliers
163	Losing the brand feeling	too expensive	not sustainable to have so much to choose between	
164	Cost	Availability	Easy of customisation	
165	Cost	Complexity	Time to manufacture	
166	of the shelf carry over from previous years or other vehicles	cost	engineering	
167	detrimental to the emotional link with the product and Brand	loss of “Premium” feeling	Customer feeling less considered from the manufacturer Brand	
168	Seat	Smell	Interactive Infotainment	
169	Accent colour incl. illumination	Ethical material package	minimum spec material	
170	less self connect, less user friendly, less trend connect	customers might get bored after a point		
171	manufacturing	ease of access and ease of choice	maintaining brand consistency	
172	Non-configurable parts by user	Too much few options when you have them to configure	High difficult menus to configure electronic devices	
173	luxurious minimalism versus more interactive, touchless... options			Not interested in own car personalisation but in easy bubble to move with that give me possible interactions (not only driving)
174	Materials are expensive	Too much of customisation	Haptics	
175	Cost	Technical requirements	The majority of material needs to be ordered in large scale to be produced by the supplier	
176	cost	logistics	local markets	
177	Cars are purchased or leased as ownership	Complexity of manufacture	Safety targets	

178	Cost	Regulatory requirements	Feasibility	
179	Seating memory	Driving habit correction	Highly convertible between storage space and cabin space	
180	ergonomics	crash regulations	cost that consumers have to pay	
181	volume	logistics		
182	Scalability and vehicle stock control	Volumes and its associated increased costs	Limit to diversity of custom designs to appeal a large range of customers	
183	fears over resale value	majority new cars are leased, customers don't spend on bespoke when they plan to return the car	order complexity and extended lead time. customers are not patient.	
184	development cost	market amount		
185	Cost	Lead time in supply	Do consumers really want to pay for physical customisation when they can do digital	
186	Colour	Modularity	Sounds	
187	Economical customization	Resistance to use technological advancements in interiors	Understanding the need for customisation.	
188	Cost			
189	It will reduce production speed	Logistics	Price	
190	tradition	culture	habit	
191	Design Standards to need to be respected	Design Quality issues may be encountered	Feasibility issues may be encountered	
192	Seats	Steering Wheel	Colour variants	
193	Introduction on supplying chain/ line	Quality of personalized part	Cost	
194	Price			
195	Brand recognition	Not inline with brand design DNA, Brand ID, Brand Values	Too difficult to make templates and special tooling/tools for customisation that are easy to understand, change, and still look good in every colour, texture, finish	
196	Low Resale value of vehicle	Limited ability to repair custom components with wear	Quality of personalisation	
197	User interface	Colour of materials		
198	Economy of scale	Lead time	Supplier management	

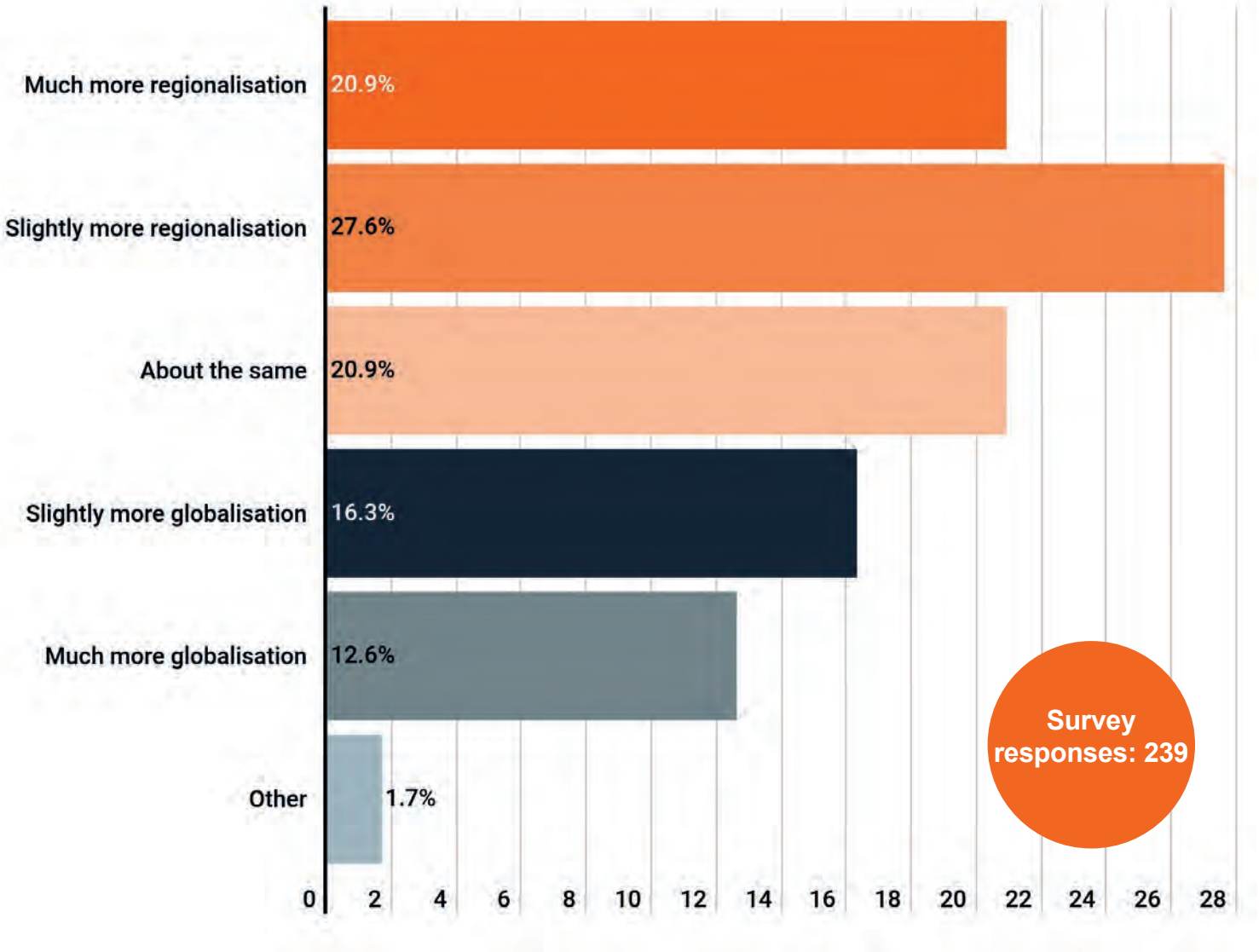
199	Safeguard	Comfort	Ease use	
200	Certification rules	Heavy logistics and supply chain	Complexity	
201	Cost of producing customised surfaces/details	Taste of the individual customer	Time taken to manufacture the wishes	
202	Cost	Too many materials must be safety tested	American consumers are used to buying off the lot	As self-driving increases, private ownership will decrease, decreasing the need for customized materials - the electronics and comfort settings will be customized to users instead.
203	cost	production time	complexity	
204	manufacturing & assembly process	limited functionality	cost vs life	
205	Cost	Global Vehicle Designs	Manufacturing simplicity	
206	technical testing	sustainability	price	
207	Different Design Tastes	Different demand level of countries		
208	Cost of large specification variants	integration with manufacture	Ensuring quality and brand image are not damaged	
209	Complexity	Cost	Control of “taste”	As seen on many luxury brands allowing the customer complete freedom doesn’t always guarantee a vehicle which the manufacturer will happily lay claim to. Often the result is a vehicle with limited resale possibility.
210	Branding	Complication of design	Material supply	
211	costs	mass industrialization	R&D	

212	display and screens fetish	standardising measures of human bodies	lack of actual options when buying, 90% of the time the interior trim is fixed with what you choose	
213	Resale values	Split on what's done at manufacturing / dealer level	What's relevant today, highly likely won't be the next year	
214	cost of making	too many choices- manufacture delay	increased cost	
215	Increased cost of initial purchase	Increased complexity	Second hand value	
216	Cost	Mentality	Market	
217	production processes	costs	materials	
218	Mass-production	Cost	Supply Chain Management	
219	car-sharing	car lifecycle - against fast changing customisation trends		
220	Cost	Stock and how to manage it	How to include personalisation in the manufacturing process	
221	Cost	Platforms & modularisation	Focus of OEMs on EV and AD technologies	
222	Material approval	Reliable suppliers	Material Processability	
223	Functionality of the car itself	Roads and infrastructure - there's only so much space on the roads	Mass production is difficult to combine with personalisation without high costs - those that want to personalize can do it aftermarket for cheaper currently.	
224	modularity	costs	safety	
225	Cost - cost to both consumer and manufacturers	Ability to change something easily (customisable parts)	Control over design - do OEM's want to lose a small control over their design work	
226	Cost	Practicality	Common sense	
227	Cost	Availability	Breadth	
228	Markets	Suppliers	Trends	
229	Manufacturing price	Safety / legislation	OEMs brand restrictions	
230	car sharing is uniformity	costs	Innovative concepts	
231	price pressure	mass product	supply chain management	
232	costs	complexity	spoilt for choice	
233	Lack of personal vehicle ownership in general	Resale value	General lack of awareness from consumers about the possibilities	
234	Motor location	Steering wheel	Autonomous tech	
235	Grain	Colour	Trim-lines	

236	Production line manufacturing has been automated, but remains fundamentally the same; an efficient method to produce lots of something cheaply, but the way this is currently purposed sacrifices flexibility/ adaptability.	Design teams unwilling/untrained/ ill equipped to empower users to make their own design decisions and enact them.	Cost	
237	Development costs	Internationalisation	Cost & value for money	
238	Cost	Taste	Scarcity	
239	Material selection	Non-modularisation	Colour	

Survey Question 11: Modularisation

As the industry moves to global vehicle platforms and vehicle models, will interiors become more standardised globally or will there be more regional divergence due to cultural differences and local consumer tastes?



27.6% selected **"Slightly more regionalisation"** and 20.9% selected **"Much more regionalisation"** indicating 48.5% believe there will be more regionalisation.

16.2% selected **"Slightly more globalisation"** and 12.6% **"Much more globalisation"** indicating a combined 28.7% believed there will be more globalisation.

Therefore, by a factor of nearly 2 to 1, respondents believe there will be a shift towards regionalisation of interiors.

"Other" respondents were just 1.7% and the 4 responses were as follows –

"More globalisation but regional CMD"

"Bigger markets get customised needs"

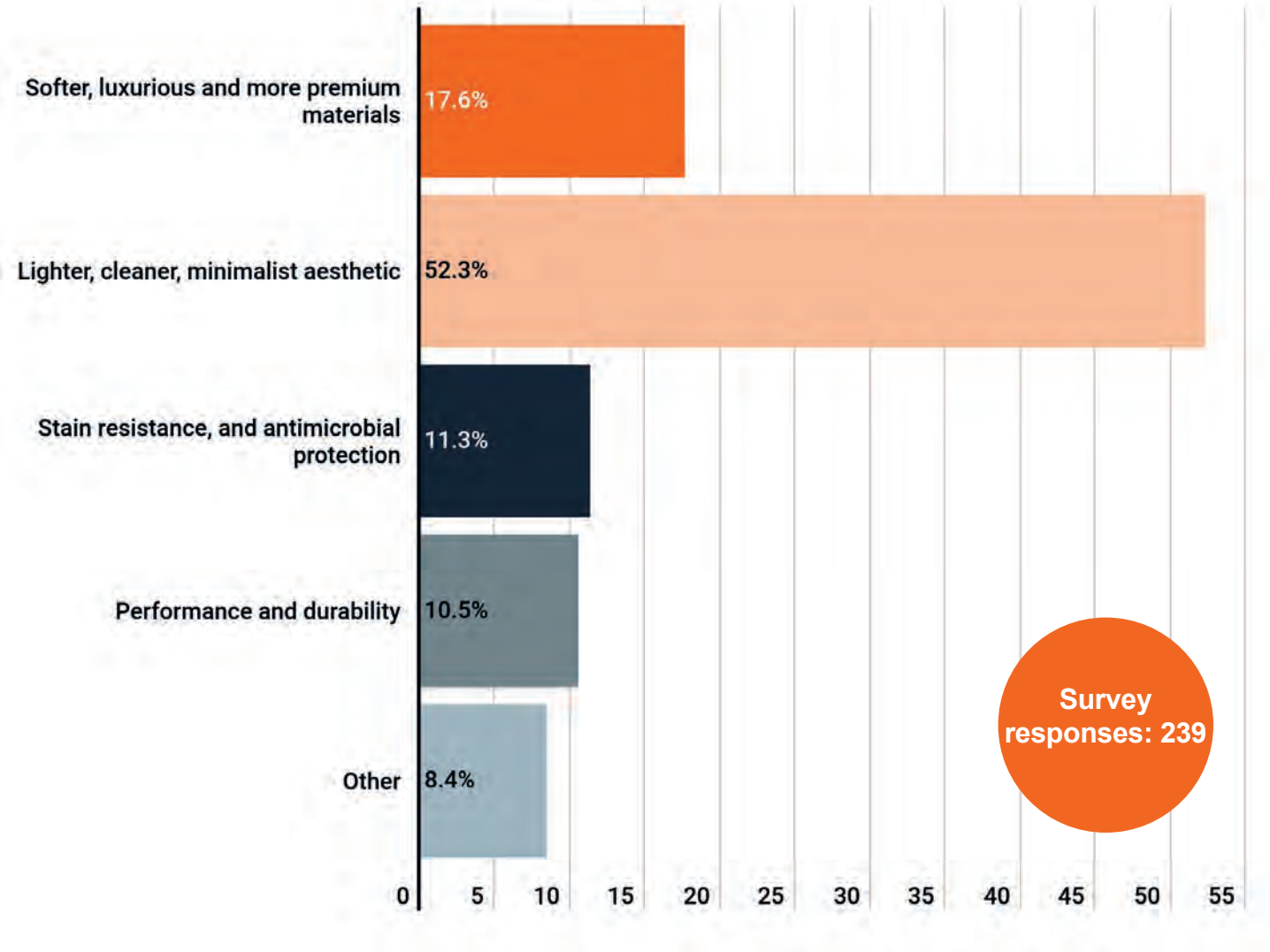
"depends on the market, luxe vs local consumer"

"More global even if it goes against users"

New Vehicle Uses

Survey Question 12: Electrification

The shift to electric vehicles presents an opportunity for automotive OEMs to differentiate and set a design language with distinctive interiors. Interiors could take precedence over exteriors. If this happens, what do you feel will be the most important factor in this design?



The response to this survey question was dominated by **"Lighter, cleaner, minimalist aesthetic"** with 52.3% of respondents selected this option. A relatively small 17.6% selected **"Softer, luxurious and more premium materials".**

For the **"Others"** option this accounted for 8.4% and the 20 responses were as follows –

Modular interiors from basic to premium

all above

"More Tech and Detail Designs"

"Closed-loop materials"

"All of the above"

"Softer, more natural and comfortable materials"

"express brand attributes more clearly"

"level of customisation"

"Customisable interiors for different uses"

"depends on brand strategy"

"Communication of wellbeing"

"It will depend on the brand/product"

"new form factors"

"Sustainable, smart and customisable materials"

"Locally produced, use cases, materials, aesthetic"

"aesthetically new directions"

"Ease of life features"

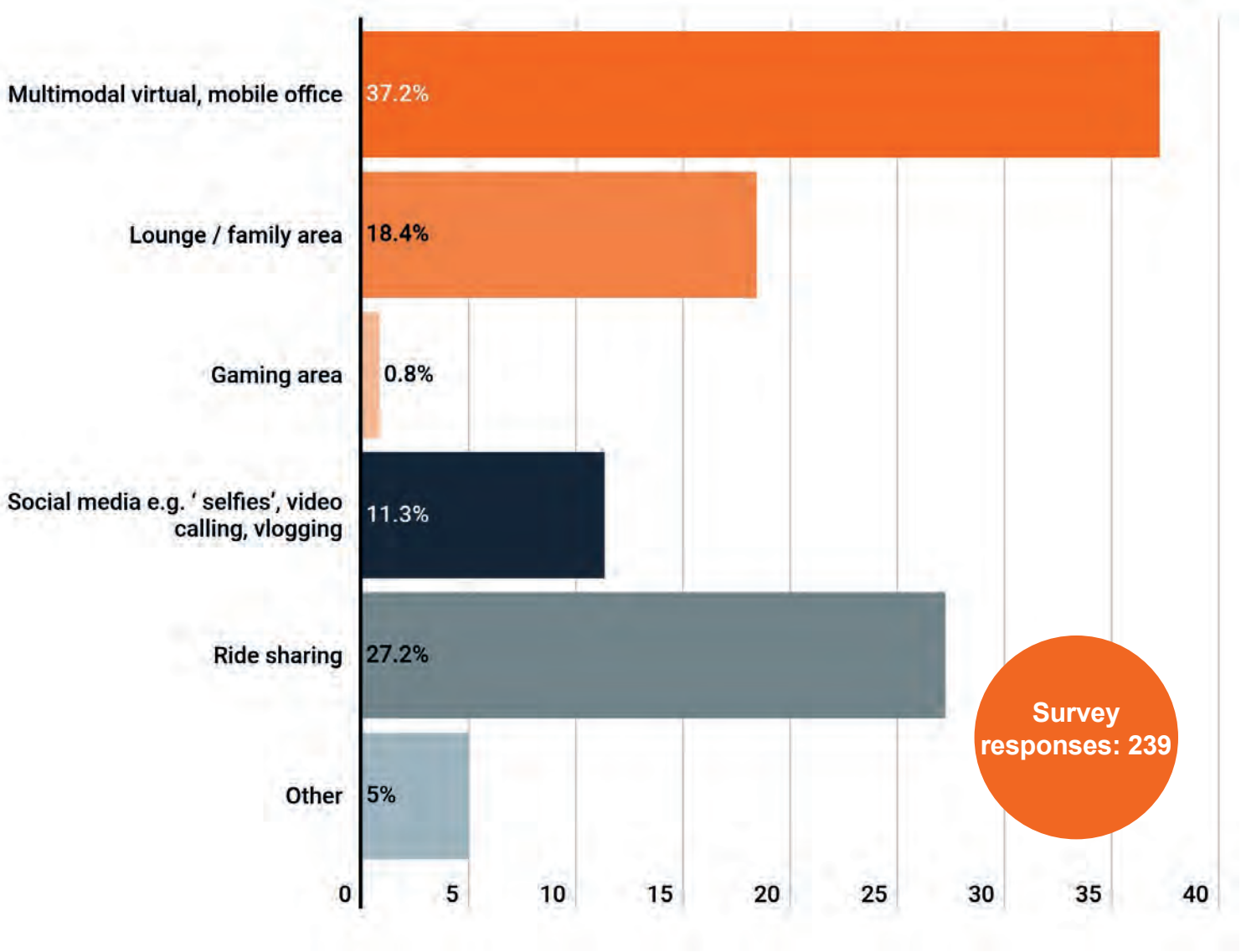
"Sustainability"

"Functional solution: a more useful vehicle"

"Space and the ability to change it"

Survey Question 13: Changing Modes

Vehicles are likely to shift from A to B modes of transport to places where users spend much more time in cars. This could radically change the design of the interior. What do you think will become the most popular use for vehicle interiors?



The replies to this survey question were strongly in favour of **"Multimodal virtual, mobile office"** with 37.2% of responses, followed by **"Ride sharing"** with 27.2% of responses and **"Lounge / family area"** with 18.4% of responses.

"Other" responses accounted for just 5.0% and those 12 responses were as follows with many stating "All of the above"–

"All of the above ;)"

"napping pod"

"combination of all listed plus mobile hoteling"

"All of the Above, and Sleeping / Rest / Relaxation"

"highly modular interior / vehicle"

"Living area serving as bridge in between two points"

"all of the above and vary by region"

"First class cabin of airplanes"

"little change - even with emerging MaaS"

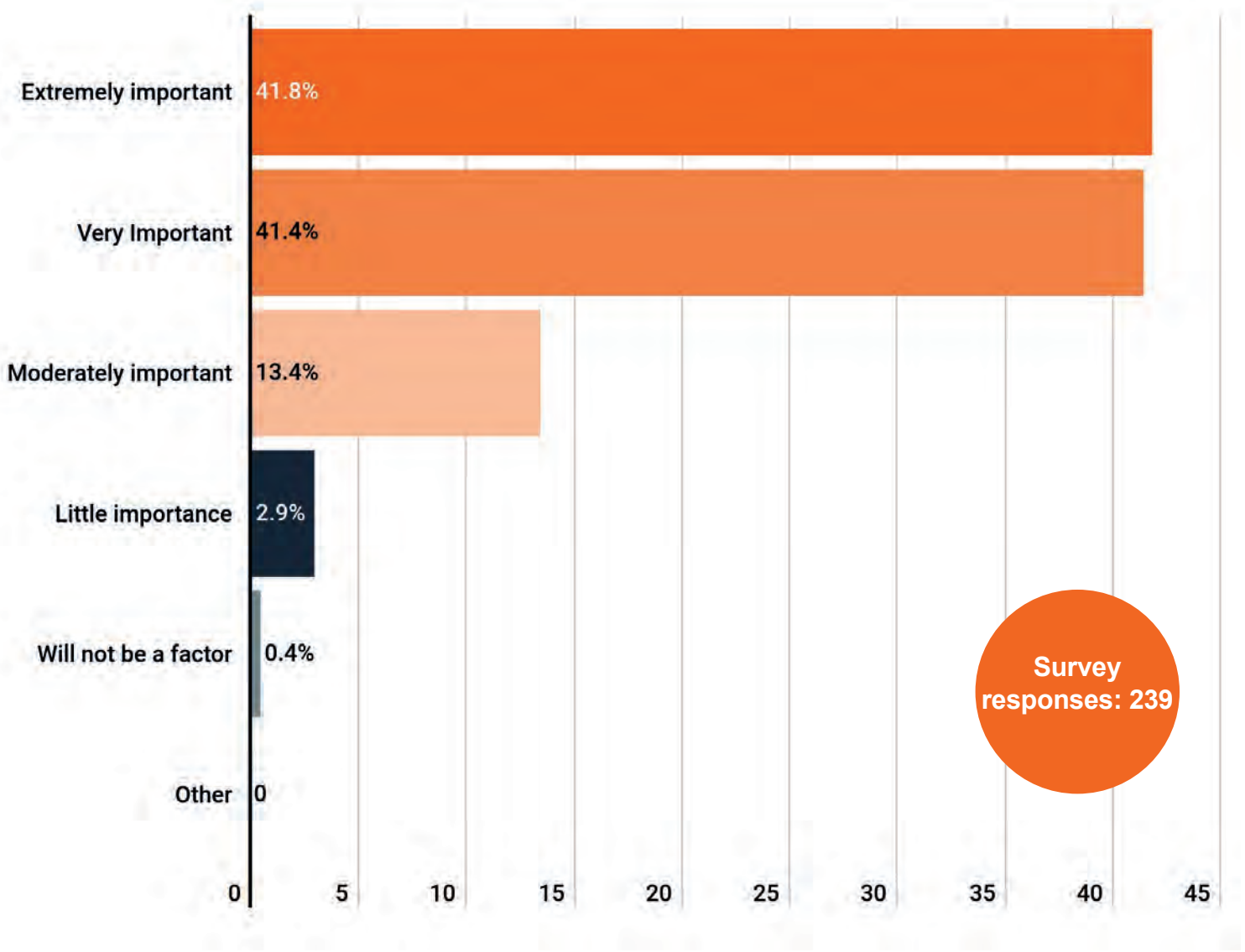
"flexible for multiple purpose"

"i need more than 50 characters...e mail me!"

"Do we really want to spend more time inside a car?"

Survey Question 14: Autonomy

Autonomy changes how occupants perceive and use a vehicle interior. Passengers comfort levels will become a key determinant in the success of these vehicles. In addition to the use of ambient lighting, noise-cancelling technology and seat positioning, how important will interior materials be in autonomous vehicles.



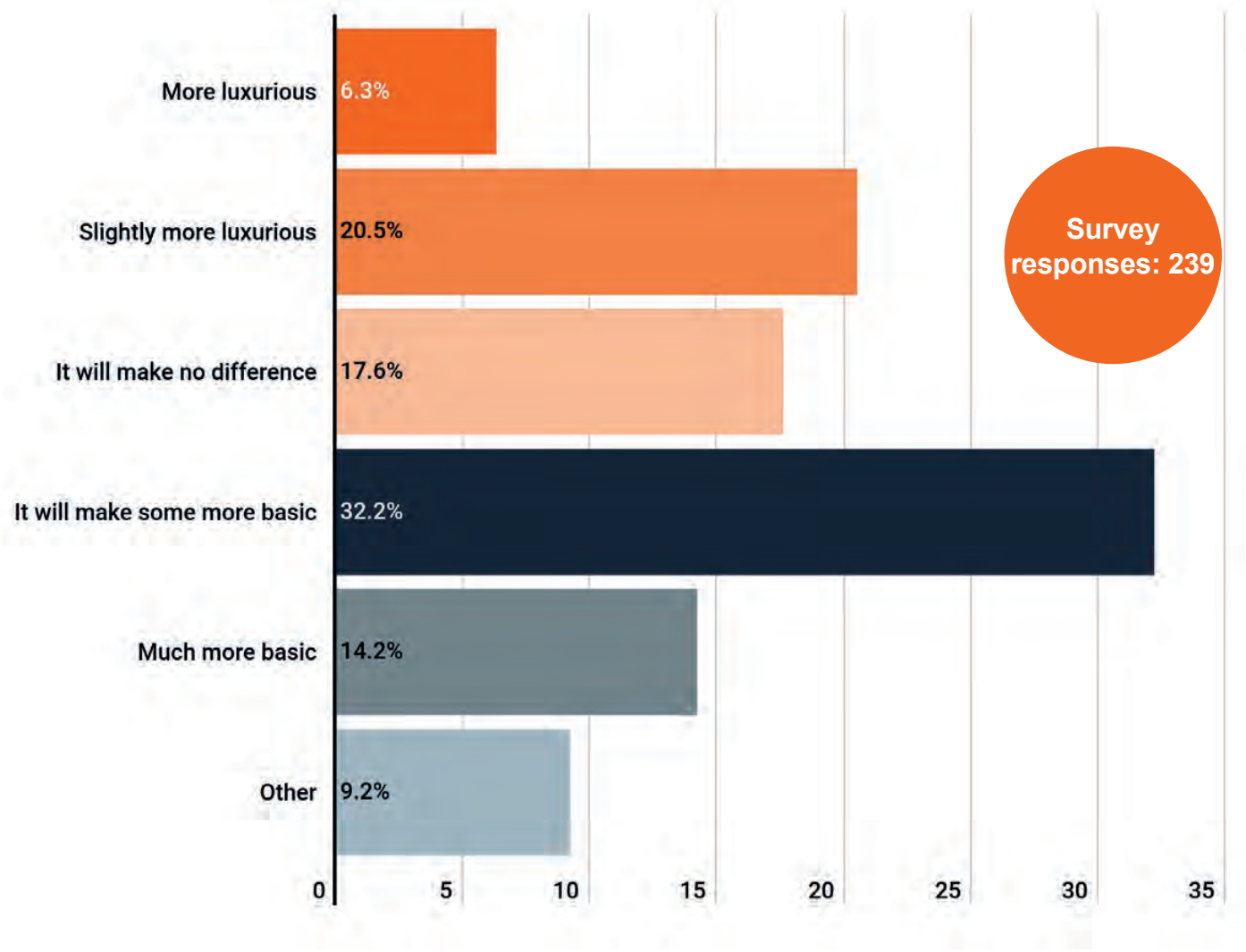
This survey question produced the most clear-cut response of all the questions.

"Extremely important" achieved 41.8% of responses, **"Very Important"** had 41.4% of responses, and **"Moderately important"** 13.4% of replies. Therefore, combined these responses indicate over 95% of respondents believe interior materials will be extremely, very or moderately important in autonomous vehicles.

There were no **"Other"** responses to this survey question.

Survey Question 15: Shared Mobility

Shared mobility increases vehicle usage as with mass transportation such as airline, rail and bus seating. Expectations of the interior are likely to change in a shared space. Will this result in surfaces and fabrics needing to be more luxurious or more basic?



This question produced a balanced and mixed spread of opinion. **"It will make some more basic"** accounted for 32.2% of responses followed by **"Slightly more luxurious"** with 20.5% of replies.

"Other" replies to this survey question accounted for 9.2% with 22 responses as follows, notably with one respondent summarising it well as **"More basic and more luxurious."**
slightly more basic, but much more robust

"Resistant"

"More natural, like a home interior"

"product specific"

"Easier to clean"

"Low maintenance yet perception of luxury"

"Uber and Lyft are taxi companies"

"functional, antibacterial, +perceived Quality"

"A little of both, depending on function"

"More functional / integrative"

"identity dependent e.g. adapts to their preferences"

"Higher performing w/o loss of aesthetics"

"More basic and more luxurious"

"dependent on segment/subscription model"

"It depends on who is the intended customer"

"Need to be cleanable and exchangeable"

"much durable"

"hygiene"

"Materials become more robust or easy to replace"

"More maintainable"

"More basic and resistant"

"It depends on the product offering..."

Credits

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