



PRIME RESEARCH

Nvidia-Drive-CX

World Car Trends 2015

“Connected Mobility and Digital Lifestyle”

New York, April 2015



WORLD CAR AWARDS

Global Expert Community Global Media Trends

75 World Car Jurors



Top 25 markets *Countries*
All automotive brands [> 150] and models *Brands*
Top opinion leading media (TV | print | online) *News channels*
2014 – 2015: > 100 million documents (blogs, forums, networks) *Social channels*



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Management Summary

This year, there is one overarching theme : “Connected Mobility and Digital Lifestyle”

Connected Mobility

The current hype of connected mobility is mainly driven by three topics:

- ▶ **Autonomous driving** – which is gaining acceptance and expected within the next 4 years
- ▶ **Smartphone integration** –the integration of Android (Google) and Apple
- ▶ **New displays and visuals** – to cope with all those new features

The new digital and electric car will offer totally new perspectives of the future design of the car. The car will become a stylish retreat while travelling. Multimedia displays will stimulate new interior designs – making the connected car a digital lifestyle statement.

New Challenges

Future technologies are paving the way for new players as well as new business models in the automotive sector. One question excites the industry and our global experts: the future role of the tech companies – especially of Apple and Google. A large majority, **68% of our jurors, expect that tech companies will become a major challenge for the established car industry** within the next 10 years. And 38% expect this to happen within the next 5 years. Whether the tech companies will succeed with their own cars – this is an open question, according to our experts. But a slight majority of more than 50% expect that they will not only be ambitious, but also successful. Do they have a realistic chance? Yes, since a modern high-tech car already includes a bigger software package than anything else – including software products like Facebook or Microsoft Office. However, it’s questionable if the low-margin car business is attractive to tech companies or if it’s more about transferring their mobile market domination into the car sector.

Autonomous Driving

The exposure of autonomous driving substantially increased over the last five years through special events, concept and serial production cars. The steep learning curve over the last three years also changed journalists’ perceptions – the once most hated advanced driver assistance feature “Autonomous Driving” has turned into one of the most admired features in 2015. In just three years, what a turn-around. **Our experts predict that by 2020, full autonomous driving will find its way to the full-size and luxury segments**, while subcompact cars as well as leisure-orientated cars (*sports cars & convertibles*) will offer a lesser degree of autonomy.

Infotainment System

In-car electronics and connectivity became increasingly more visible in Global media over the last 5 years. The most important infotainment feature – *smartphone integration* – means **an integration of Apple and Google due to their domination of the smartphone OS market**. Apple and Google have a smartphone market share of more than 93% - and that was in 2013. The number will be even higher for the last year. Infotainment systems of the OEM’s are still benchmark. However, Apple and Google with their infotainment offerings are very close and much better evaluated than the worst 5 infotainment systems of OEM’s.

Smart Efficiency

Smart efficiency / e-mobility is the unprecedented top trend of recent years. While the oil price is expected to return to the 2010-2014 average price of 100 USD per barrel no sooner than 2020, the current low oil price leads to slower progression in the development of alternative fuels.

Fuel cell electric vehicles gain the most momentum in 2015, while all other electric powertrain options remain stable. However, for the first time, pure battery electric vehicles are seen as the least promising powertrain option.

FCEV

Fuel-cell technology ramps-up for a second time in 2014/15 and becomes highly visible in global media. Toyota clearly dominates FCEV coverage in 2014/2015 YTD with the Mirai and generates 70% share of voice. But Hyundai and Honda also demonstrate significant effort with their fuel-cell technology and generate fair visibility.

FCEVs receive slightly less criticism than BEVs in global media over the last year. Fuel-Cell technology has the chance for a comeback as the next generation EV. However, **Hydrogen infrastructure is the biggest challenge for FCEVs.**

FCEVs receive a lot of praise from the experts: “They’re impressive for their ease of driving, quietness, range and speed of refuelling.”

BEV

After the slowdown in 2012/2013, BEVs are now seeing a substantial increase in media visibility, pushed by a variety of new battery electric vehicle models. **Out of a significant number of BEV models in 2014-2015 YTD, the Tesla Model S and BMW i3 combined account for more than 2/3 of all coverage.** Almost every third battery electric vehicle story is about either one of them.

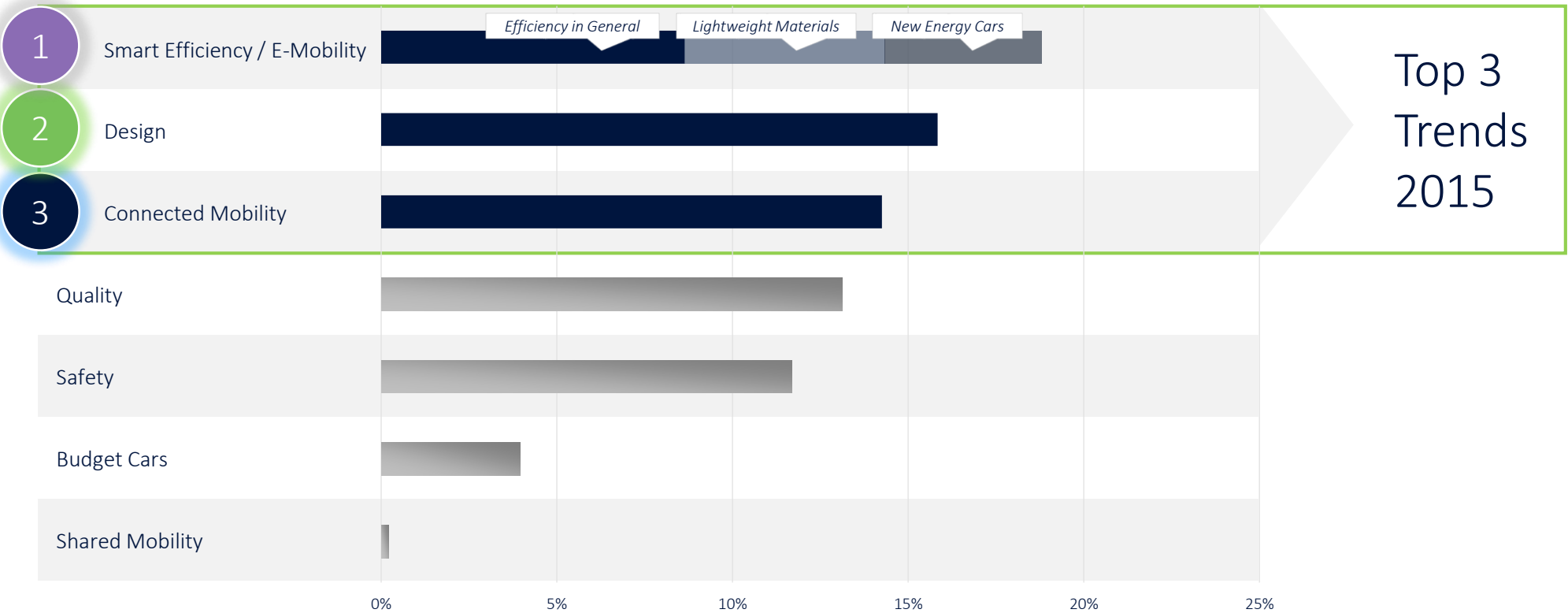
The EV market in Norway grew by 130% in 2014 compared to the previous year driven by attractive governmental incentives like no purchase tax, no VAT, no tolls, free and extra parking areas for EVs, proper EV infrastructure and a clean Norwegian energy production. China is gaining more and more momentum with its ambitious e-car plans (5m e-cars on the road by 2020) and its heavy infrastructure investments, while Germany and USA show limited e-mobility momentum. **The key to the roll-out and success of BEVs are advanced battery technology and increased range.** Tesla & BMW continue their outstanding EV reputation in 2015 with Model S and i3.

Lightweight

Lightweight coverage on rests at a somewhat consistently low level over the past few years, however weight is increasingly criticised within the media. It is highly agreed that **suppliers are contributing significantly in developing lightweight technologies.** There is a trend towards an even closer cooperation between OEMs and their supplier in order to achieve innovative solutions.

“Connected Mobility and Digital Lifestyle”

The current ‘top trend cluster’ is driven by smart efficiency / e-mobility, design and connected mobility.



1

Connected Mobility



New Challenges

- › Autonomous Driving
- › Infotainment System

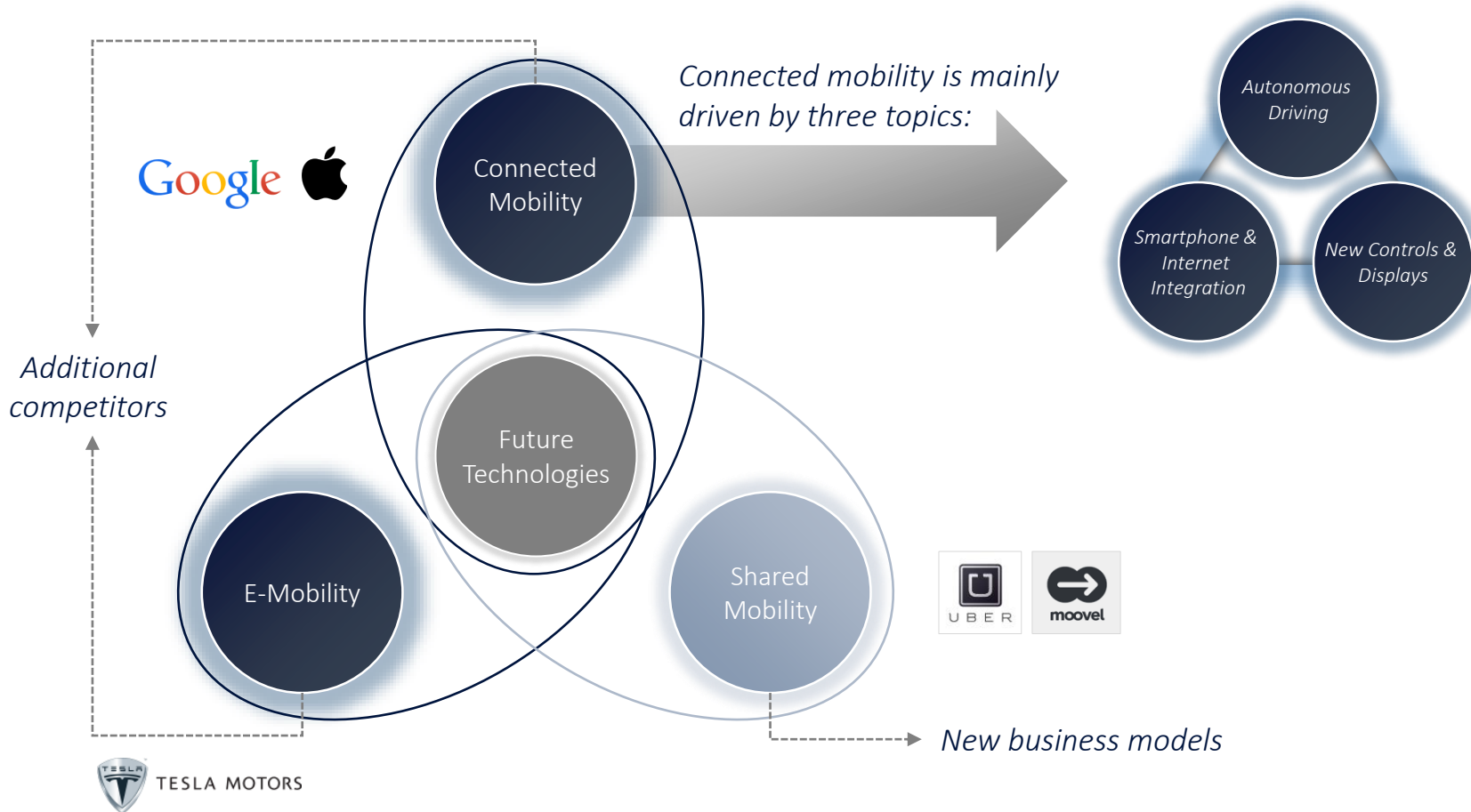
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Smart Efficiency

- › FCEV
- › BEV
- › Lightweight

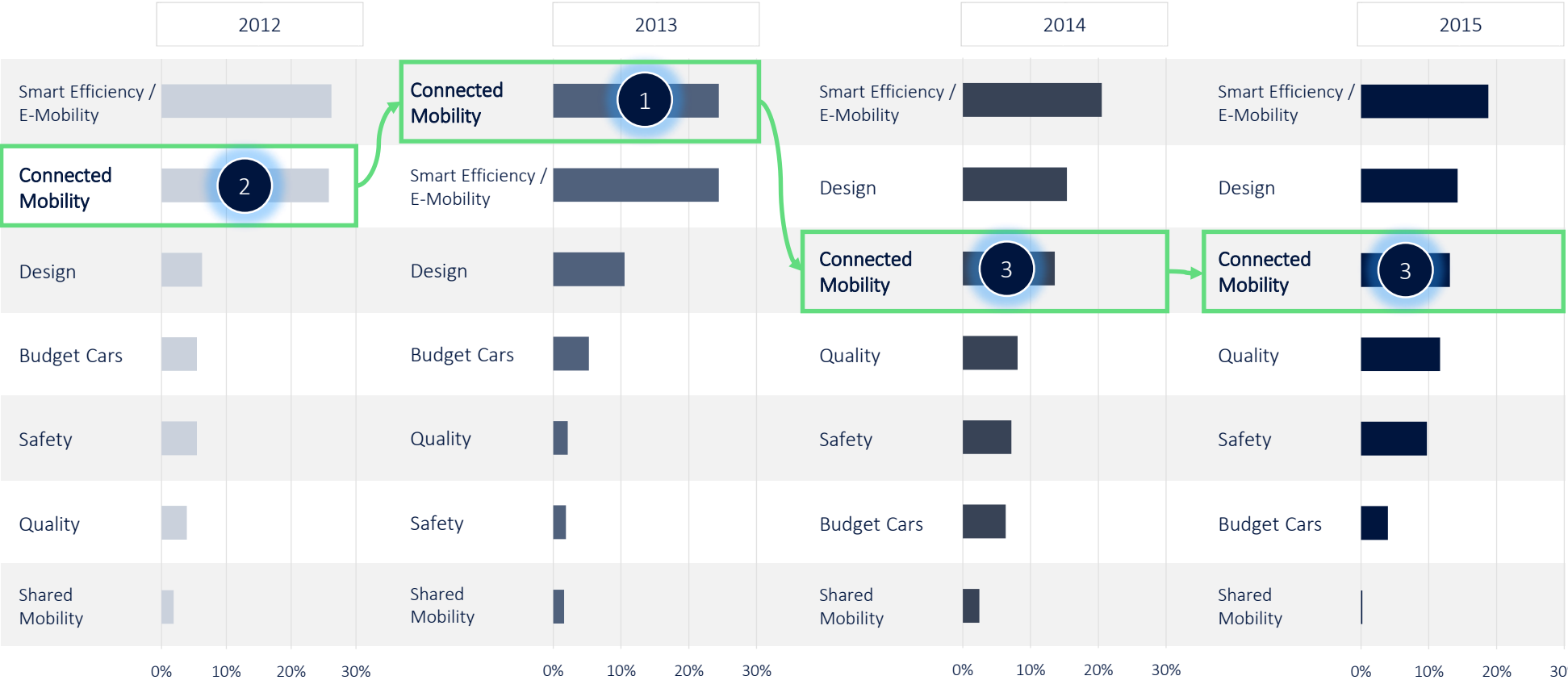
Future technologies are paving the way for new players

... as well as new business models in the automotive sector. The current hype surrounding connected mobility is mainly driven by three topics: Autonomous driving, smartphone & internet integration and new controls & displays.



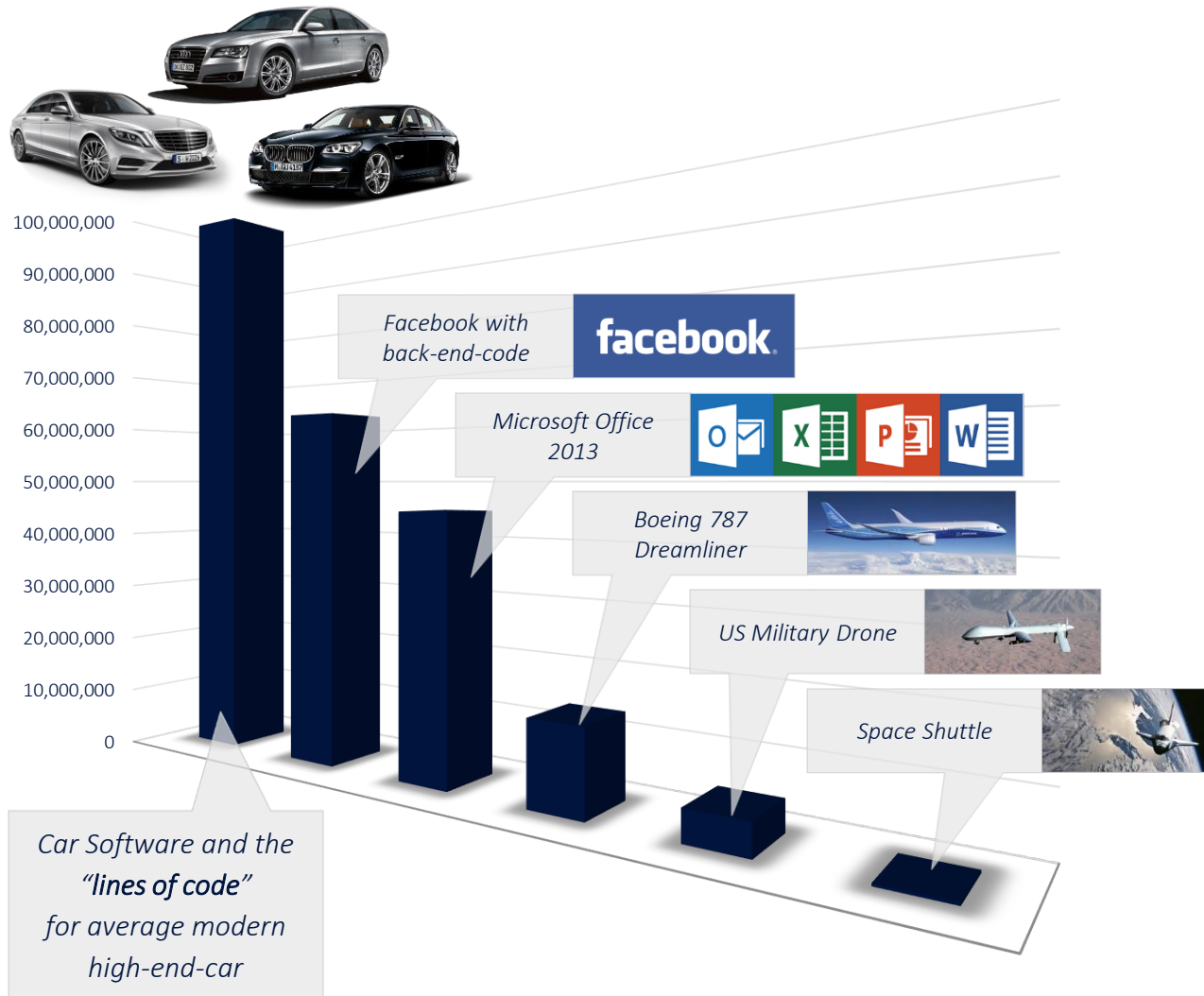
Connected mobility remains a top trend in 2015

Connected mobility has always been within the top 3 trends for the last four years, peaking in 2013 as #1.



The “digital” car | > 100 million lines of code

Cars are no longer only hardware, they are also software products. Cars already have more lines of code than aircraft and operating systems like Windows 8 or Apple Tiger.



The digital perspective

While the car and tech industry have moved closer together than ever, it's questionable whether the low-margin car business is attracting the tech companies or if it's more about transferring their mobile market domination into the car sector.

! The undisputed formula: → Car data = big data = big interest



= The high-likely equation: → Design and lifestyle, as well as smart battery technology, are the core competency areas of Apple and Google.

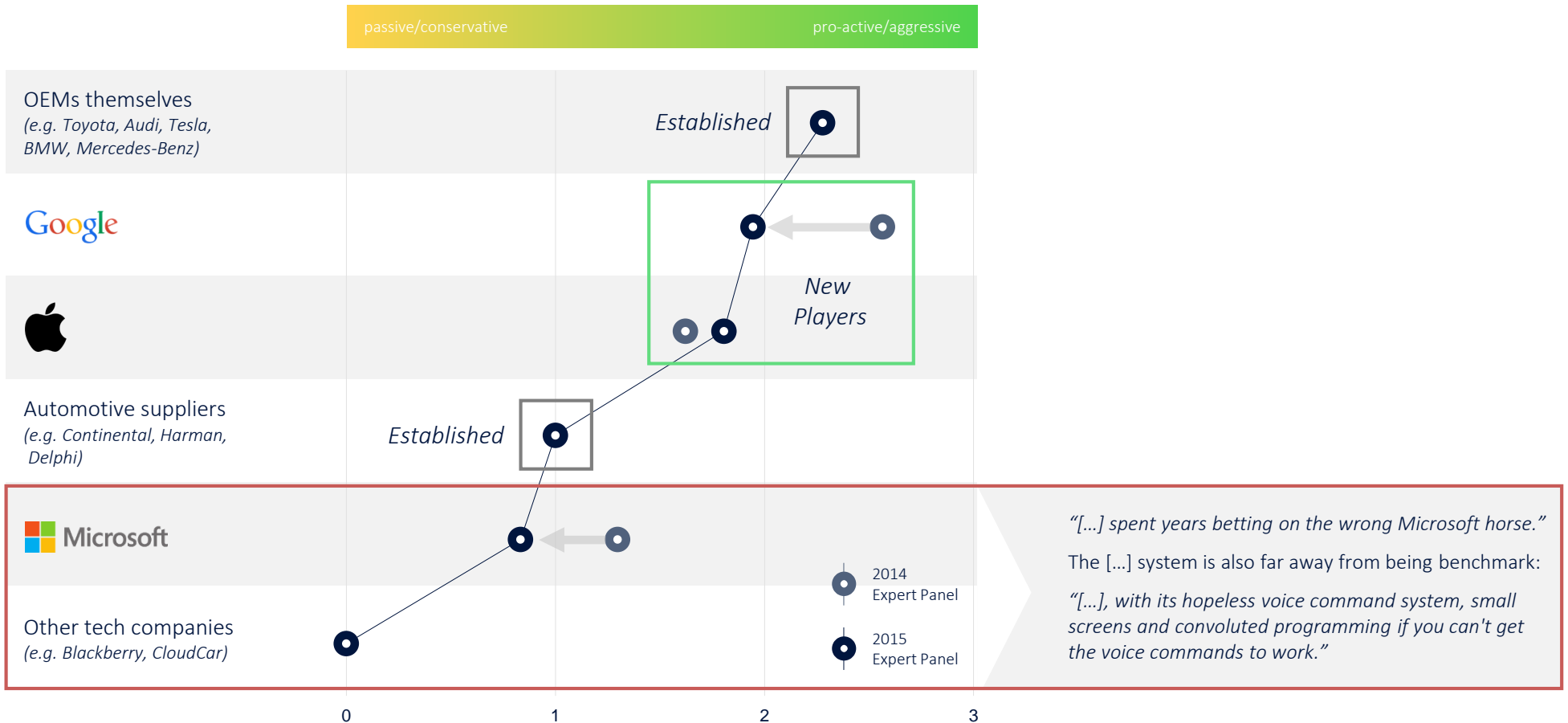


? The question-mark: → Is the car industry an attractive business model for Silicon Valley?



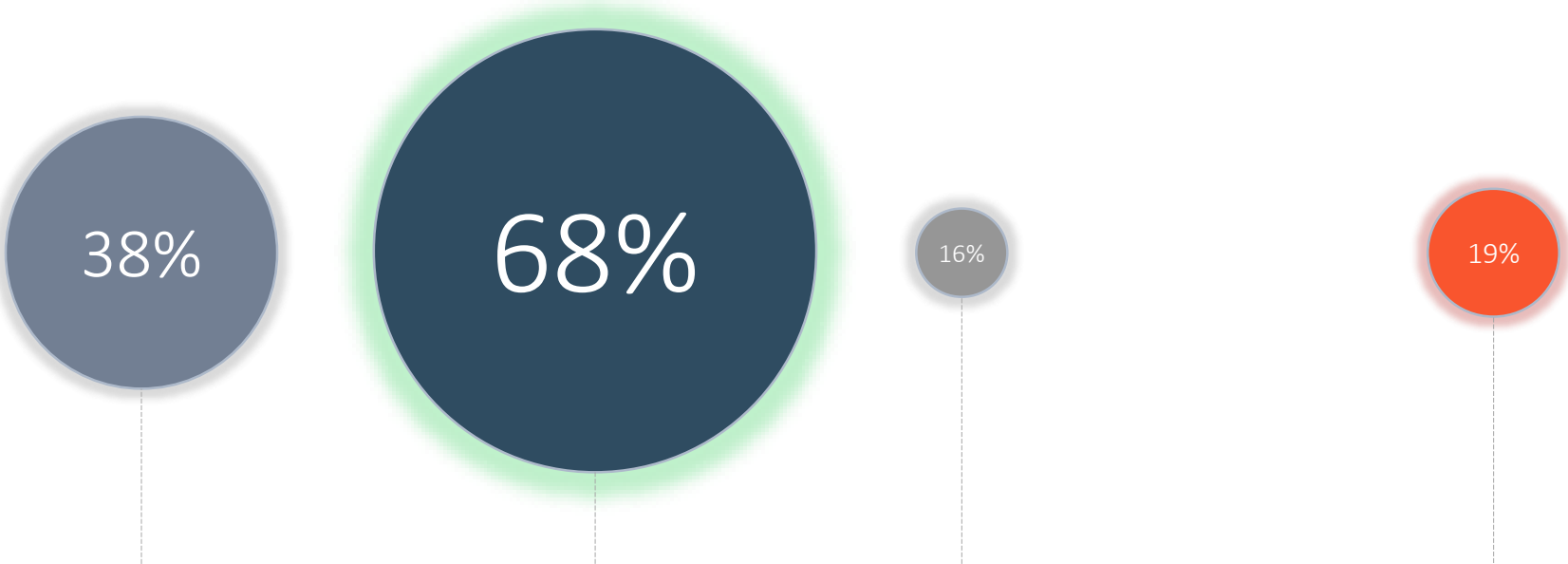
OEMs are seen as key drivers for the “digital car”

Google and Apple are clearly seen as the key tech companies for the “digital car”. Microsoft and other tech companies are seen as more conservative.



Tech companies will become a challenge for established car manufacturers

Only 19% of the experts believe that tech companies will *never* become a threat to the established car manufacturers with their own vehicles.



“Within the next 5 years”

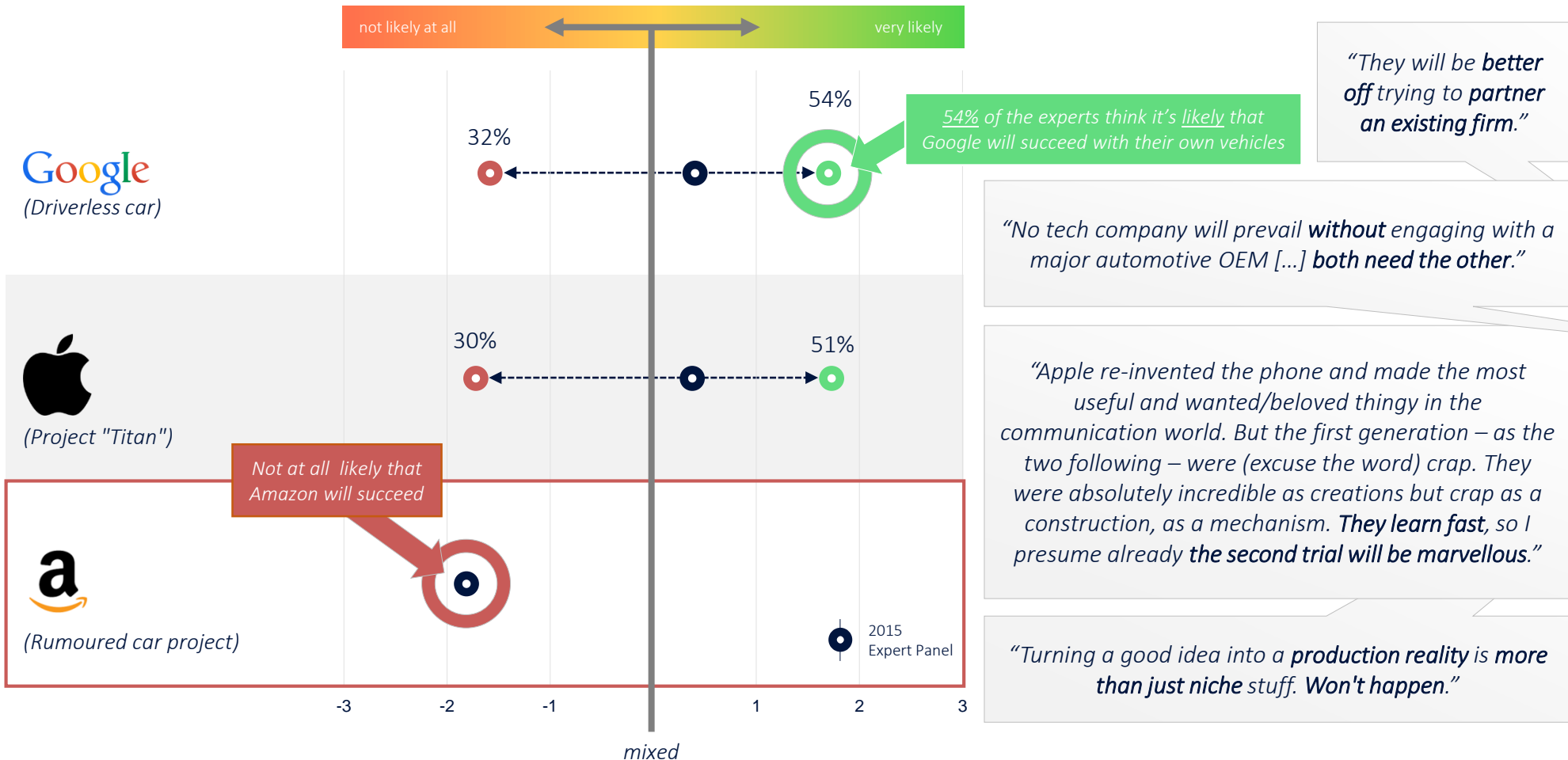
“Within the next **10** years”

“15 years or longer”

“Never”

Split opinion: Will tech companies *succeed* with their own cars?

At this point in time, it is unclear whether Google and Apple will succeed in the car sector with their own vehicles. Amazon is seen in the most critical light and is viewed as very likely to fail.



Three major challenges for tech companies entering the car biz

1

Manufacturing and engineering

- › Safety
- › Quality
- › No manufacturing history
- › Perfection in mechanical terms
- › Global development requirements

“Striking the **balance** between **manufacturing, quality and sales.**”

“Assembly **quality** is a **tricky** thing that **takes years** to get right.”

“I can easily imagine them re-inventing the car as super-sophisticated means of infotainment-in-motion, but the **most down-to-earth mechanical problems aren't easy** or fast to comprehend.”

2

Sales and marketing

- › Sales and distribution network
- › Maintenance / service infrastructure
- › Image
- › No experience, not much knowledge about car customers

“All in all, to **keep customers satisfied** with new products will be **challenging.**”

“Car customers **cannot be treated by an arrogant business model as for example the way Apple treats its iPhone customers today!**”

“The challenge that they **mount against each other**, as non-automotive new entrants **majoring on much the same product advantages.**
And the possibility of a **backlash against their dominance**, which might even lead to their break-up.”

3

Financial attractiveness

- › Slim profit margin (compared with technology sector)
- › Economies of scale

“Their **biggest issue** will be their **willingness to accept car industry margins** of at best 10 percent and at worst in the mid decimals. It's not what they're used to.”



“What will be the biggest challenges for tech companies (like Apple, Google, Amazon) to enter the car sector with their own vehicles?”

1

Connected Mobility

- › New Challenges
- ▶ Autonomous Driving
- › Infotainment System

2

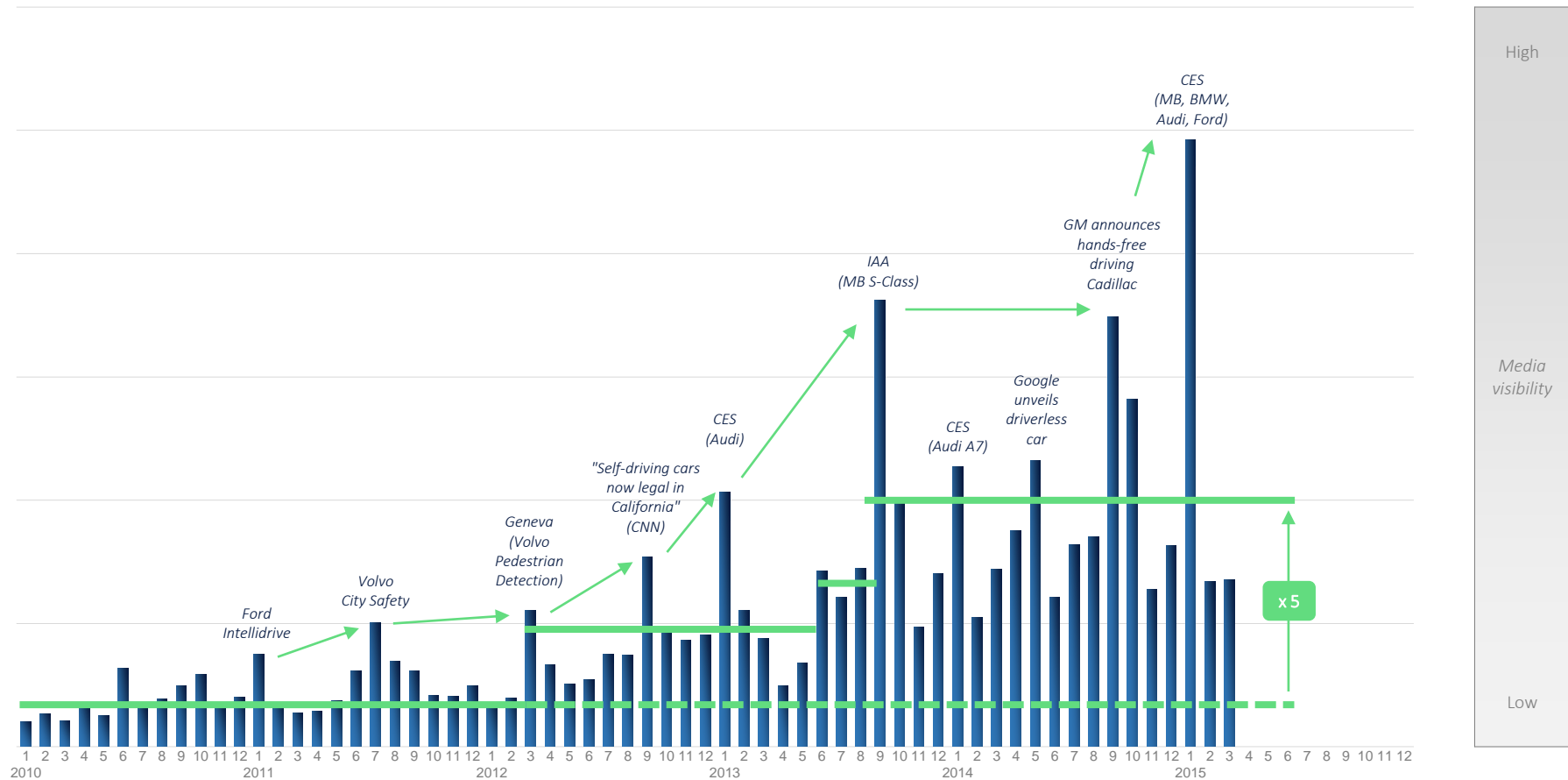
Smart Efficiency

- › FCEV
- › BEV
- › Lightweight



Autonomous driving becomes increasingly visible in media

Significant increase in media coverage – peaks due to shows and individual events.



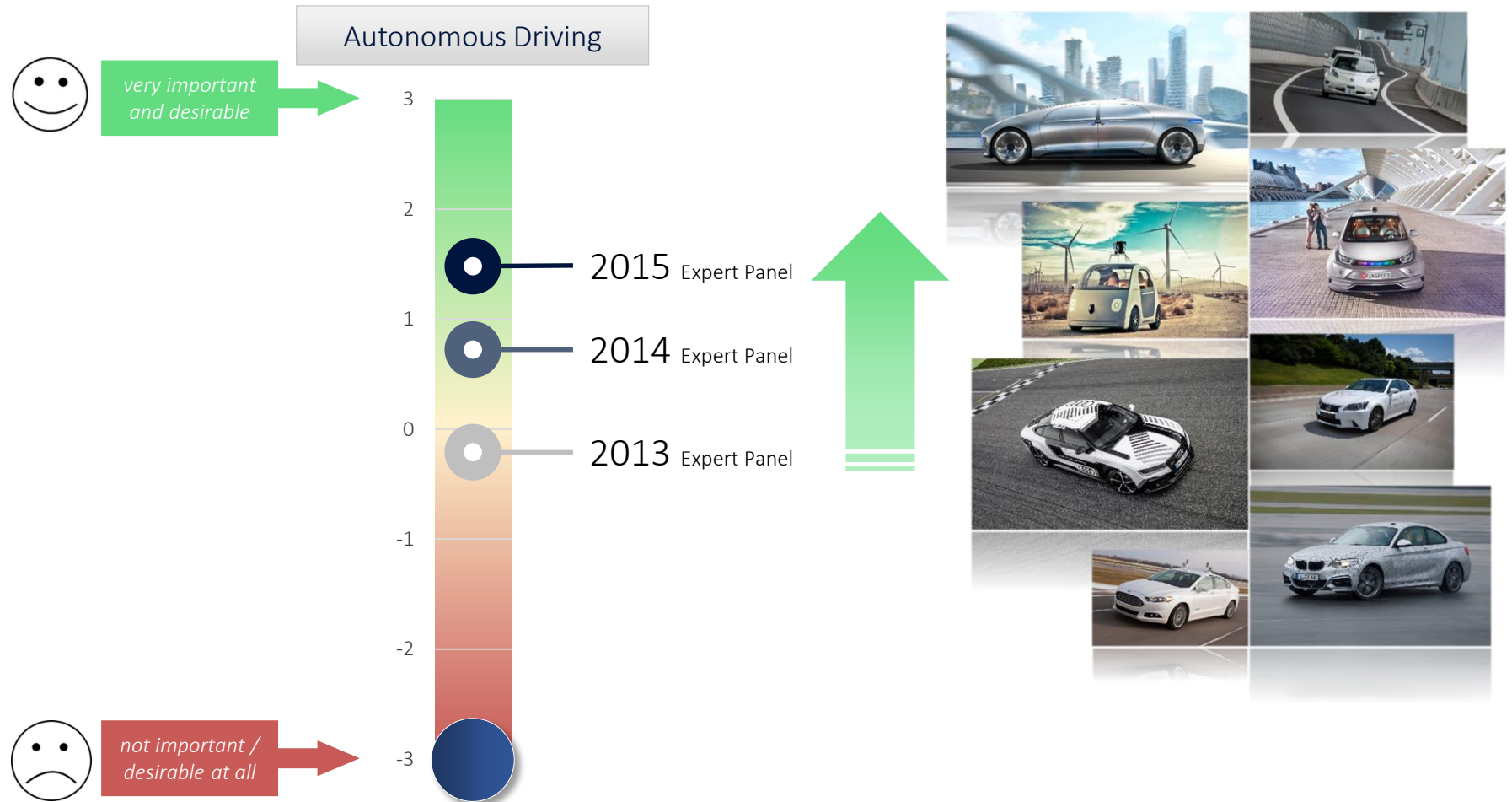
Increased exposure through special events and concept cars

Autonomous Driving at the CES 2015.



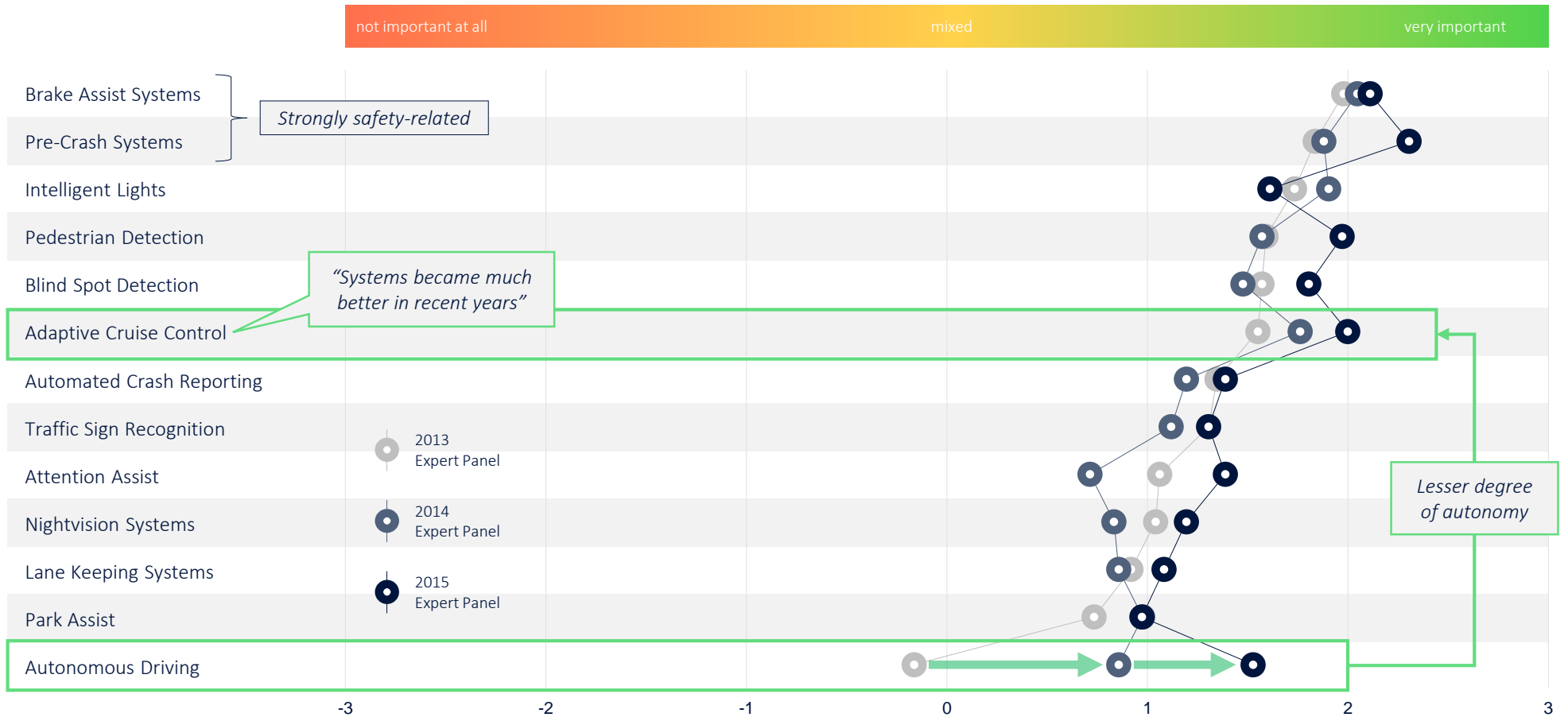
Autonomous driving wins further acceptance in 2015

Steep learning curve over the last three years, changing journalists' perceptions – the once most-hated Advanced Driver Assistance feature has turned into one of the most admired features.



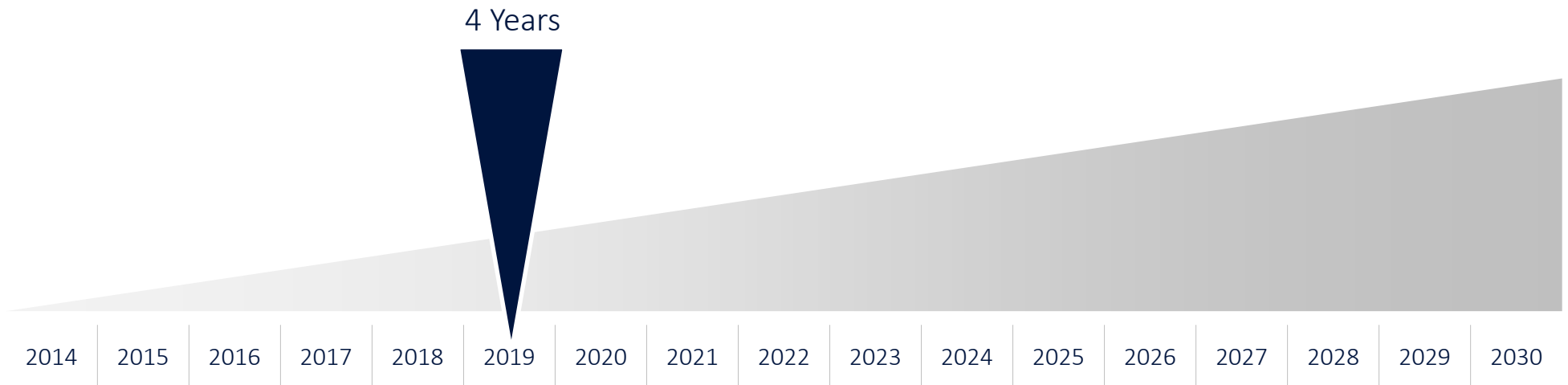
Adaptive cruise control also wins further credit in 2015

Overall, safety-related driver assistance systems are evaluated much more positively than comfort features.



Autonomous cars are expected within the next 4 years

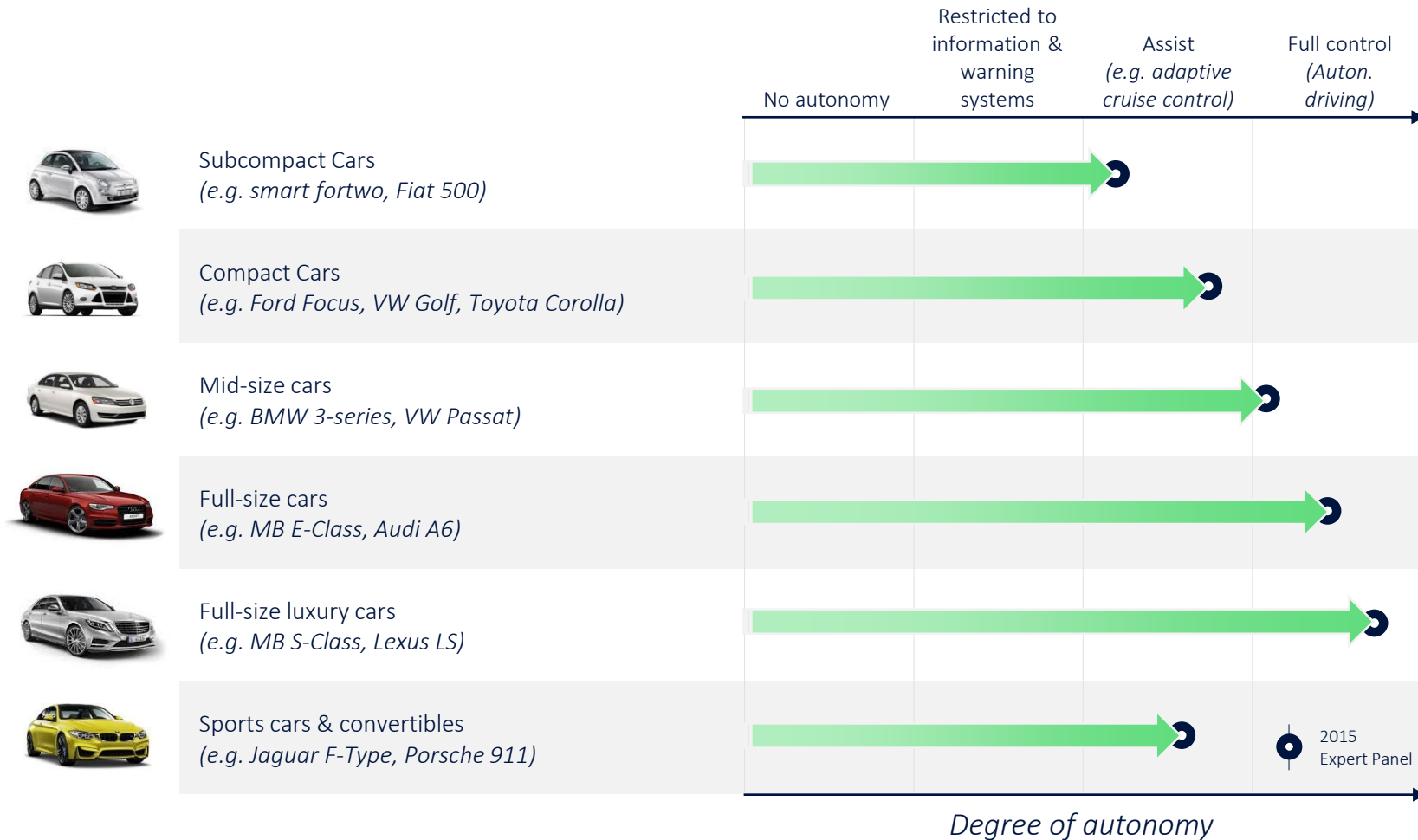
The world car experts are anticipating autonomous cars in series production within the next four years.



“When do you expect to see fully autonomous driving cars in series production?”

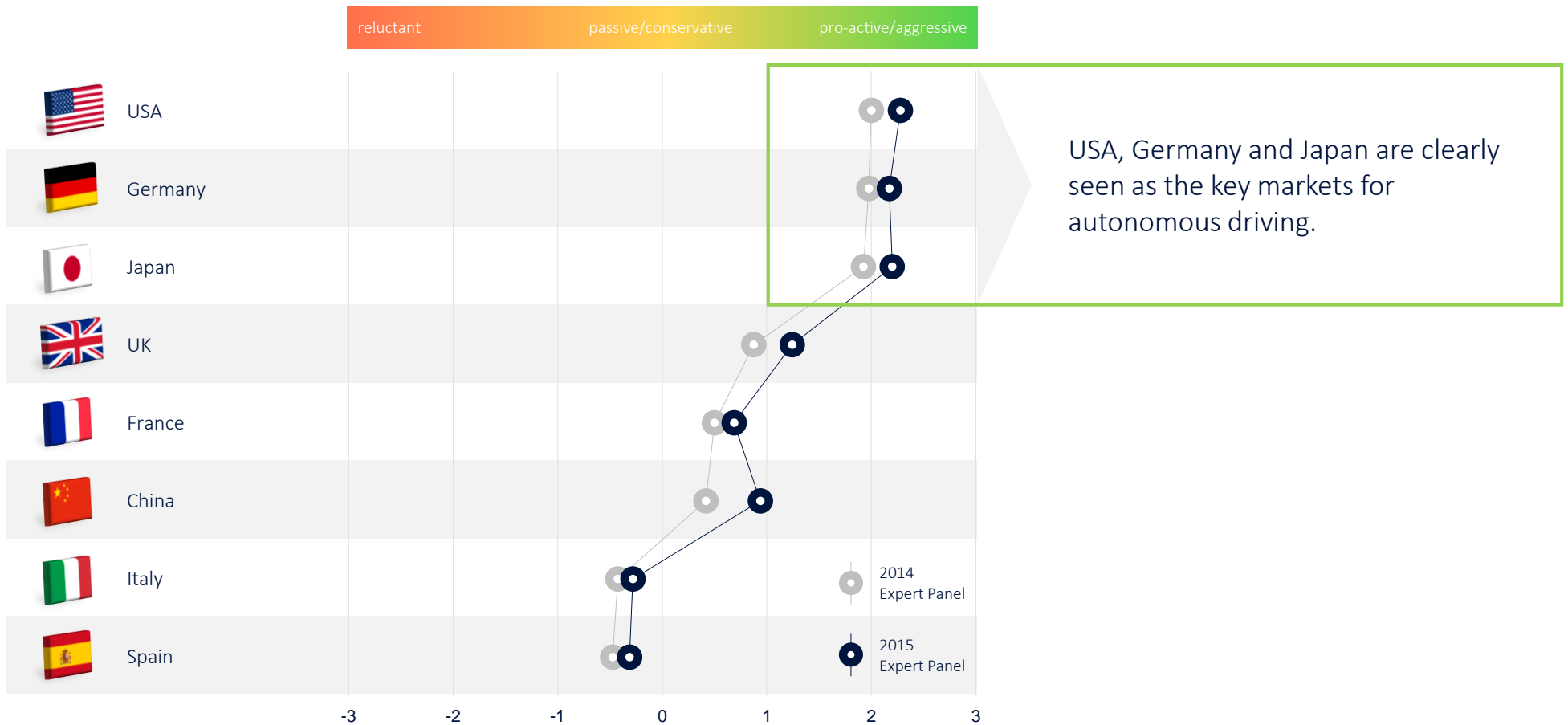
Autonomous driving not limited to luxury cars

By 2020, full autonomous driving will find its way to the full-size and luxury segment, while subcompact cars as well as leisure-orientated cars (*sports cars & convertibles*) will have a lesser degree of autonomy.



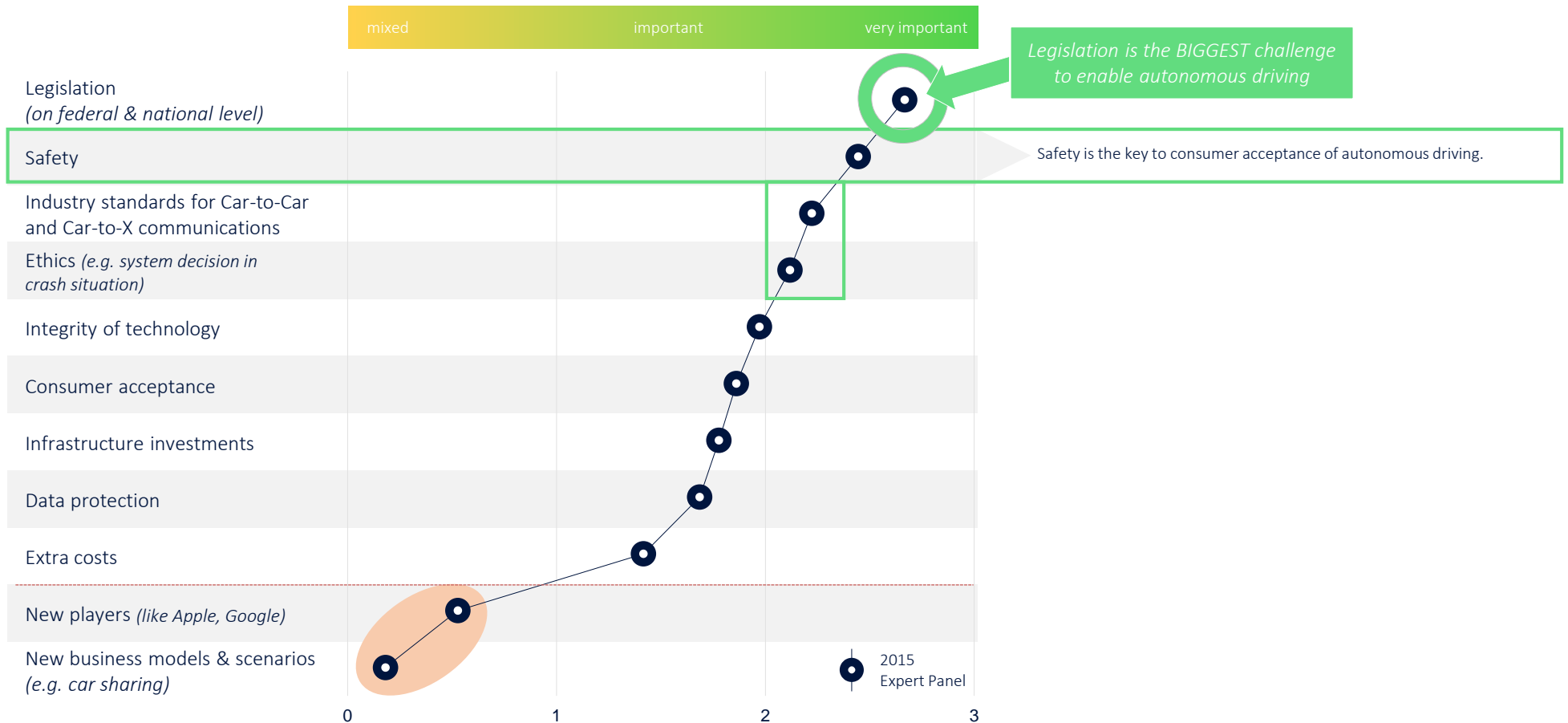
USA, Germany, Japan remain key autonomous driving markets

Due to high costs and the need for infrastructure, autonomous driving will be strongly pushed by the most developed car markets.



Safety is key to consumer acceptance of autonomous driving

However, Car-to-Car communications and ethics are also seen as roadblocks before autonomous driving can be integrated into the market.



“From your point of view, how challenging are the following aspects to enable autonomous driving?”

1

Connected Mobility

- › New Challenges
- › Autonomous Driving
- ▶ Infotainment System

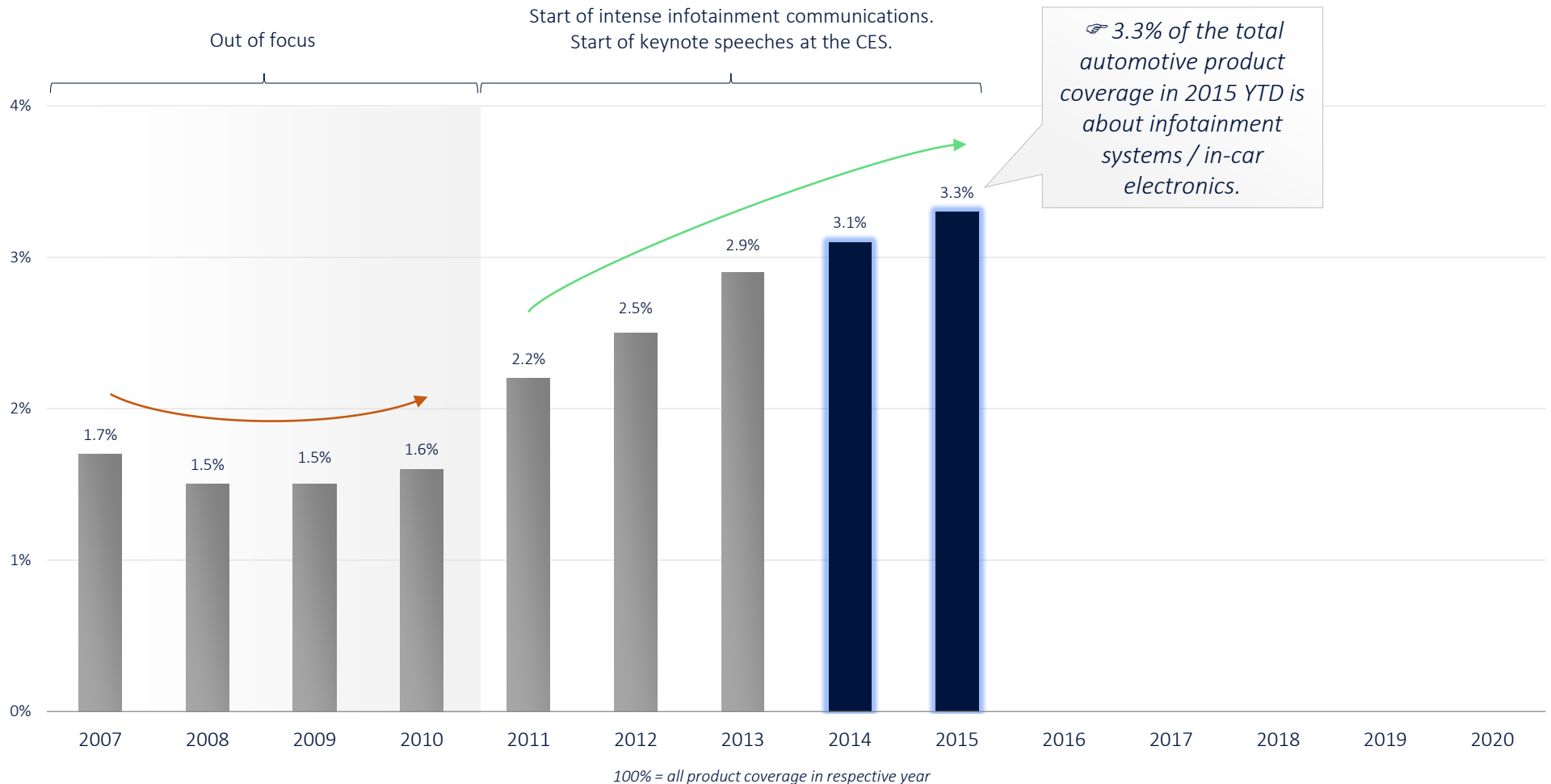
2

Smart Efficiency

- › FCEV
- › BEV
- › Lightweight

In-car electronics and connectivity increasingly more visible

Substantial increase in media attention for in-car electronics and connectivity.



The most important infotainment feature – *smartphone integration* – means an integration of Apple and Google

A full smartphone integration also implies full audio integration and navigation and web access, making a lot of current features redundant.



Google (Android) and Apple (iOS) together have **more than 96% Global market share** for smartphones (operating systems).



“Here is a list of in-car infotainment, communication, navigation and human/machine interface features. How important and desirable are the following features from your point of view?”

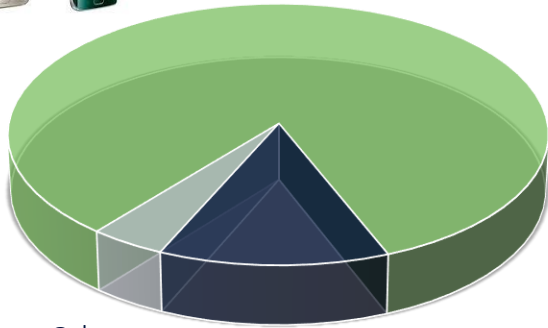
Domination of Google and Apple in the smartphone OS market

Windows phones and RIM OS only account for less than 4% of sales in 2013. While Symbian used to have more than 60% market share in 2007, it has now completely disappeared from the market.

World-wide smartphone sales (2013)



android 83%



Other
4%

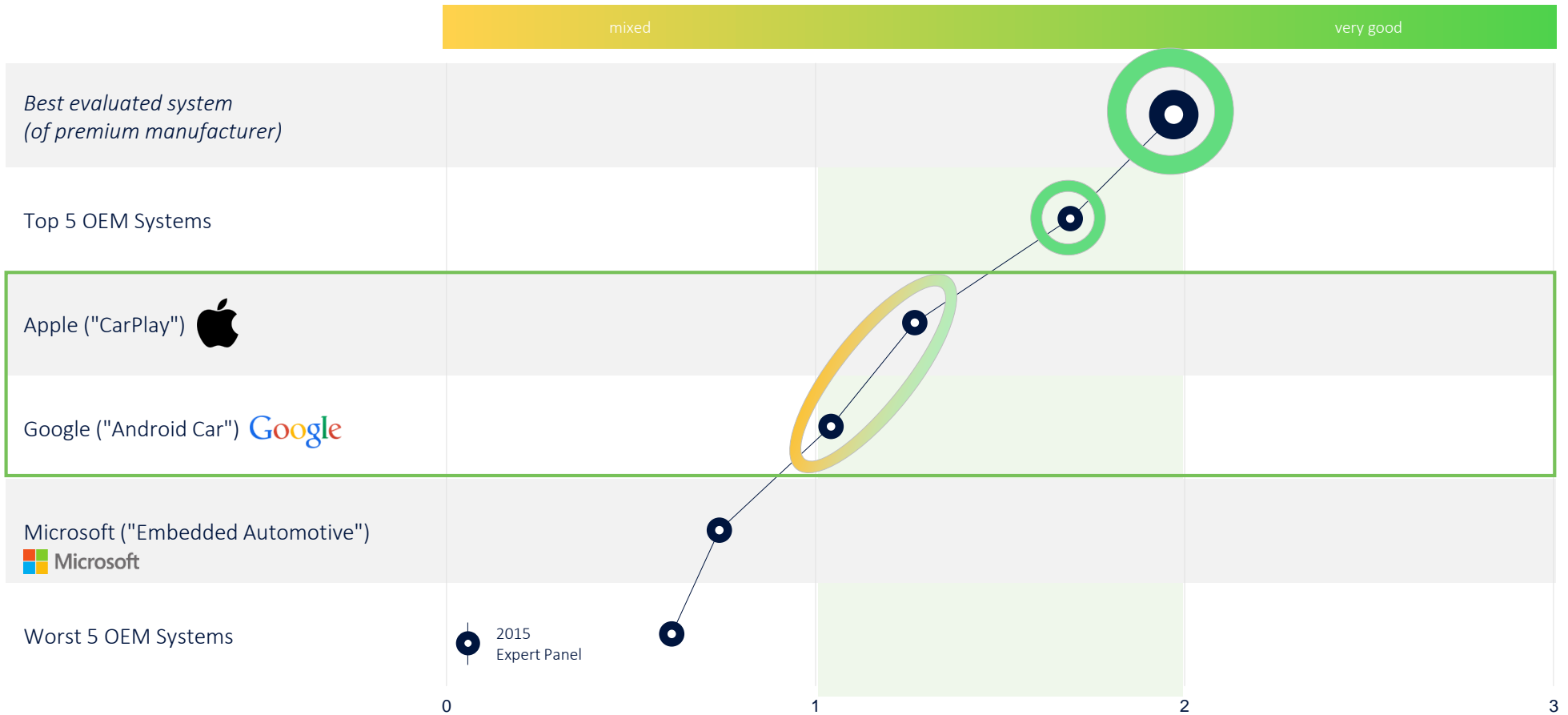
iOS
13%



Google > 96% market share

OEM infotainment systems are still industry benchmark

However, Apple and Google are very close with their infotainment offerings and are much better-evaluated than the worst 5 OEM infotainment systems.



"From your point of view, how would you rate the infotainment systems of the following car manufacturers / tech companies?"



1

Connected Mobility

- › New Challenges
- › Autonomous Driving
- › Infotainment System



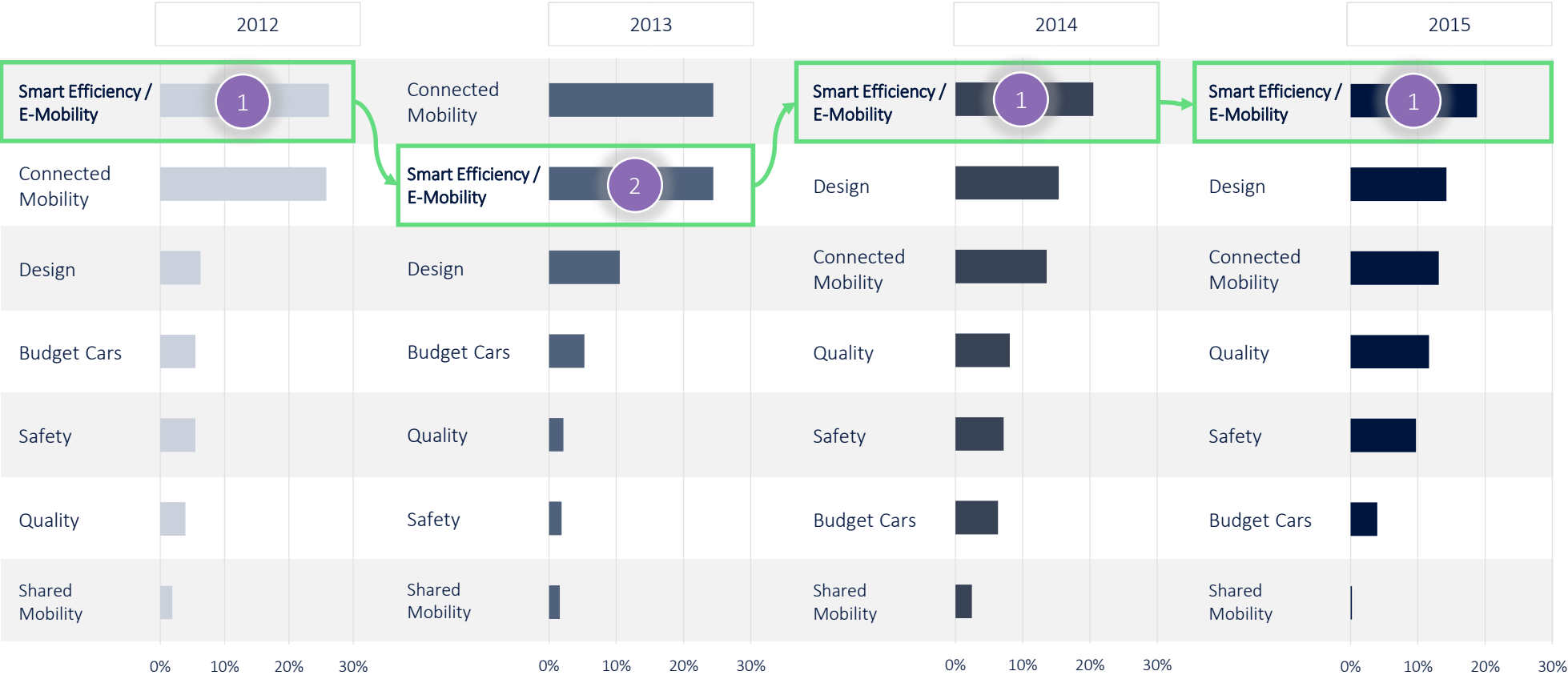
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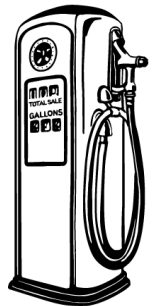
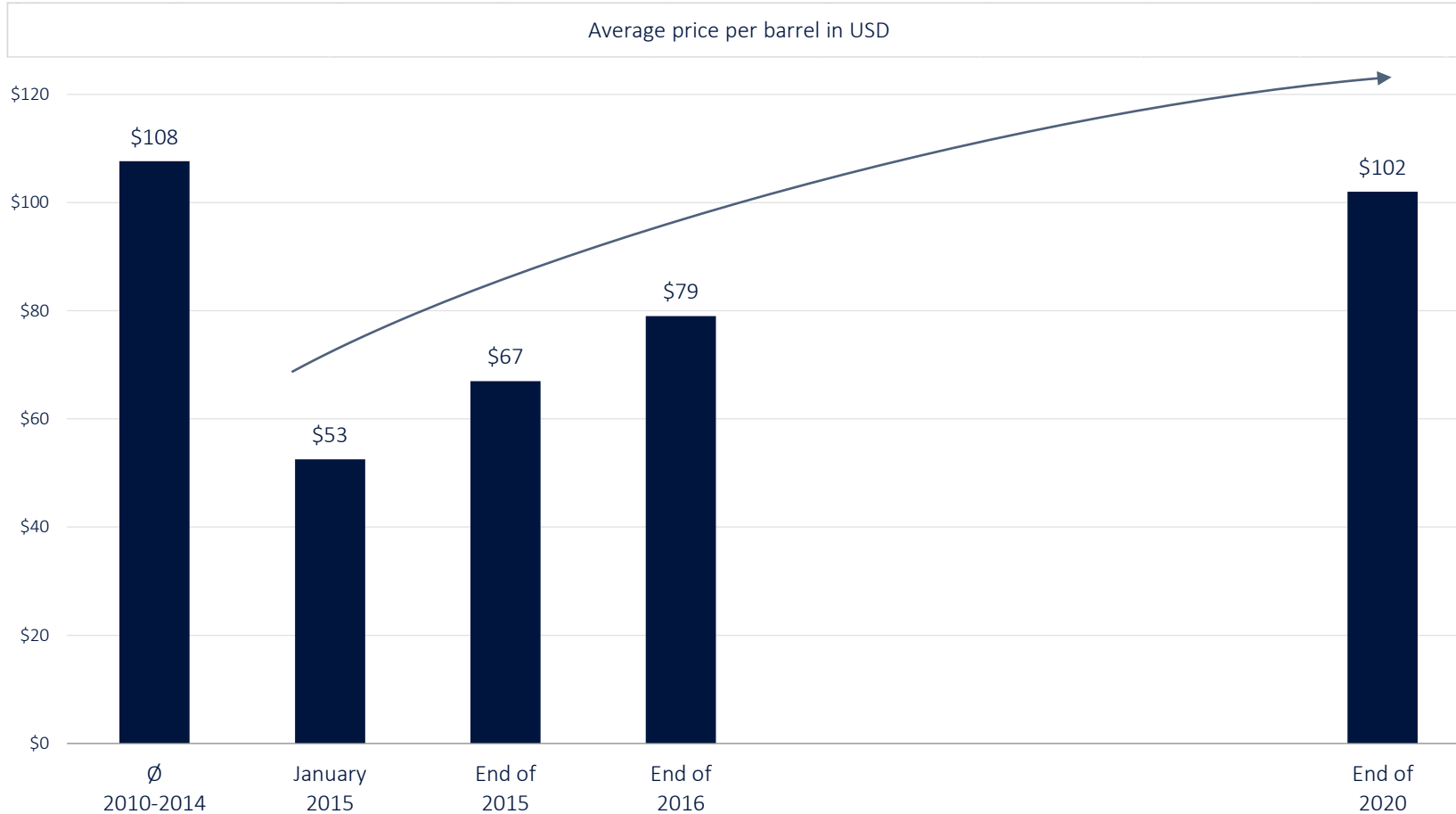
Smart efficiency / e-mobility is the clear top trend of recent years

Smart efficiency dominates the top trends over the last four years.



No further decrease in oil price expected

The oil price is expected to return to the 2010-2014 average price of 100 USD per barrel no sooner than 2020.



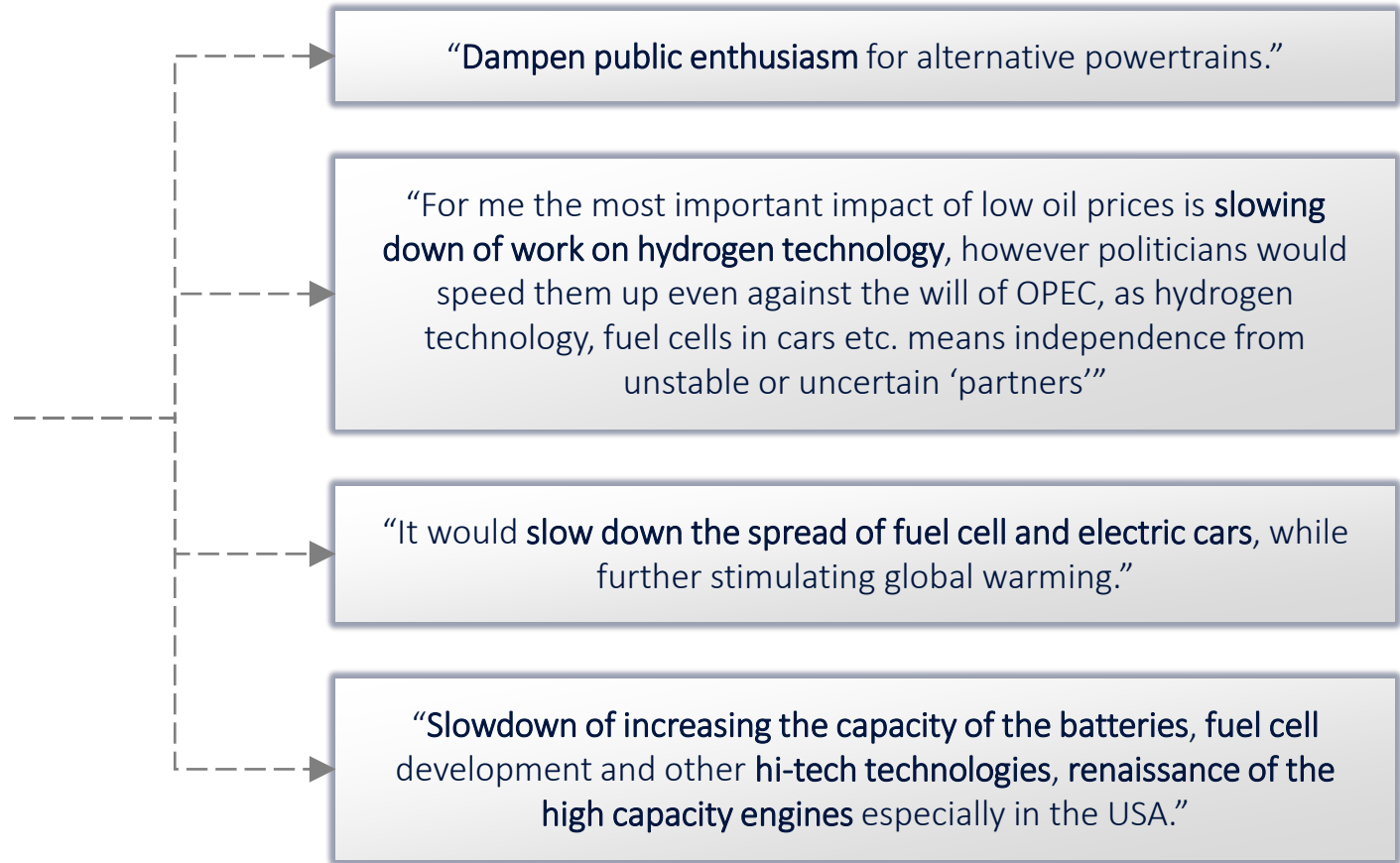
“The oil price has dropped from \$ 107.62 (average price per barrel 2010 – 2014) to \$ 52.51 in 2015 (average price per barrel). Where do you think the oil price will end up in the following years (in USD per barrel)?” 30

The current low oil price sees negative impact on alternative fuel progression

Low oil prices lead to worries about slower progression in alternative fuels.

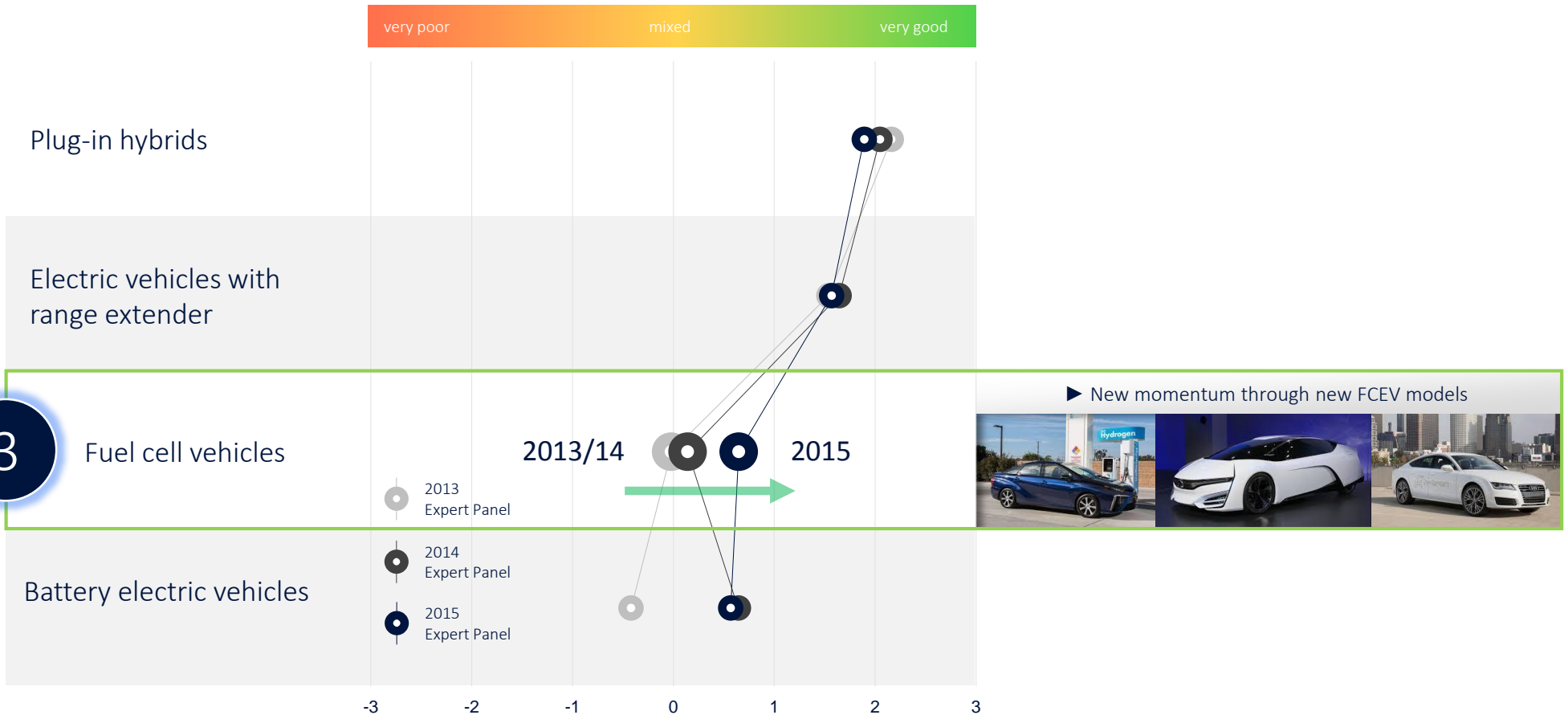


Low oil price



Despite the low oil price, electric vehicles don't lose momentum

Fuel cell electric vehicles gain biggest momentum in 2015, while all other electric powertrain options remain unchanged. However, for the first time, pure battery electric vehicles are seen as the least promising option.



1

Connected Mobility

- › New Challenges
- › Autonomous Driving
- › Infotainment System

2

Smart Efficiency

- ▶ FCEV
- › BEV
- › Lightweight

Fuel-cell technology ramps-up for a second time in 2014

In the last 10 years, Honda showed the strongest ambitions of all manufacturers regarding fuel cell technology, followed by Hyundai/Kia and Mercedes-Benz, and, more recently, Toyota.

Fuel-Cell “Hype” period

Most major manufacturers focus on FCEV as battery technology is not improving fast enough and the range issue, as well as high costs, are considered hard to solved.

Attention-shift to BEV

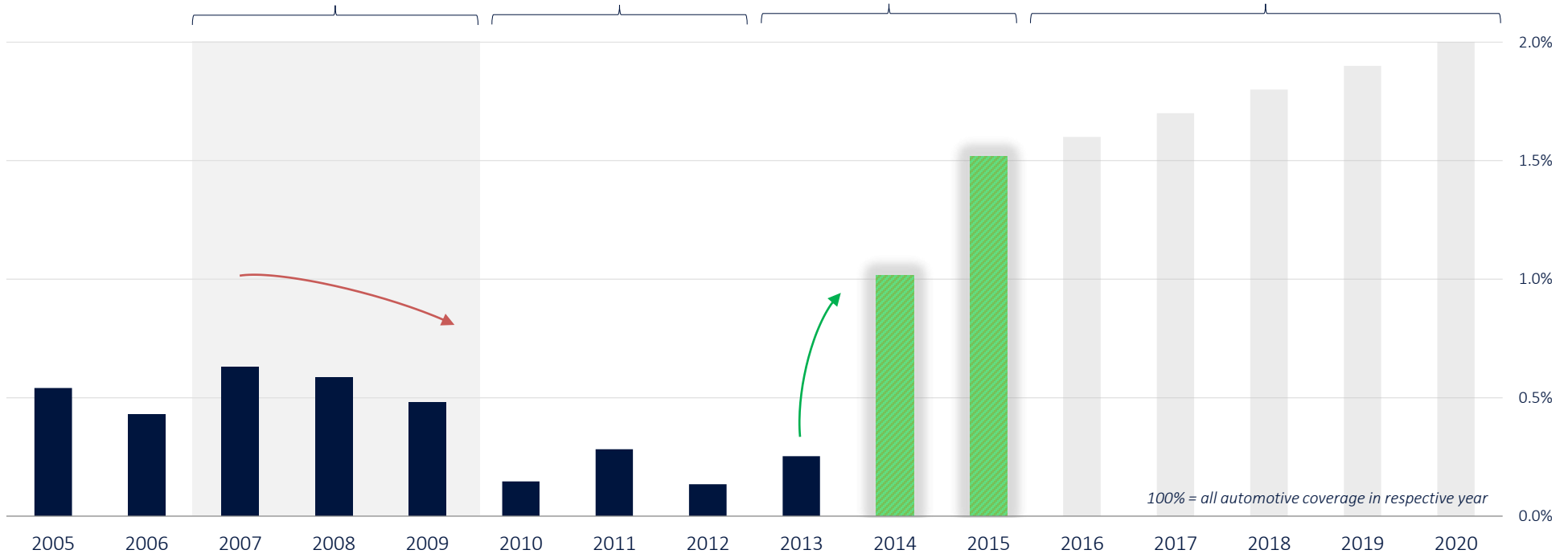
First volume BEVs appear on the market and the BEV hype begins. Manufacturers shift their focus on battery electric vehicles rather than continuing their FCEV strategy.

Re-Focus on FCEV

Manufacturers, especially Toyota & Hyundai/Kia, continue to focus on FCEV. In 2014, announcements of affordable FCEVs in series strongly increase.

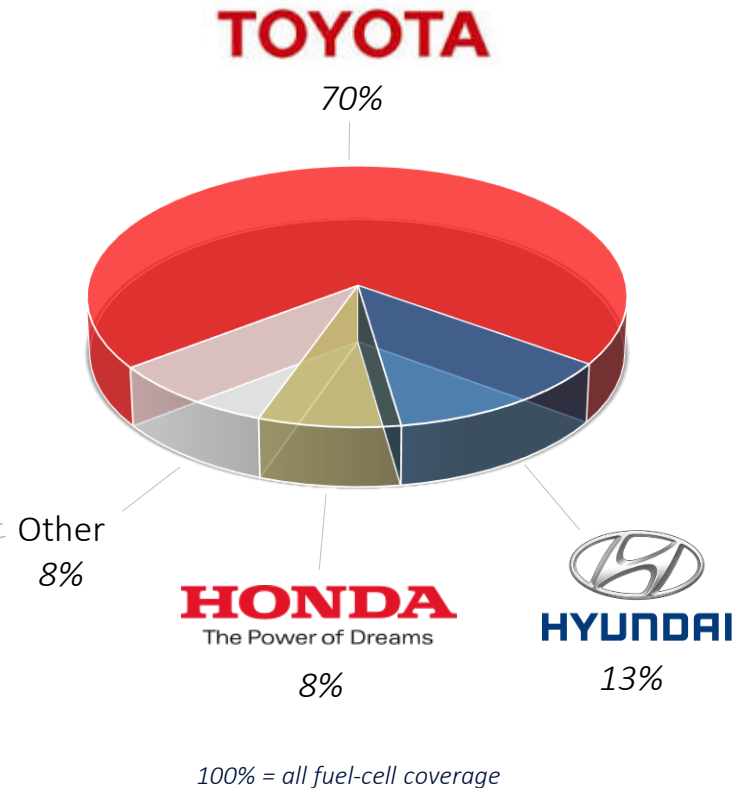
Comeback as “Next Generation EV”?

FCEV in series (*announcements*):
Honda: 2016 | Daimler: 2017



Toyota clearly dominates FCEV coverage in 2014/2015 YTD

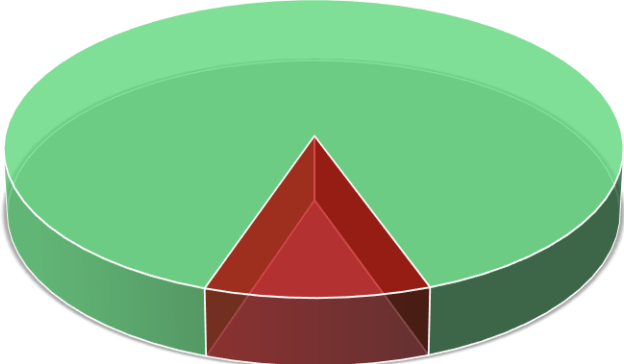
But also Hyundai and Honda are highly visible with their fuel-cell technology.



"Just the fact that much of the industry doesn't have its eye on the technology." ...is seen as a threat.

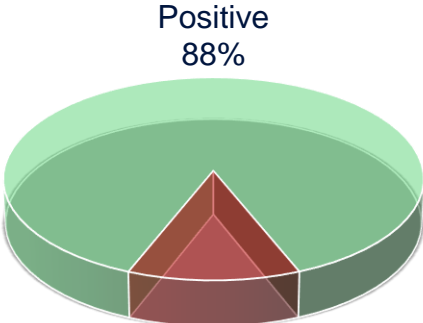
"Gasoline succeeded in becoming ubiquitous in large part because there was a consensus among manufacturers and suppliers after a certain point. We're admittedly way off from that, but I don't exactly see fuel cells reaching that point any time soon."

FCEVs receive slightly less criticism than BEVs in Global media



Negative
11%

100% = all FCEV coverage



Positive
88%

Negative
12%

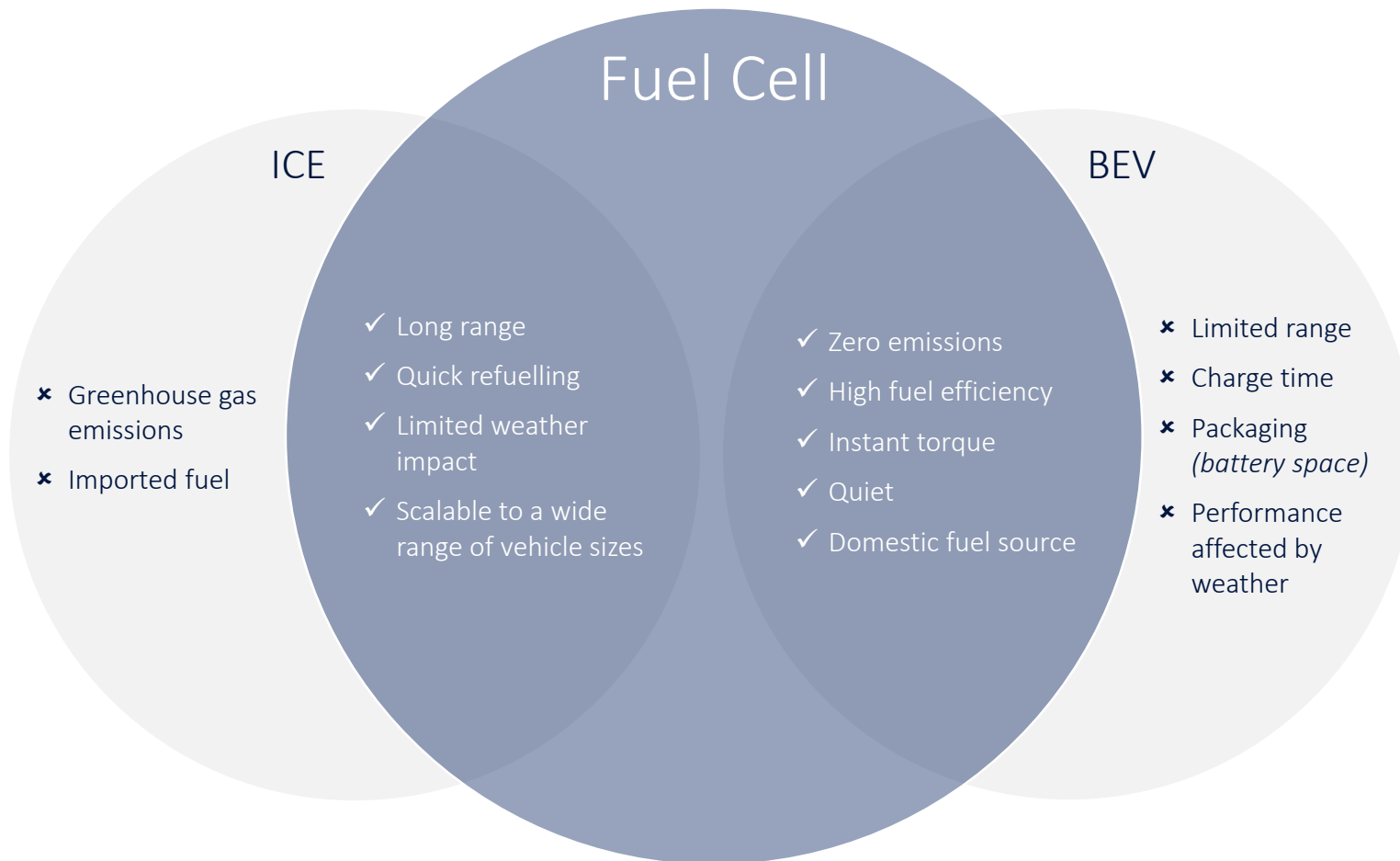
100% = all BEV coverage

+ 1pp

Fuel-cell technology is combining the best of ICE and EV

Fuel-Cell technology has a chance of a comeback as the next-generation EV.

“Zero emissions and manageable technology combine to provide what looks like long-term viability.”



FCEV SWOT – a highly complex and controversial topic

Strengths	Weaknesses
<ul style="list-style-type: none"> › Zero emissions (<i>when driving</i>) › Range › Ease and speed of refuelling › Potentially cheap to run (<i>cheap fuel</i>) › 'Normal' driving experience & practicality in daily use (<i>pure e-car in terms of driving</i>) › <i>Comfort (like e-cars, especially quietness)</i> › Fits within most modern “platforms” 	<ul style="list-style-type: none"> › Infrastructure › High emissions of conventional hydrogen production › High cost to produce fuel-cell stack › Complexity (<i>more than just a battery pack and software</i>) › Explosion danger of the hydrogen. › Losing fuel while parking the vehicle for a longer period of time (<i>hydrogen can't be stored in a car without leak</i>) › Lack of character
Opportunities	Threats
<ul style="list-style-type: none"> › Clean mobility › Urban driving during high pollution periods and access to zero-emission areas › Tightening government emissions regulations › Free from „political economy” › Lesser dependence on oil › Combine the use of hydrogen cars with private home use, like heating/cooling systems. This would allow customers to fill up their cars at home from private resources. New ways of approaching power grid › Hydrogen generation in a clean way and in quantity: it has the potential to solve many of the car's problems. Development of the solar cells and other renewable energies could help to produce the hydrogen at lower costs and without emissions › Commercial or public service vehicles as well as car sharing 	<ul style="list-style-type: none"> › Long lead-in time › Low-level public information. Also, tech is too "fancy" for a seven-second soundbite › Recent u turn in the US (<i>fracking</i>) and low oil prices › Just the fact that much of the industry doesn't have its eye on the technology › Need for huge infrastructure investments: losing could be more than winning › Taxation of hydrogen. High tax, high price. Risk that hydrogen fuel becomes a luxury issue › If governments relax emission regulations, need for FCVs will diminish and automakers will refocus on easier technologies. › Regular EVs as well as advanced battery technology, hybrids and better internal combustion engines › Perception of explosion danger of hydrogen



“How would you describe the strengths, weaknesses, opportunities and threats of ‘Fuel Cell Electric Vehicles’ (FCEV)?”

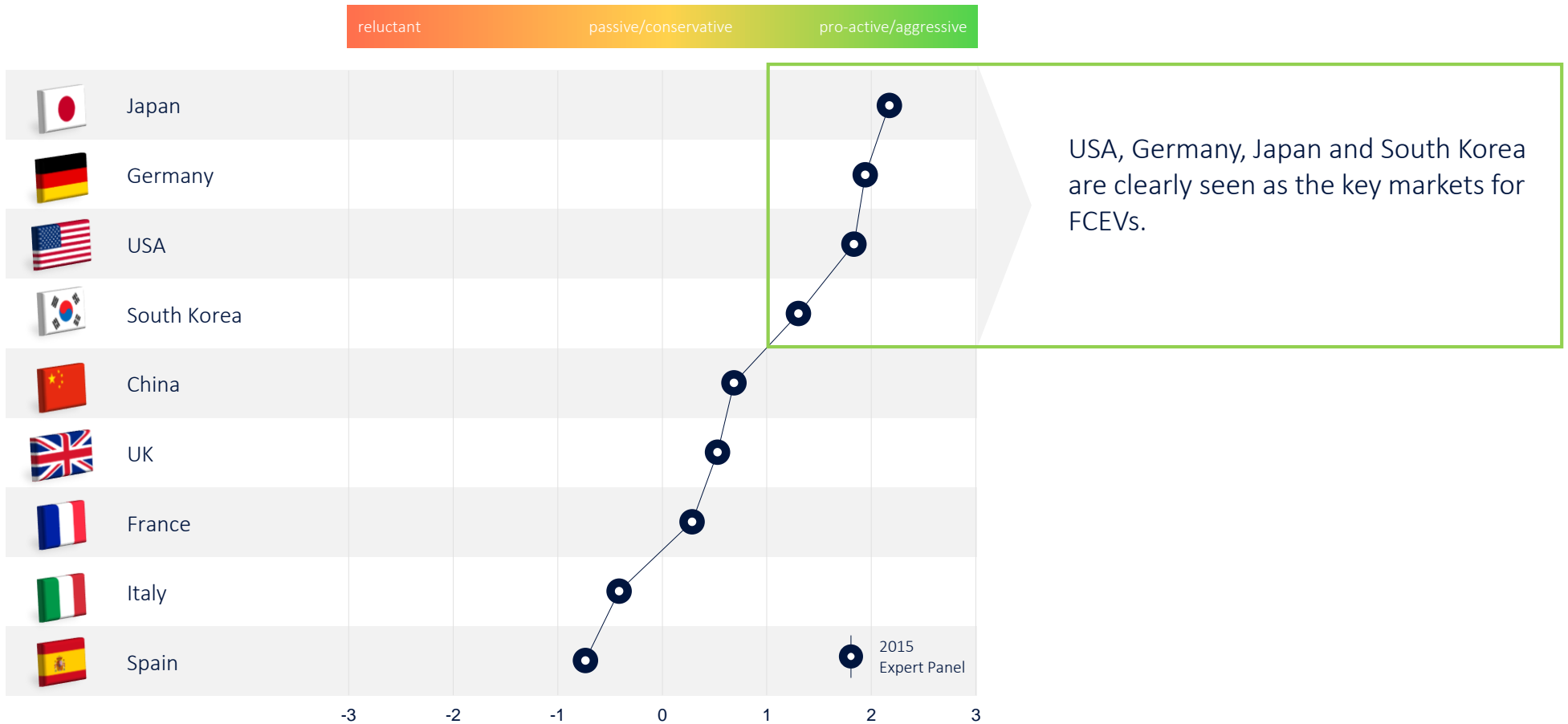
Hydrogen infrastructure is the biggest challenge for FCEVs

While costs are an issue for both technologies, FCEVs are much less dependent on advanced battery technology and increased range.



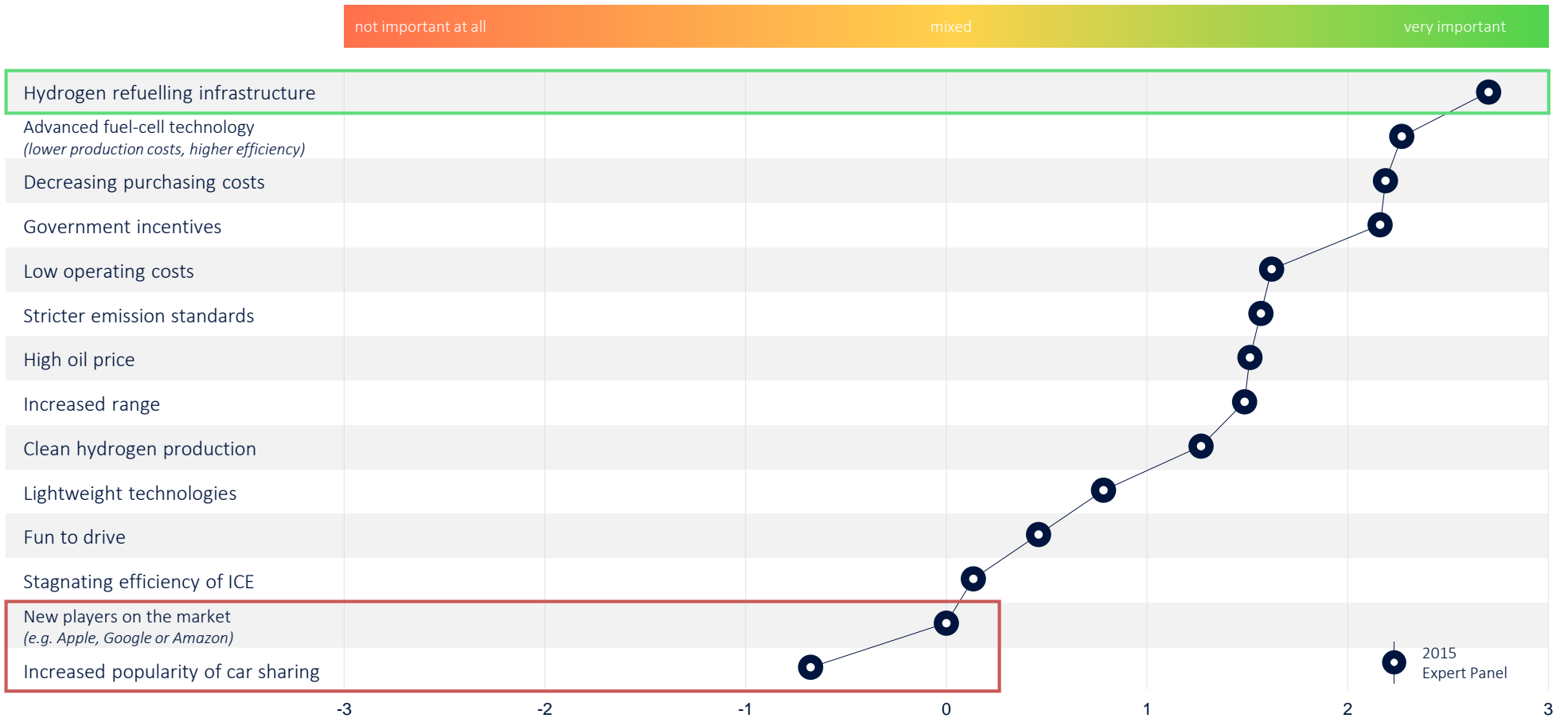
Key markets for FCEVs are USA, Germany, Japan and South Korea

Linked to the involvement of Japanese, German, American and South Korean manufacturers in the FCEV technology, their home markets are seen as the key drivers for this new technology.



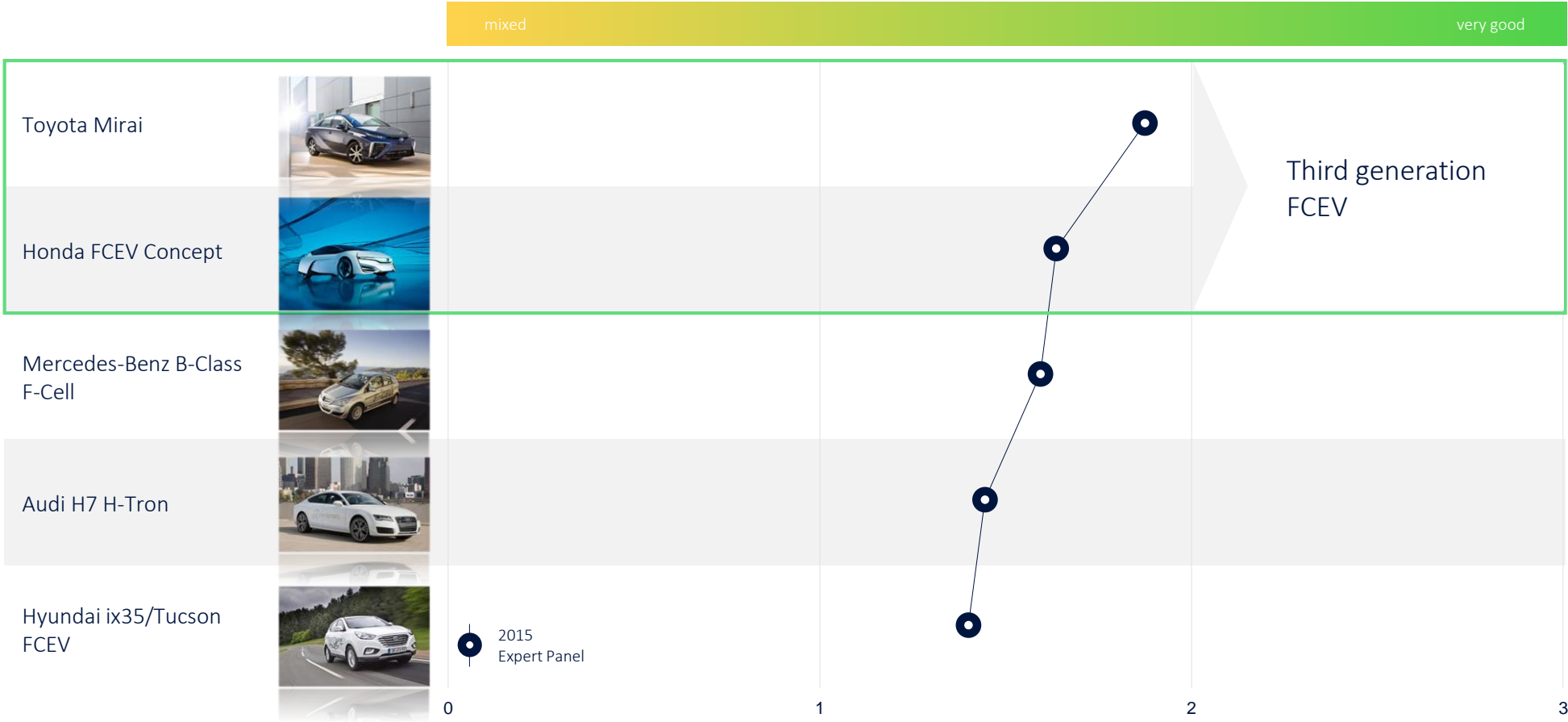
Hydrogen infrastructure is the key to FCEV success

Car sharing or new players won't have any impact on the success of FCEVs. Interestingly, "Fun to drive" is also not seen as a key factor.



Praise for all fuel cell vehicles

FCEVs receive a lot of praise from the experts.



“Pain-free, fuss-free – quite enjoyable, as is the experience of driving an electric vehicle.”

Overall positive driving experience of FCEV.

“Impressed by how normal it is to drive and how production ready it is.”

“They're impressive for their ease of driving, quietness, range and speed of refuelling.”

“Its an e-car and drives like an e-car.”

“Completely unremarkable - just like a regular electric car.”

“[...] a very good way to drive in terms of dynamics [...] no range problems and no battery issues, close to the ideal.”

“It's a different driving behaviour. You are more focussed on saving energy while driving than enjoying the fun of driving dynamics.”

“They remain, to my mind, a bit unrefined and in need of more work.”

“They are uneventful and dull, overweight vehicles with futuristic pretensions, like most BEVs.”



“Have you driven a “Fuel Cell Electric Vehicle” (FCEV) yet? If yes, what was your experience?”




1

Connected Mobility

- › New Challenges
- › Autonomous Driving
- › Infotainment System

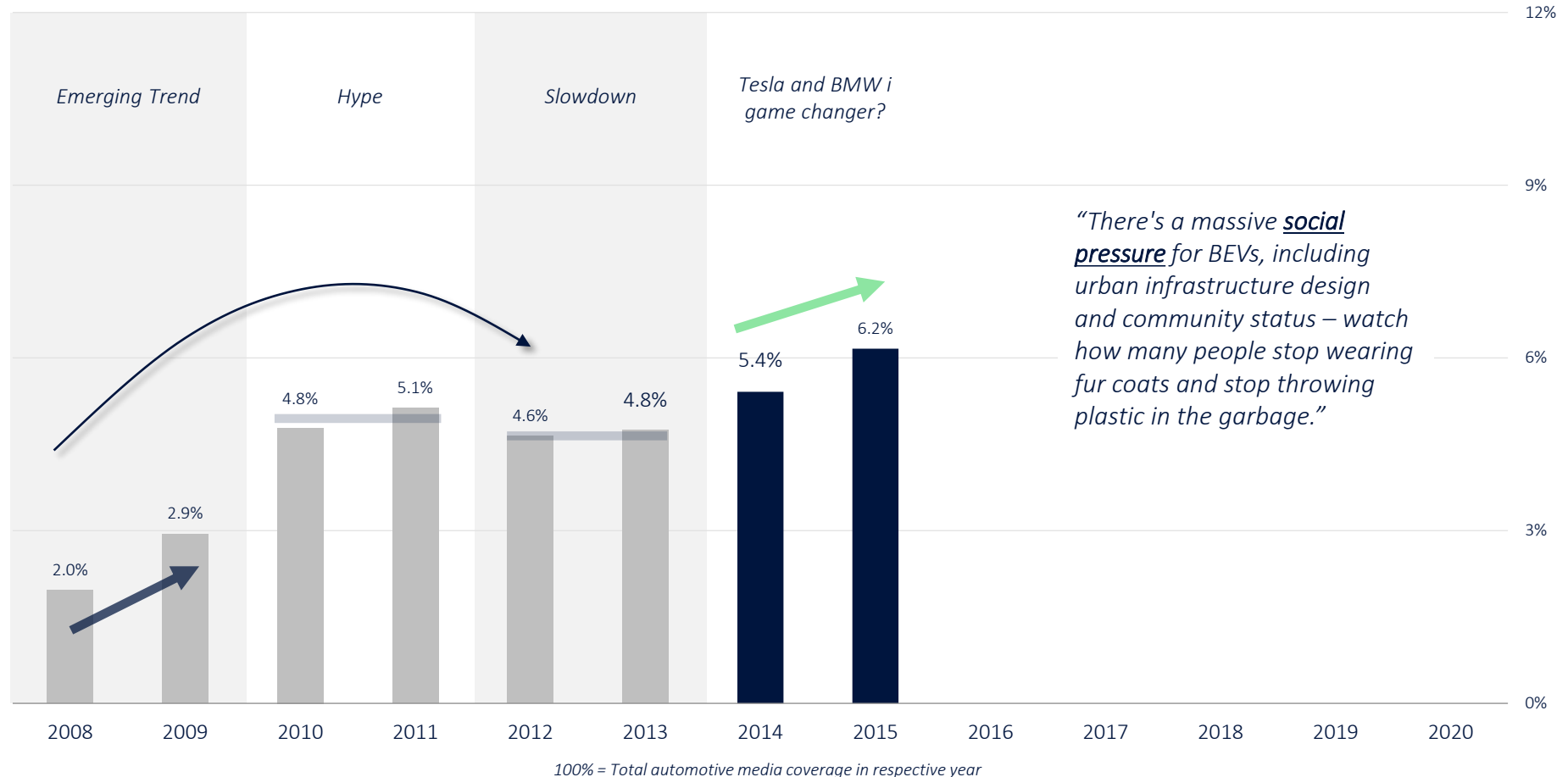
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- › FCEV
-  BEV
- › Lightweight

BEVs with substantially increasing visibility in 2014/2015

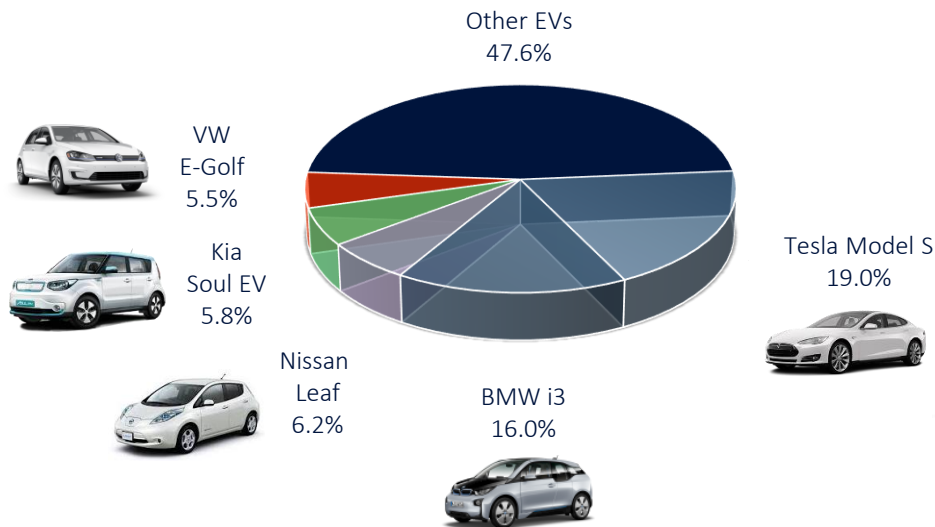
After the slowdown in 2012/2013, BEVs are now seeing a substantial increase in media visibility, pushed by a variety of new battery electric vehicle models.



Visibility of BEVs is pushed by Tesla Model S and BMW i3

Out of a huge variety of BEV models in 2014-2015 YTD, the Tesla Model S and BMW i3 combined account for more than 2/3 of all coverage. Almost every third battery electric vehicle story is about either one of them.

2014-2015 YTD



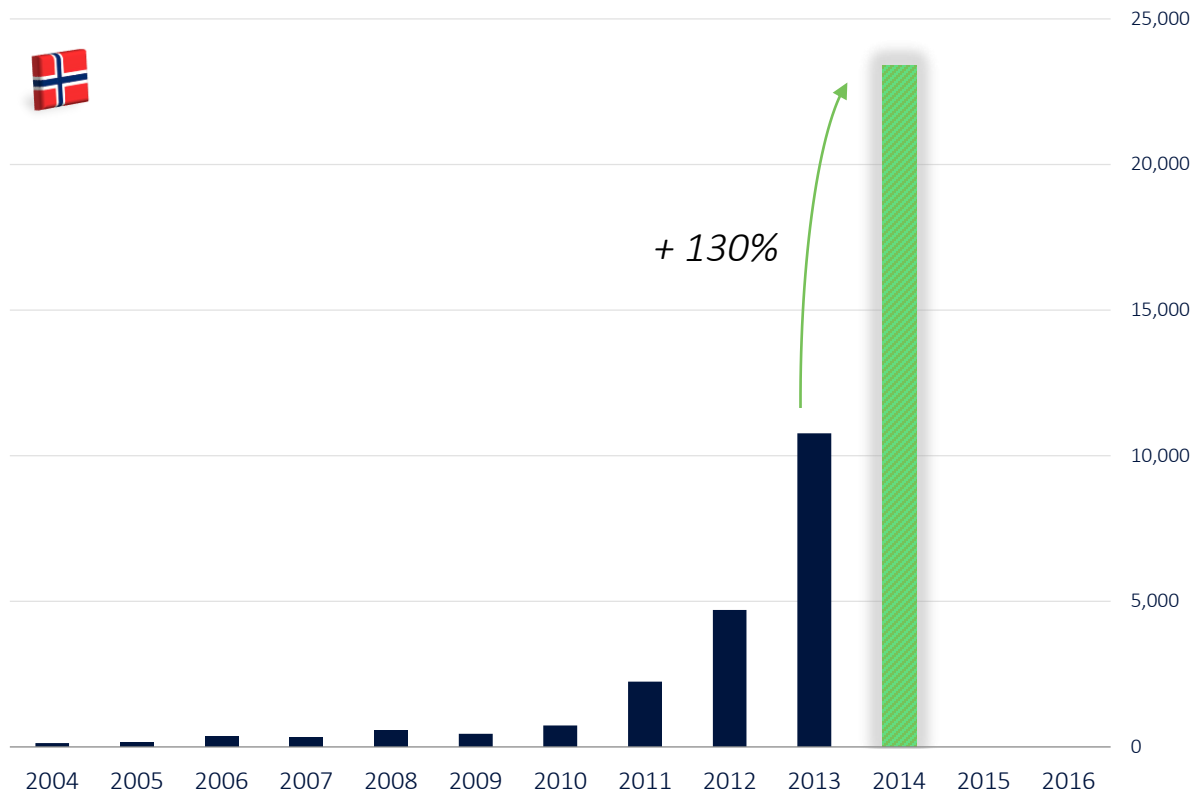
Top 5 models account for more than 50% of total BEV coverage in 2014/15

100% = Total electric vehicle coverage in 2014/2015 YTD

Norway: Tesla achieves an 11% market share in March '14

Exponential growth of EVs in Norway; especially the Tesla Models S due to generous government subsidies.

Electric vehicles registration figures in Norway

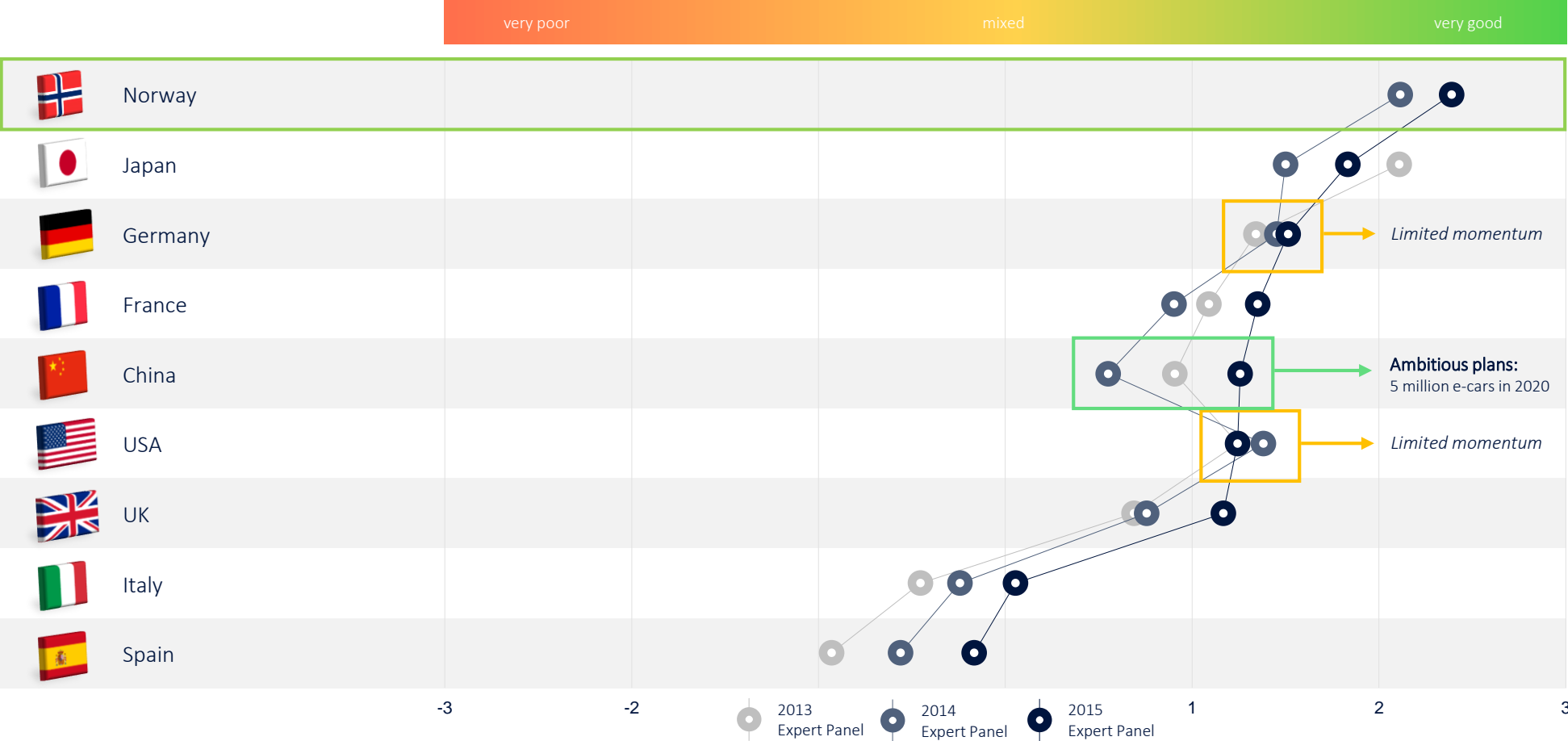


- › The EV market in Norway grew by 130% in 2014 compared to previous year
- › No purchase tax, no VAT and no tolls are making EVs very attractive.
- › Free and extra parking areas for EVs.
- › EV infrastructure.
- › Clean Norwegian energy production.



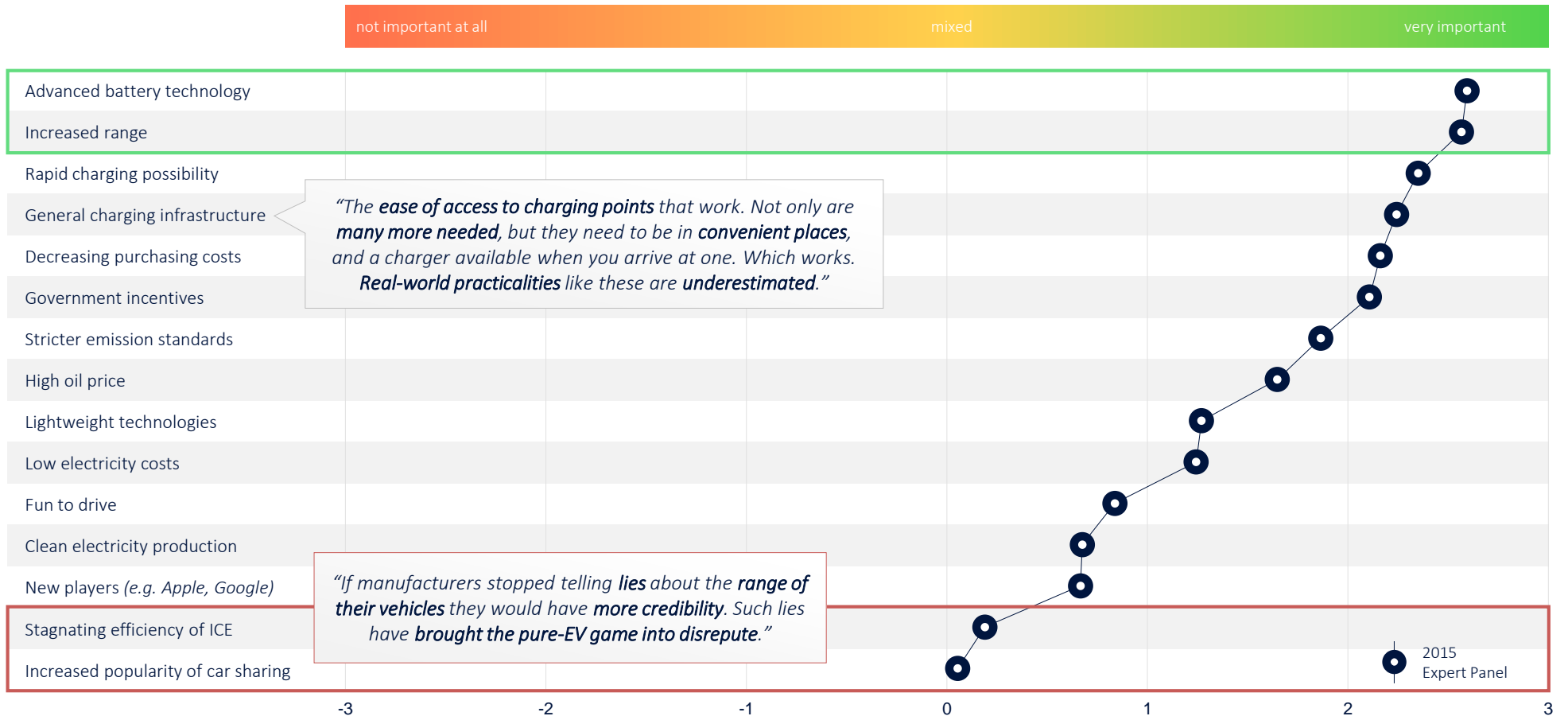
Germany and USA with limited e-mobility momentum

The former benchmark market for E-Mobility, Japan, somewhat loses the confidence of the expert community and remains on one level with Germany and the USA.



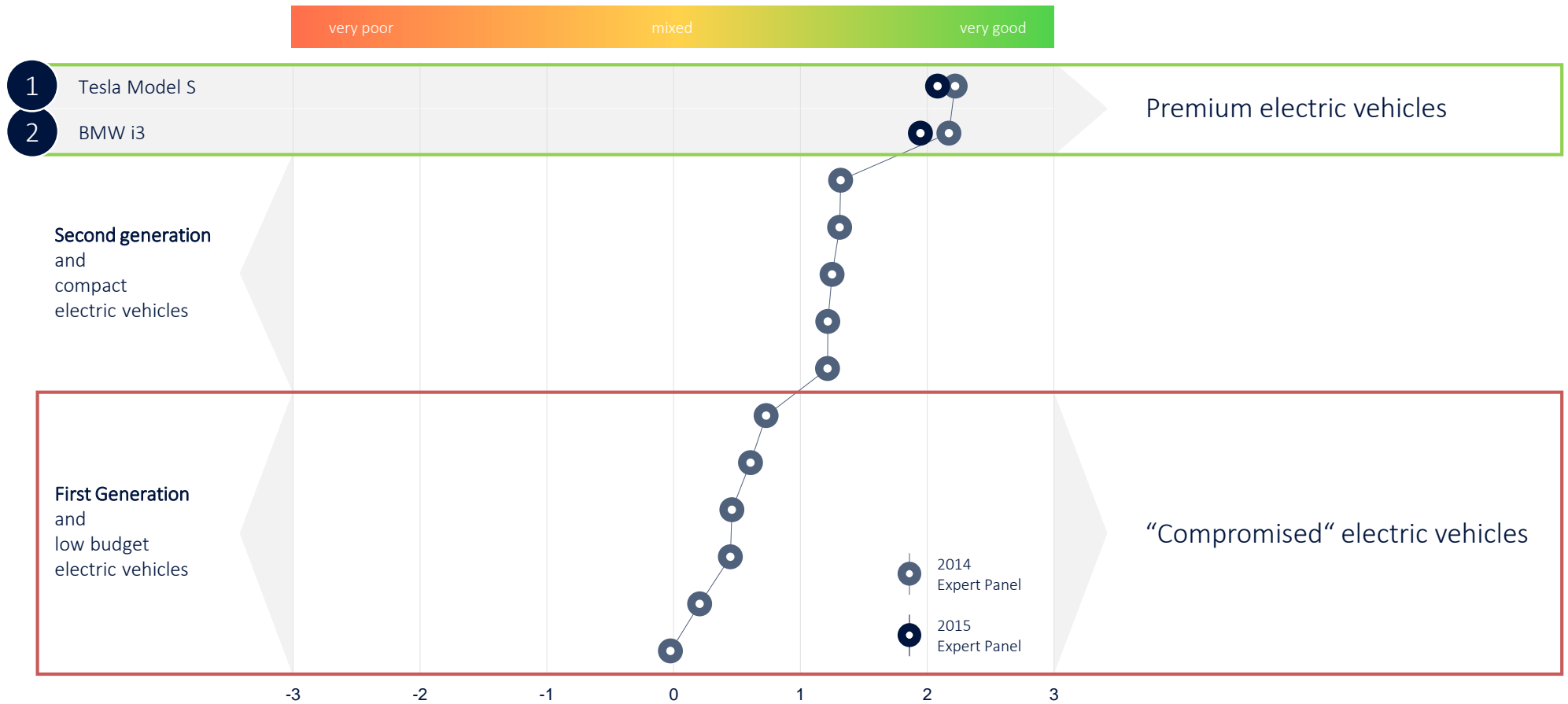
Advanced battery technology and increased range are key

Interestingly, clean energy production is not seen as a crucial factor for the further roll-out of battery electric vehicles.



Tesla & BMW continue their outstanding EV reputation in 2015

BEVs gain further credit in 2015 due to i3 and Tesla Model S – Premium electric vehicles might be the game changer in the future.



"How would you rate the following e-cars from a general perspective?"

1

Connected Mobility

- › New Challenges
- › Autonomous Driving
- › Infotainment System

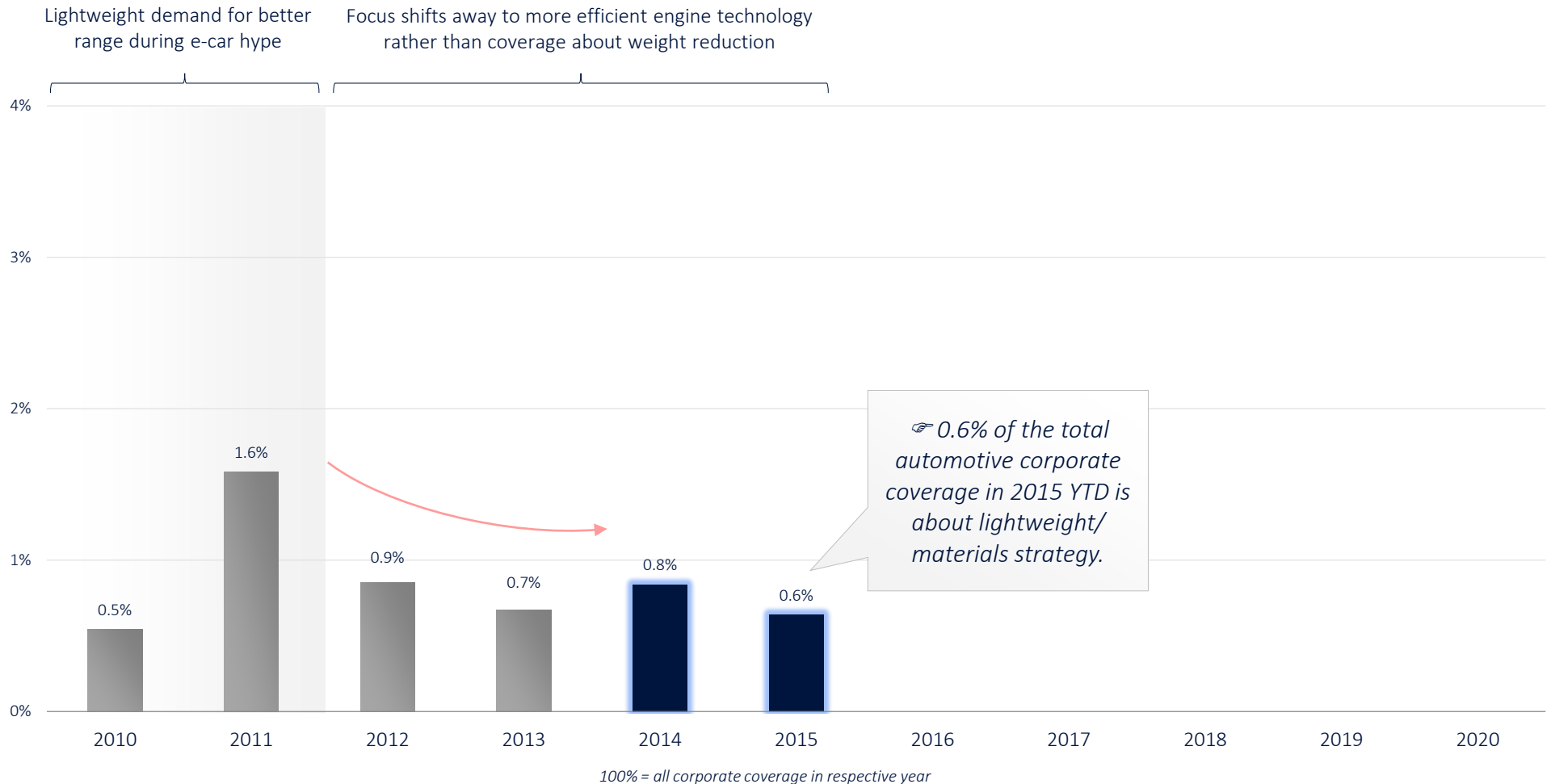
2

Smart Efficiency

- › FCEV
- › BEV
- ▶ Lightweight

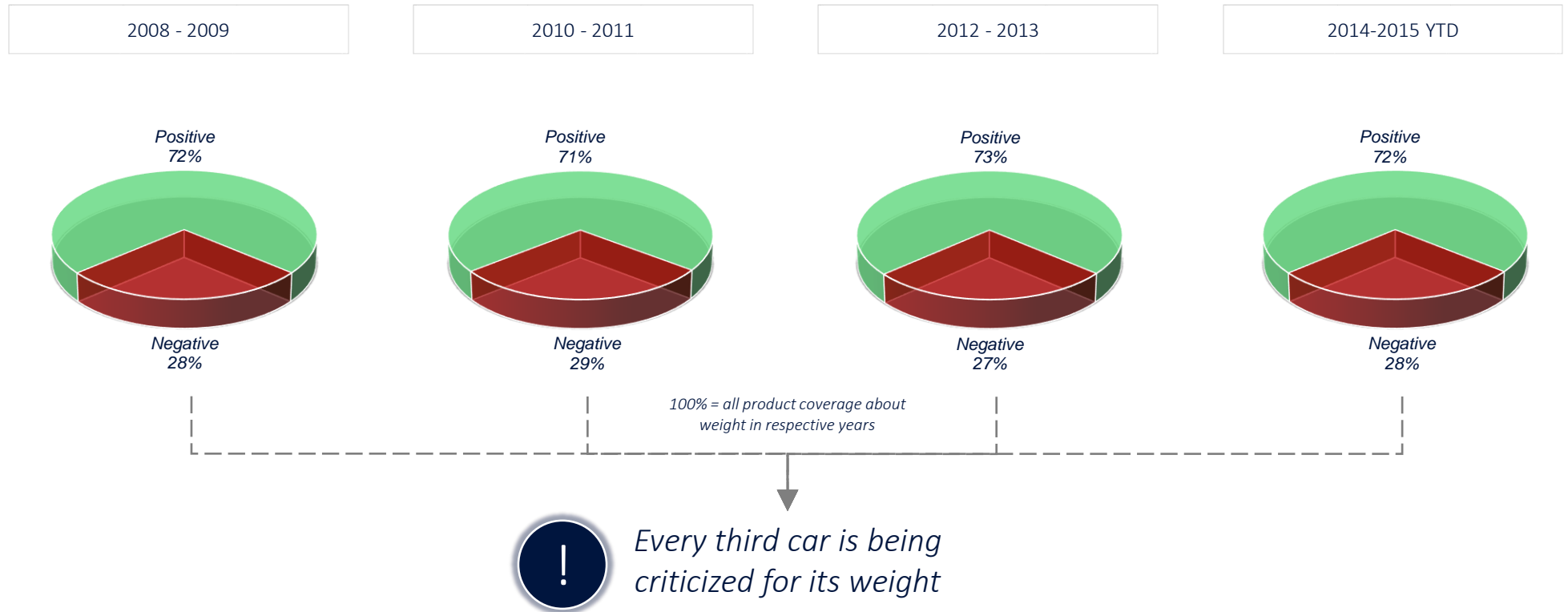
Lightweight coverage on a somewhat constant low level

Promises vs. facts: Coverage about lightweight/materials within the product strategy never took-off in Global media. What counts in the end is the simple and totally transparent 'curb weight' of a vehicle.



Tonality of actual curb weight on constant rather critical level

Weight is one of the most critical product aspects in Global media and hasn't stagnated over the last 7 years in terms of tonality.



Smart material-mix is the most promising weight saver

Two important shifts in perception – the Ford F150 and Jaguar XE for aluminium and the BMW i3 for carbon fibre.



Clever material mix is seen as the most promising technology for further for weight saving in the automotive industry.

The **BMW i3** has changed the perception of carbon fibre: from an expensive and exclusive to an affordable, mass-market material for weight-saving.

The new **Ford F-150** as well as the **Jaguar XE** shift the image of **aluminium** from a rather exclusive to a more volume material for weight-saving.

High strength steels are still evaluated very positively, but are seen as a kind of maxed out option for weight saving due to the already widespread use within the industry .

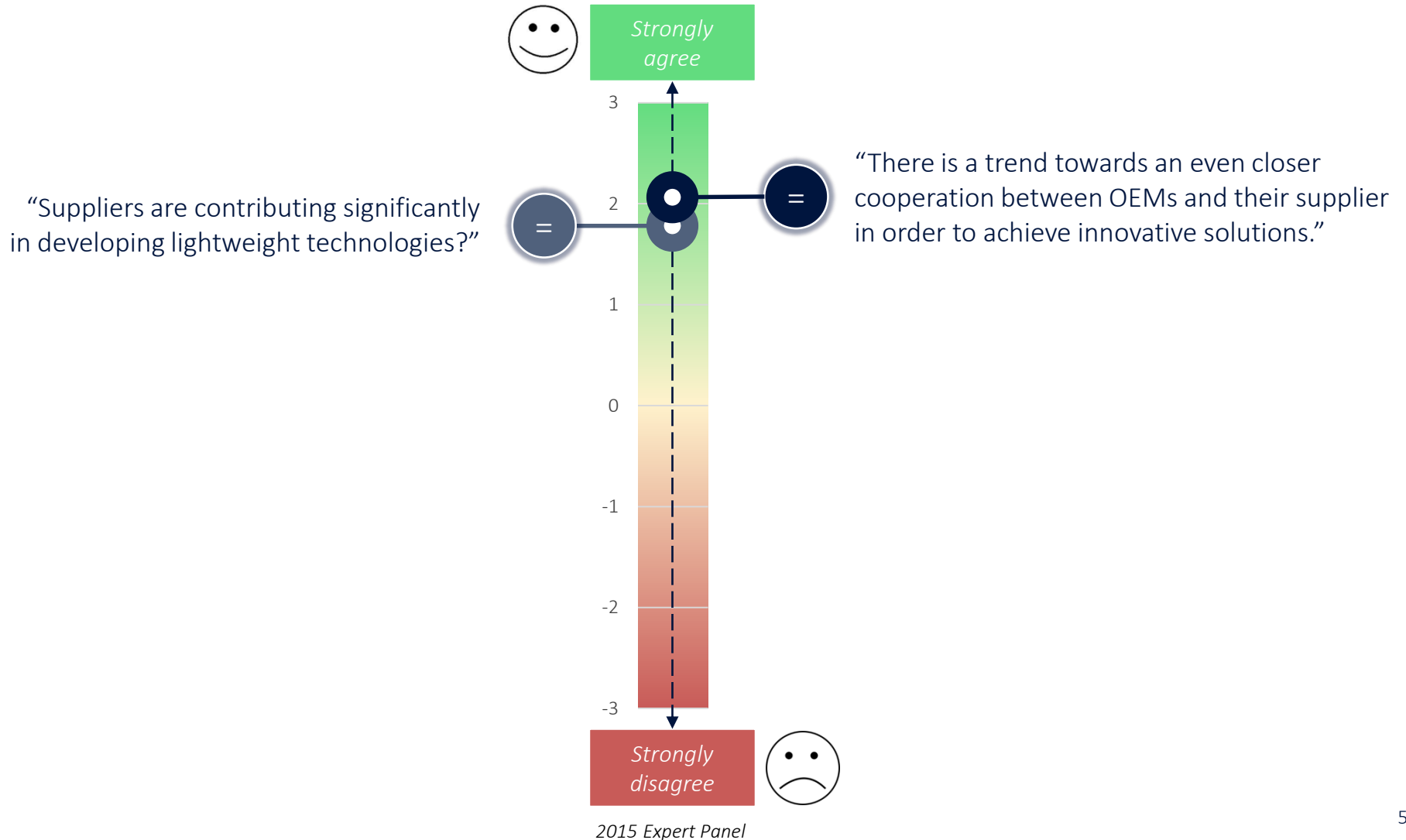
The actual downsizing of an engine for weight reduction has lost slight momentum compared to last year, but is still evaluated very positively.



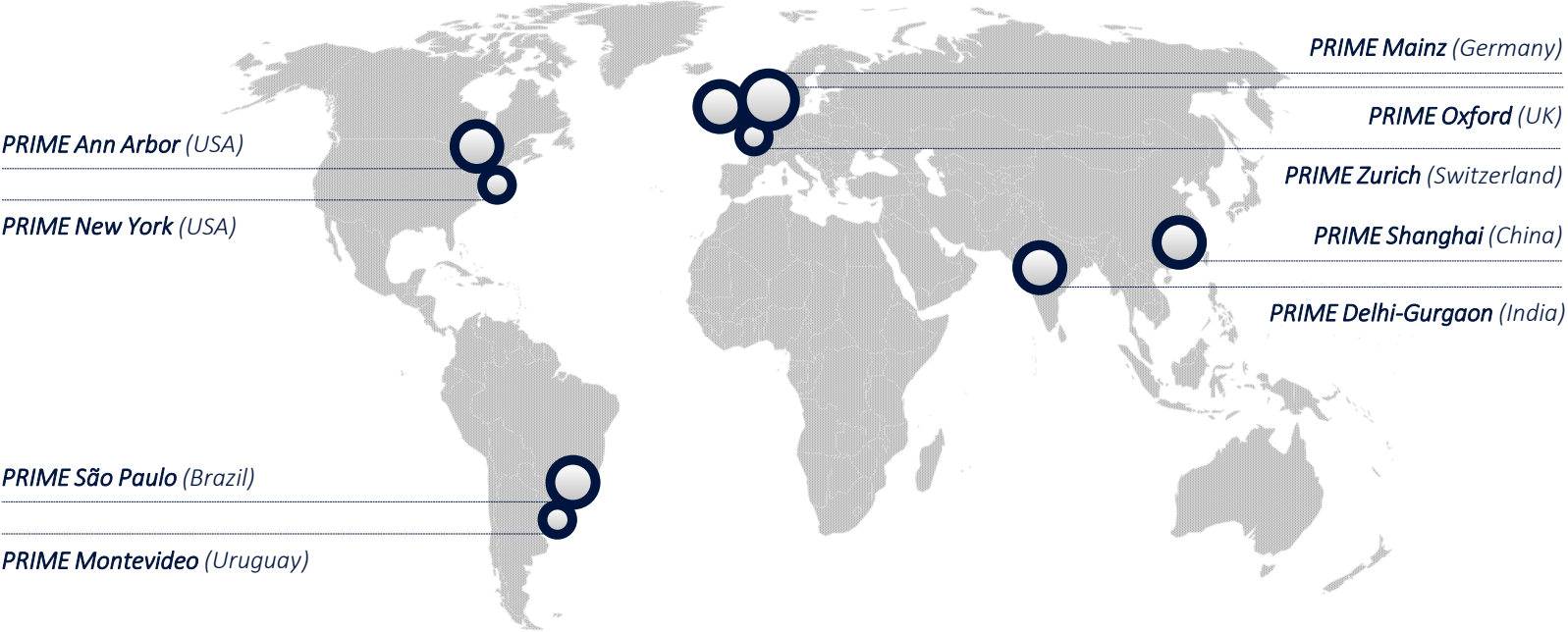
“From your point of view, what are the most promising lightweight technologies?”

Suppliers with substantial influence on lightweight technologies

... through closer cooperation with the OEMs together with significant research & development in the field.



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