

Frost & Sullivan's Research and Market Consulting Group

Global Trends, Technology Roadmaps and Strategic Market Analysis

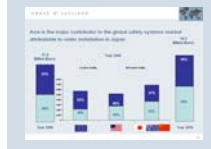
AUTOMOTIVE SAFETY & DAS



Presentation to Automotive World Briefing – 14th May 2008

Nick Ford – Senior Consultant

Agenda for Safety & DAS



Overview of the Market for Safety and DAS Technologies



Active Safety Technologies – Identifying Growth Opportunities



Passive Safety Technologies – Growth Opportunities in a mature market

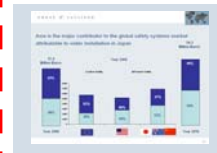


Customer Attitudes and Perceptions towards Safety Technologies



Conclusions

Agenda for Safety & DAS



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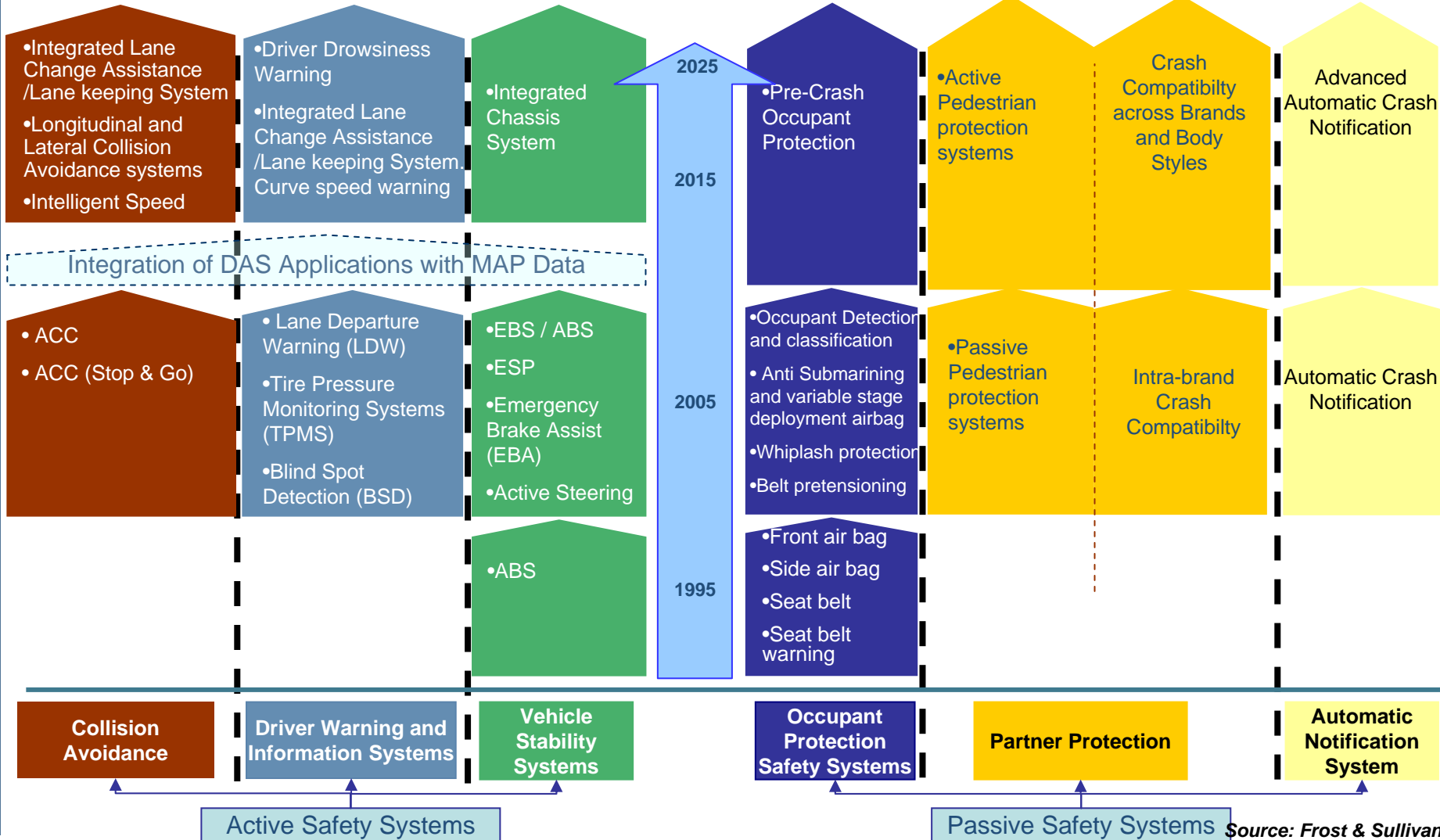


Conclusions & Recommendations

Safety Systems Evolution 1995 - 2015

Inter-section support, Urban Driving Assistance, Rural Driving Assistance

Global Safety Systems Technology Roadmap



Key Product Launches in Automotive Safety Market – 2007

Collision avoidance is a key development area – Europe’s first system using Radar + Camera sensor fusion for Emergency braking

Driver Alert Control (DAC)

Production Models : S80, V70 and XC70

Sensor Used : CMOS Camera

Developed by : Volvo, Mobileye

System Functioning : LDW camera monitors distance between the car and the road lane markings to determine whether the driver risks losing control or not.



Park4U Semi-autonomous Parking

Production Models : VW Touran, Tiguan

Sensor Used : Ultrasonic sensors

Developed by : Valeo

System Functioning : The system measures a parallel parking space and guides the car into the gap taking steering control, with the driver required to just accelerate or brake.



Collision Warning with Automatic Braking

Production Models : S80, V70 and XC70

Sensor Used : Camera + Radar

Developed by : Volvo, Mobileye, Delphi

System Functioning : Sensor fusion of radar and camera data for obstacle detection with initial audio and video warnings followed pre-charging of the brakes or automatic-braking in the case of driver inaction.



PathFindIR – Automotive Night Vision (Aftermarket) *

Sensor Used : Far Infra-red camera

Developed by : FLIR + NAV-TV

System Functioning : PathFindIR is an autonomous, **stand-alone camera system** that uses **thermal imaging** for improved road visibility in night driving conditions. The system can be installed on any vehicle platform quickly and easily.



Lane Departure Warning (LDW) – Camera Based

Production Models : BMW 5-Series

Sensor Used : CMOS Camera

Developed by : Siemens VDO + Mobileye



* Launched in 2008

Key events/concepts in Automotive Safety Market – 2007

Renewed interest in monitoring driver and driving behaviour for accident prevention

Attention Assist System

Expected Launch Year : 2009

Developed by : Mercedes

System Functioning : The system **warns** the driver of **tiredness** using various **sensors to analyse driving behaviour**. The system creates a **driver behaviour profile** during normal driving and compares it in different scenarios **to detect fatigue**



Blaupunkt “Dual View” System *

Expected Launch Year : 2009

Developed by : Bosch

System Functioning : The system displays **two different programs on a single screen** with the **driver and passenger** able to view different images based upon the angle of viewing, with space requirements remaining the same.



Integrated Project GST

(Global System for Telematics)

Developed by : Renault + BMW

System Functioning : Renault and BMW jointly developed a rescue scenario and implemented it for the first time in vehicle prototypes, focusing specifically on **inter-vehicle communication**. The prototypes have **interoperable telematics with open architecture** for easy communication.



Saab – Driver Attention Warning System

Developed by : Saab

System Functioning : Development project for designing a system that **Detects Driver Drowsiness & Driver Inattention** – Utilizes **two miniature infra-red cameras**, one installed at the base of the driver’s A-pillar and the other in the center of the main fascia, **focused on the driver’s eyes**.

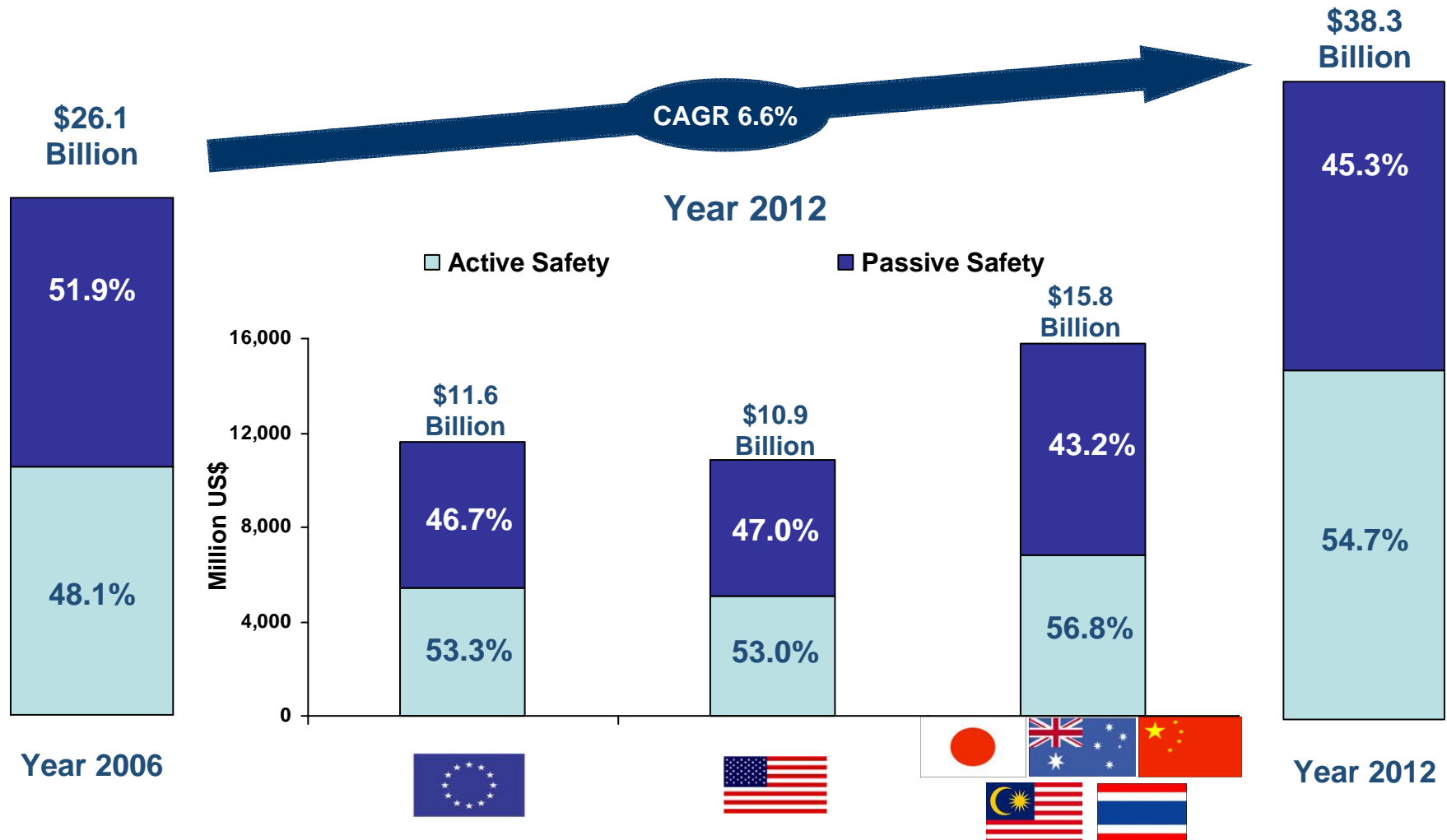


* Announced in 2008

Asia is the Major Contributor to the Global Safety Systems Market Revenues Attributable to Wider Installation in Japan



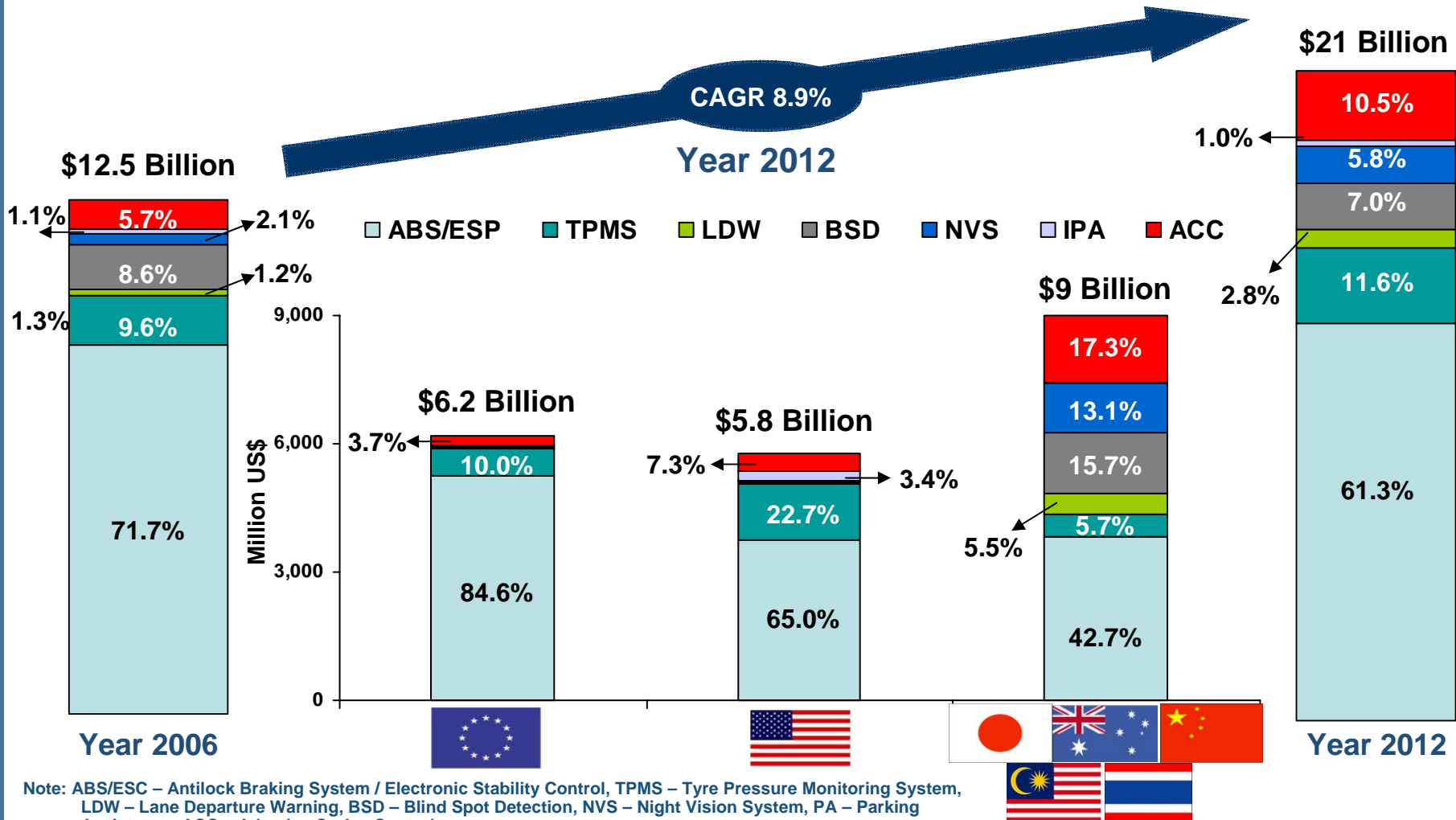
Global Safety Systems Market – Revenue Forecast



Global Active Safety Systems Market Revenues to Exceed 20 Billion USD by 2012



Global Active Safety Systems Market: Revenue Forecasts (in Million US\$), 2006 and 2012



Note: ABS/ESC – Antilock Braking System / Electronic Stability Control, TPMS – Tyre Pressure Monitoring System, LDW – Lane Departure Warning, BSD – Blind Spot Detection, NVS – Night Vision System, PA – Parking Assistance, ACC – Adaptive Cruise Control

Note: All figures are rounded. Source: Frost & Sullivan

Global Active Safety Systems Market – Revenue Forecast

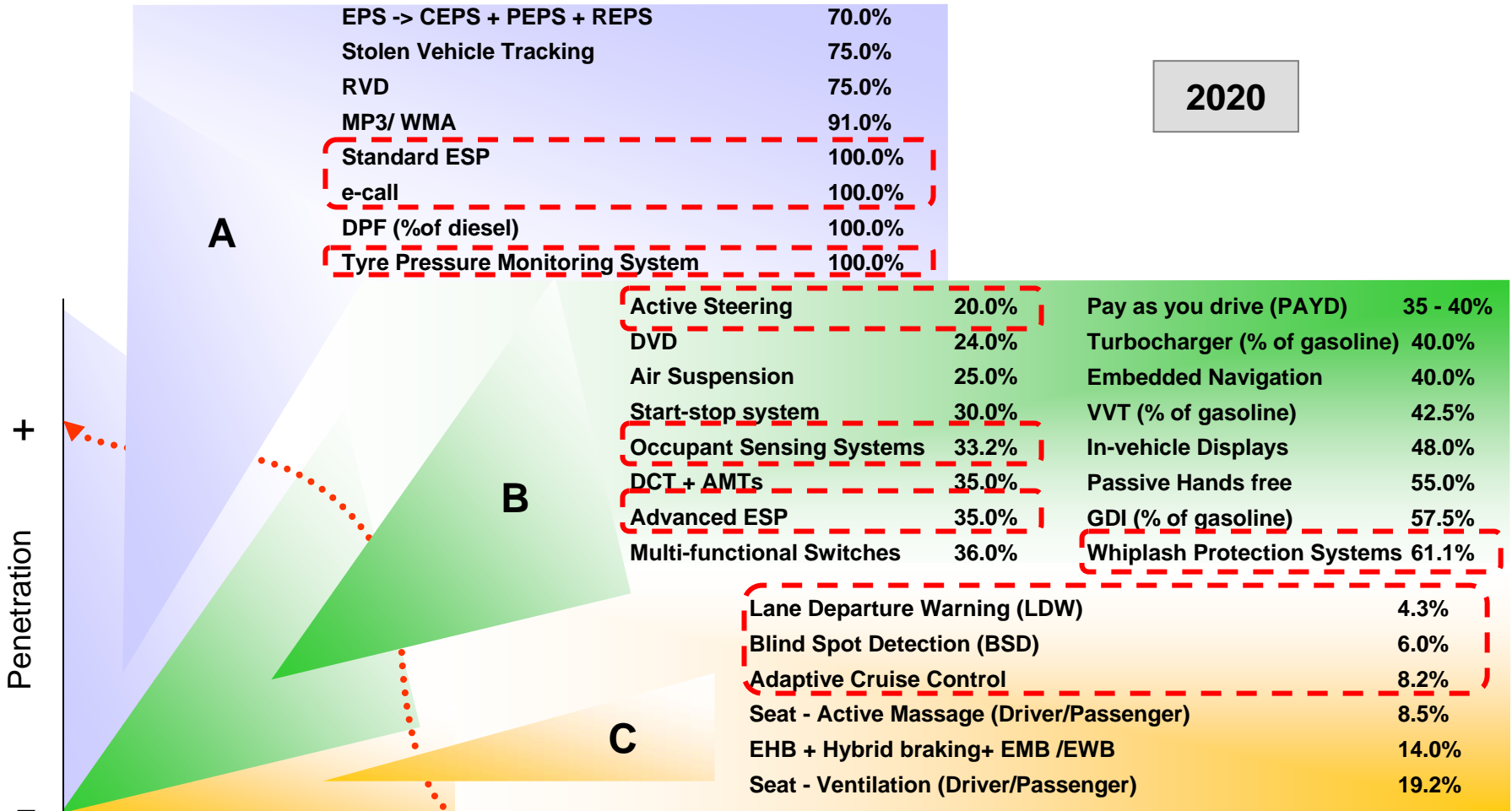
Legislation driven technologies like ESP, e-Call and Tyre Pressure Monitoring systems are expected to have a high penetration in EU

Leading European Automotive Technologies

A – Technologies Driven By Legislation

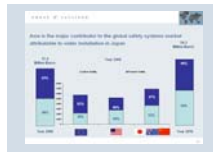
B – Features Standard in higher segment vehicles, but optional in mid and lower segments

C – Features that will only be available as option



Source: Frost & Sullivan

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Customer Attitudes and Perceptions towards Safety Technologies

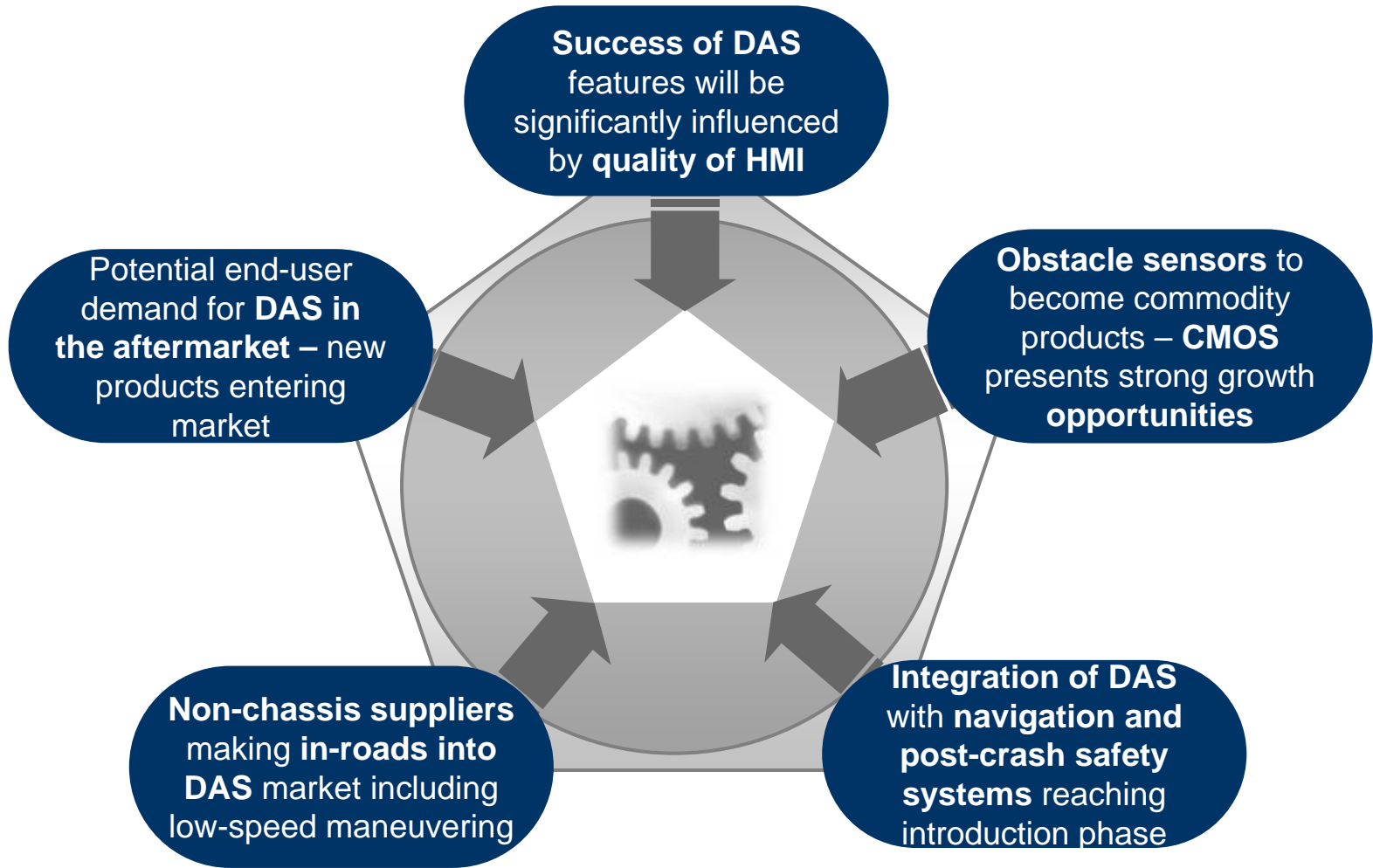


Conclusions & Recommendations



Active Safety Systems – The Burning Topics

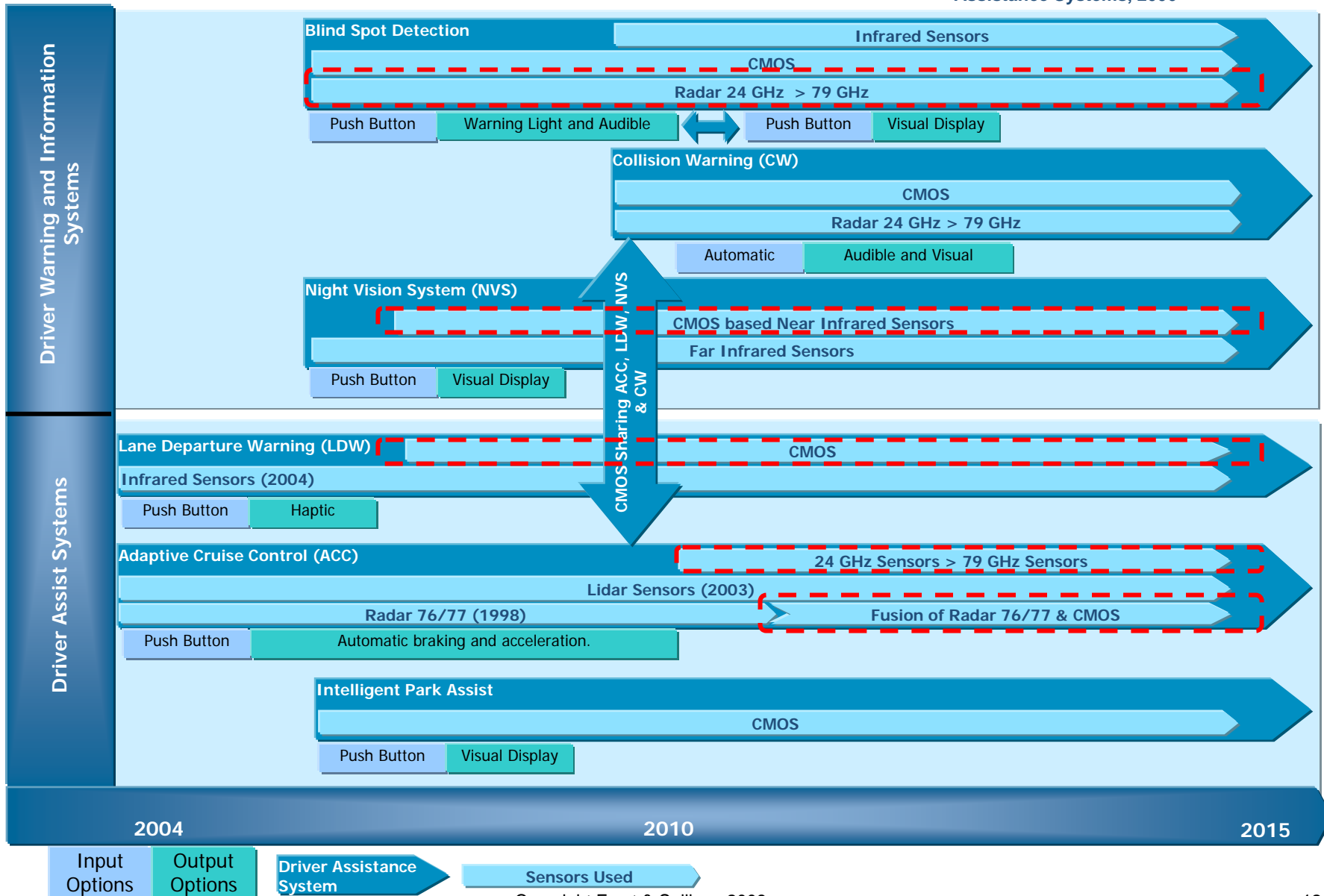
Key Conclusions – Active Safety Systems











Source: Frost & Sullivan study on European Markets for Advanced Driver Assistance Systems, 2006

Key Dimensions – Systems, Sensors, HMI



OEMs Need to educate Consumers of Benefits of Haptic Feedback

Example of HMI Preferences

Systems	Input	Preferred Location	Output	Preferred Location
 <p>Blind Spot Detection</p>	H	Haptic: Centre Stack, Steering Wheel	V H	<p>Visual: Above Rear View Mirror, A-Pillar</p> <p>Haptic: Steering Wheel, Seats</p>
 <p>Drowsiness Detection</p>			A H	<p>Haptic: Steering Wheel, Seats</p>
 <p>Park Assist System</p>	A H	Haptic: Centre Stack, Steering Wheel	A V	<p>Visual: Rear View Mirror, Central Display</p>
 <p>ACC</p>	H	Haptic: Centre Stack, Steering Wheel	A H V	<p>Visual: Instrument Cluster, Central Display</p> <p>Haptic: Steering Wheel</p>
 <p>LDW</p>	H	Haptic: Centre Stack, Steering Wheel	A H V	<p>Visual: Instrument Cluster, Central Display</p> <p>Haptic: Steering Wheel</p>
 <p>SPEED ALERT</p>	H	Haptic: Centre Stack	A H V	<p>Visual: Instrument Cluster, Central Display</p> <p>Haptic: Steering Wheel</p>

Audio | Video | Haptic

Host of ADAS Applications where Digital Map Data is a Key Component for Enhanced Accuracy and Results

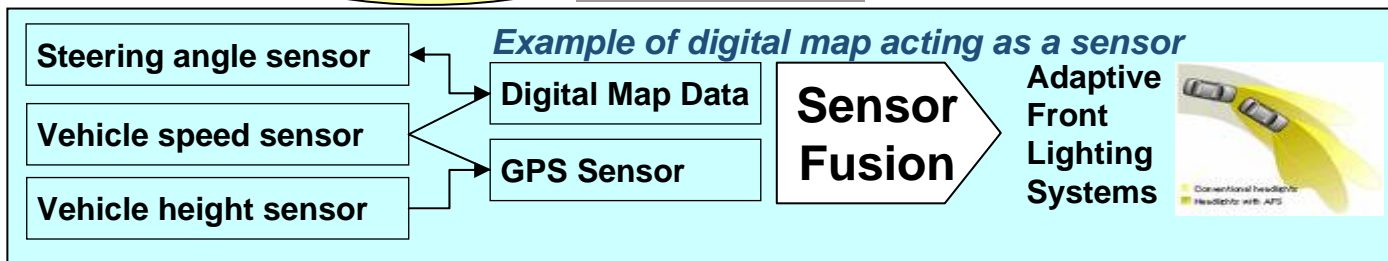
European Active Safety Market Growth Areas



TOYOTA

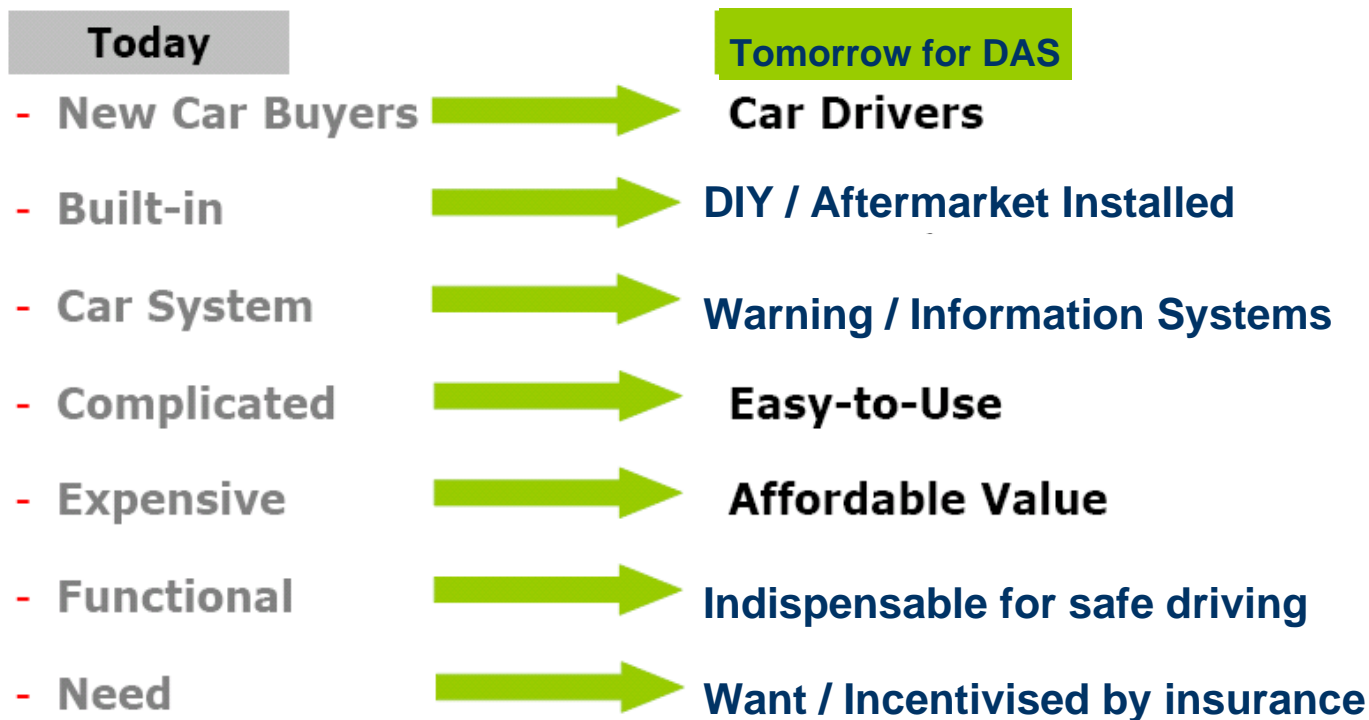
Curve Warning & Driving Stability Improvement System

- Toyota jointly developed with Aisin and currently available in Europe on select Toyota models
- System uses digital map data to sense curvature radius
- Suspension damping forces gets optimum control in line with the curvature radius



Significant Aftermarket Potential for DAS – No “Breakthrough” Product Thus Far

Case Study - TomTom GO was launched in a market dominated by complex, expensive, built-in car navigation systems. TomTom GO managed to position itself not just as another technical product, but as an easy, smart and accessible consumer solution, moving to take a 56% market share

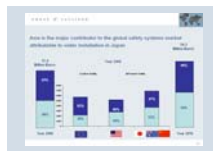


Systems Already in Market



Source: Frost & Sullivan

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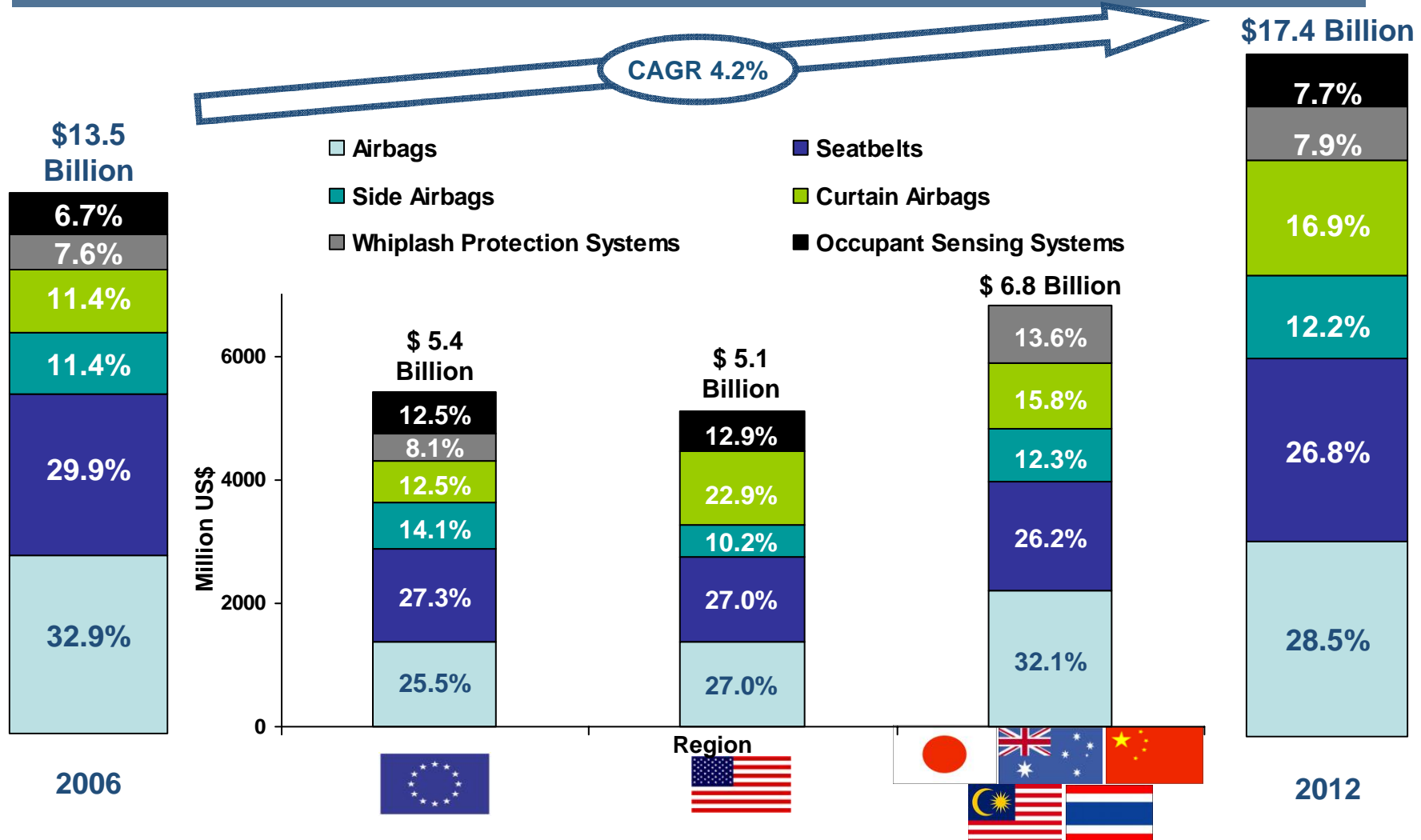


Conclusions & Recommendations

Global Passive Safety Systems Market Revenues to Reach 17.4 Billion USD by 2012



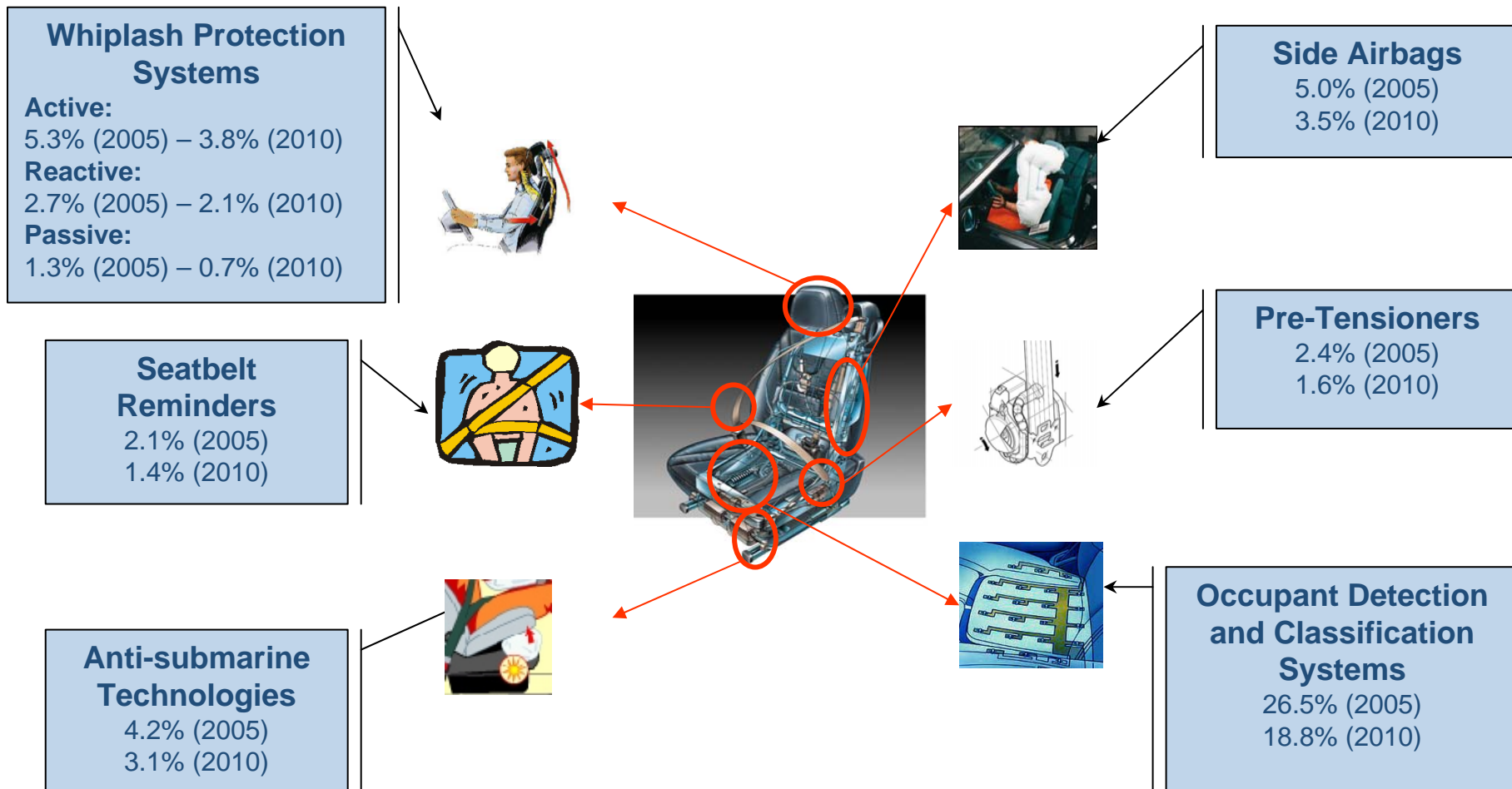
Global Passive Safety Systems Market: Revenue Forecasts (in Million US\$), 2006 and 2012



Global Passive Safety Systems Market – Revenue Forecast

Seat is the Heart of Occupant Safety in all Crash Scenarios

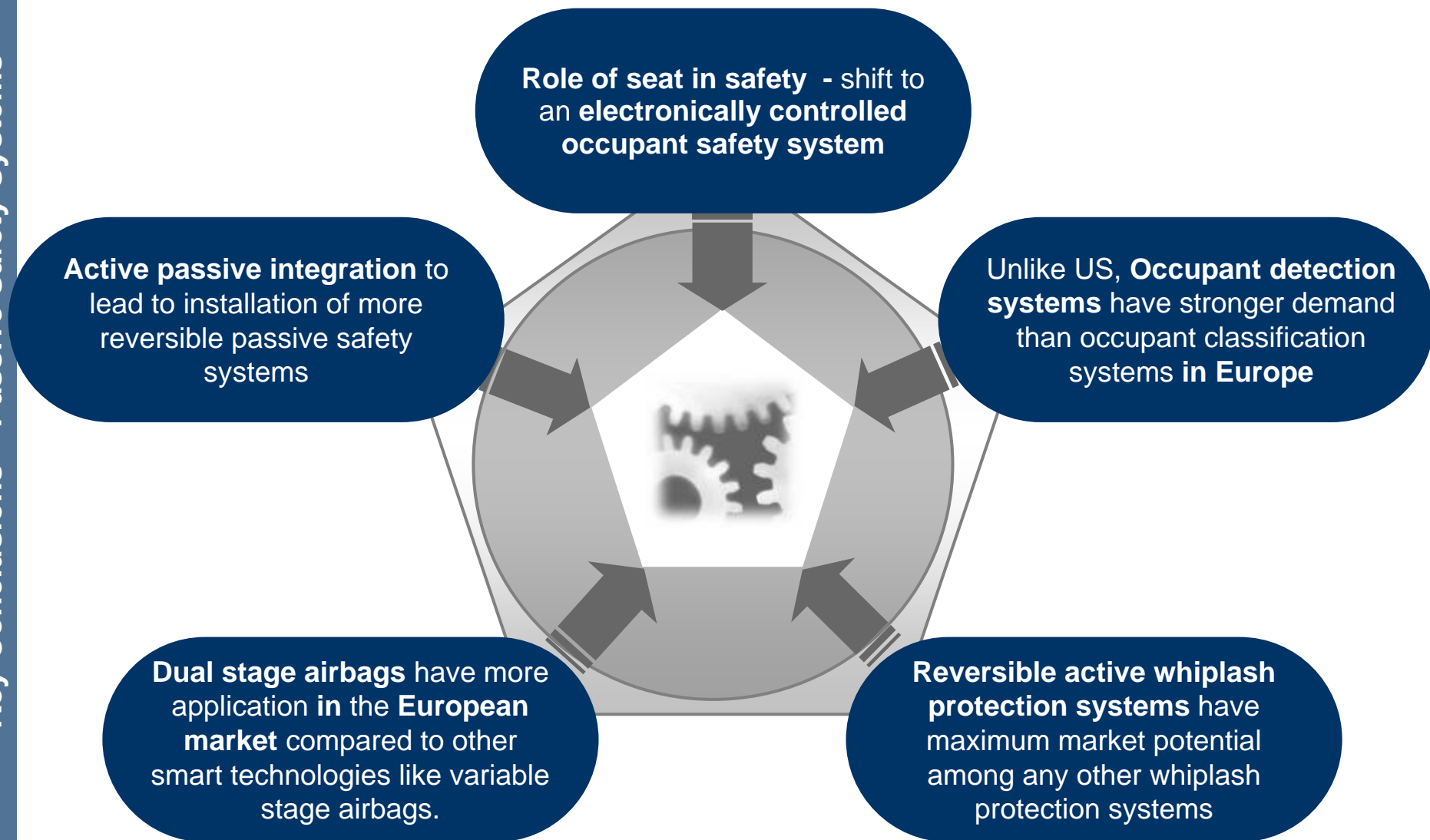
OCS Estimated to Cost around 26.5% of Seat



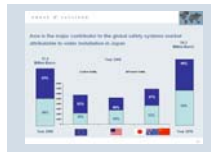
Source: Frost & Sullivan



Key Take Home Points for Passive Safety Systems



Agenda for Safety & DAS



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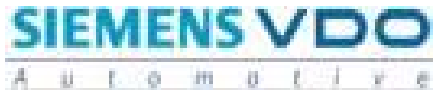
Customer Attitudes and Perceptions towards Safety Technologies



Conclusions

List of Clients who Invested in a Recent Multi-Client Study

- Frost & Sullivan developed this study to enable manufacturers and suppliers to better understand the expectation of customers, their desirability for safety and willingness to pay.
- The quality of the methodology is emphasised by **6 OEMs and 4 Tier 1 suppliers** sponsoring the study.
- List of clients for this study -



HONDA



HYUNDAI



OPEL

Methodology - Benefits of Safety Systems

Vehicle Stability Systems

- Alerting the driver if vehicle deviates from the lane inadvertently

Emergency Braking Assistance

- Active Steering

- Reducing **braking distance** on a straight line under dry road conditions
- Reducing **braking distance** on a straight line under wet road conditions

Driver Warning and Info Systems

- Tyre Pressure Monitoring
- Lane Deviation warning
- Blind Spot warning
- Driver Drowsiness
- Seatbelt Warning

Collision Avoidance Systems

- Adaptive Cruise Control Systems
- Lane change assistance system
- Lane keeping System

- Alerting the driver if he/she is trying to change lanes and if there is a vehicle in the blind spot area

Occupant Protection Systems

- Ensuring the vehicle keeps a safe distance from those ahead
- Anti-submarining
- Airbags
- Knee airbags

- Allowing the driver to change lanes only if it is safe to do so

- Automatically summoning emergency services in case of a crash

Other Passive Safety Systems

- Post-crash automatic notification systems
- SOS button
- Post-crash automatic notification systems

Legend

Normal driving Situation

Emergency Situation

Pre-Crash Situation

In-Crash Situation

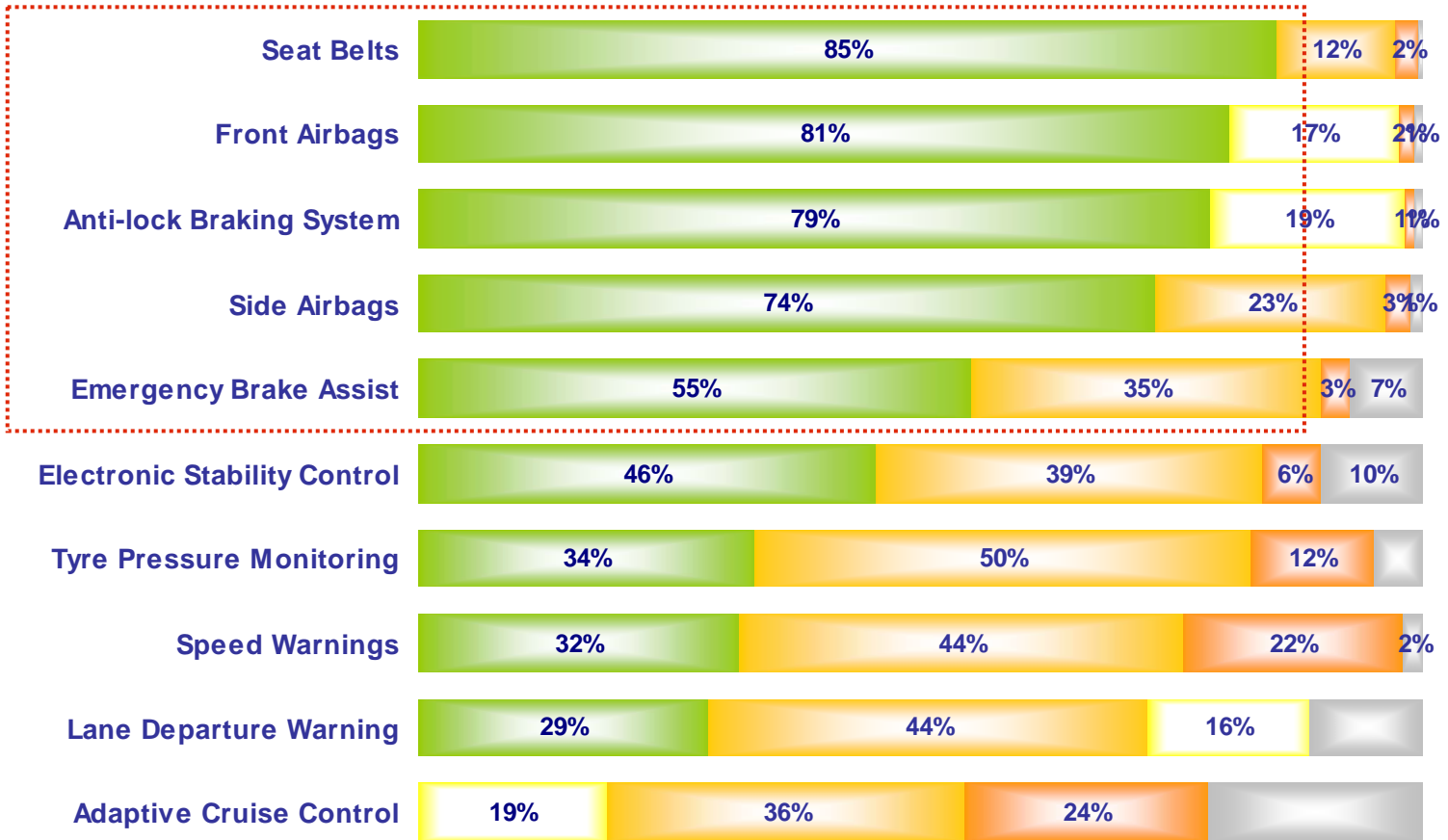
Post-Crash Situation



Only Features that Play a Role During the Actual E of the Crash Are Perceived to be Contributing to Safety

Respondents perceive technologies (ABS, Seatbelts, Airbags) traditionally associated with accident scenarios to play an important part in vehicle safety. Technologies not primarily associated with accident scenarios are perceived to be not as important to vehicle safety.

Voice of Customer Study on Safety – Europe



■ *Plays an Important Role*
■ *Contributes somewhat to Safety*
■ *Contributes little to Safety*
■ *Don't Know*

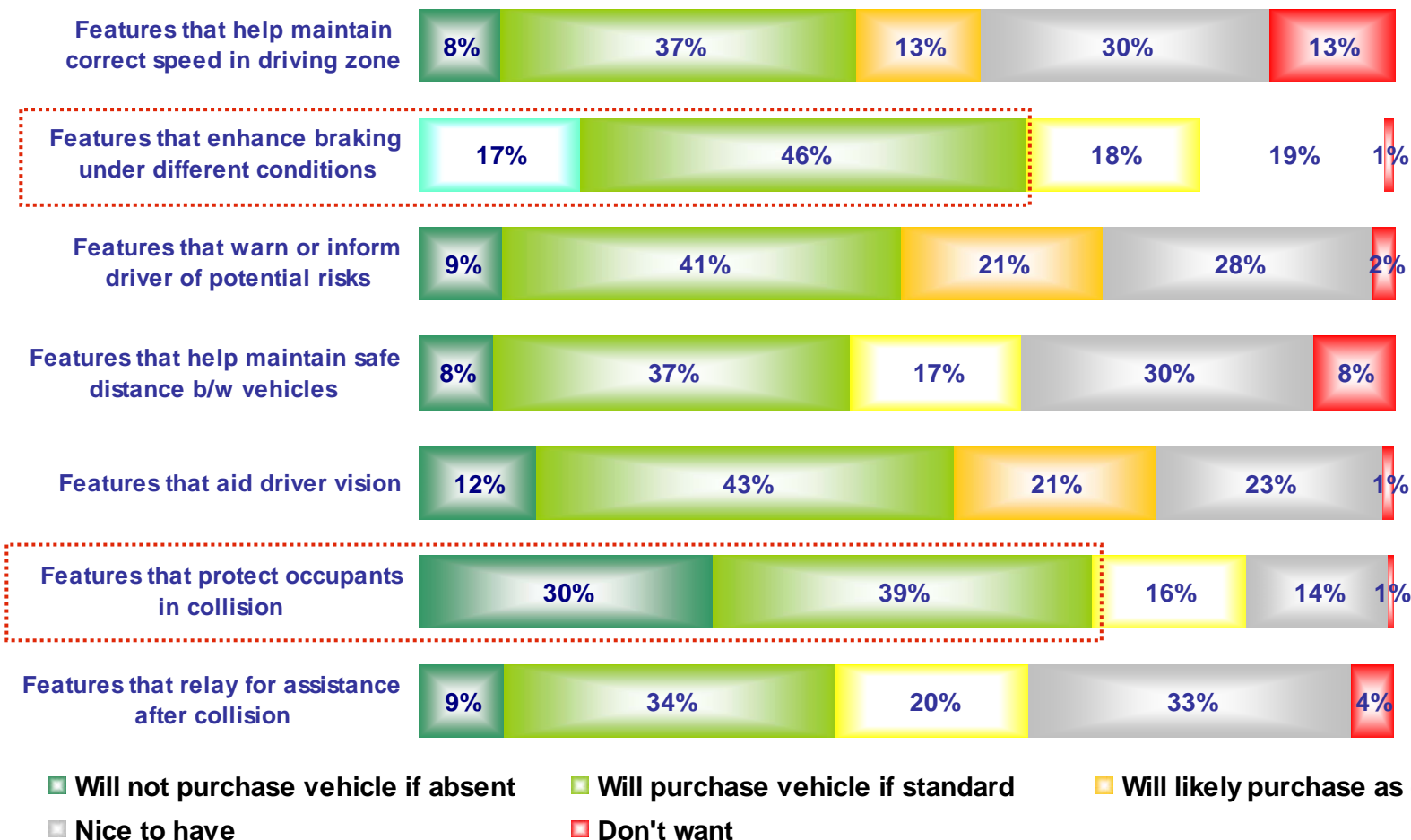
Q.2 How important are the following technologies to overall vehicle safety?

Source : Information from Consumer research study done with 1,635 respondents



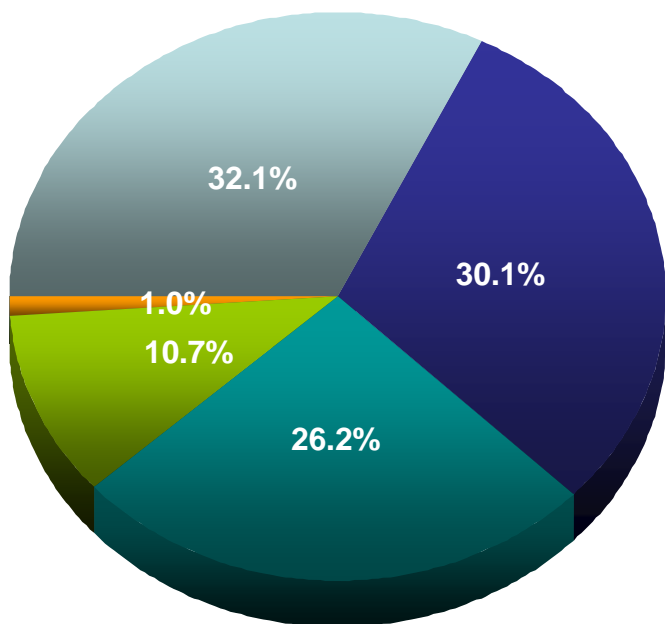
Preferred Systems

Across Europe, 'traditional' occupant protection and braking technologies are preferred over newer active technologies.

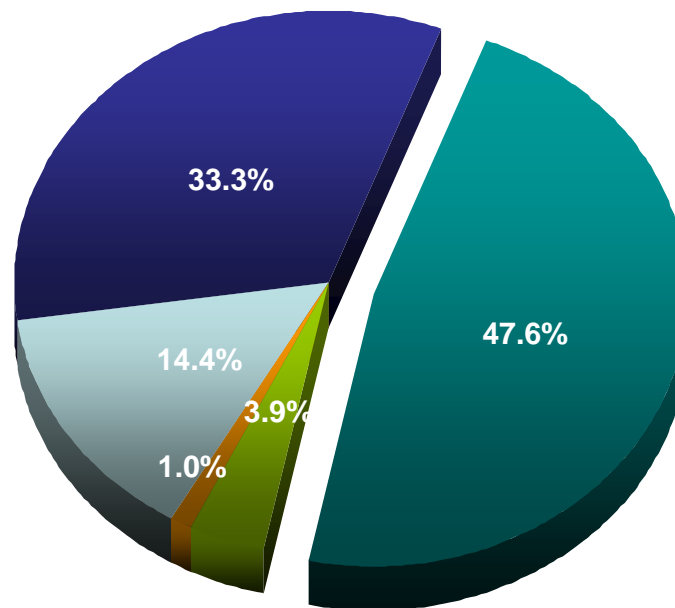


Q.10 How important are the following to you when you consider a package of safety features for your vehicle?

Consumers in Europe Significantly Concerned About Front-end Collisions Contrast to US Consumers Concerned about Rear-end Impact

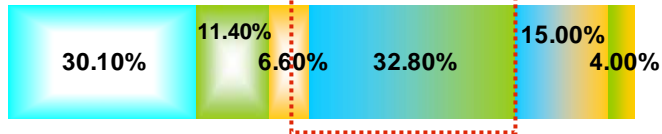


- Forward Impact
- Lateral Impact
- Rear-end Impact
- Rollover after impact
- Other

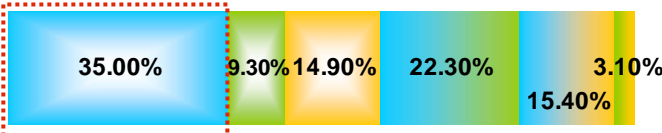
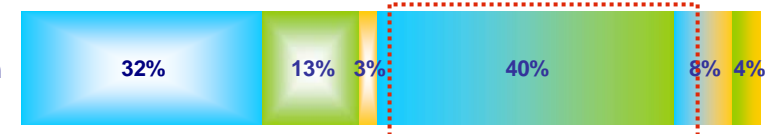


- Front Impact
- Lateral Impact
- Rear-End Impact
- Rollover after Impact
- Rollover without Impact

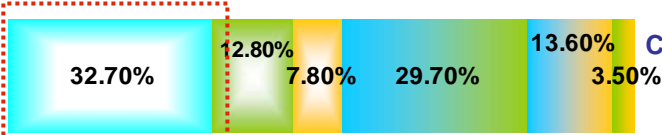
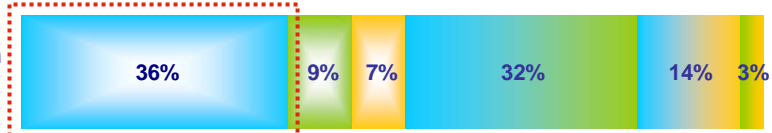
Consumers Prefer Audio / Visual Feedback for Most Emergency Situations – Need to Educate Benefits of Haptic Feedback



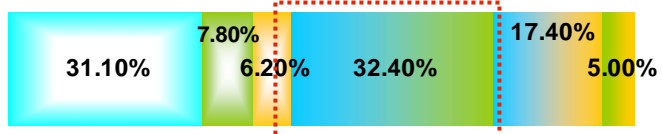
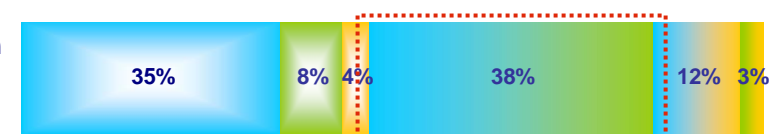
You are fast approaching an obstacle ahead



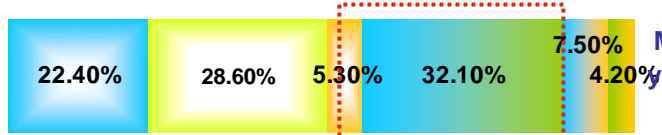
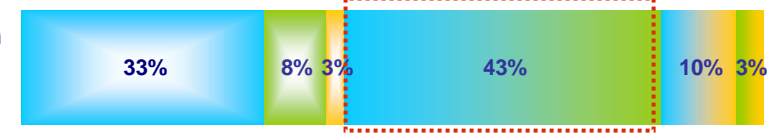
Your vehicle drifts from its lane when your attention is diverted



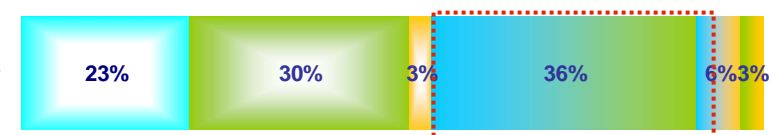
Changing lanes when a vehicle is in your blind spot



A vehicle/pedestrian suddenly appearing ahead

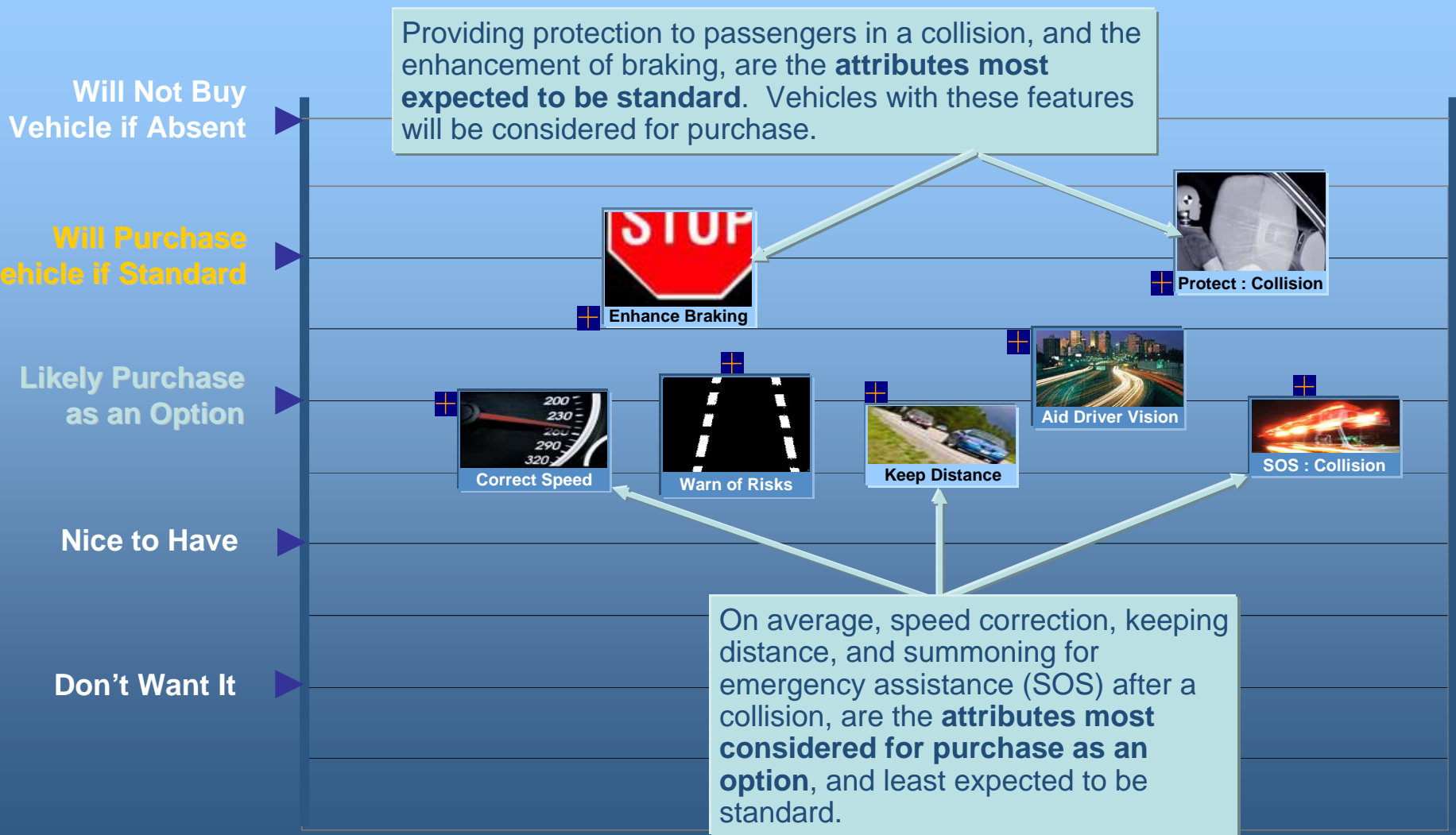


Major malfunction in your vehicle (e.g. low tyre pressure)



■ Audio
 ■ Visual
 ■ Haptic
 ■ Audio & Visual
 ■ Audio & Haptic
 ■ Visual & Haptic

Relative Importance of Safety Attributes – EUROPE



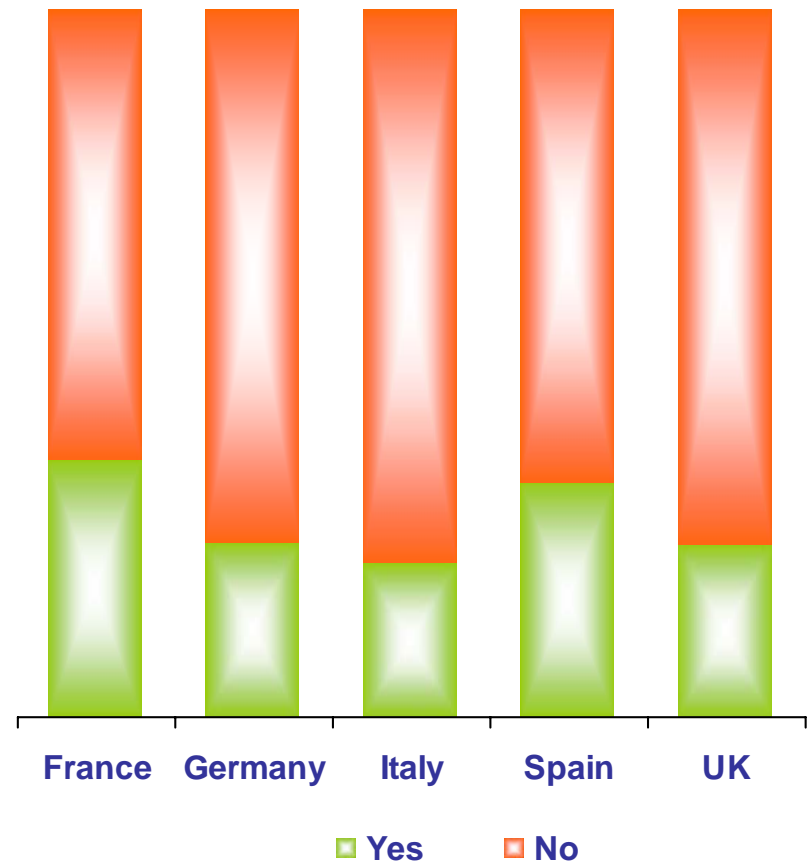
* These are based on the mean scores of the importance ratings for each attribute.



Only 28 percent of the respondents have heard of Euro NCAP, with the highest in France (36 percent) and lowest in Italy (22 percent)

- The A&B segment in Italy registered the lowest level of awareness in Europe, with 16 percent and the highest awareness was within the D&E segment (43 percent) in France.
- Half of the respondents who know of Euro NCAP want more than the rating to assess the safety of vehicles, with the highest being in Spain, and the lowest in the UK.
- 21% of all respondents say a good Euro NCAP will make them more likely to purchase the vehicle. However, this increases to significantly in the case of respondents already aware of Euro NCAP.
- Hence, while Euro NCAP is effective, measures need to be put in place to increase consumer awareness of its purpose and benefits.

Have you heard of Euro NCAP (New Car Assessment Program)?



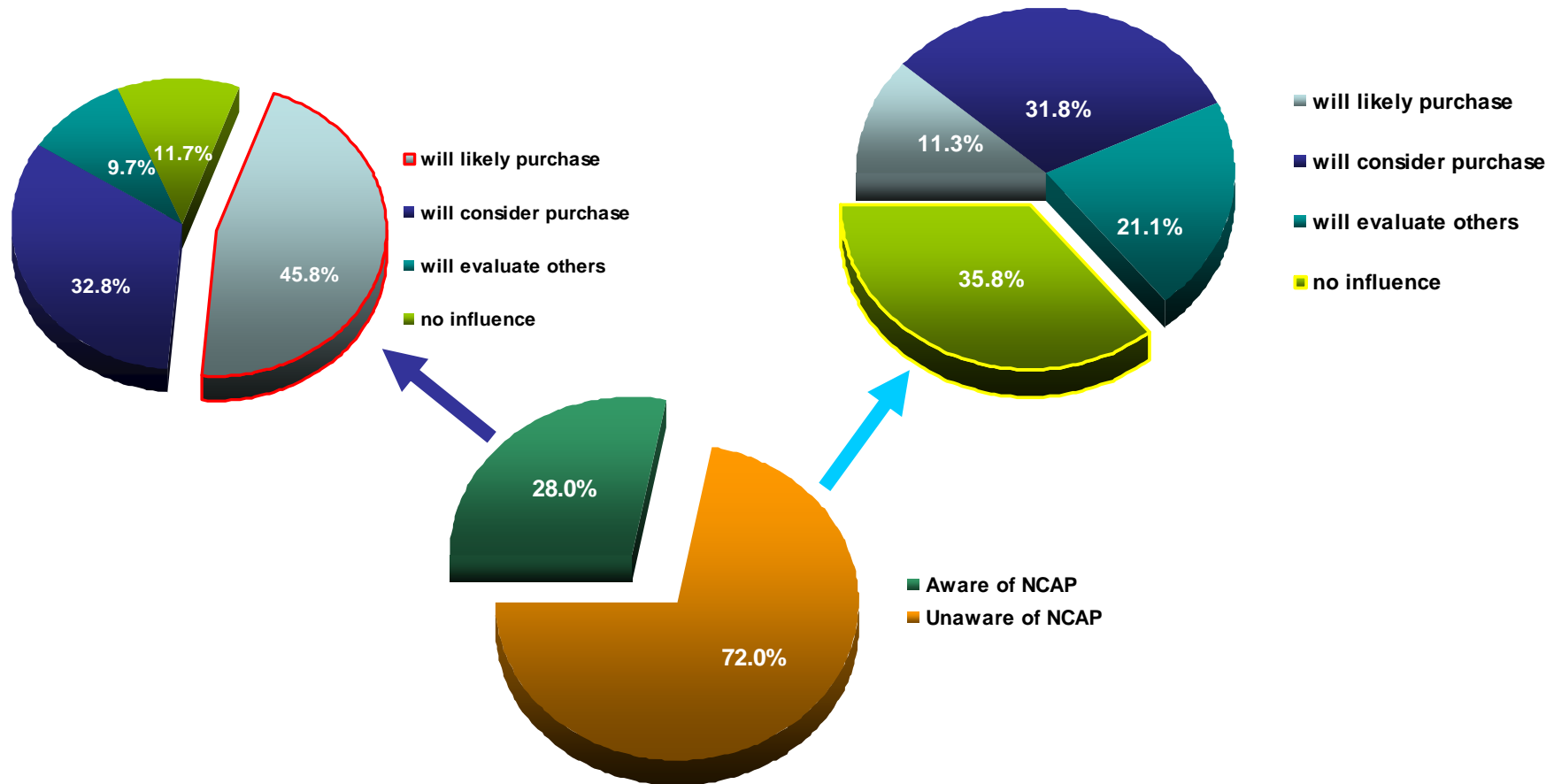
Source : Information from Consumer research study done with 1,635 respondents



Influence of Euro NCAP Awareness in Vehicle Purchasing Decision

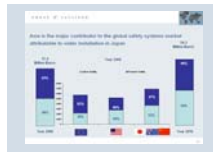
Respondents who were aware of Euro NCAP were more likely to be influenced by a good Euro NCAP rating.

45.8% of respondents who were aware of Euro NCAP were likely to purchase a vehicle with a good NCAP rating, while 35.8% of respondents who were not aware of NCAP were not likely to be influenced by a good NCAP rating. Awareness of Euro NCAP is a major and significant factor on the influence of a good Euro NCAP rating in the purchase decision (Chi-Square= 279.0, at p=0.0000)



Source : Information from Consumer research study done with 1,635 respondents

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Conclusions

Conclusions in Europe

Key Conclusions

Expect passive pedestrian safety solutions to be increasingly offered as a differentiator

- According to a Frost & Sullivan consumer research study, around 30% of the respondents in Europe are willing to pay for pedestrian safety systems.

Expect more affordable driver assistance systems in the Small car segment and increase ADAS offerings in the SUV segment

Expect increased focus on Blind spot detection and Lane departure warning technologies rather than Adaptive Cruise Control

Aftermarket suppliers entering the market offering fast introduction of ADAS using dealer fit programmes

Passive safety systems – occupant detection / dual airbag systems still a major Safety technology and will grow further

Thank You for your Attention

Questions?