



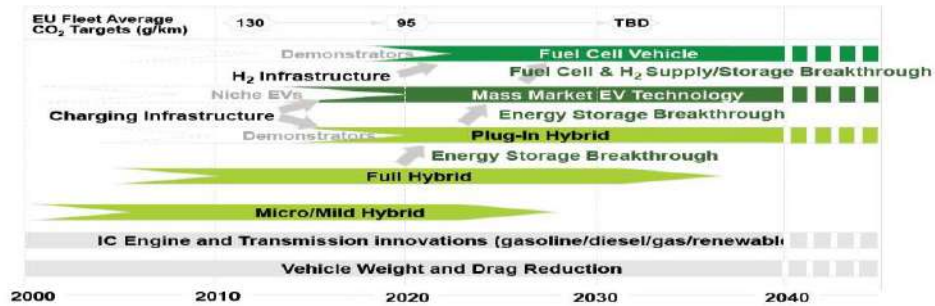
Passenger Car Roadmap



Updated by the Advanced Propulsion Centre in collaboration with and on behalf of the Automotive Council

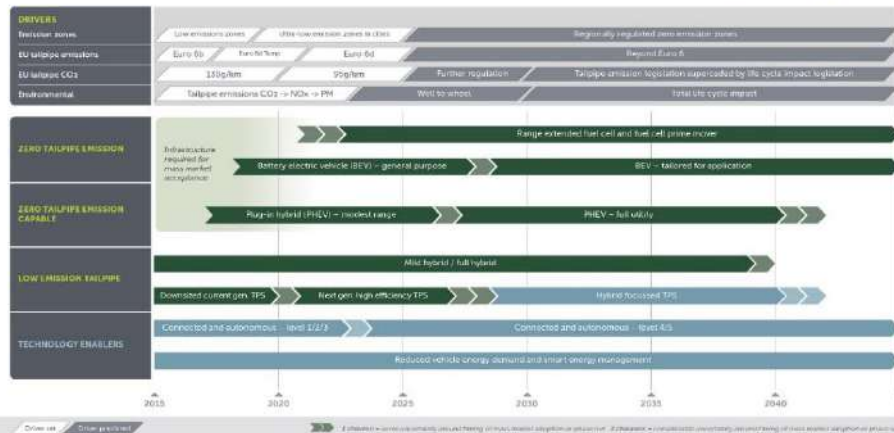
Executive summary – Passenger car roadmap

Passenger car low carbon technology roadmap



PRODUCT ROADMAP 2017: PASSENGER CAR

Roadmap Approved by the Automotive Council and the Advanced Propulsion Centre



- The 2009 passenger car roadmap identified tailpipe CO₂ legislation as the primary driver with technologies slowly transitioning from micro/mild hybrids to fuel cell vehicles, with energy storage breakthroughs being the major implementation barrier.
- The 2017 roadmap acknowledges there has been a move from CO₂ as the sole driver to improved local air quality and the drive for zero emission operating zones.
- The “stepping stone” transitional movement between products has been removed, which reflects there are multiple and not just a single future solution.
- There is a greater articulation of technology evolution and potential market discontinuities.
- There is a recognition that thermal propulsion systems will transition from the sole propulsion device to being part of a hybrid system.
- The impact of vehicle connectivity and autonomy and how this effects vehicle utilisation and ownership models is given greater recognition.
- Infra-structural requirement has replaced “technology break through” as the main implementation barrier.

Update process: *The product roadmaps were developed using the following approach*



The process was co-ordinated by the **Advanced Propulsion Centre** on behalf of **Automotive Council**.

Review of existing product roadmaps ✓



Research the new economic, social, technical and legislative drivers ✓

1-1 confidential interviews ✓

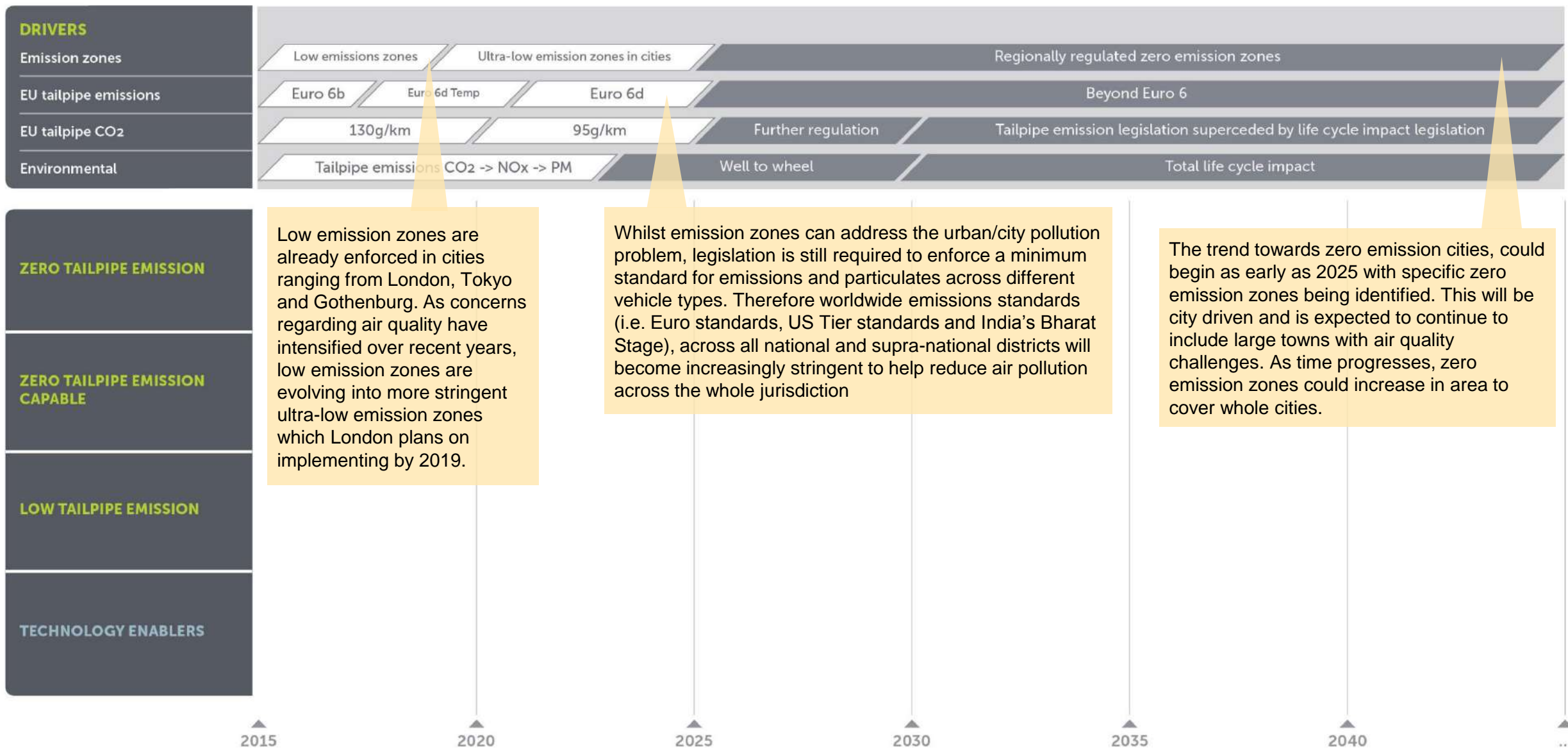
Consensus with participating OEM's ✓

Review with Automotive Council Technology working group ✓

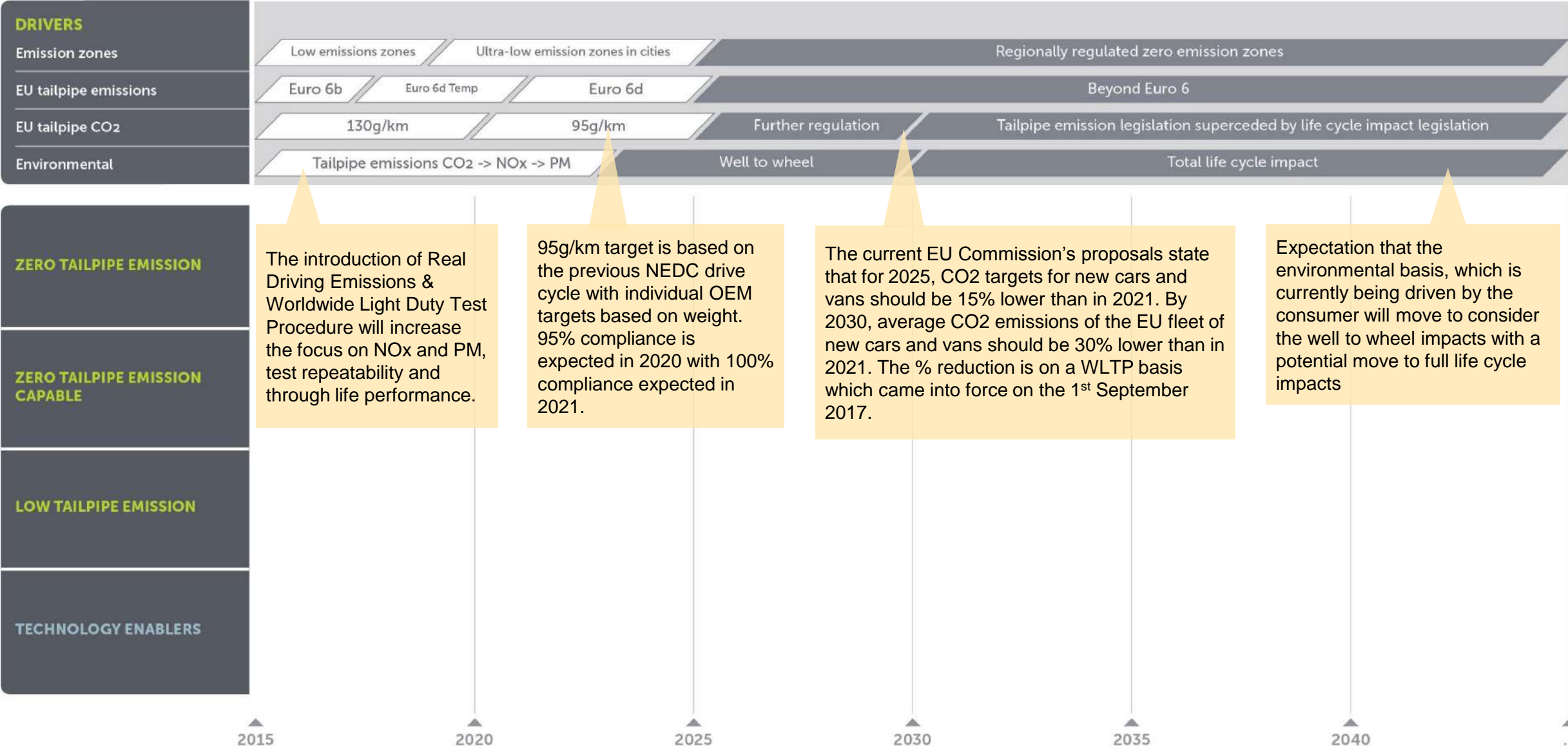
Developed new product roadmaps endorsed by the Automotive Council ✓



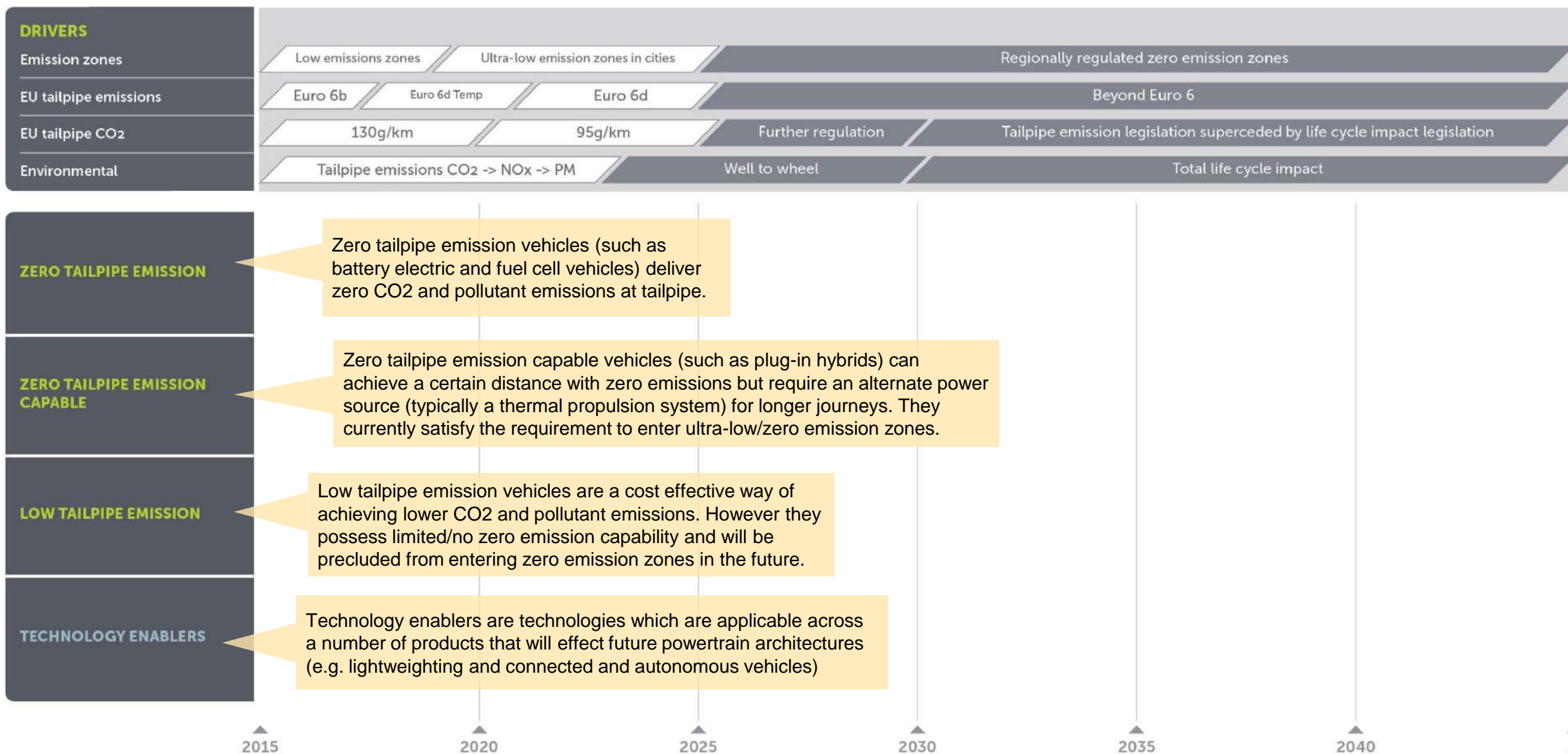
Drivers: Drivers have been defined as both regulatory and standards but also take into consideration the environmental basis which is market driven by the consumer



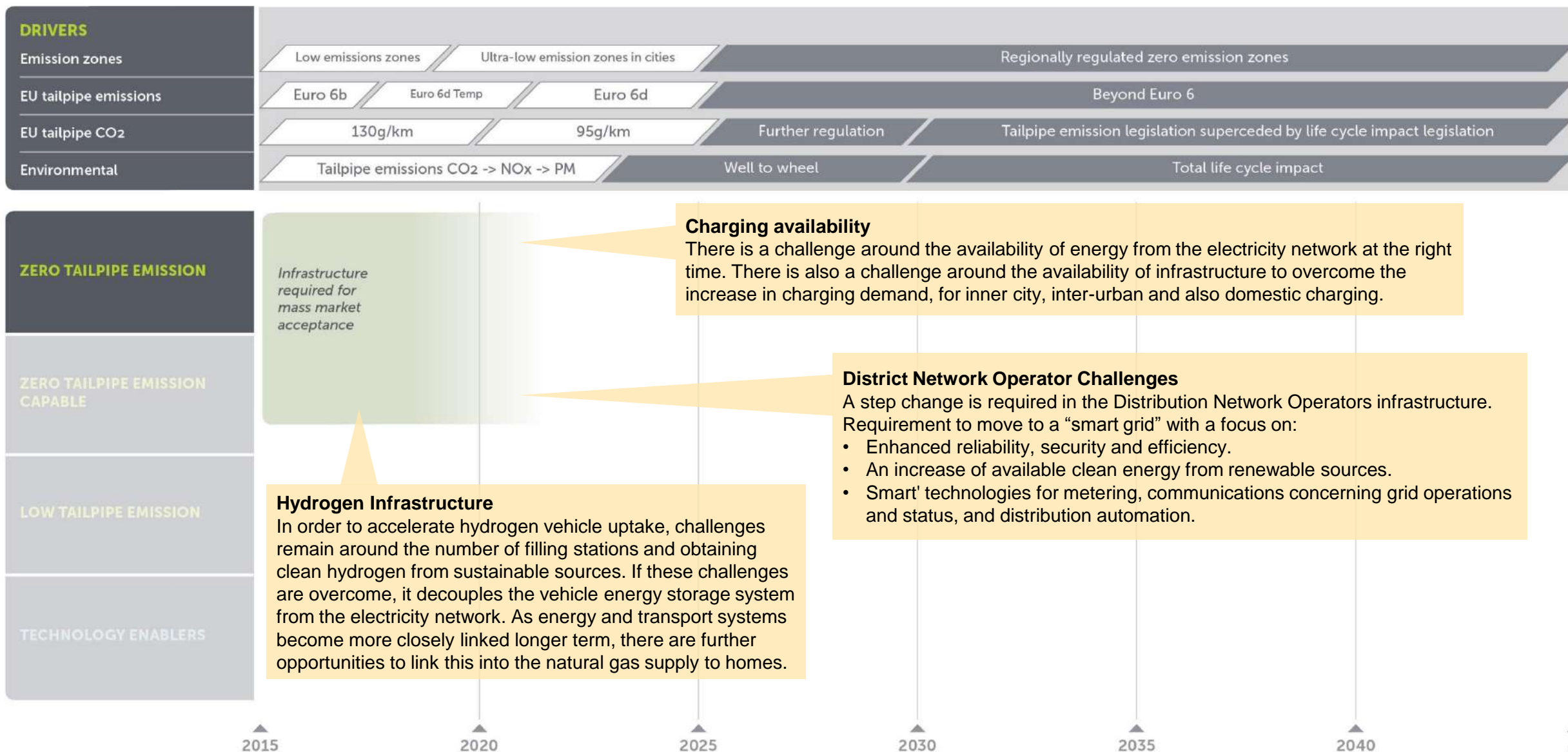
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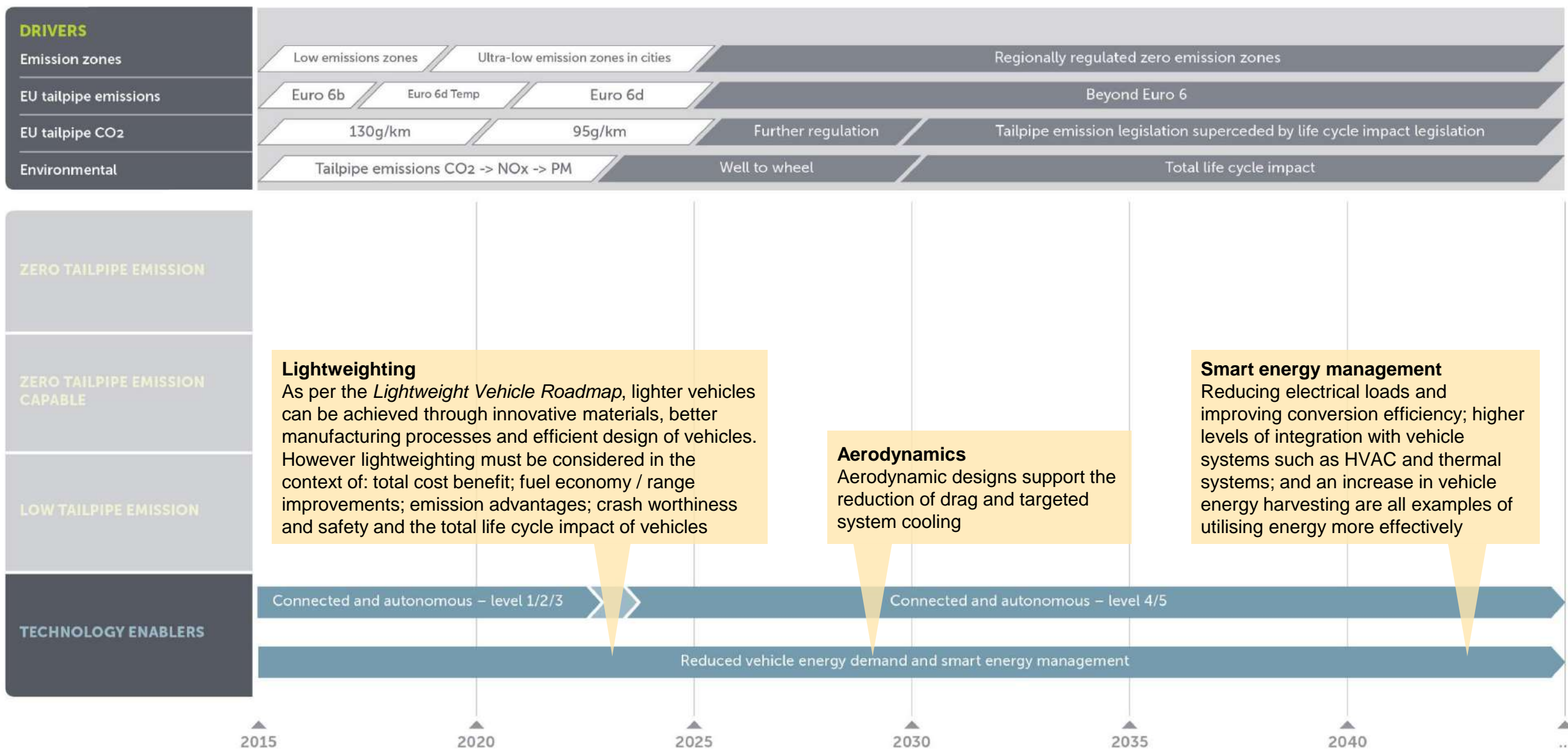
Categories: *In response to CO2 and pollutant emission legislation, passenger car products can be categorised as low tailpipe emission, zero tailpipe emission capable and zero tailpipe emission with supporting technology enablers*



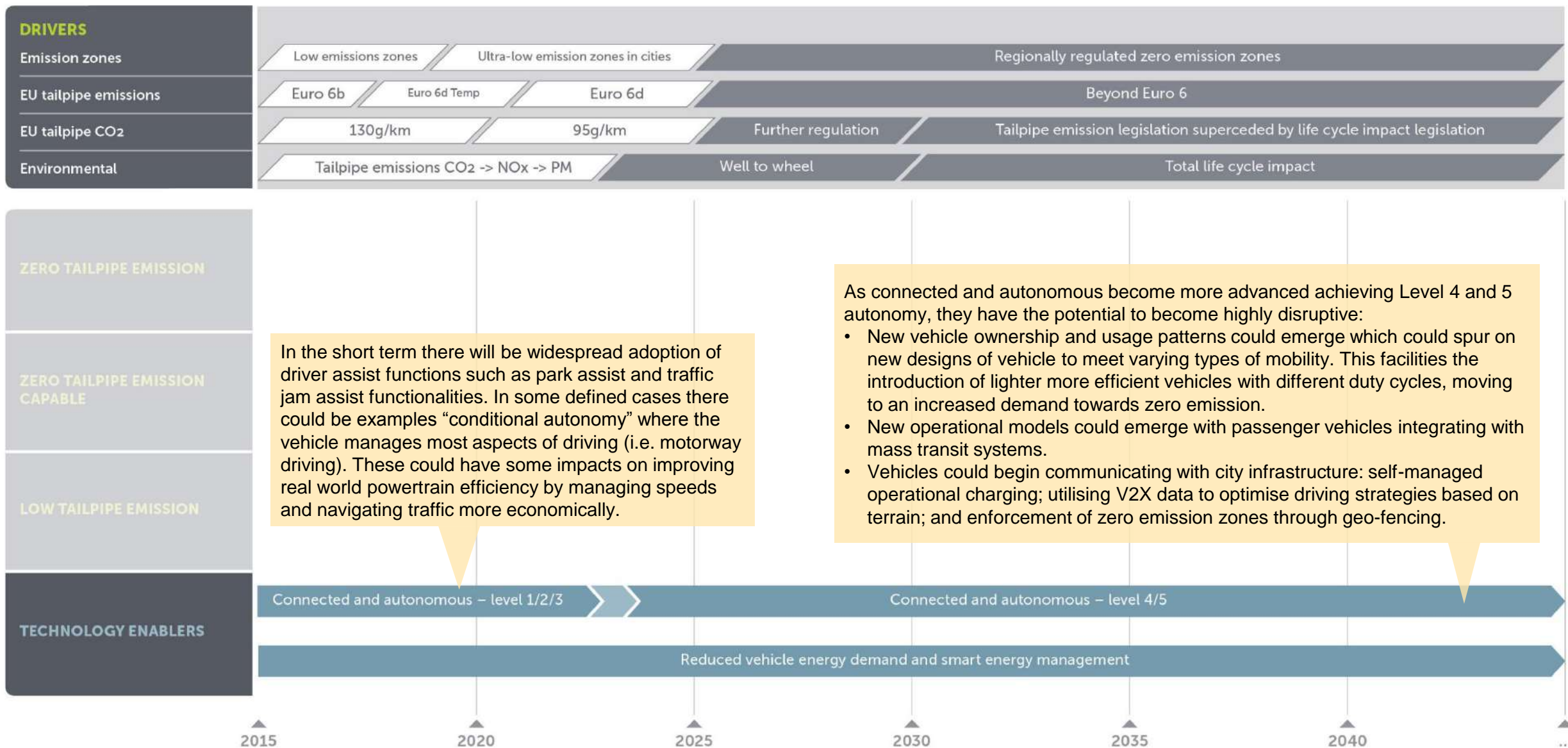
Infrastructure: Mass market adoption of alternatively fuelled vehicles is highly dependent on introducing a refuelling infrastructure capable of handling the increased energy demand from transport



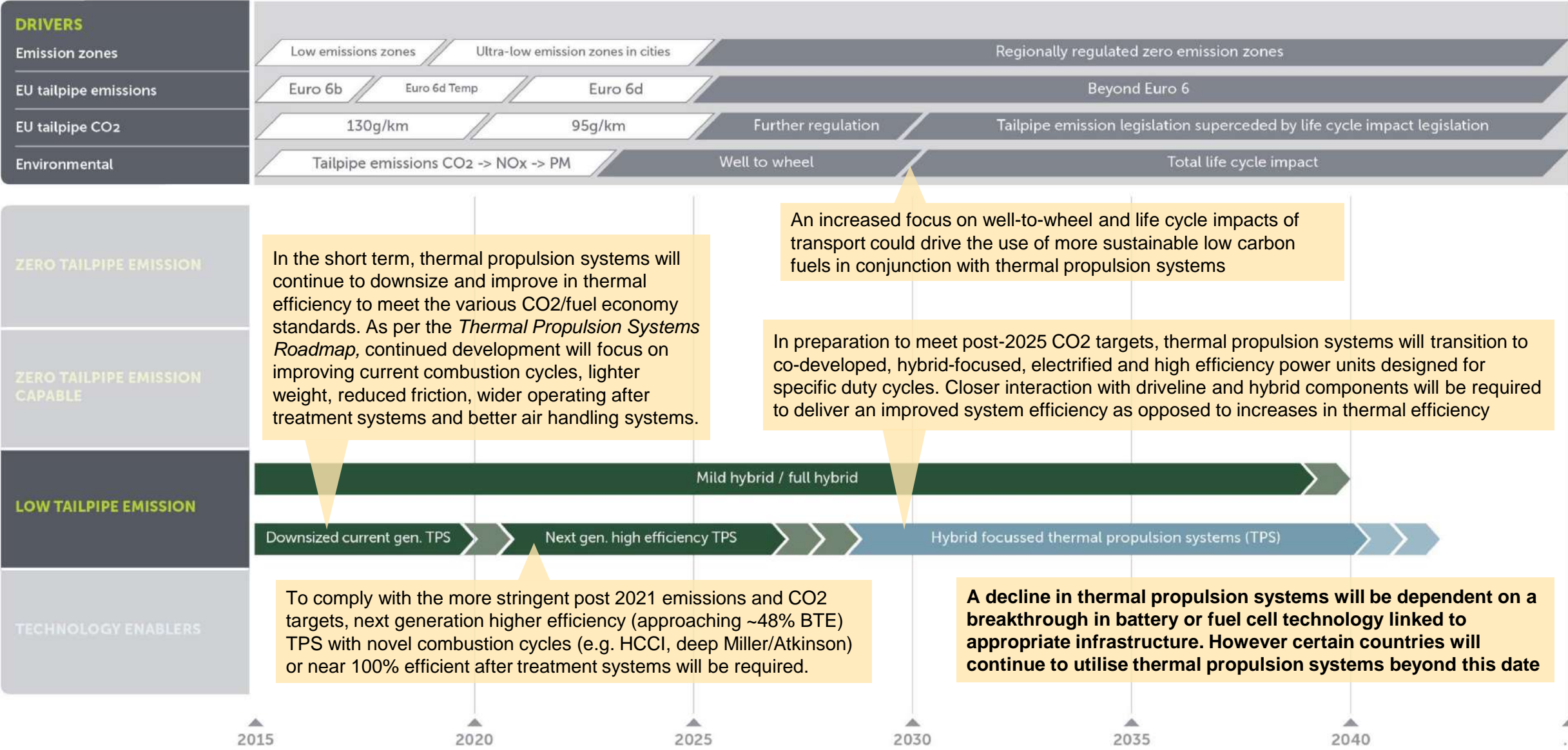
Technology enablers: *Lightweighting, smart energy management and improved aerodynamics are continuous engineering tasks that are fundamental for all vehicle types.*



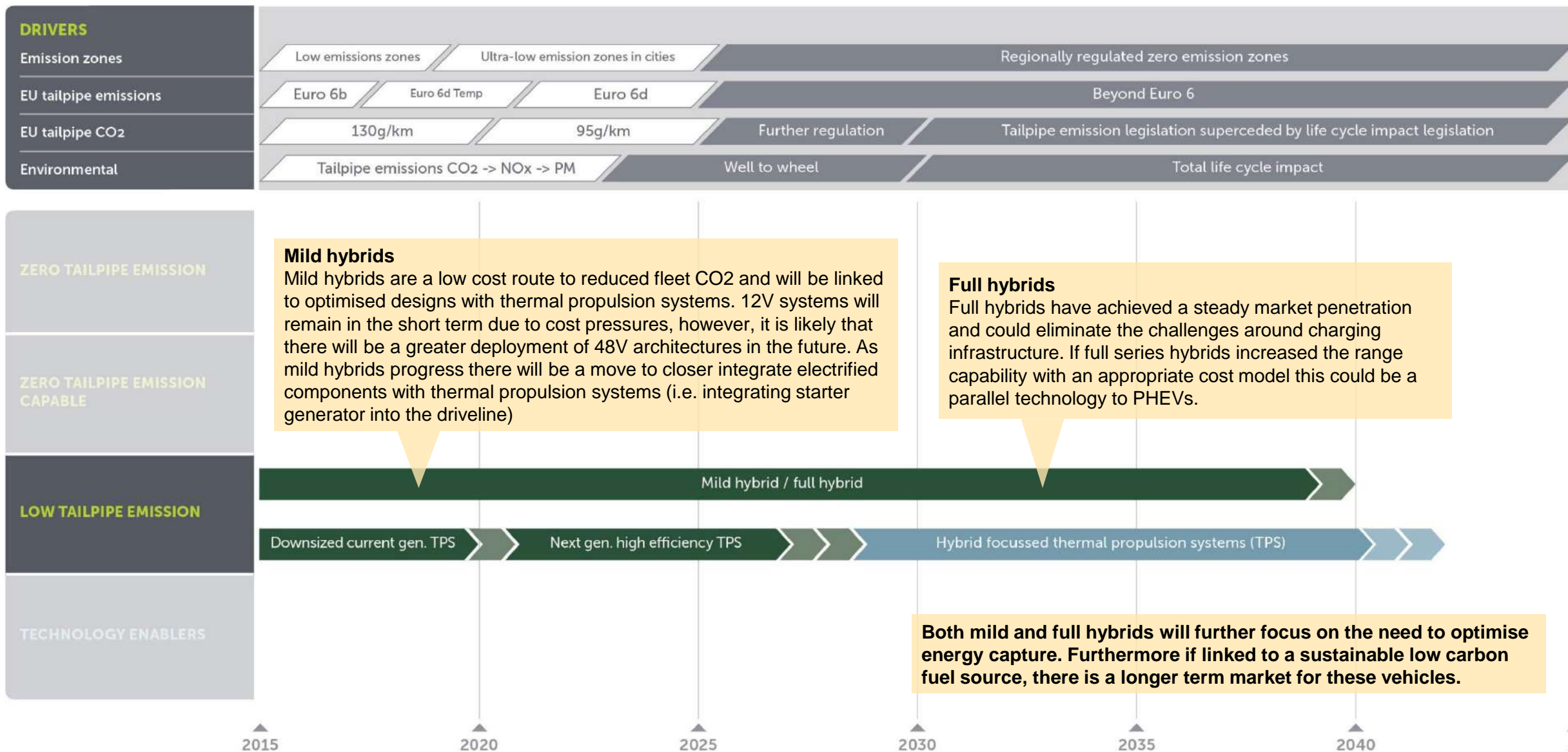
Technology enablers: Vehicles that are connected and autonomous have the potential to alter powertrains with new emerging business models and drive cycle changes



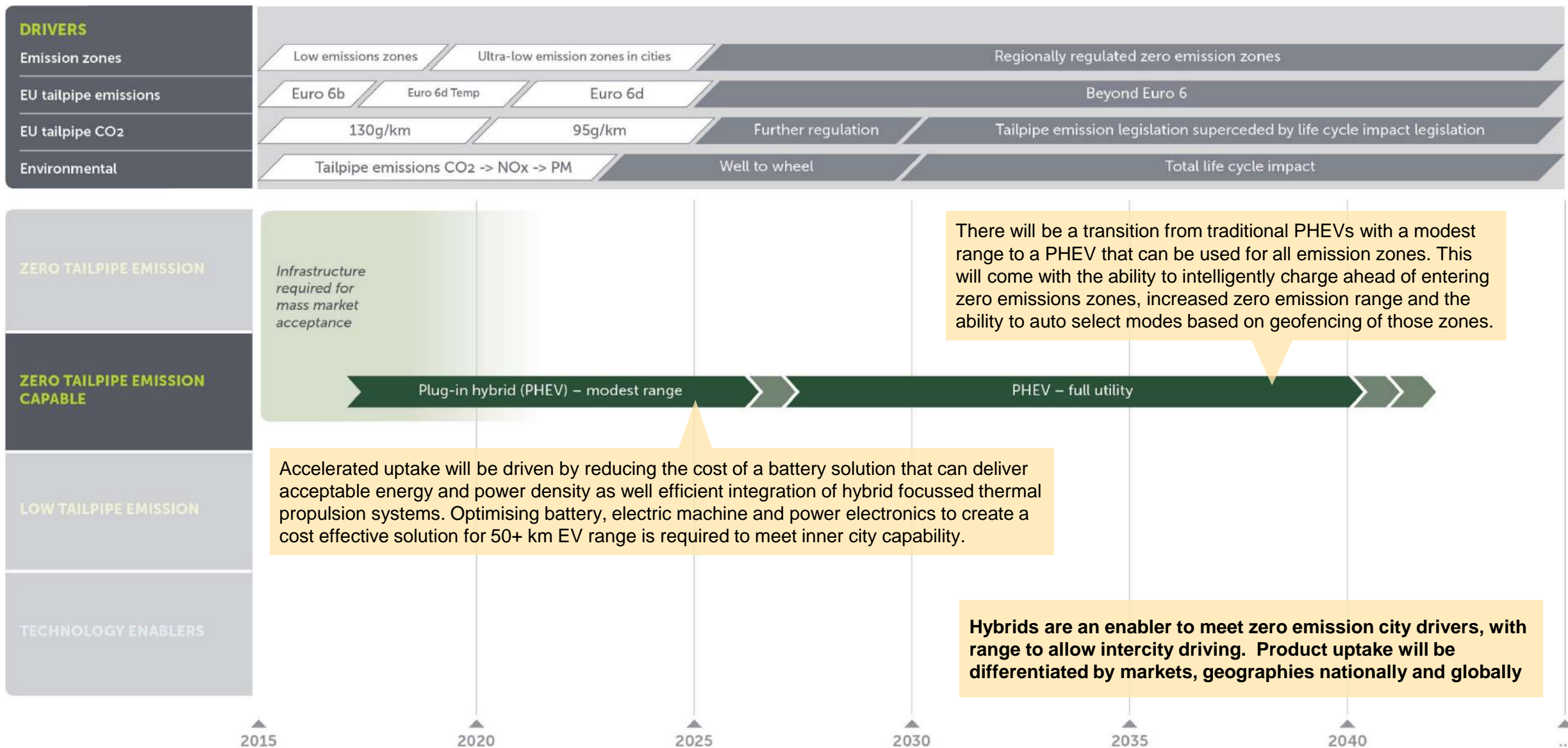
Low tailpipe emission: Thermal propulsion systems remain critical for future passenger car powertrains but they will increasingly function as part of system rather than act as the sole propulsion device



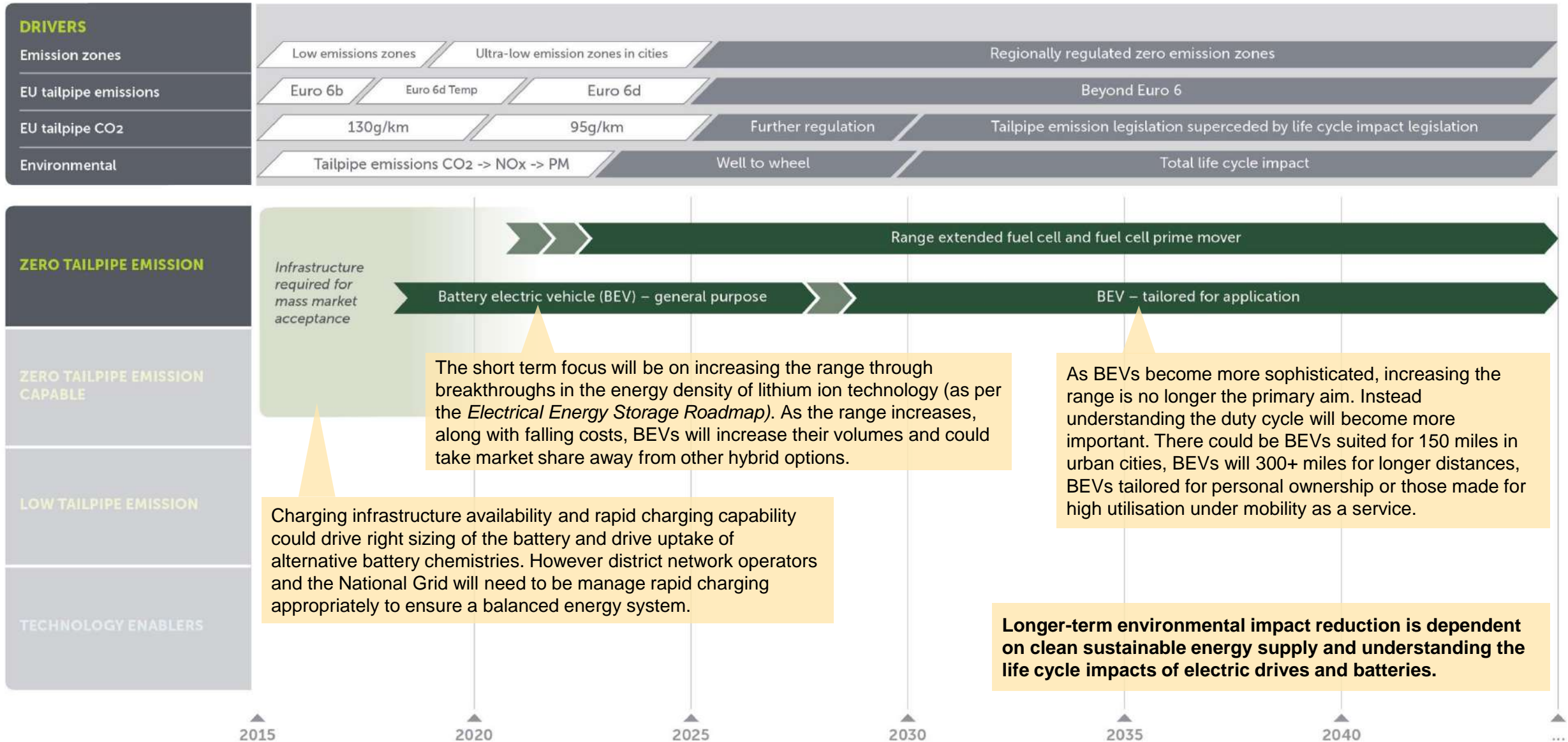
Low tailpipe emission: Both mild and full hybrids are a lower cost way of achieving lower CO2 and pollutant emissions



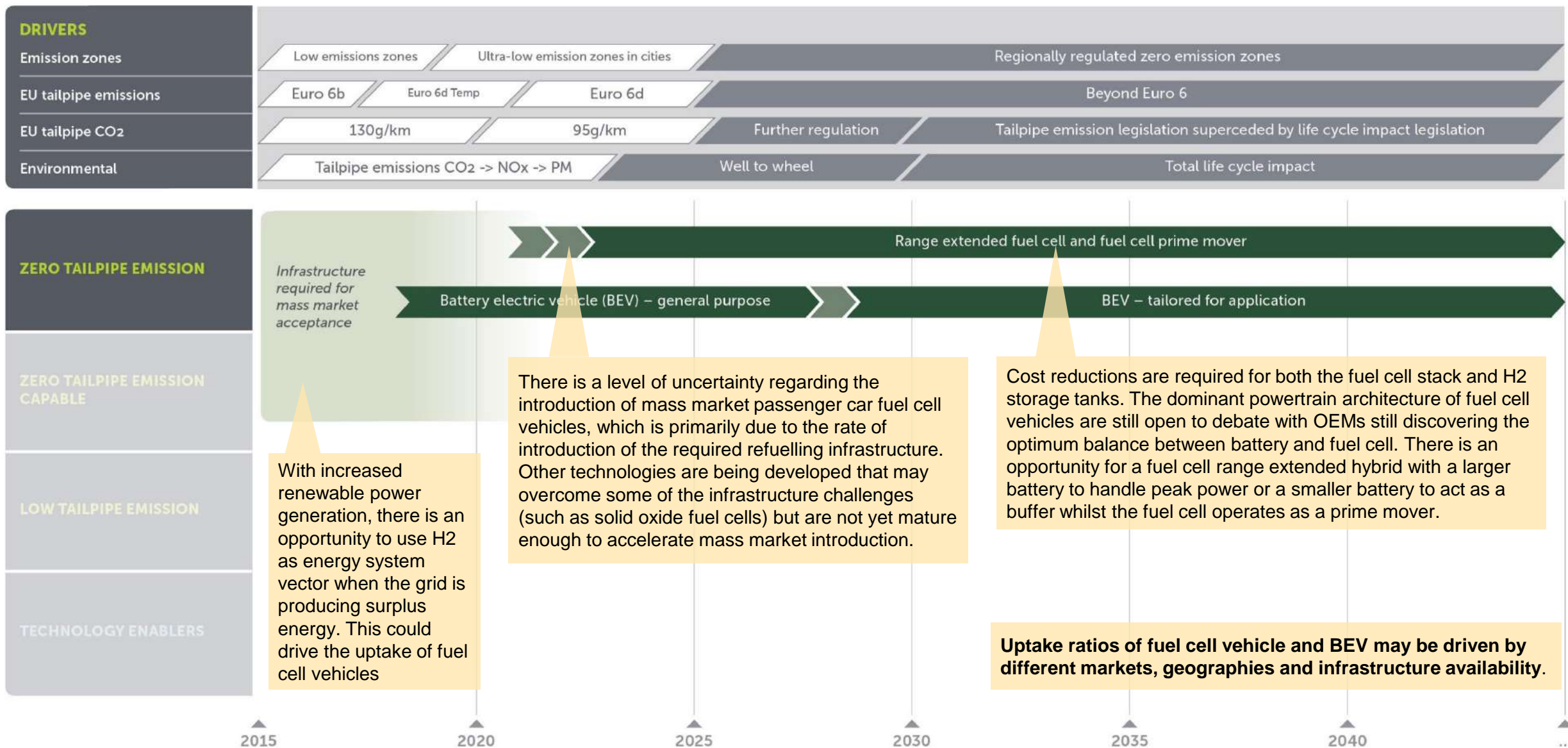
Zero tailpipe emission capable: Plug-in hybrids are a pragmatic approach in achieving a zero emission range capability for cities and travelling long distances with an alternate power source



Zero tailpipe emission: Improvements in battery technology are needed to increase the range in the short term but longer term BEVs will be tailored for bespoke applications

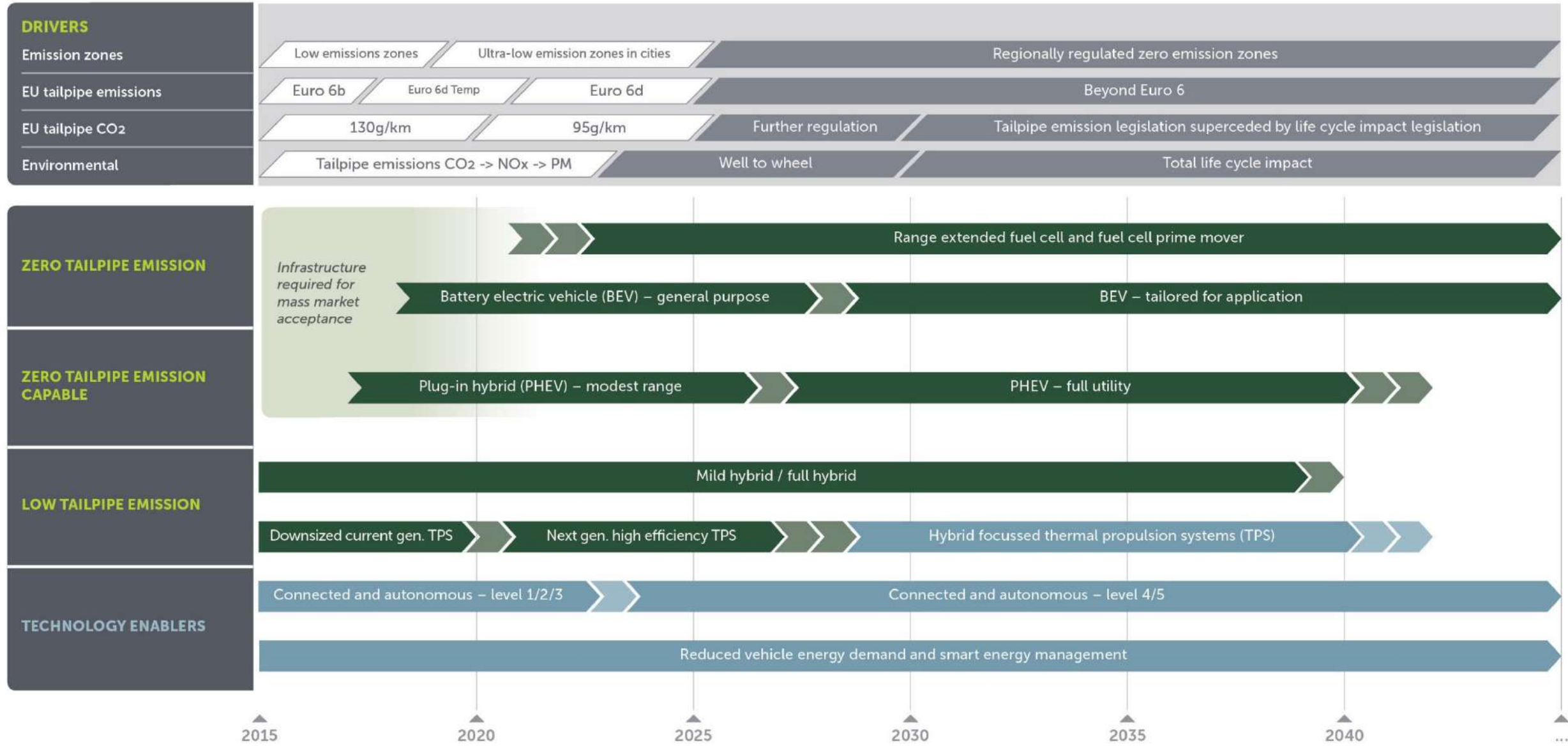


Zero tailpipe emission: Fuel cell vehicles still need overcome the infrastructure challenges but provide a competing solution to battery technology when looking at the whole energy system



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Roadmap developed by the Automotive Council and the Advanced Propulsion Centre



Driver set
 Driver predicted
 Solid bar represents >1% global marked adoption and is preceded by significant product and process R&D
 >>> 1 chevron = some uncertainty around timing of mass market adoption or phase out
 >>>> 2 chevrons = considerable uncertainty around timing of mass market adoption or phase out