

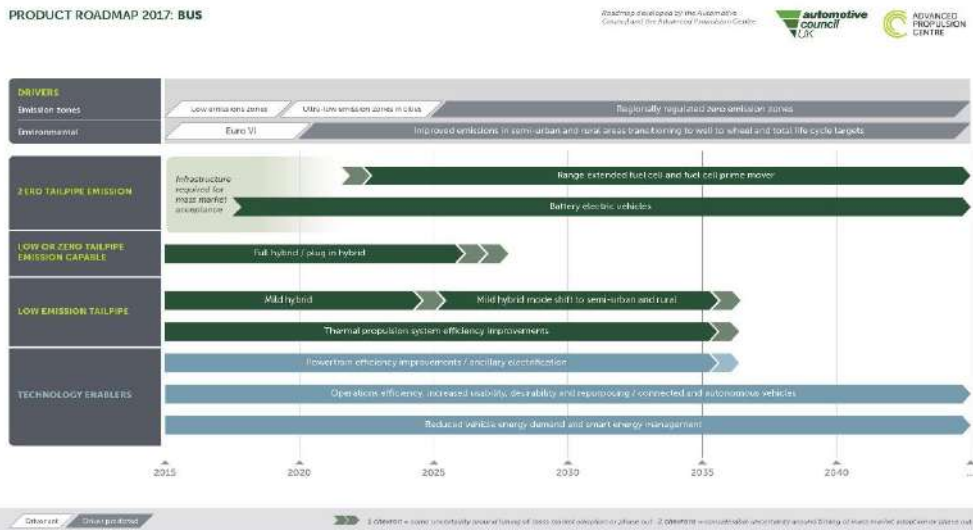
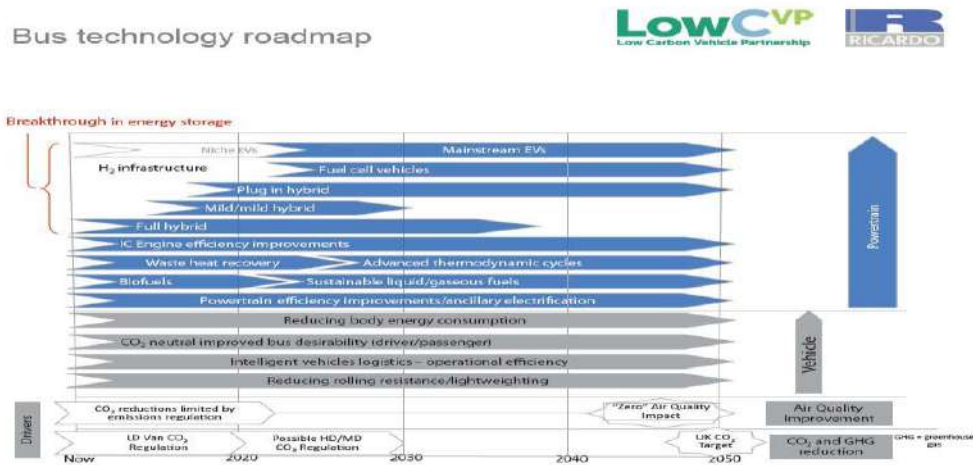


Bus Roadmap



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

Executive summary – Bus roadmap



- The 2013 bus roadmap acknowledged both CO₂ and air quality as drivers and identified vehicle and powertrain level innovations - **with a slow evolution from hybrid technology to zero emission capable solutions**
- **The 2017 roadmap reflects the growing importance of air quality and zero emission operating zones on bus manufacturers which is causing a product stratification**
- **A cost effective carbon reduction solution is required for semi-urban/rural buses and a practical zero emission bus is required for city/urban operations**
- **The potential impact of vehicle connectivity and autonomy on how buses integrate into an intelligent public transport system is incorporated into this roadmap**
- **Infra-structural requirement has replaced “technology break through” as a noticeable 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 ✓

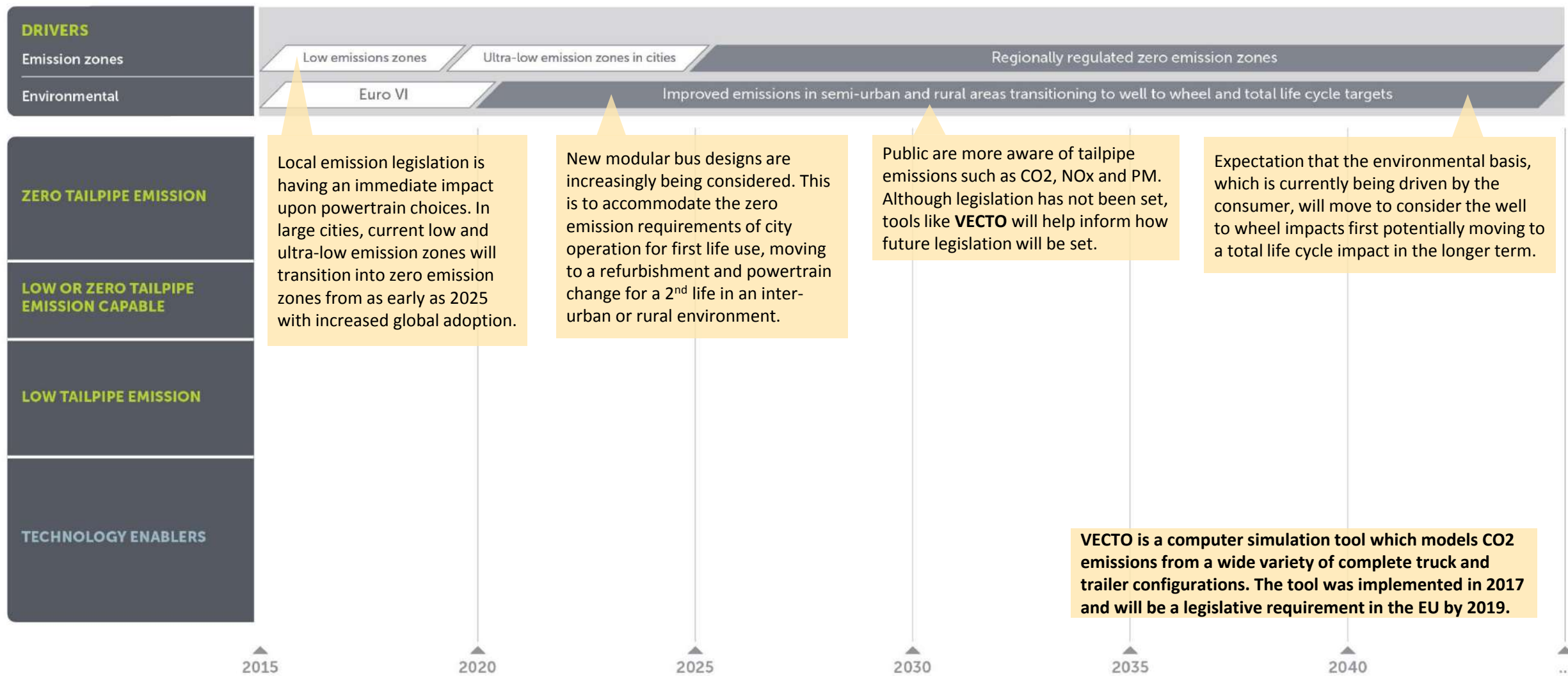
Consensus with participating OEM's ✓

Review with Automotive council Technology working group ✓

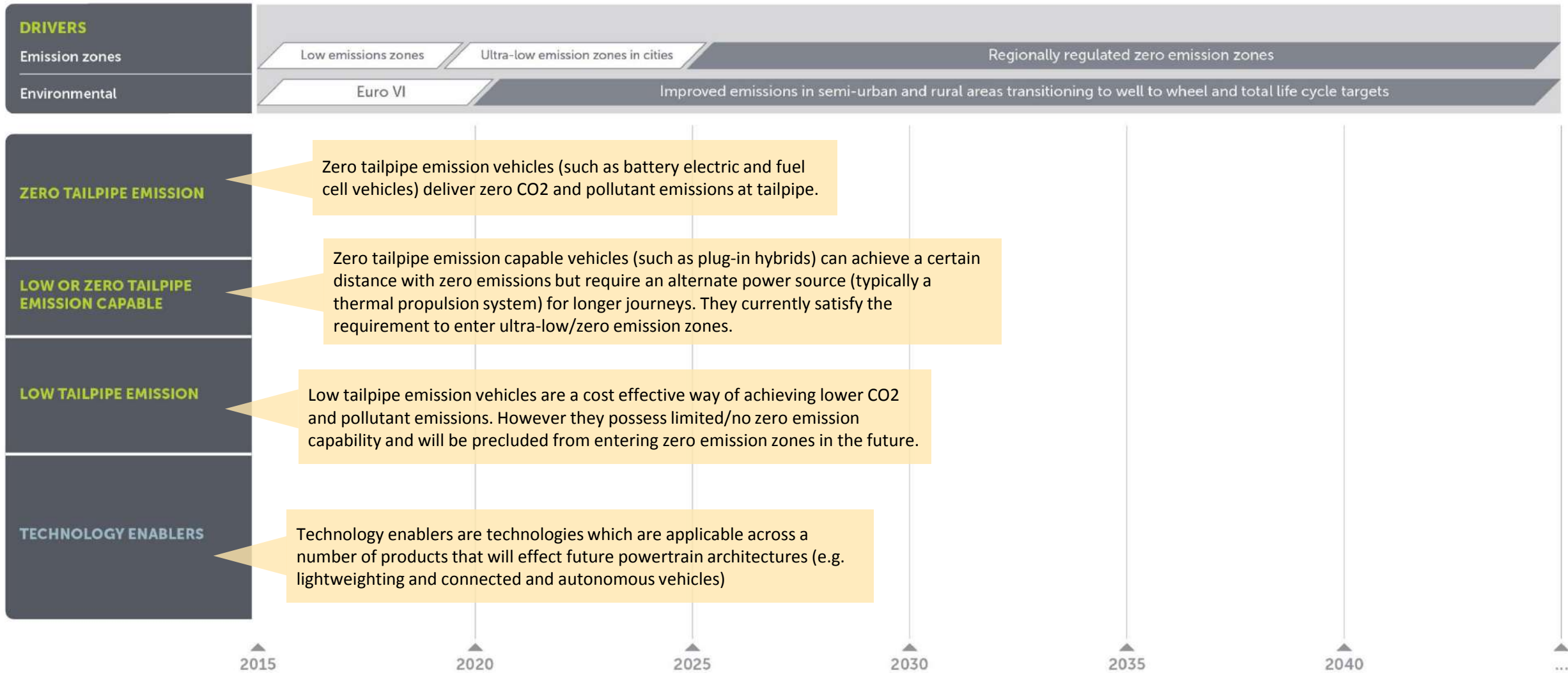
Developed new product roadmaps endorsed by the Automotive Council ✓



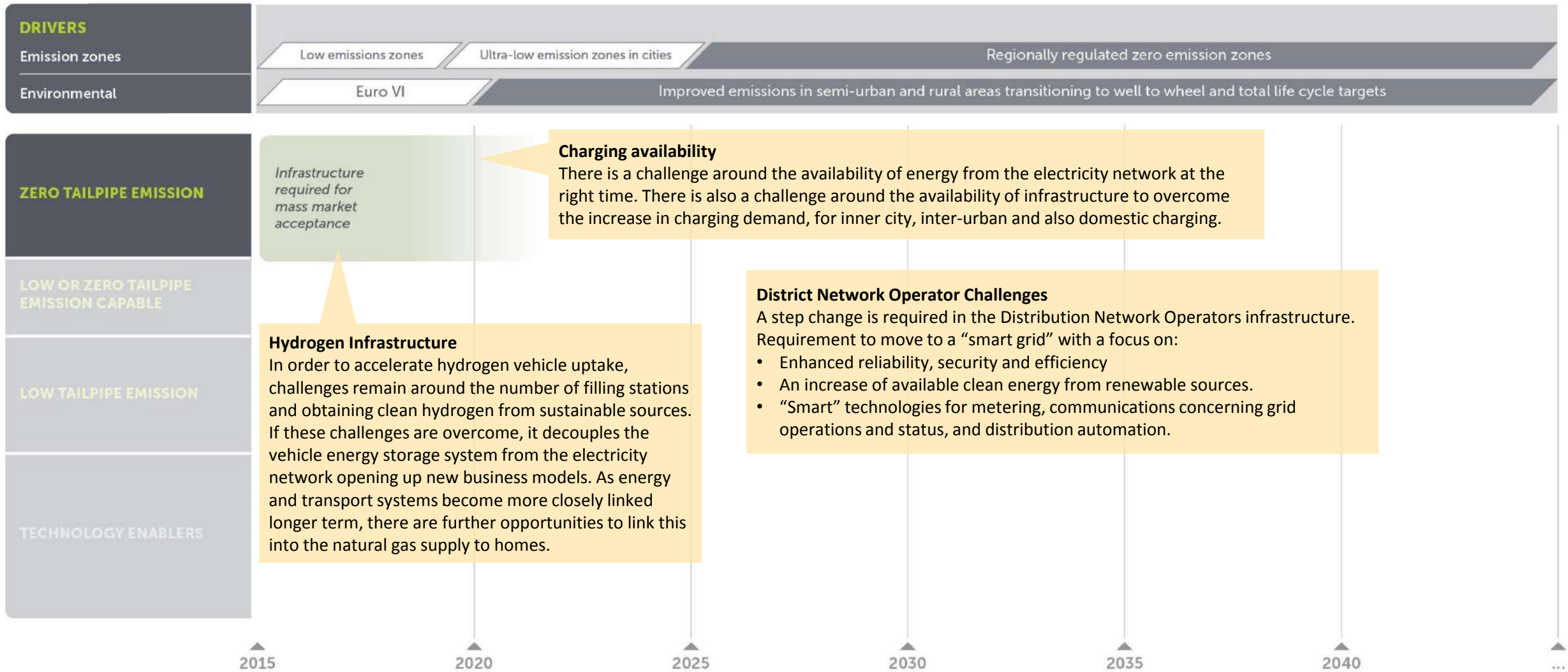
Drivers: Drivers have been defined as both regulatory and standards but also take into consideration the environmental basis which is market driven by the consumer



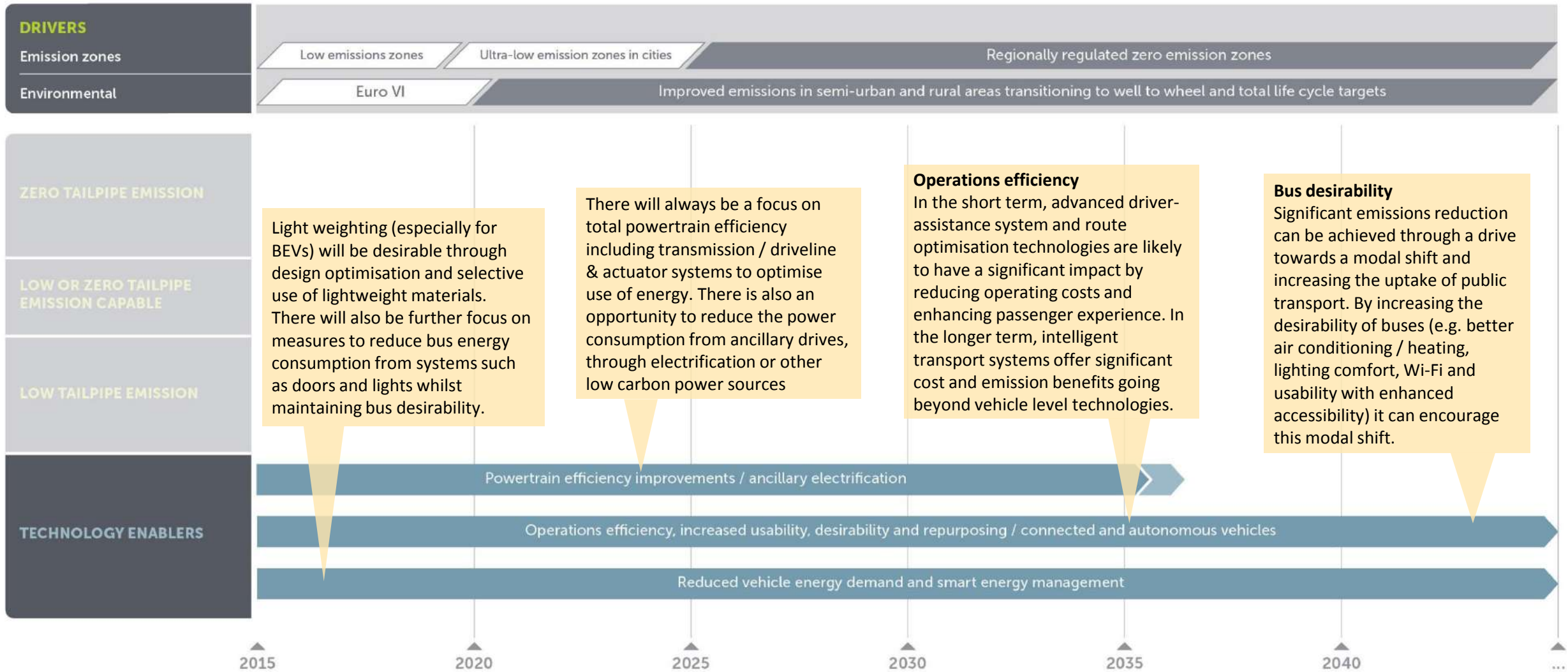
Categories: *In response pollutant emission and CO2 legislation, buses can be categorised as low tailpipe emission, low or zero tailpipe emission capable and zero tailpipe emission with supporting technology enablers*



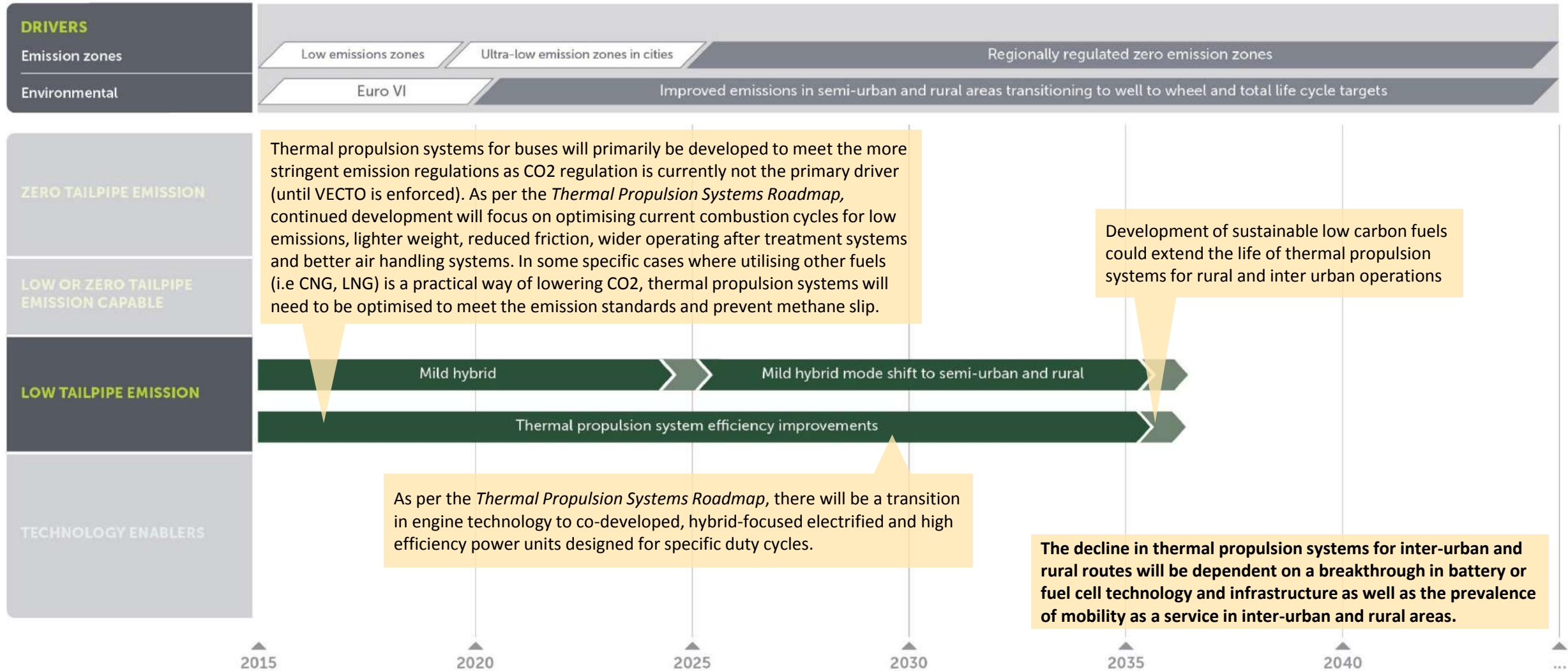
Infrastructure: Mass market adoption of alternatively fuelled buses is highly dependent on introducing a refuelling infrastructure capable of handling the increased energy demand from transport



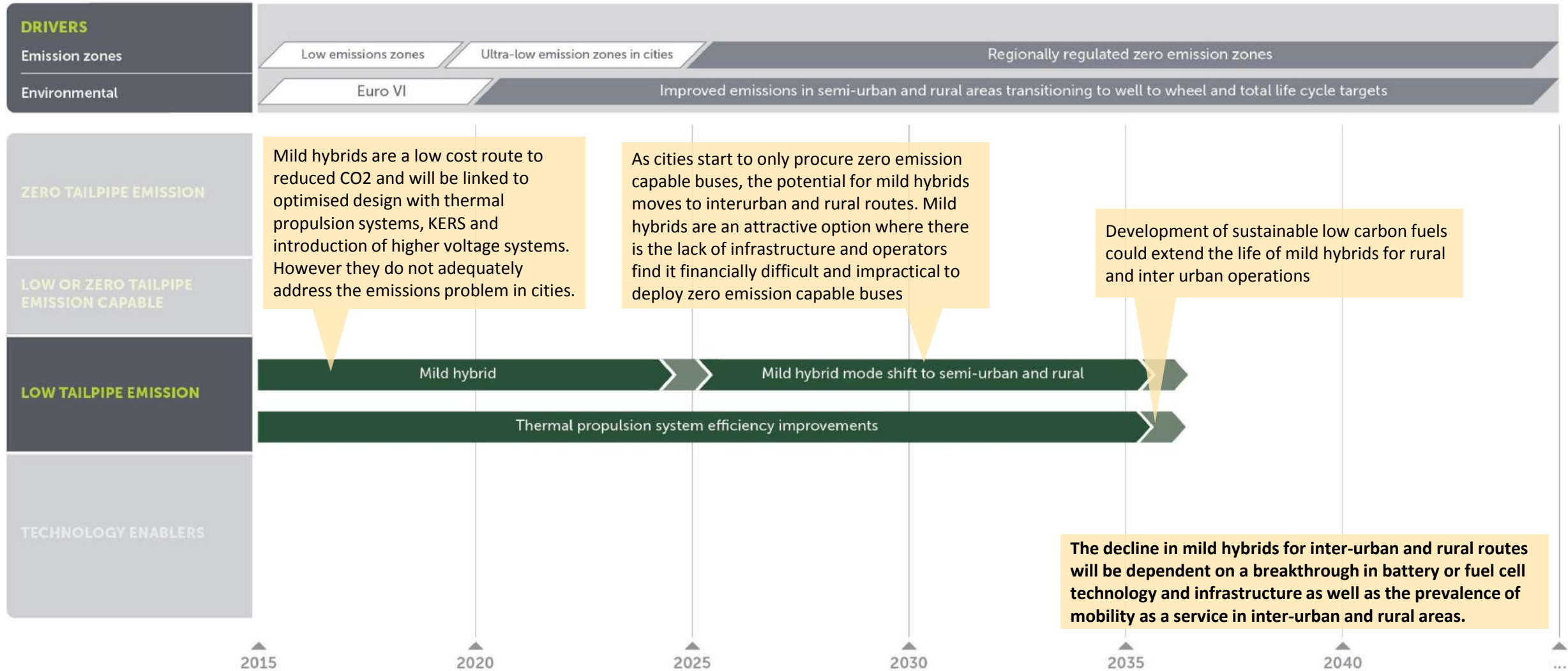
Technology enablers: Smart energy management, improved powertrain efficiencies and optimising operational efficiency will all improve bus powertrains



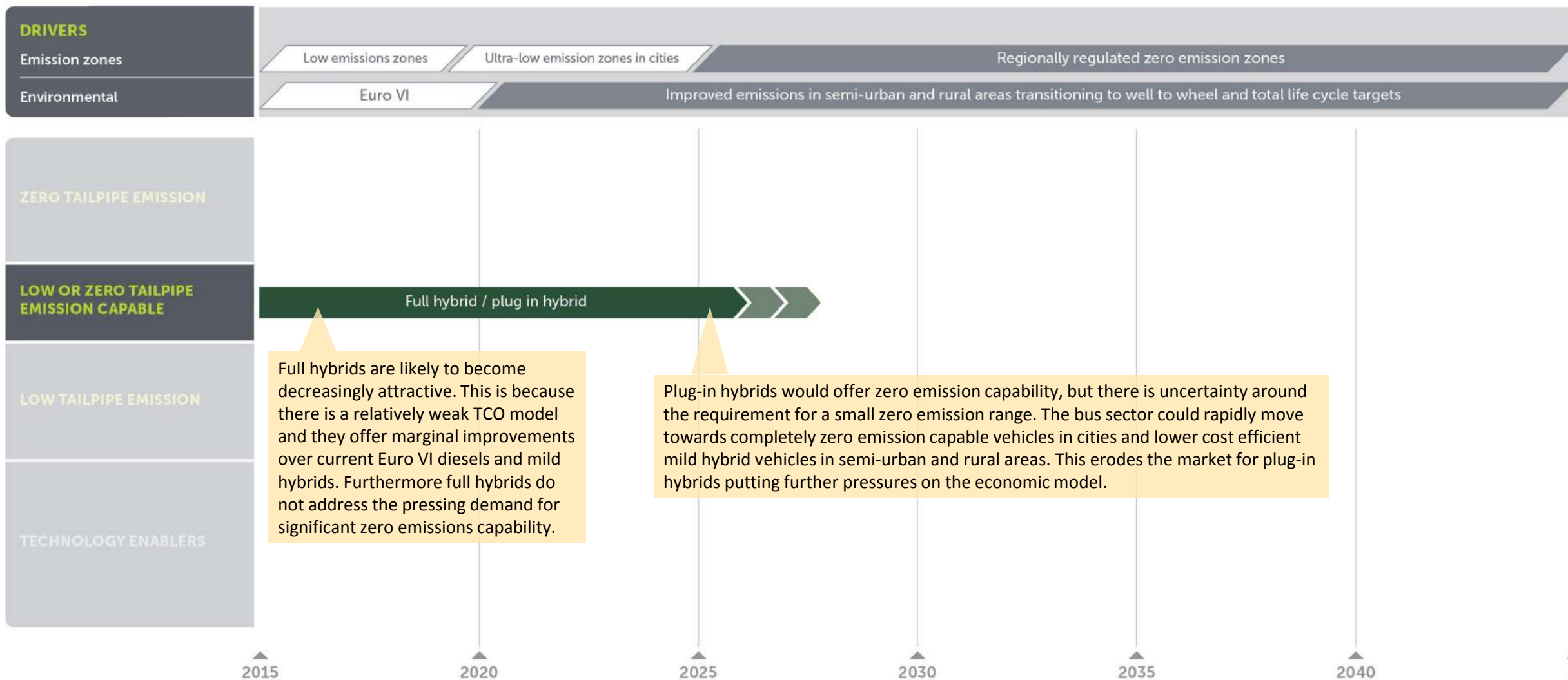
Low tailpipe emission: Thermal propulsion systems will remain important for rural and semi-urban buses in the short to medium term but they will function as part of a wider propulsion system



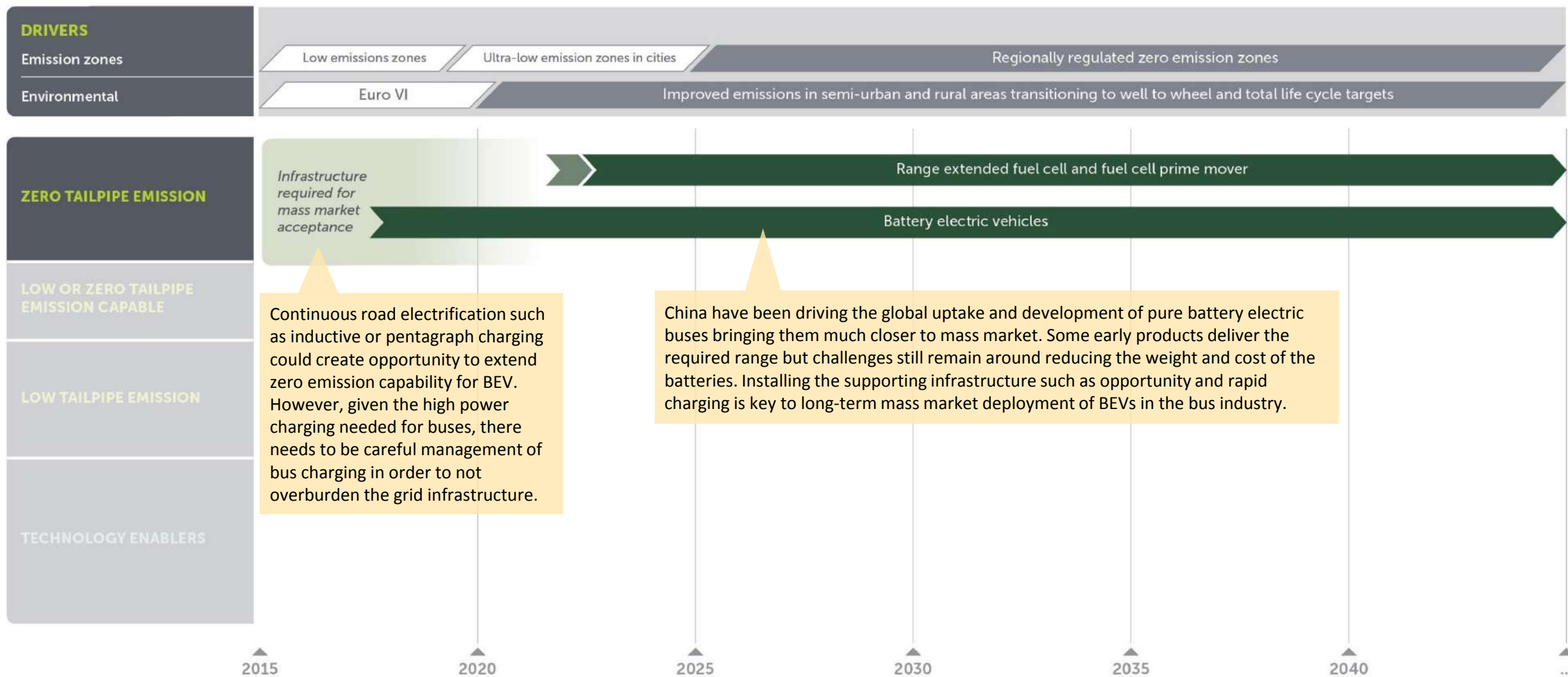
Low tailpipe emission: Mild hybrids offer significant CO₂ benefits for inter-urban and rural bus routes at an attractive cost



Low or zero tailpipe emission capable: Full hybrids may become less attractive due to the cost effectiveness of mild hybrids and plug-in hybrids are uncertain given the rapid drive towards completely zero emission buses



Zero tailpipe emission: Battery electric buses are a commercial reality in China but challenges still remain around the weight and cost of battery packs as well as the grid infrastructure



Zero tailpipe emission: *The timing of mass market introduction of fuel cell buses is uncertain given the current lack of infrastructure, however uptake could be driven first by captive fleets that have a central refuelling location*

