

APTA Sustainability Conference August 8, 2017

Bob Devine
BAE Systems, Power and Propulsion Solutions

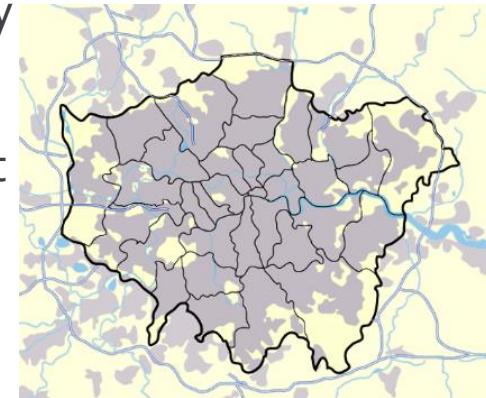
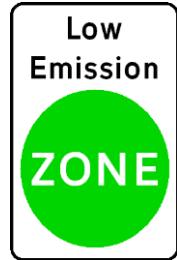


Cities eliminating cars and moving towards low and zero emission transportation to remain livable

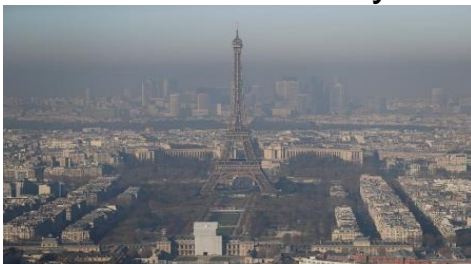
- Trend toward urbanization and revitalization of city cores
- Population growth, higher population densities -> emissions concentrations

Goals and Commitments:

- Oslo – getting very close to all ZE Transit – no cars in city 2019
- London – Mayor Khan – LEZ & ULEZ zones, phase in all ZE transit by 2050, ban purchase of diesel by 2025
- Amsterdam – Emission free transportation by 2025
- Copenhagen - Carbon Neutral by 2025 – Transportation key element
- Paris – by 2020, 20% vehicle emissions reduction – badging & eliminating car lanes
- Quebec – ZE by 2040
- Los Angeles – Zero emissions transportation by 2030
- Seattle - Zero emissions transportation by around 2030
- NYC – Mayor Bloomberg coordinating plan for US cities to uphold Paris C40 agreement
- CARB – all transit ZE by 2040



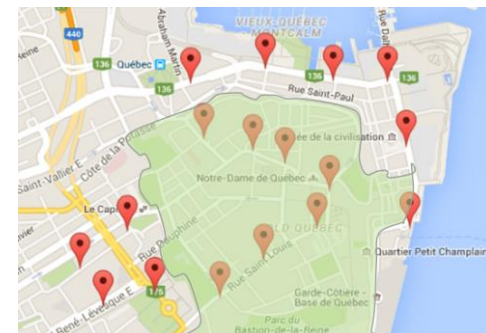
London Low Emission Zone



Thomas Samson/AFP/Getty Images



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Quebec Historic District

The challenge... London for example

Delivering on the Mayor's commitment; "tackling the worst pollution hotspots by delivering cleaner buses on the dirtiest routes"

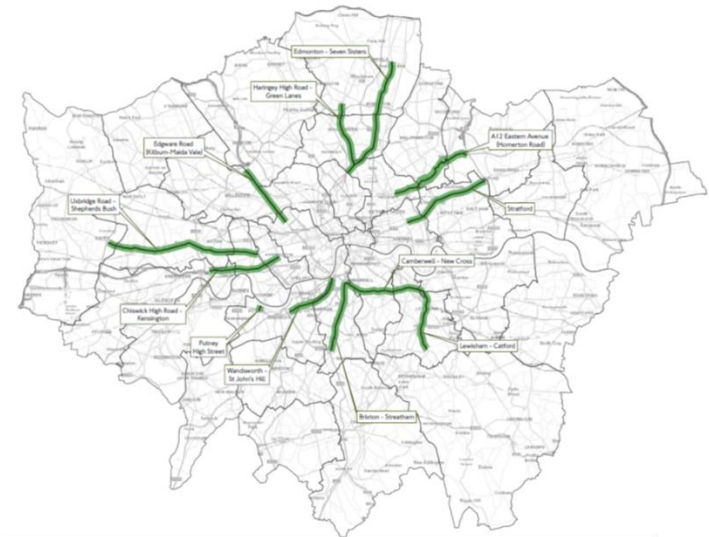
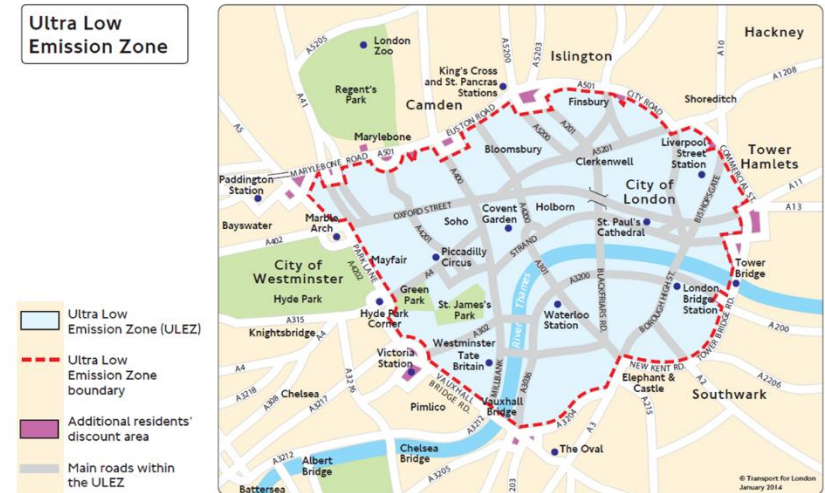
- Accelerated implementation of the ULEZ
- Introduction of Clean Bus Corridors

Battery-Electric and Fuel Cell buses can provide a zero emission solution:

- + Full time zero emissions operation
- + BEBs works well on specific routes
- + FCBs longer range, route independent

Series Electric Hybrids with Extended Engine off Modes can provide a part time ZE solution:

- + Zero emissions at street level
- + ZE ranges up to of 6 miles / 40 minutes addresses worst air quality areas and routes that touch the ULEZ
- + Automatic Geo Fencing form ZE mode
- + Complementary/Bridging technology between conventional and Full ZEB



What Transits are (naturally) Concerned With

- Costs – Capital and Operating including infrastructure, facilities, charging/fuel, maintenance and training
- Range and Range Variability – Seasonal (heating/cooling) impacts and battery aging effects
- Availability, Route Planning and Assignments – How will my day to day operations and ability to provide services be affected?
- Will there be an impact to weight and seating capacity?
- How will utilization factors affect my fleet size for same level of service?
- How well does ZEB technology work in northerly/cold climates?
- How do I protect my investment in infrastructure of the long term – will my charging / refueling infrastructure work for any ZE bus that I buy?
- How does support and obsolescence management work over the long term (12 – 15 years)?
- What support can OEMs be relied on to provide now and over the long term?
- How does the technology transition / phase in work? (across all aspects of my operation)
- What do I have to do differently to specify and procure ZEB bus that will work for my agency? Do I have the staff and the expertise?
- How do I gain confidence that economic benefits / payback can be realized and/or subsidies are sustained?

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What do we need to do phase-in near/zero emission buses

- Transit Agencies
 - Develop and have a strategy and plan for the future
 - Perform gap analysis of current strategy Vs required future strategy
 - Fill the gaps
 - Identify and Develop partnerships with infrastructure suppliers, OEMs, technology suppliers
 - Identify funding for infrastructure and technology
 - Define training and staffing to sustain new product
 - Define gates to demonstrate success of strategy
 - Collaborate with EVERYONE! – Peers, Stakeholders, Energy Suppliers. Learn from Experience
- Product and Technology
 - Assess gaps in current technology versus future technology operational performance
 - Develop or support in developing complete solutions: product, infrastructure, training and other sustainment tools
 - Develop and provide technology roadmap for long term product support and enhancement

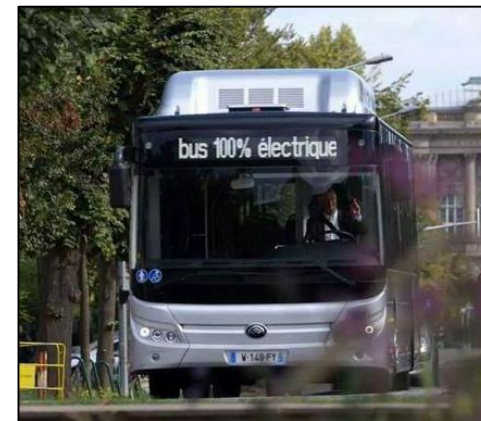
Zero Emission Bus testing in Paris



Ballore – Blue Bus



Irizar i2e



Yutong



BYD

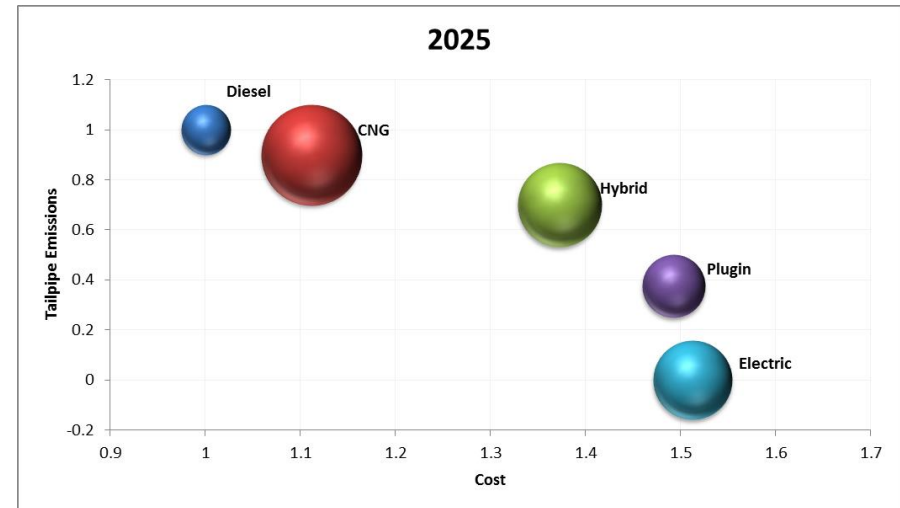
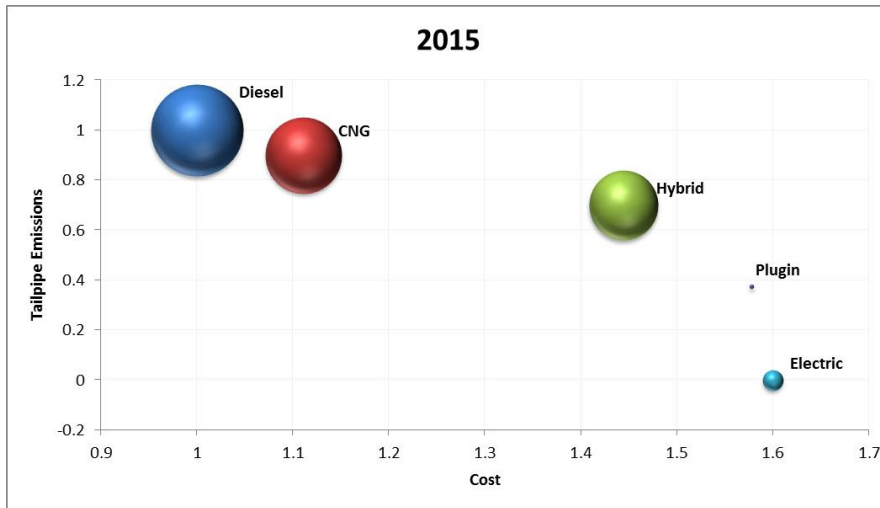


Solaris Urbino EV



Iveco GX Elec

Future Trends - North America Transit Bus



Expectations:

- Reduction in conventional diesel bus purchases
- Growth in CNG bus purchases
- Cost reductions in Hybrid, Plug In, Battery Electric and Fuel Cell Buses
- Moderate growth in (series) Hybrid
- Significant Growth in Plug In/Battery Dominant Hybrid and all Electric & Fuel Cell

Data from Oct 2016 Frost and Sullivan report

Thank you

Bob Devine
BAE Systems
Power & Propulsion Solutions

Robert.w.devine@baesystems.com
607-770-3276