Electric Buses – A Decade of Development
Electric Buses – A Decade of Innovation & Learning

• EV Solo introduced in March 2009
  – 50 miles range
  – 35 passengers
  – 80 kWh

• Latest generation EV bus into service in March 2019
  – 150 mile range
  – 60 passengers
  – 240 kWh

• A decade of operation. Lots of lessons learned
A Decade of EVs – Key Lessons Learned

• Battery electric buses deliver

• Less charging is more

• Efficiency remains king

• Innovation is accelerating

• Costs are coming down
Lessons Learned – EV Buses Deliver

• >95% availability

• 15 hour operation today

• Suitable for a wide range of duties
  – Park & ride to TfL operation

• Oldest vehicles in service 9 years

• 100,000 miles plus
EV Lessons Learned – Less Charging is More

• Charging ages batteries

• The faster the charge the shorter the battery life

• Charging a culture shock for operators

• Fast charging or high charge demand is expensive

• Low density batteries limit range & need fast charging to deliver service
  – Vicious circle of weight & complexity

• Focus on overnight charging via more energy with no weight penalty
EV Lessons Learned – Efficiency Remains King

• Bus battery energy a precious resource
• Zero Emission heating an added challenge
• Energy = weight, cost, charge demand & infrastructure
• EV Future based on lightweight platforms with efficient drive lines & systems
EV Lessons Learned – Innovation is accelerating

• Clean air agenda driving innovation
  – Zero emission at point of use
  – Electrification of cities

• Rising global OE EV involvement fuelling innovation
  – Drive line
  – Batteries

• Tier 1 suppliers replacing boutique engineering start ups

• Battery chemistry evolving rapidly
  – Energy density doubling every 15 years
  – >150% increase in energy carried for <5% weight increase
EV Lessons Learned – Costs are coming down

- Battery 50% of EV premium
- Battery costs per kWh more than halved 2010 – 2017
  - kWh increases have masked trend
- Prediction of €100 Per kWh by 2025
- €100/KWh reduces EV premium by 35%
- Volume supply base will bring additional savings
- WLC reducing through extended warranties
• 30% increase in available energy

• >200 zero emission miles on a single charge

• Battery packs future proofed for chemistry change

• Leased packs with second lives & whole life warranties

• Whole life cost less than diesel

• lower cost fast charging?

• Technology will deliver