



# The Electric Bus

## Get on Board!



# Why Go Electric?



- Clean – No Tailpipe Emissions
- Quiet – Less motor noise and vibration
- Comfortable – Smooth Starts and Stops
- Efficient – Lowest Fuel Cost, Lowest Maintenance Cost



# Clean – No Tailpipe Emissions



- A battery electric bus does not emit:
  - Greenhouse gas (CO<sub>2</sub>) that harms the planet
  - Particulates that cause health problems
  - Smog-forming combustion byproducts (they stink)
- Benefits Include:
  - Cleaner air in our communities
  - Less asthma and respiratory disease
  - Less global warming



# Quiet – Less Motor Noise



- Electric motors make less noise than internal combustion motors
- Electric motors do not vibrate like gas, diesel, or CNG motors
- When the bus is stopped, the electric motor is stopped, but a gas engine must keep idling
- Electric motors produce high power at low speed, so they do not need to be revved up to get the bus moving
- A more pleasant experience for riders, drivers, and bystanders



# Comfortable – Smooth Ride



- Electric buses use regenerative braking – the motor becomes a generator that recharges the battery as it slows the bus
- Starts and stops are smoother than with a gas engine, gear shifts, and friction brakes
- That means less particulates from brake wear, and cleaner air
- The result is a smoother and more pleasant ride



# Efficient – Low Cost Operation



- Electric motors are more efficient – less energy is wasted as heat
- Even if the electricity is generated by burning fossil fuel at a power plant, it takes less fuel than an internal combustion engine on the bus
- If the electricity is from renewables like solar and wind, the carbon emissions are zero and the fuel cost is even lower
- Batteries are usually charged at night, when unused wind power is plentiful and rates are the lowest
- Maintenance costs are lower for electric motors



# Issues



- Initial Cost of Buses
- Range
- Operations and Maintenance
- Charging Infrastructure
- Electricity Cost



# Bus Cost



- Electric buses are still more expensive than diesel or CNG
- Total cost of ownership is lower due to lower fuel & maintenance
- Competition and economies of scale will further reduce initial cost
- Over the last four years, the cost has dropped by 20 to 25%
- This is mainly due to improved battery technology
- Costs are expected to decline further relative to other fuel types





# Range



- Rapidly improving battery technology is improving range
- Battery density has increased by 40% in the last four years
- Buses with 200 miles per charge are commonly available
- Maximum ranges keep increasing, 350 miles/charge is available
- Well over half of urban bus routes are less than 150 miles/day



# Operations and Maintenance



- Electric buses have lower maintenance costs than other fuel types
- Electric drive trains have far fewer moving parts
- Oil changes are not required
- Electric motors last longer than internal combustion engines
- Electric transit vehicles (trains, trolleys) have been in use for more than 100 years – the technology is mature
- Extended warranties on batteries are available
- Some companies offer battery leases



# Charging Infrastructure



- There is a one-time startup cost to install charging infrastructure
- SDG&E is working on innovative approaches to funding, where they would install and rate-base the electrical infrastructure



# Electricity Cost



- Electric power is already the cheapest bus fuel per mile
- Installing solar on or offsite could reduce costs further
- Low Carbon Fuel Standard Credits are about \$9,000 per bus per year
- Charging can mostly be done when electricity rates are lowest
- Utilities are proposing favorable new tariffs for transit electrification



# Get On Board the Electric Bus



- This summer, the California Air Resources Board (CARB) will be issuing a rule requiring a transition to electric buses in future years
- Many transit agencies are already running some electric buses, and more have electric buses on order
- It is time for our transit agencies, MTS and NCTD, to get on board



## For More Information



- Union of Concerned Scientists Report on Electrification of Transit <http://www.ucsusa.org/clean-vehicles/electric-vehicles/freight-electrification#.WQ3pktyVu01>
- King County Wa Feasibility Report [http://kingcounty.gov/~media/elected/executive/constantine/news/documents/Zero\\_Emission\\_Fleet.ashx?la=en](http://kingcounty.gov/~media/elected/executive/constantine/news/documents/Zero_Emission_Fleet.ashx?la=en)
- EBUS <http://ebus.com/>
- GreenPower <http://www.greenpowerbus.com/>
- Proterra <https://www.proterra.com/>