

# CHARGING INTO THE FUTURE

Colin Mickle [cjmickle@ucdavis.edu](mailto:cjmickle@ucdavis.edu) Jessica Siegel [jssiegel@ucdavis.edu](mailto:jssiegel@ucdavis.edu) Katrina Sutton [kmsutton@ucdavis.edu](mailto:kmsutton@ucdavis.edu)

## ZERO-NET ENERGY

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### UNITRANS AT A GLANCE

- 4.5 PASSENGERS / VEHICLE MILE
- SERVES 18% OF UCD COMMUNITY
- 20 BUS ROUTES
- 49 BUSES
- 1,000,000+ MILES / YEAR
- 3,900,000 PASSENGERS / YEAR

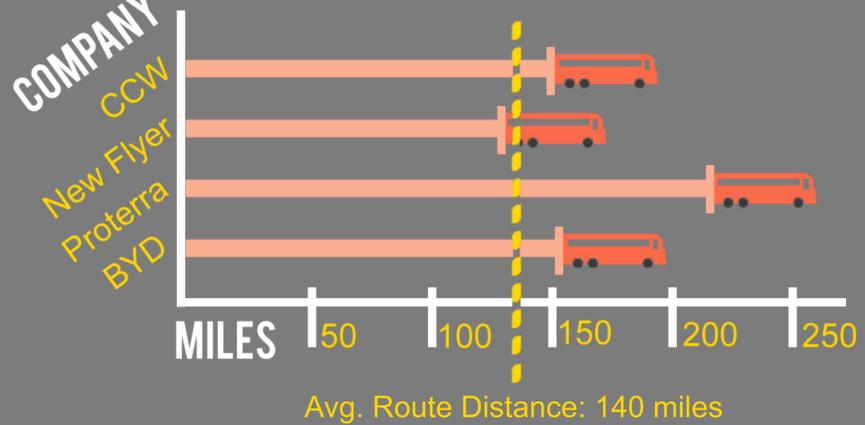
### ABSTRACT

The UC Davis bus service, Unitrans, has a fleet of 49 buses – 44 are run on compressed natural gas (CNG). In the next 3 years, 13 buses will be replaced. However, rather than purchasing more CNG buses, Unitrans is considering adding electric buses to their fleet to save money and reduce greenhouse gas emissions. In our report, we review current electric bus technology and perform cost and emissions analysis for electric versus CNG buses. Our findings indicate that most electric buses are compatible with the average route demands of Unitrans. Furthermore, the results of our economic and emissions model suggest each electric bus could reduce 33 metric tons of CO2 equivalent per year and save roughly \$213,000 for the usephase of the vehicle relative to CNG.

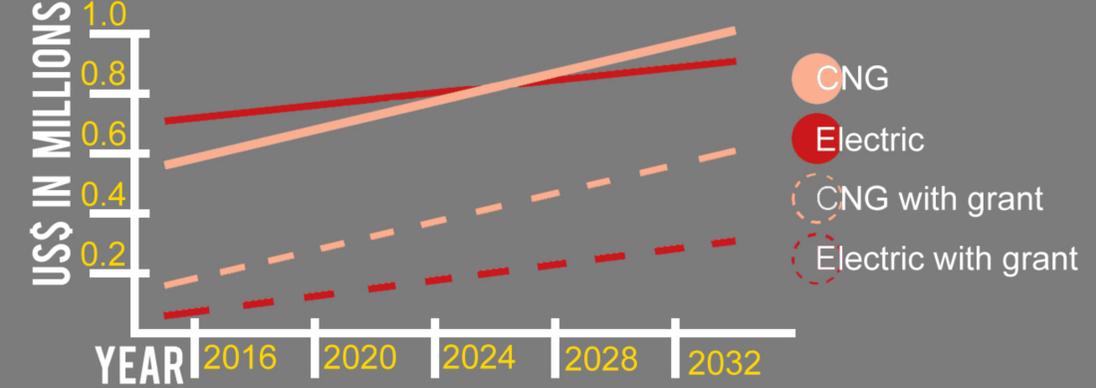
### METHODS

Data for a CNG bus, including miles per therm and cost estimates, came from the Unitrans accounting inventory. For an electric bus, we averaged the specifications of four marketleading electric buses to determine the cost, range, and kilowatthour per mile. Per Unitrans data, we assumed an average of 20,000 annual miles per bus with a 12-year lifetime. Uncertainty arose when we forecasted prices from a blended projection calculation from the UC Davis Office of Environmental Stewardship and Sustainability for CNG and E3 estimates for electricity. Maintenance was assumed to be \$0.60 per mile for CNG buses from Unitrans data; electric bus maintenance costs were assumed to be \$0.40 per mile according to a Protterra representative. Per a California Air Resources presentation, the grant funding potential for a CNG bus was \$431,000 and \$656,000 for electric. The installation of charging infrastructure was excluded.

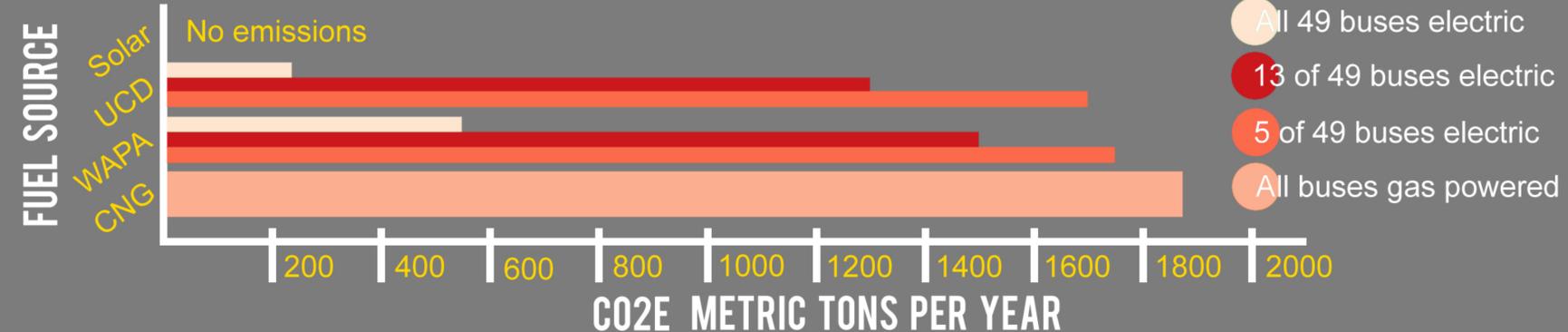
### RANGE PER CHARGE



### CUMULATIVE BUS COST



### POTENTIAL FLEET EMISSIONS



### CONCLUSIONS AND RECOMMENDATIONS

Our results indicate that electric buses can feasibly replace some CNG buses in the Unitrans fleet. Furthermore, while dependent on capital costs, grant funding and energy prices, electric buses are likely to have lower lifetime costs compared to CNG. Finally, the emissions reductions associated with electric buses are significant. For instance, if electric buses were powered by attributed solar electricity, the bus and its fuel would have zero greenhouse gas emissions associated with its usephase. If 13 buses are charged on the UC Davis power grid, Unitrans will reduce emissions by 540 metric tons of CO2e per year. Further research should determine how many electric buses are feasible for Unitrans and what infrastructure is required to transition to a majority electric fleet.