



# Critical Answers for Smart Deployments

10 September 2018

Zero Emission Bus Conference

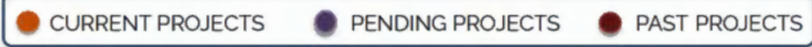
A green arrow graphic pointing to the right, located to the left of the speaker's name.

**Matt Boothe**  
Engineering Consultant

# Battery Electric Bus in the 90s



# CTE Zero Emission Bus Projects



# The Biggest Challenge

"Diesel Gallons" On Board

100



40' Diesel Bus

12



40' Battery Bus (450 kWh)

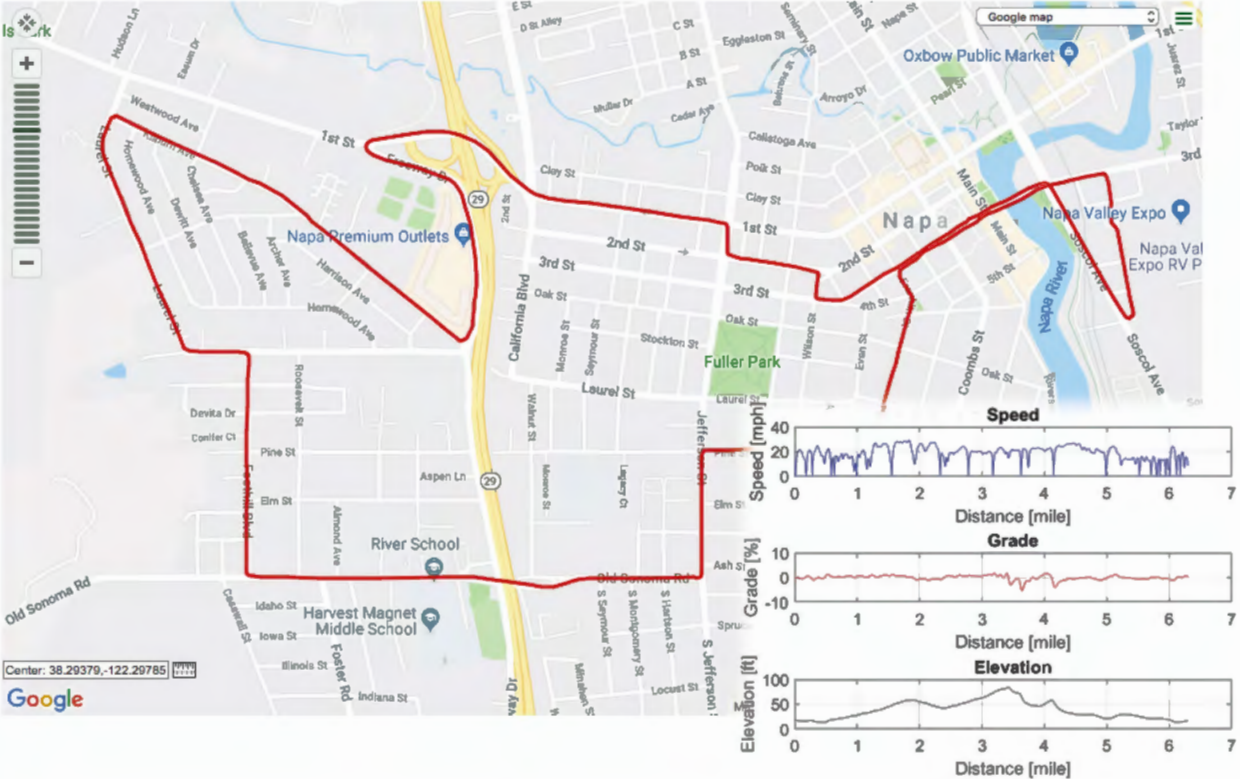
DOE: 38 kWh is equivalent to 1 gallon of diesel

# Naïve Method—Range

Battery Bus Study  
 $450 \text{ kWh} \div 1.8 \text{ kWh/mi}$   
 $= 250 \text{ mi range}$

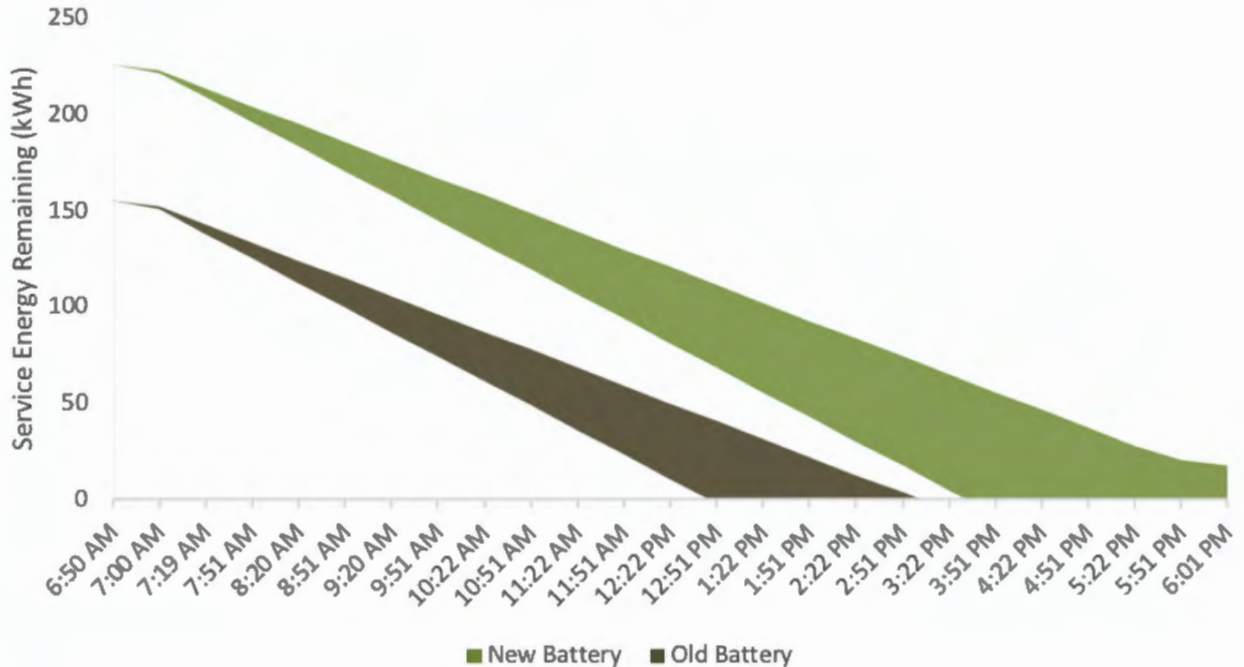
Block	Distance	Ok?
1994	197	✓
2008	172	✓
3233	159	✓
1541	201	✓

# Prudent Method—Model the Routes



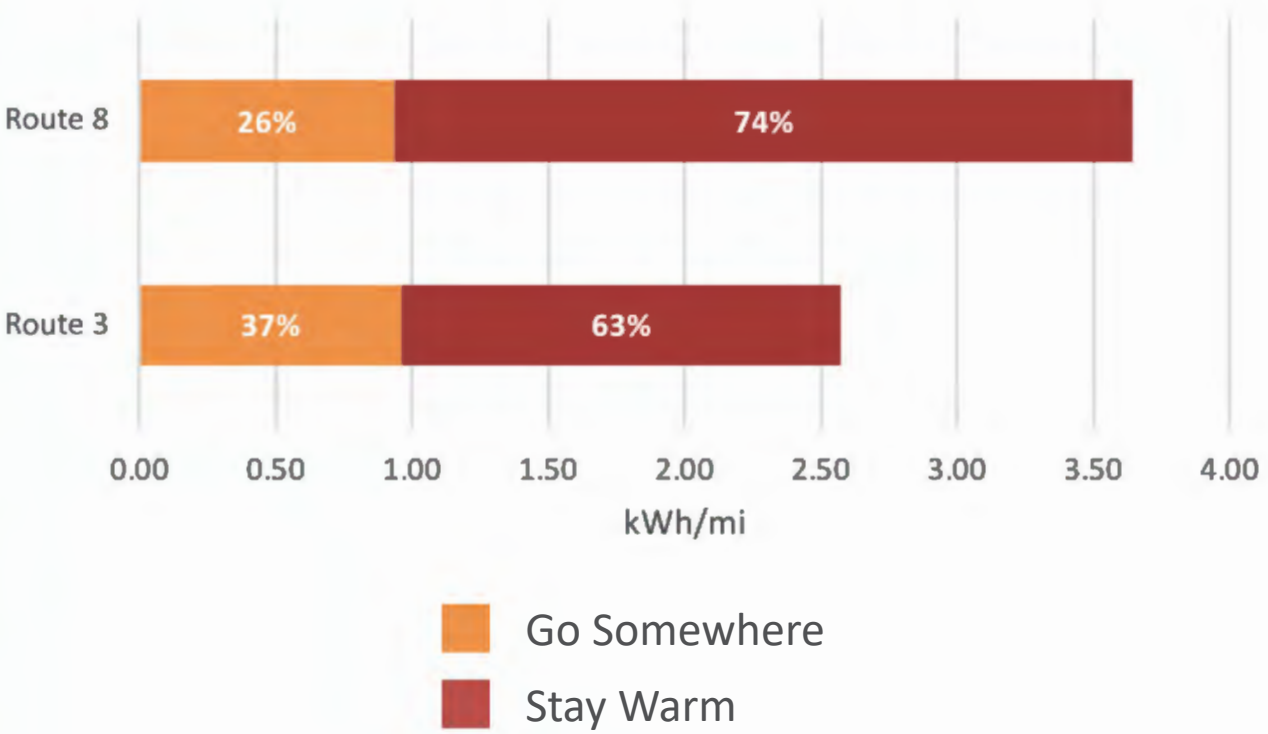
# Prudent Method—Model the Blocks

Block 2008





# Prudent Method—Include HVAC





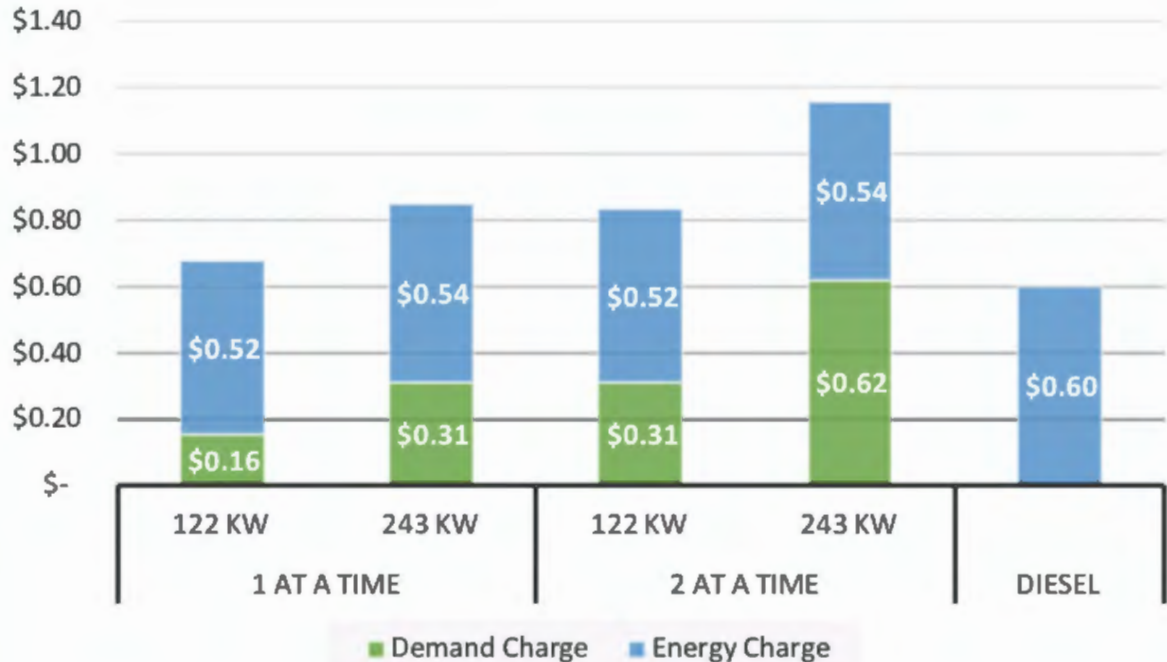
# Naïve Method—Fuel Cost Estimates

## Battery Bus Fueling Cost

- National Average: 12 ¢/kWh
- $300 \text{ kWh/day} \times 12 \text{ ¢} =$   
\$36/day

# Prudent—Charge & Rate Modeling

## Fuel Cost Per Mile



## Other Critical Questions

WHAT ABOUT  
HYDROGEN?

HOW CAN WE  
TRANSITION THE  
WHOLE FLEET?

SHOULD WE  
CHARGE  
ON ROUTE?

WHAT DO WE  
NEED IN OUR  
TECH SPEC?

CTE can help you get critical answers to  
your deployment questions.