Feasibility of The Transition to a Battery Electric Bus Fleet in Public Transit

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#TransitTrends

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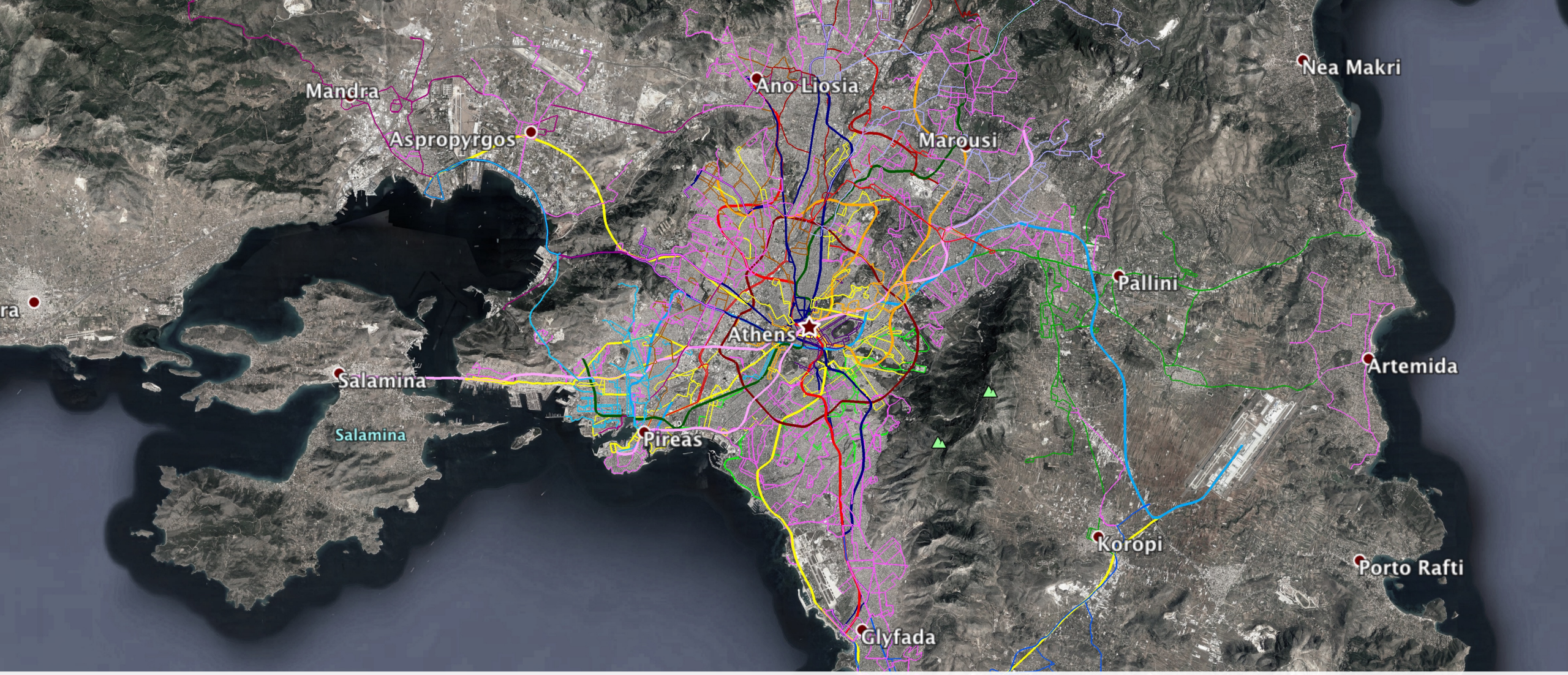
Some Personal Facts

- Born and raised in Athens, Greece
- Redesigned the bus route network in Athens at age 17



No, seriously!

Some Personal Facts

- Born and raised in Athens, Greece
- Redesigned the bus route network in Athens at age 17
- NTUA – MS Diploma in Surveying Engineering, 2016
- (still bothering elected officials and transportation planners in the meantime…)
- IIT – ME in Transportation Engineering, 2019

- CMAP – Transportation Planning Intern, 2018-2019
- CTA – Service Planner, Bus (upcoming)

Overview

Introduction

Goals and Objectives

Methodology

Case Study

Results

Findings

Introduction

Public transit is…

- Essential in dense areas
- Efficient
- Outdated
- Underfunded

Transit Asset Management is about…

- Performance
- Data
- New technologies
- New management strategies
- Resilience
- Prioritized investments

Goals and Objectives

- Is diesel getting more efficient?
- Is diesel-electric hybrid the middle ground?
- Is electric the way to go?

- State of Good Repair?

Or simply…

Are electric buses worth the investment?

Methodology

CTA Vehicle data

Cost Projections

Model Formulation

Icons: fontawesome.com

Methodology (cont.)

Costs Considered

- Vehicle purchase
- Fuel
- Maintenance
- Overhaul

Model Formulation

1. Cost measures
2. Supporting data projections
3. Case study analysis

Data Sources and Assumptions

What data we used

- National Transit Database – NTD
- CTA Press Releases
- California Environmental Protection Agency
- Energy Information Administration – EIA
- American Public Transportation Association – APTA

What we assumed

- Useful life 14-15 years (FTA/CTA)
- One mid-life overhaul per vehicle at 7th year
- Annual mileage per vehicle: 30,000
- Fleet size is maintained
- Vehicle size is maintained

Case Study – Chicago Transit Authority

Second largest public transit agency in the US

- 1.97 billion annual passenger miles
- 1.5 million average weekday unlinked trips
- 140 bus routes
- 52.3 million annual bus revenue miles on over 25,000 daily bus trips

1,859 buses in total

- 1,618 diesel
- 239 hybrid
- 2 electric
- 304 articulated
- Oldest buses serving since 2002

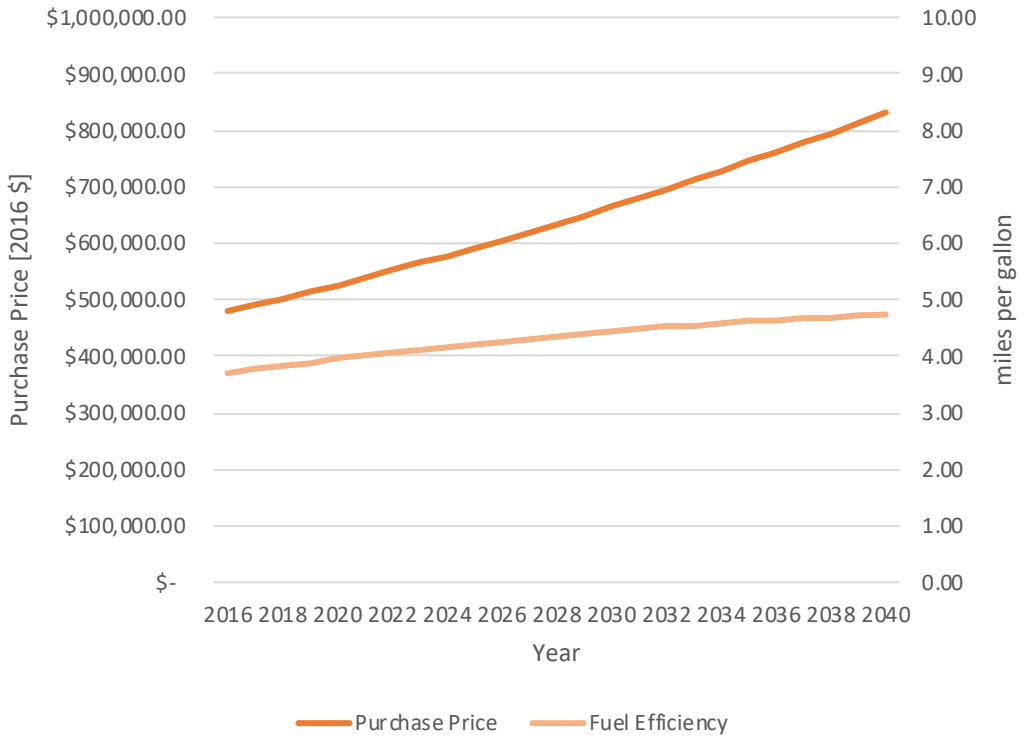
Case Study (cont.)

- 24-year analysis (2016-2040)
- Four Alternative Strategies:
  - Same as current technology (CTA)
  - Diesel only
  - Diesel-electric hybrid only
  - Battery electric only
- Three Diesel Price Scenarios:
  - Average price and discount
  - Low price (high discount)
  - High price (no discount)

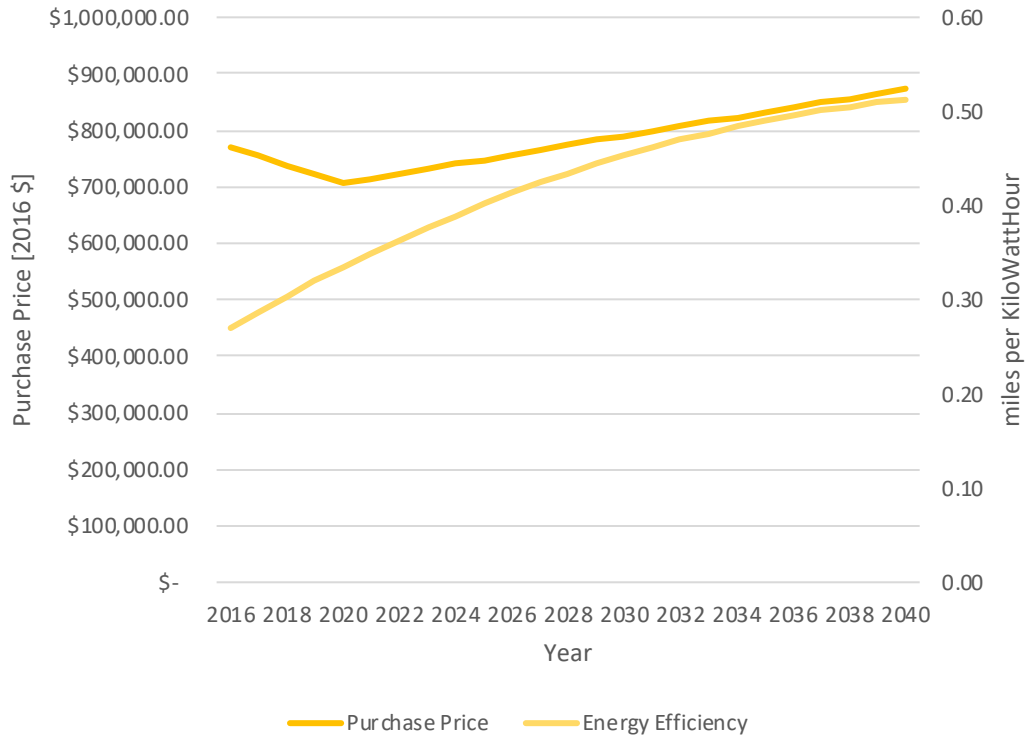
*Diesel discounts based on EIA's diesel price for transportation and past orders from CTA

Cost and Efficiency Projections

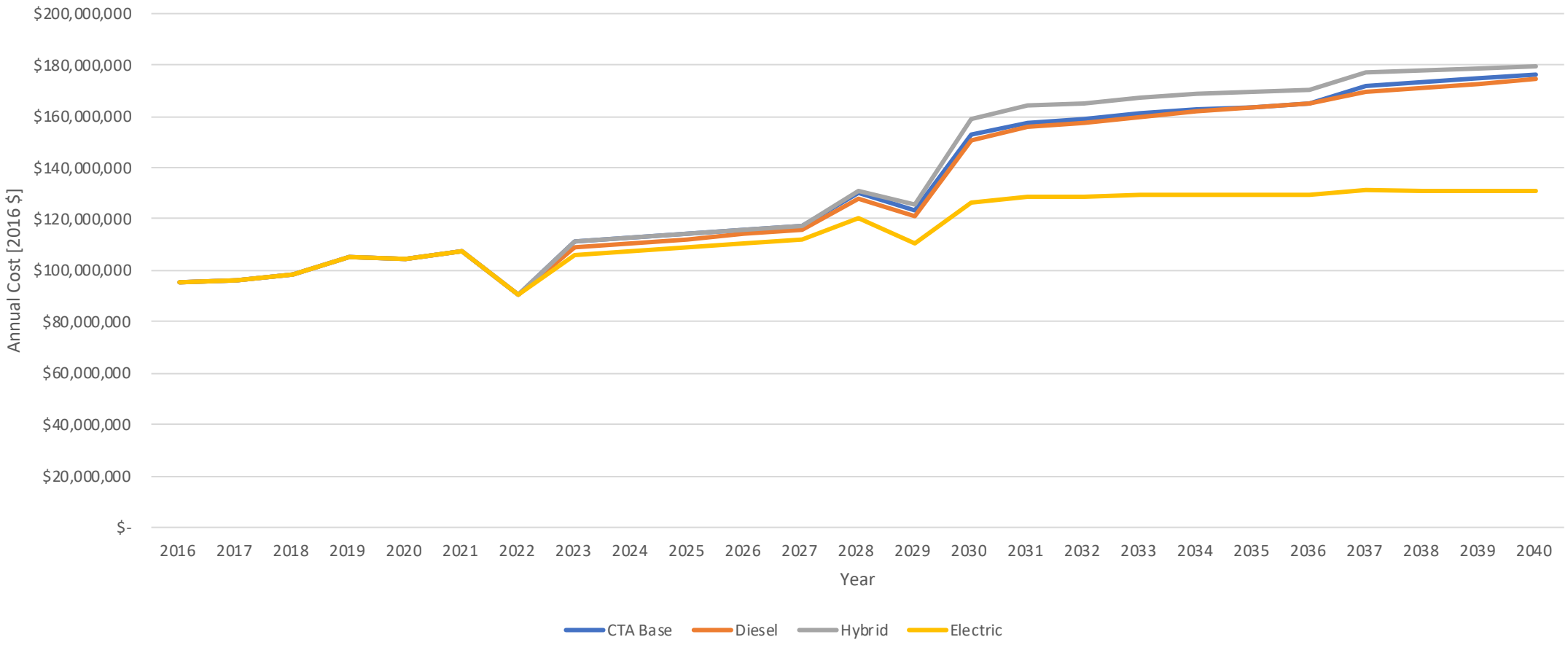
Diesel



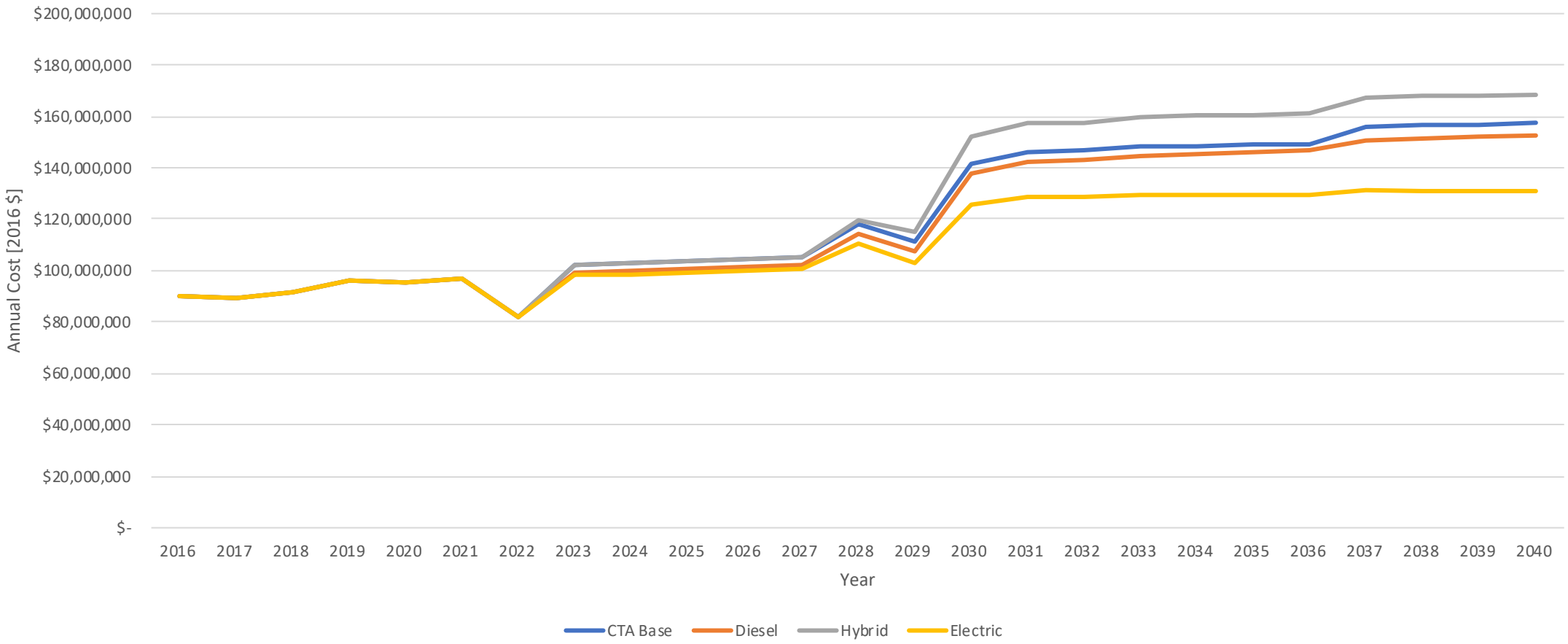
Electric



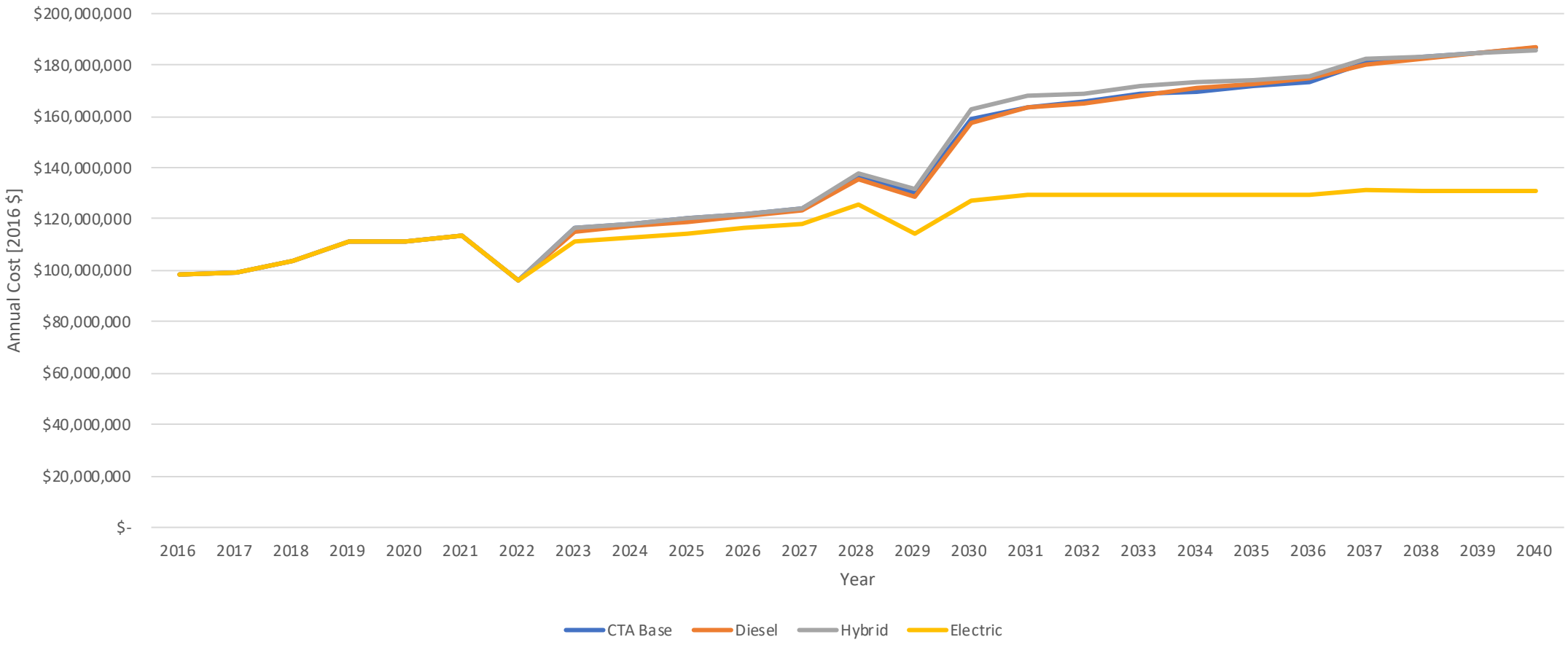
Results – Average Diesel Price Scenario



Results – Low Diesel Price Scenario

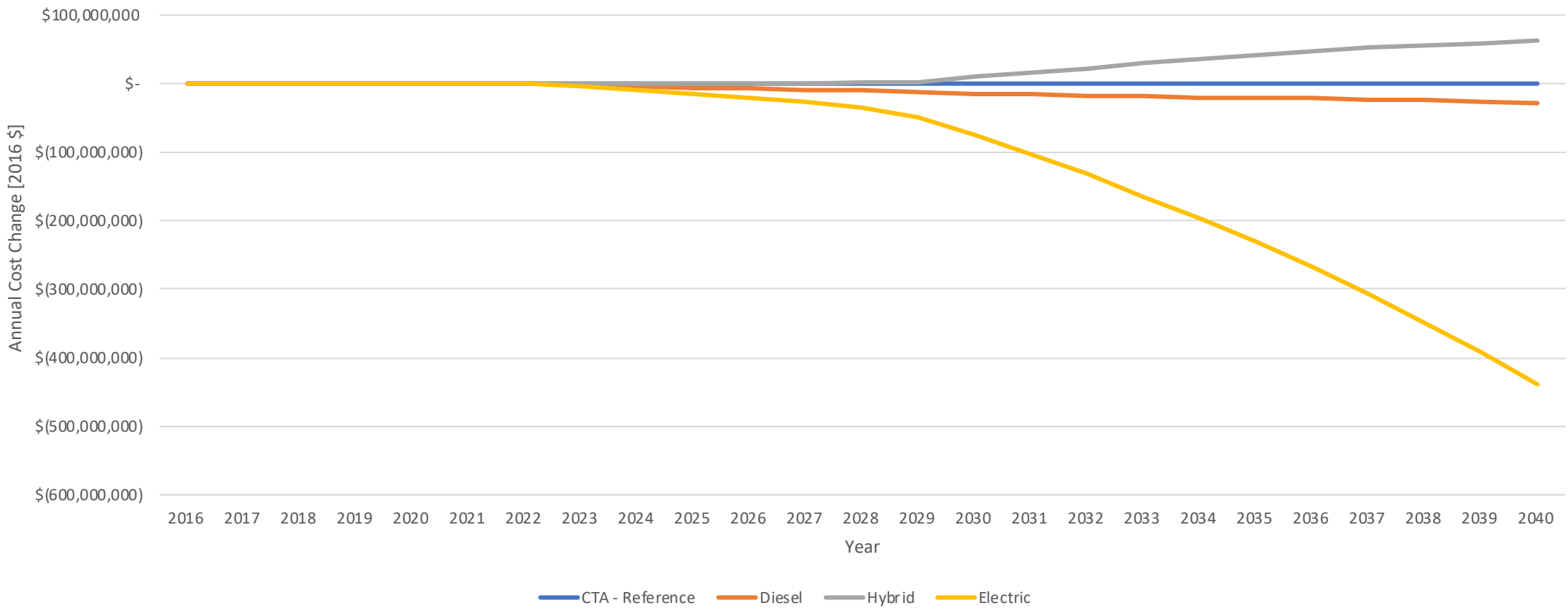


Results – High Diesel Price Scenario

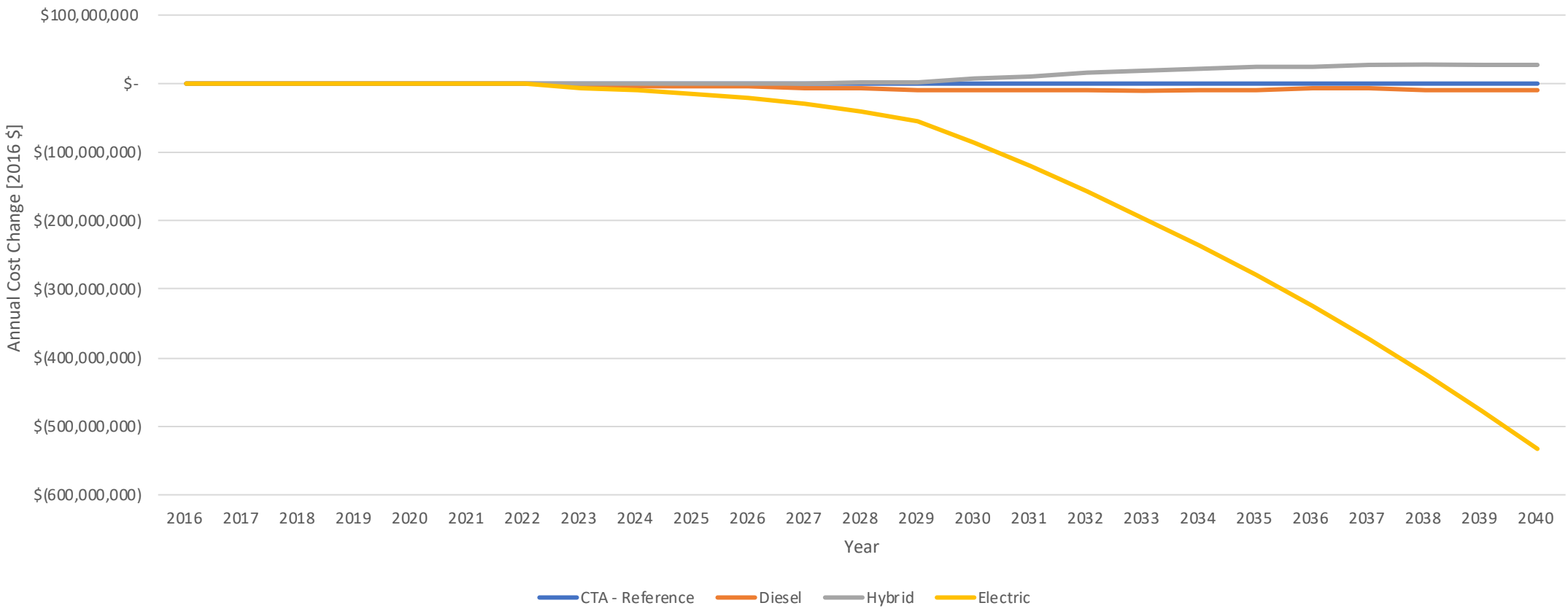


So, what?

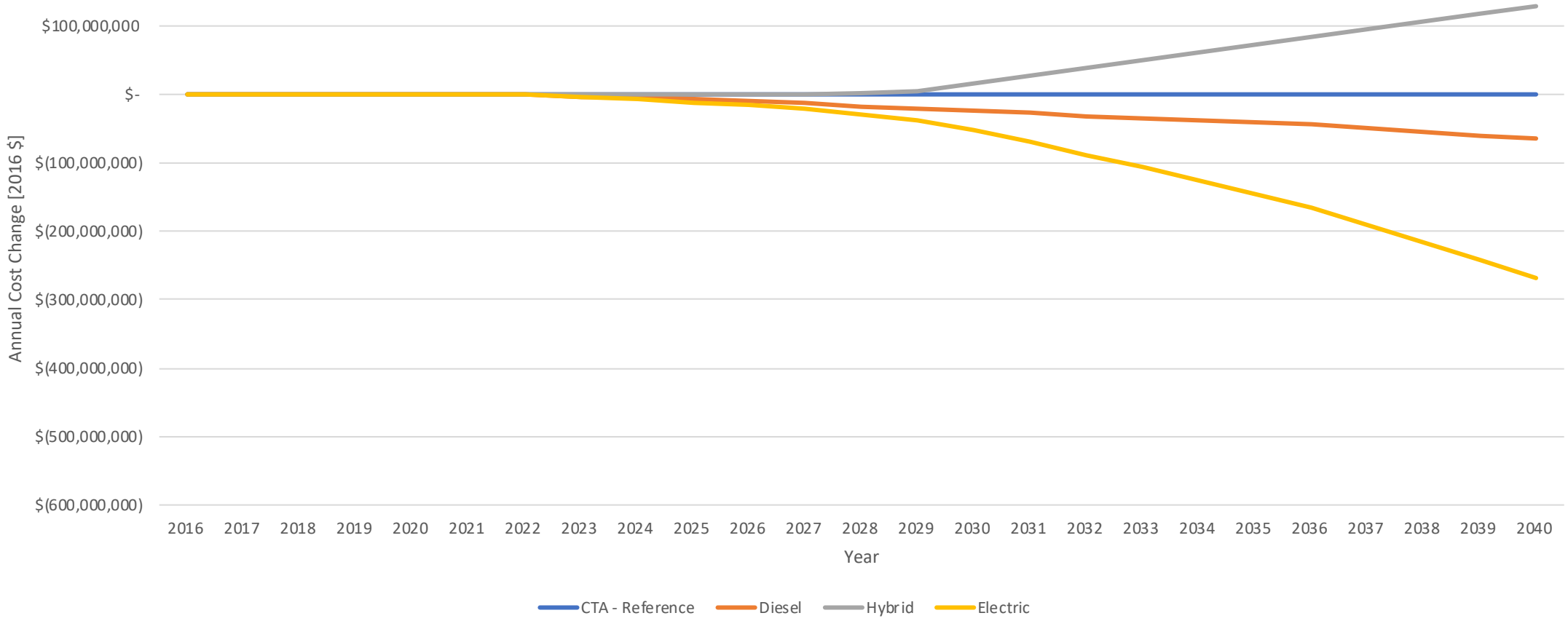
24-year Cumulative Cost Change



With high diesel prices…



Even with low diesel prices we can save a lot!



Findings

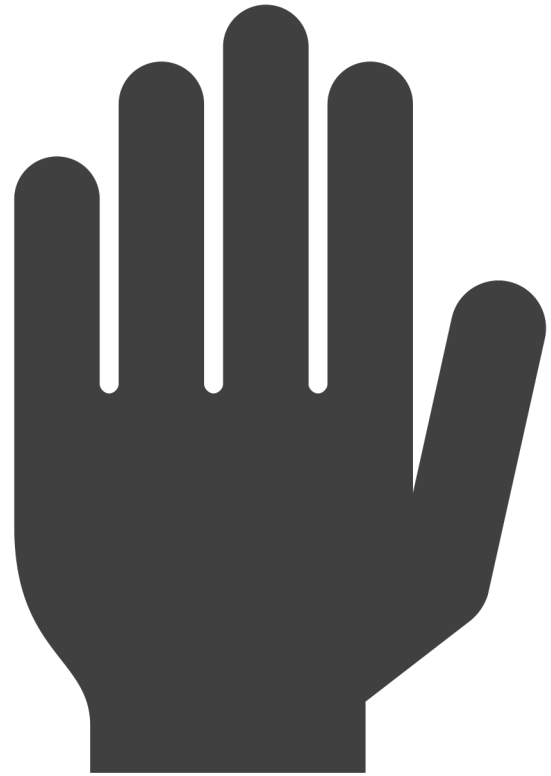
- A transition to electric buses is by far the most efficient solution
- Hybrid buses are more efficient only in high diesel price scenarios
- Savings range from 200 to more than 400 million US dollars (2016)
- Diesel bus technology can still get more efficient

  However, at a marginal pace
- Electric buses will become more affordable in the near future

Let’s switch to electric buses tomorrow, then!

Not so fast!

It is not a perfect world…



More to consider

- Cost of installing charging stations?
  - Plan required
- Battery electric? It’s not the only option!
  - How about en-route charging for example?
- Costs accuracy
  - CTA knows their spending better
- Sky is the limit
  - After all, this is just a master’s project…

Thank you!

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