Fleet Replacement Needs
• Non-Revenue Fleet
• Paratransit Fleet
• Fixed-Route Fleet

Zero Emission - Innovative Clean Transit Rule (ICT)
• Hydrogen VS Electric
• Funding Needs
Fleet Management Plan

Updates since 2016 Plan

- **2018** - GCTD Completed Transit Asset Management Plan (TAM)

- **2018** - Board adopted a “Zero/Near Zero Emissions Policy”

- **2019** - CARB Adopted Innovative Clean Transit (ICT) rule requiring agencies set a goal of zero emissions fleets by 2040

- **2019** - Purchased 5 new Gillig 40’ buses, and 5 Ford Transits

- **2019/2020** - GCTD completed “near zero” engine replacements

- **2020** - Purchased 9 electric sedans (relief cars)
Repower Project Complete

New exhaust system burns hotter = 9 x better emissions

New L9N Cummins Engine

Reduced Emissions from Trucks and Buses
- Reduces smog forming NOx emissions by 90% vs. EPA NOx Standard
- NOx emissions from TEN L9N powered vehicles = emissions from ONE 2010 certified vehicle
- Clean technology for Clean Air Act Ozone Nonattainment areas
- Reduces greenhouse gas emissions
- Will be certified to the US Environmental Protection Agency (EPA) and California Air Resources Board (ARB) Optional Low NOx Emissions Standards of 0.02 g/bhp-hr.

NOx Emissions Reduction Impact

Performance and efficiency matches the current ISL G engine

Improves air quality and lowers noise pollution
Repower Exhaust Ventilation

Before Repower

After Repower: Exhaust venting for heat dissipation
Electric Nissan Leaf

- 2020 Nissan Leaf
- 10 charging stations. Preparation for future fleet needs.
- Existing conduit from facility build reduced cost tremendously.
- Reduction in CO2 and noise pollution.
Non-Revenue Fleet

Non-Revenue Acquisition Forecast

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- 5 Electric Nissan Leaf’s delivered.
- 4 more on the way.

These 9 vehicles will drastically reduce the carbon footprint for GCTD’s non-revenue fleet.

GCTD’s first Zero-Emission Vehicles (ZEV).
## Paratransit Fleet

### Current Paratransit Fleet

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### Paratransit Fleet Acquisition Forecast

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Fixed Route Fleet

NEEDS: By 2025, 43 buses will reach or surpass the Useful Life Benchmark (ULB).

GCTD Replacement Plan:

- 3 CNG Buses 2020-21
- 9 CNG Buses 2021-22
- 9 CNG Buses 2022-23
- 8 CNG Buses 2023-24
- 14 Zero-Emission 2024-25
  (Hydrogen Fuel Cell Buses & Infrastructure)
CARB: Innovative Clean Transit Regulation

- **2026**: Innovative Clean Transit (ICT) regulation states 25% of all buses purchased by GCTD must be zero-emission.

- **2029**: All purchases must be 100% zero-emissions for small transit agencies (Fewer than 100 buses).

- **2040**: All transit agencies transition to 100% zero-emissions fleets.
# Fixed Route Fleet Forecast

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<td>Fixed Route Fleet Size</td>
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</table>
ICT Reg & GCTD Fleet Replacement Timelines

25% of GCTD VEHICLE PURCHASE MUST BE ZEB

2020 2021 2022 2023 2024 2025 2026

MARCH 2020 BOARD MEETING 3 CNG Buses 9 CNG Buses 9 CNG Buses 8 CNG Buses 14 ZEB Hydrogen Fuel Cell Buses

2020 2021 2022 2023 2024 2025 2026

25% of GCTD VEHICLE PURCHASE MUST BE ZEB

2020 2021 2022 2023 2024 2025 2026
Hydrogen vs. Electric

- **Fleet Mobility:** Average range of hydrogen bus higher than electric.
  - Hydrogen: **300-340 miles** per fill up.
  - Electric: 125-175 miles per full charge.

- **Weight Reduction:** Less battery weight in hydrogen bus.
  - Battery weight has caused issues for manufacturers.

- **Down time of vehicles:** Hydrogen fill-up similar to CNG (7-10 minutes)
  - Electric 8-10 hours to fully charge batteries (Battery degradation issues)

300-340 miles
Proven range (300 to 340 miles, with advanced fueling technology that can extend this range by almost double)

- Significant reduction in vehicle weight and vehicle axle weight to maximize passenger loads
- Fast refueling speeds comparable to conventional diesel and CNG buses
- 1:1 replacement of conventional buses enabling full flexibility for route planning and operations
Range Issues Familiar

RANGE

2019 Gasoline four-door sedan – 444 miles

2019 FCEV four-door sedan – 360 miles

2019 BEV four-door sedan – 150 miles
• How Hydrogen Works

1 minute 17 second video

https://youtu.be/EgFCLBDn2es
Hydrogen Fuel Cell Bus

- Hydrogen Storage
- Battery Thermomangement
- Electric Drive System
- HVAC
- Traction Motor
- Air Compressor for Fuel Cell System

Energy Storage

Drive System Thermomangement

Pure Water Vapor Exhaust

Thermomangement for Fuel Cells Provides additional heat for the cabin

Fuel Cell System
Hydrogen Fuel Cell Bus

Hydrogen Fuel Cell Bus Price Trends

- Decrease in fuel cell cost
- Decrease in battery cost
- Improved design for manufacture and assembly
  - Mass production optimization
  - Standardization between FC electric and battery electric
  - Reduced complexity and highly repeatable assembly
- Expanded supply chain with increased competition
- Manufacturing volume will reduce cost

*Note: Actual bus price will vary based on battery capacity and customer options*
Hydrogen Fuel Cell Bus

- Cost to Produce Hydrogen Fuel forecasted to fall (up to 80% by 2030)

The many uses of hydrogen

- **Fuel for**
  - Transport
  - Power: Electricity, Peaking Plants

- **Heat for**
  - Industry: Steel, Cement, Paper, Food, Aluminum
  - Buildings: Residential & Commercial

- **Feedstock for**
  - Chemicals: Fertilizers, Fuel refining, Plastics
  - Products: Metallurgy, Food, Glass

Source: BloombergNEF

The many uses of hydrogen
Information Exchange
OCTA, Sunline, AC Transit

- OCTA
- 10 Hydrogen Fuel Cell buses
- Hydrogen Trucked In

(OCTA Fleet is 510 buses)
Solar Panels & Battery Storage

- Enable self-sufficiency regarding electric usage/rates.
- Current fueling schedule dictated by revised peak rate times.
- Solar battery storage will allow GCTD to operate as needed while avoiding high electric charges.
Solar Panels and Battery Storage

Use solar panels to charge battery storage to power a hydrogen station for a *Zero-Emission footprint*.

**Other Hydrogen Program Assets**

- Rooftop Solar at CMF
- Trellis Solar at D6 (Hayward) Division
- SOFC at D4 (Oakland) Division

*Power Sources that Support On-site Hydrogen Production by Electrolyzer*
On-site generation of hydrogen through water electrolysis powered by solar provides a true Zero-Emission Footprint when combined with a hydrogen fuel-cell vehicle. Excess hydrogen generated has potential for revenue source.

- Electrolyzer and/or Reformer
- GH2 as back-up
- As little as $1.75M investment
- 1 – 100 buses

Green solutions
Independent of delivered fuel
Fleet Replacement Costs: $36 MILLION over 5 YEARS

The estimated total cost to replace 43 buses is $36 million.

<table>
<thead>
<tr>
<th>Estimated Cost to Replace 43 buses over the next 5 years</th>
<th>$596 K</th>
<th>$614 K</th>
<th>$632 K</th>
<th>$651 K</th>
<th>$1,300 K</th>
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<tbody>
<tr>
<td>Number of Buses Replaced</td>
<td>3 CNG</td>
<td>9 CNG</td>
<td>9 CNG</td>
<td>8 CNG</td>
<td>14 ZERO</td>
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<td>Funding Need for the Next 5 Years (2020-2025)</td>
<td>$1,788 K</td>
<td>$5,526 K</td>
<td>$5,688 K</td>
<td>$5,208 K</td>
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<td>CAMQ</td>
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<td><strong>Funding Need for the Next 5 Years (2020-2025)</strong></td>
<td>$36.41 Million</td>
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</table>

Potential Funding Sources:
- Federal Competitive Grants CMAQ/5339/LowNo
- State Competitive Grants (TIRCP, LCTOP etc)
- Innovative Partnership with other agencies or businesses
- Local Revenue Measure for Zero Emissions Planning

Planning Grants
- STEP Grant / CARB Grants (for Zero Emissions Planning)

Challenge: We do not have a source of Local Matching funds, which puts us as a disadvantage when competing for these grants.
ICT Reg & GCTD Fleet Replacement Timelines

- **2020**: MARCH 2020 BOARD MEETING
- **2021**: 3 CNG Buses
- **2022**: 9 CNG Buses
- **2023**: 9 CNG Buses
- **2024**: 8 CNG Buses
- **2025**: 14 Hydrogen Fuel Cell Buses
- **2026**: 25% of GCTD VEHICLE PURCHASE MUST BE ZEB

**Key Dates**
- **2020**: 25% of GCTD VEHICLE PURCHASE MUST BE ZEB
- **2029**: 100% of GCTD VEHICLE PURCHASE MUST BE ZEB
- **2040**: ALL TRANSIT 100% ZEB

**Timeline**
- **2020**
- **2021**
- **2022**
- **2023**
- **2024**
- **2025**
- **2026**
- **2027**
- **2028**
- **2029**
- **2030**
- **2031**
- **2032**
- **2033**
- **2034**
- **2035**
- **2036**
- **2037**
- **2038**
- **2039**
- **2040**
QUESTIONS?