Fresno Area Express: Innovative Clean Transit Regulation Rollout Plan

June 18, 2020

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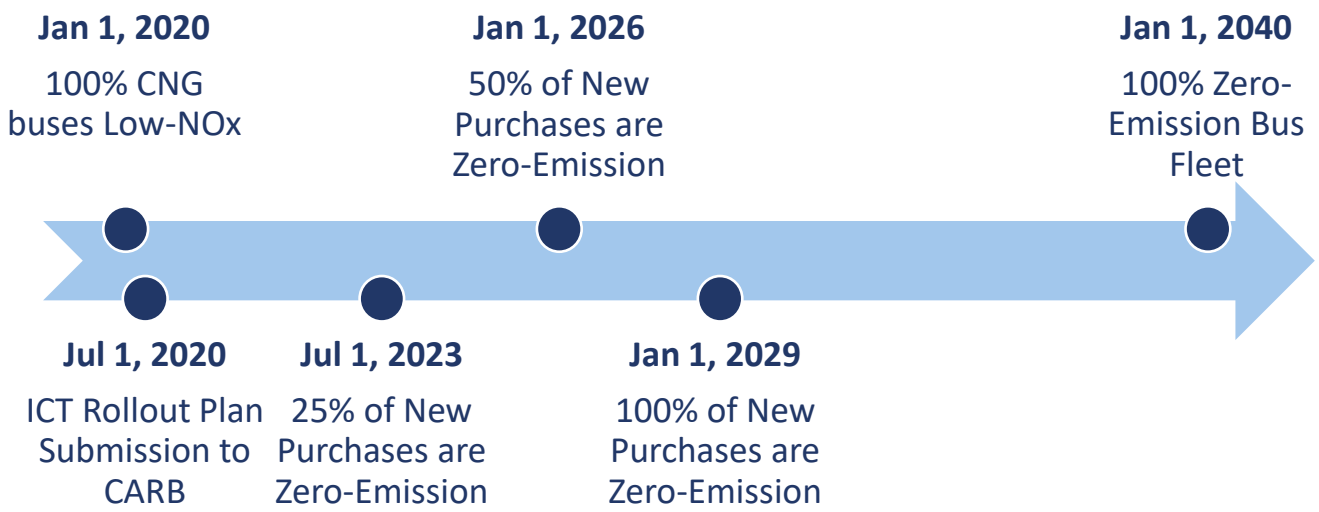
CARB ICT Regulation

- Innovative Clean Transit (ICT) Regulation adopted December 14, 2018
- Requires agencies to transition fleet to 100% zero-emission by 2040
- FAX qualifies as a large transit agency
- Governing board to approve the Rollout Plan through the adoption of a resolution and submit to CARB by **July 1, 2020**

ICT Regulation Timeline for a Large Agency

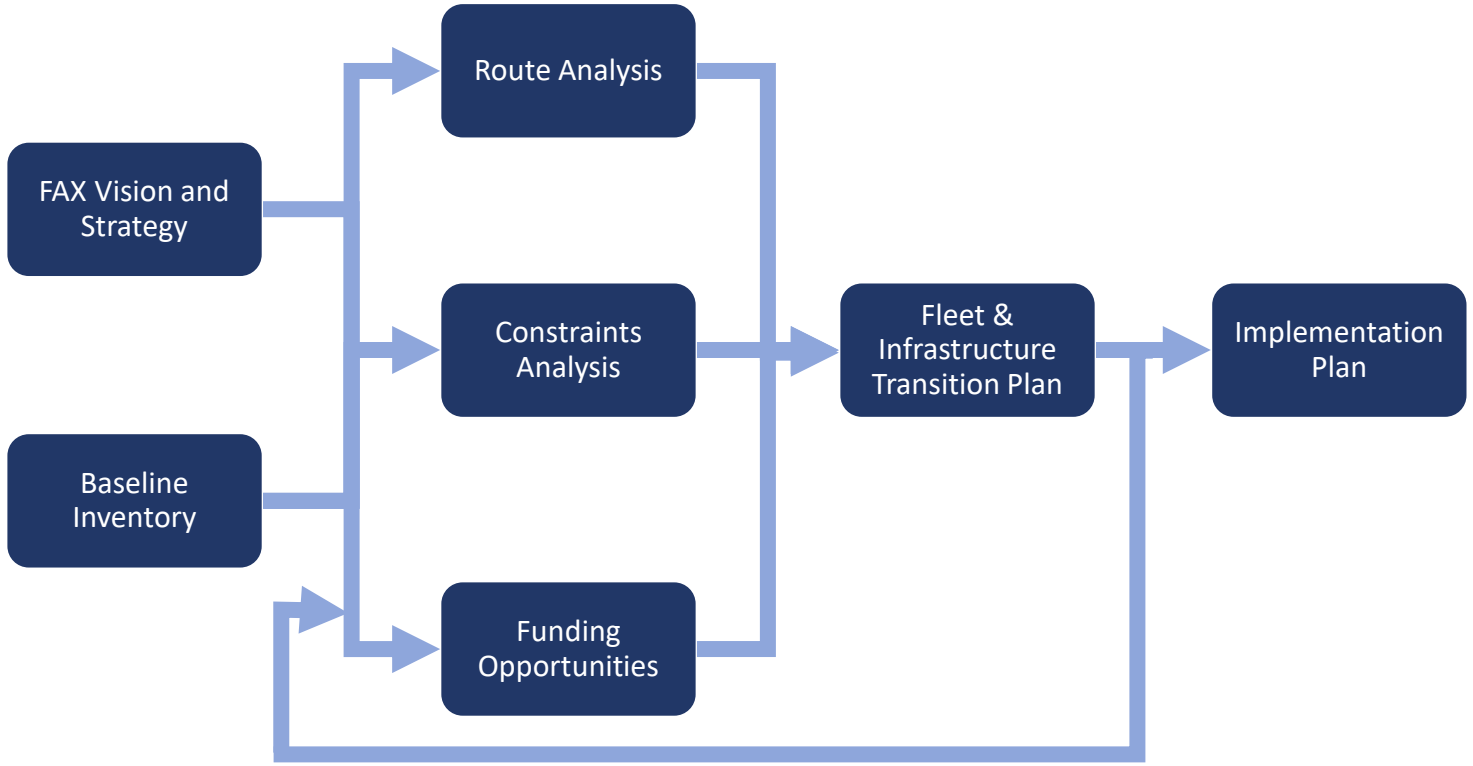


ICT Rollout Plan Requirements

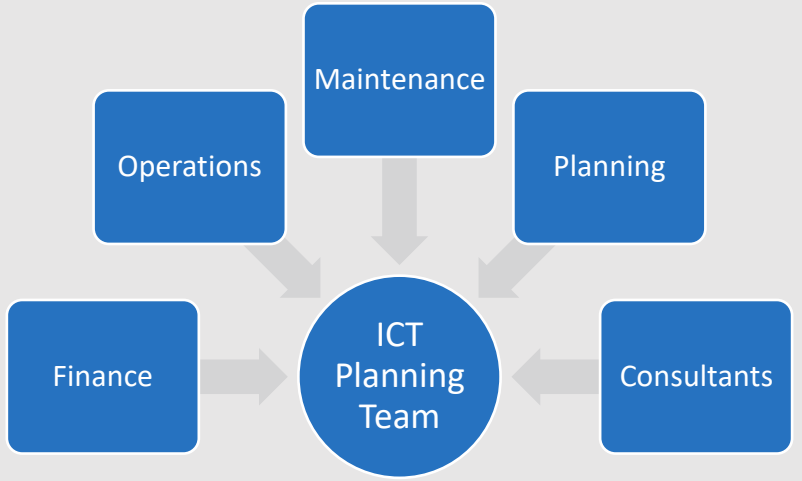
- Schedule for replacement of all buses including technology type
- Schedule for installation of fuelling/ charging infrastructure
- Description of required facility upgrades
- Identification of potential funding sources
- Description of Impact on disadvantaged communities
- Training plan for maintenance and operations staff

ICT Plan Development Process

- Highly iterative and collaborative process to develop optimal plan
- Conducted energy-based modelling to estimate capabilities of battery electric buses on FAX routes and determine fuel cell electric vs battery electric bus split
- Investigated other infrastructure related constraints (e.g., electrical capacity)
- Forecasted cost based on current offerings and projected trends



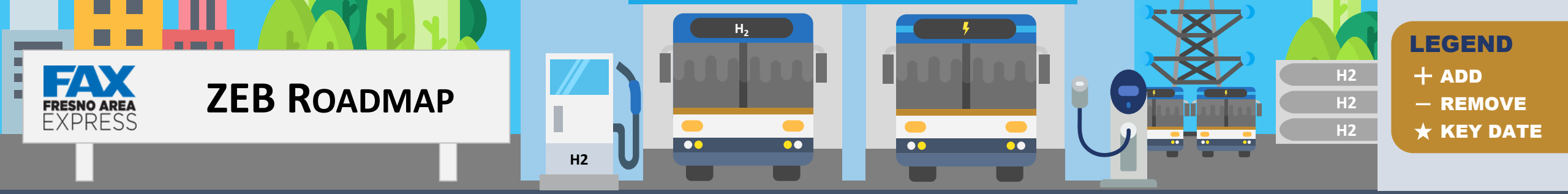
Working Team



- Developed vision and strategy with FAX working team
- Created a collaborative project team spanning FAX departments
- Held bi-weekly meetings to solicit feedback and promote engagement

Guiding Principles

- No buses scheduled to retire before end of useful life
- Mix of battery and fuel cell electric buses to optimize performance and minimize cost
- Avoid large procurement cost in a single year
- Ensure ICT requirements and PG&E battery electric bus adoption schedule met
- Maintain level of service currently provided

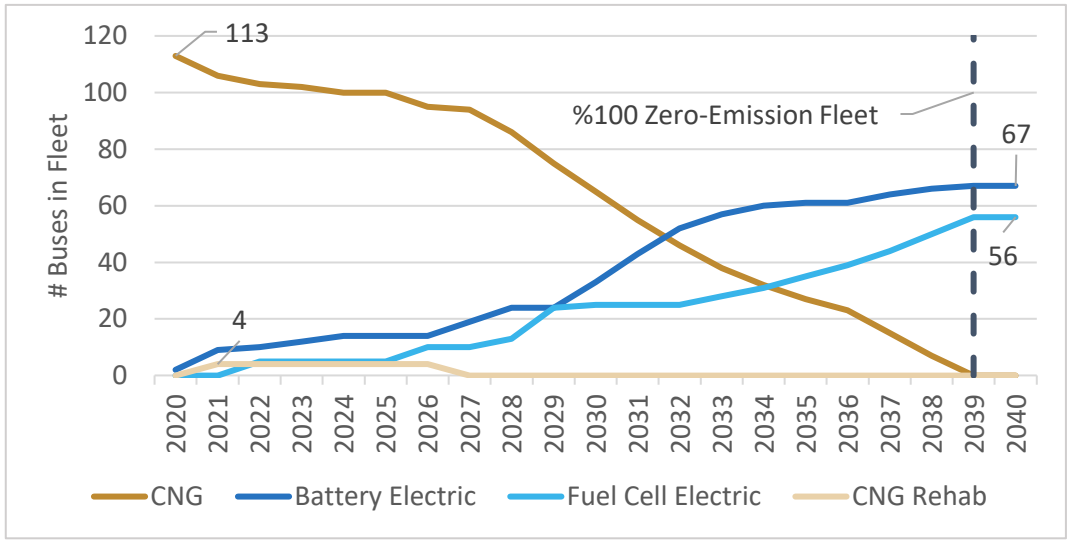


	2020	2025	2030	2035	2040
Fixed Route	2% ZEB	15% ZEB	47% ZEB	78% ZEB	100% ZEB
Paratransit	0% ZEB	0% ZEB	50% ZEB	100% ZEB	100% ZEB
Battery Electric Infrastructure	+ Upgrade to 3 MW Electric Transformer		+ Upgrade to 5 MW Electric Transformer		
Hydrogen Infrastructure	+ Install 300 kg/day delivered Liquid Hydrogen Station	– Retire gas equipment at Handy Ride facility + Upgrade delivered Liquid Hydrogen Station to 750 kg/day	+ Upgrade delivered **Liquid Hydrogen Station** to 1500 kg/day	– Retire **CNG** equipment at Handy Ride facility – Retire **CNG** equipment at fixed route facility	
Buses	+ First Battery Electric Bus enters fixed route fleet + First Fuel Cell Electric Bus enters Fixed Route fleet	+ Last CNG bus purchased in fixed route fleet – Last gas bus in paratransit fleet retires		– Last CNG bus in paratransit fleet retires – Last CNG bus in fixed route fleet retires	
Milestones	★ First Zero Emission **fixed route** bus enters fleet	★ First **Zero Emission paratransit** bus purchased	★ **50% Zero Emission paratransit** fleet ★ **50% Zero Emission fixed route** fleet	★ **100% Zero Emission paratransit** fleet	★ **100% Zero Emission fixed route** fleet

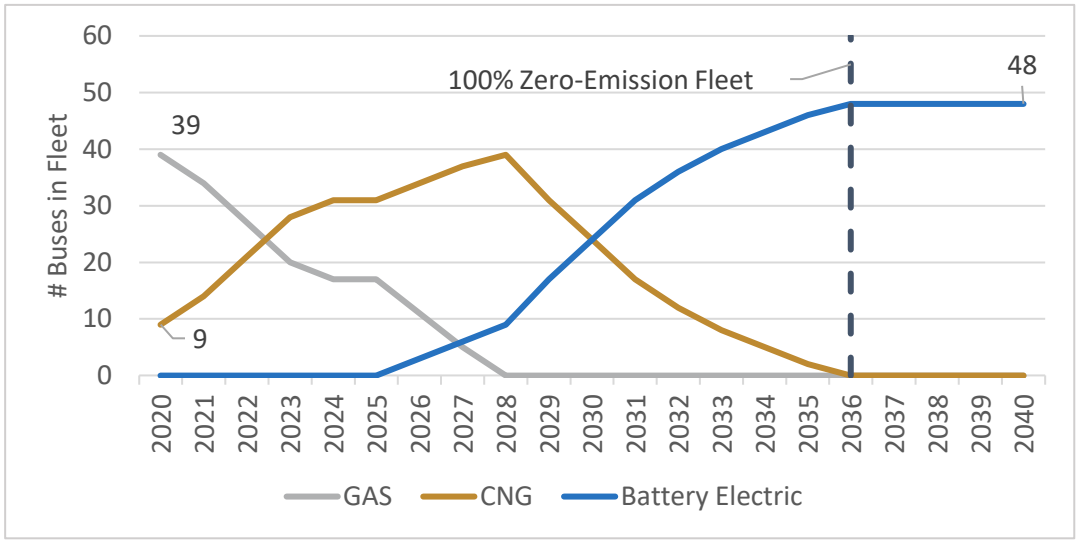
FAX Fleet Composition

Fixed route and paratransit fleet composition from 2020-2040

- Fixed route fleet has early zero-emission bus adoption – driven by PG&E contract
  - 4 CNG buses rehabilitations in 2021 to distribute number of bus procurements per year
  - 5 fuel cell bus purchases in 2022 to gain experience
- Paratransit fleet transitioned in accordance to the ICT requirements
  - All replacements before 2026 are CNG
  - Zero-emission purchases begin in 2026



Fixed Route Fleet Transition Plan



Paratransit Fleet Transition Plan

Fixed route fleet 100% zero-emission by 2039

Final composition – 67 Battery, 56 Fuel Cell

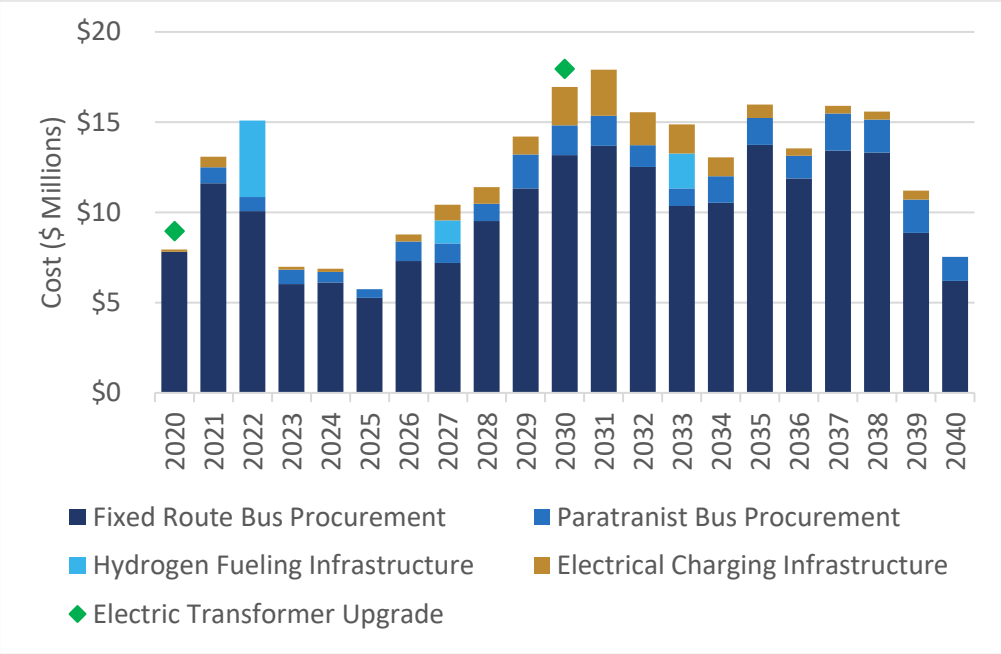
Paratransit fleet 100% zero-emission by 2036

Final composition – 48 Battery, Fuel Cell

Total Capital Expenditure: 2020-2040

Includes bus purchases and fueling/charging infrastructure

- Costs include zero-emission buses and replacement of CNG vehicles

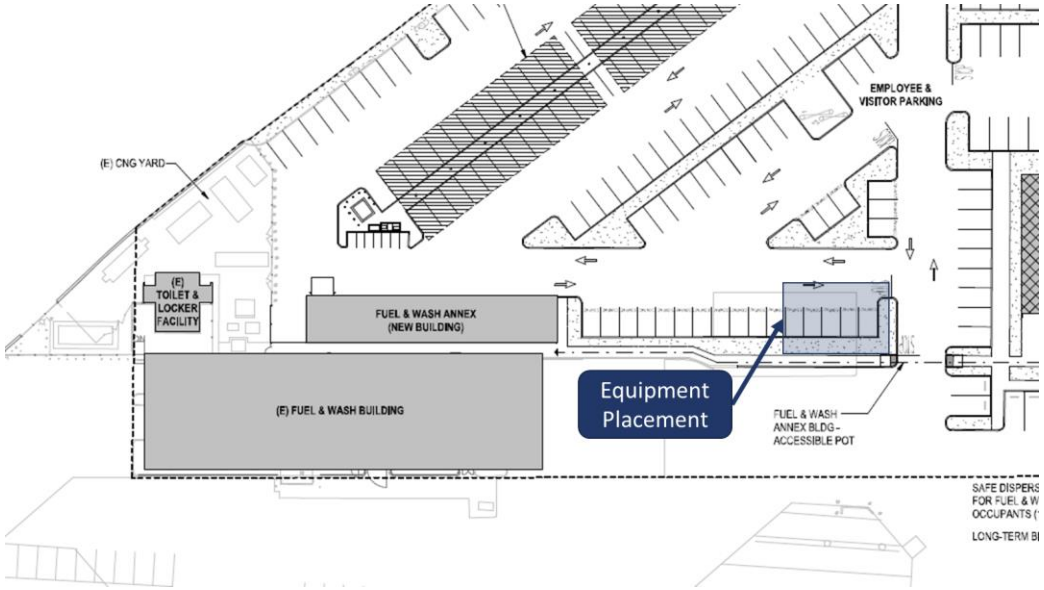


Capital Expenditure Type	# of Units	Total Cost ($ Millions)
Battery Bus Chargers	58	$15.9
Fixed Route Buses	191	$209.9
Paratransit Buses	123	$25.4
10 Bus Hydrogen Fueling Station	1	$4.2
25 Bus Hydrogen Fueling Station Upgrade	1	$1.3
50 Bus Hydrogen Fueling Station Upgrade	1	$1.9
Paratransit Buses	123	$25.4
Total	**n/a**	**$258.6**

Total capital expenditure (buses and infrastructure) 2020 – 2040: ***$258.6 million***

Hydrogen Infrastructure

Option 1: Install on-site



Pros	Cons
No need to purchase new site	Loss of parking spots (~11 spots)
Fueling logistics unchanged	Potential disruption to traffic flow
	Extra safety precautions required due to proximity to buildings

Option 2: Purchase New Site

Pros	Cons
No spatial siting constraints	Cost to purchase land
Additional parking available for fleet	Cost to equip new site (utilities, etc.)
	Change in bus fueling procedure (vehicles must leave yard)

Funding Sources

Transition payed for with annual FTA formula funds and special state and federal funding sources

- Targeted use of federal funds (FTA) following transition plan adoption schedule
  - Estimated $114.9 million available over duration of plan

- Special funding from competitive grants and voucher programs will make up the balance.

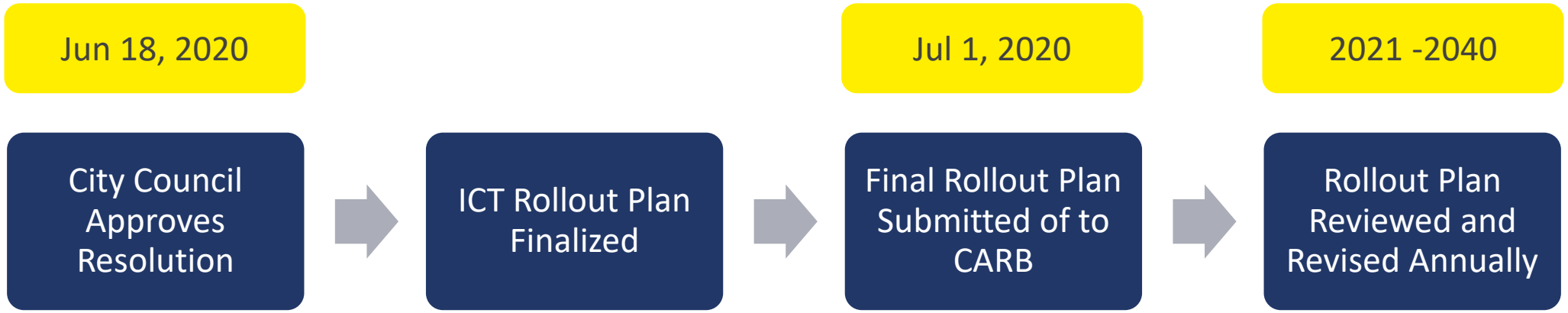
- In some cases funding from multiple sources can be stacked for a given project or vehicle

Example Special Funding Programs

Type	Name	Purpose	Offering	Funds Available
Competitive	FTA 5339 (b) Bus & Bus Facilities	Bus procurement and related facilities	80% of capital costs	$457 million (FY2020)
	FTA 5339 (c) Low or No Emission Vehicle	ZEB procurement and fuelling/charging infrastructure	85-90% of capital costs	$130 million (FY2020)
Voucher	VW Mitigation	ZEB procurement	$400,000/Fuel Cell Bus; $180,000/Battery Bus	$130 million (until exhausted)
	HVIP	ZEB procurement	$300,000/Fuel Cell Bus; $175,000/Battery	$142 million (FY2019 - currently exhausted)

Path to Completion

- City Council must approve the rollout plan through the adoption of a resolution prior to submission to California Air Resources Board (CARB)



- Annual review to assess plan based on:
  - Impact of securing special funding on transition schedule
  - Impact of technology improvement on recommended bus and infrastructure types
  - Operational learnings
  - Updated service offerings
  - Other factors – e.g., economic impact of COVID-19

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Appendix

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Battery Bus Range Analysis

Determining how many blocks in the fleet can be satisfied by battery electric buses

- Battery electric bus range estimated using energy model analyzing requirements on FAX routes

Range Analysis Type	Range (mi)	
	E2	E2 Max
Manufacturer	161-230	232-328
Route analysis (New Bus)	140-168	180-190
Route analysis (10% Degradation)	**120-145**	**180-190**

Limiting Case

- Analyzed the average daily percent of buses assigned to routes between ranges:
  - E2: ≤ 120 miles
  - E2 Max: > 120 miles & ≤ 180 miles
  - Fuel Cell: > 180 miles
- Analyzed block stats to find percent of routes between vehicle ranges

Parameter	E2	E2 Max	Fuel Cell
Daily Bus Assignments (%)	6%	57%	38%
Block Stats (%)	9%	55%	36%

Limiting Case

Route Analysis Results

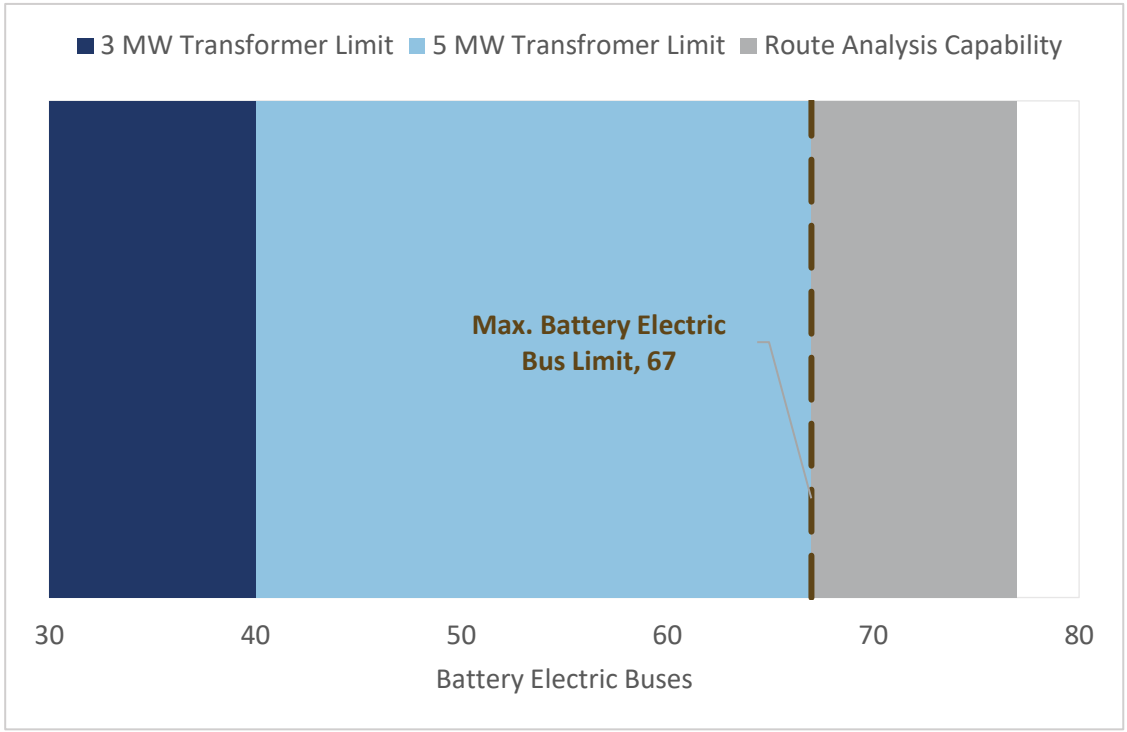
- Analysis accounts for:
  - Bus speed and elevation change
  - Battery degradation from aging
  - Ambient temperature

Route Analysis	Battery Bus Model	
	Proterra E2	Proterra E2 Max
Block	Completed Distance (mi)	
GPS Data 240	135.49	189.48
038-003 12.07.19	129.68	184.33
GPS Data 200	135.49	190.30
045-002	148.76	205.29
022-002	148.17	176.09
GPS Data 150	127.56	150.26
001-014	139.43	145.94
041-005	130.75	143.46
009-001	138.13	138.87
012-003	122.36	137.71
038-003 Sat	122.36	137.34
041-006	117.29	117.29
Range (mi)	**120 - 145**	**180 - 190**

Determining Split of Battery and Fuel Cell Buses

Expected number of battery electric buses primarily limited by available electrical capacity

- Electrical Infrastructure Upper Limit
  - 3 MW transformer capacity of 20 chargers and 40 battery buses
  - 5 MW transformer capacity of 34 chargers and 67 battery buses
- Route Capability Upper Limit
  - Approximately 77 buses could be battery powered depending on specific model of battery buses purchased
- Maximum number of battery buses is based on 5 MW transformer upgrade
- Electrical infrastructure is the primary limiting factor on the number of battery buses in the fleet



Battery Electric Bus Limits based on Electrical Capacity and Route Capability

Final Bus Fleet Composition:

- *67 Battery Electric Buses*
- *56 Fuel Cell Electric Buses*