NREL Transforming ENERGY | 45th anniversary

City of Dallas

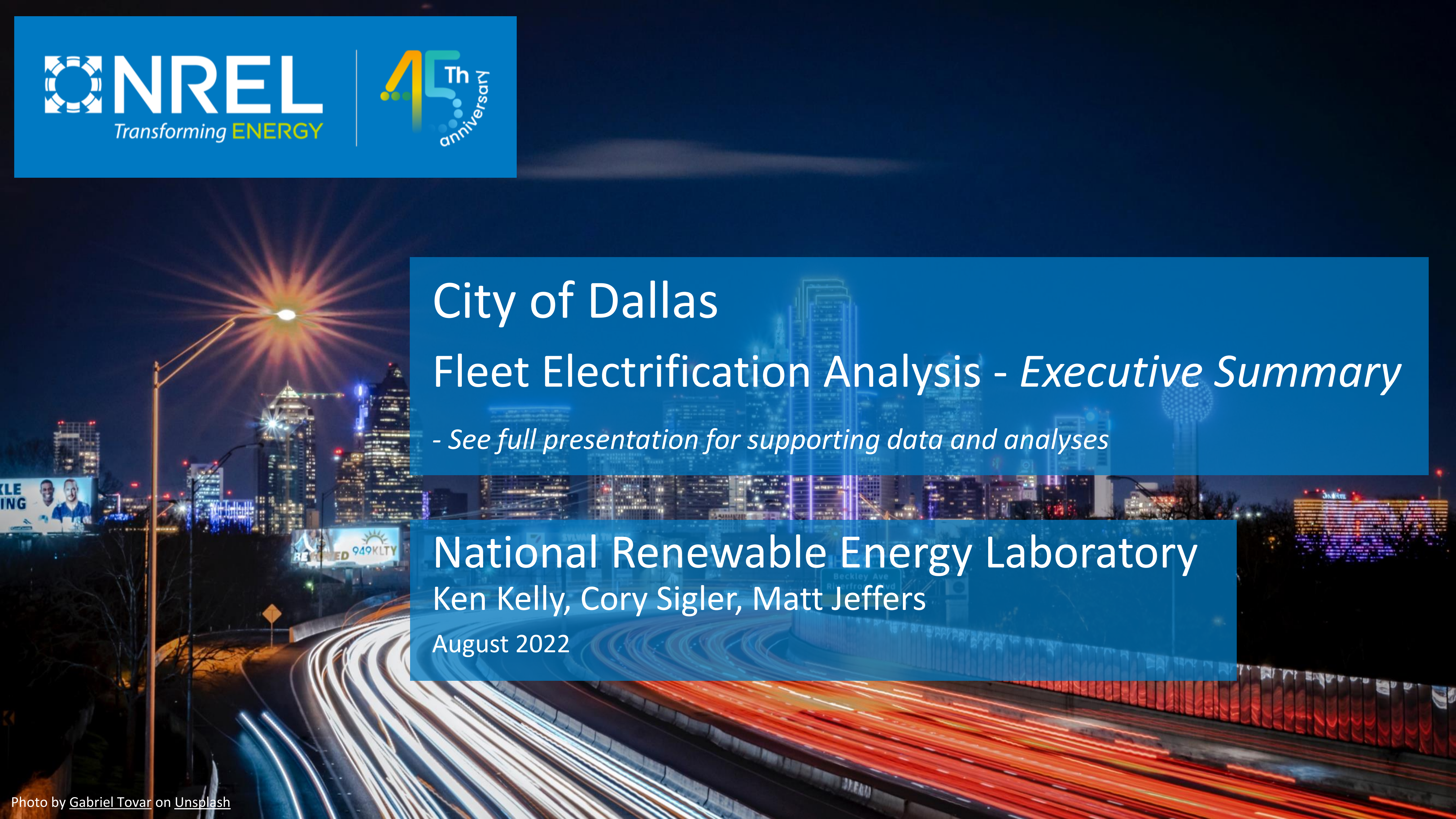
Fleet Electrification Analysis - *Executive Summary*

- See full presentation for supporting data and analyses

National Renewable Energy Laboratory

Ken Kelly, Cory Sigler, Matt Jeffers

August 2022



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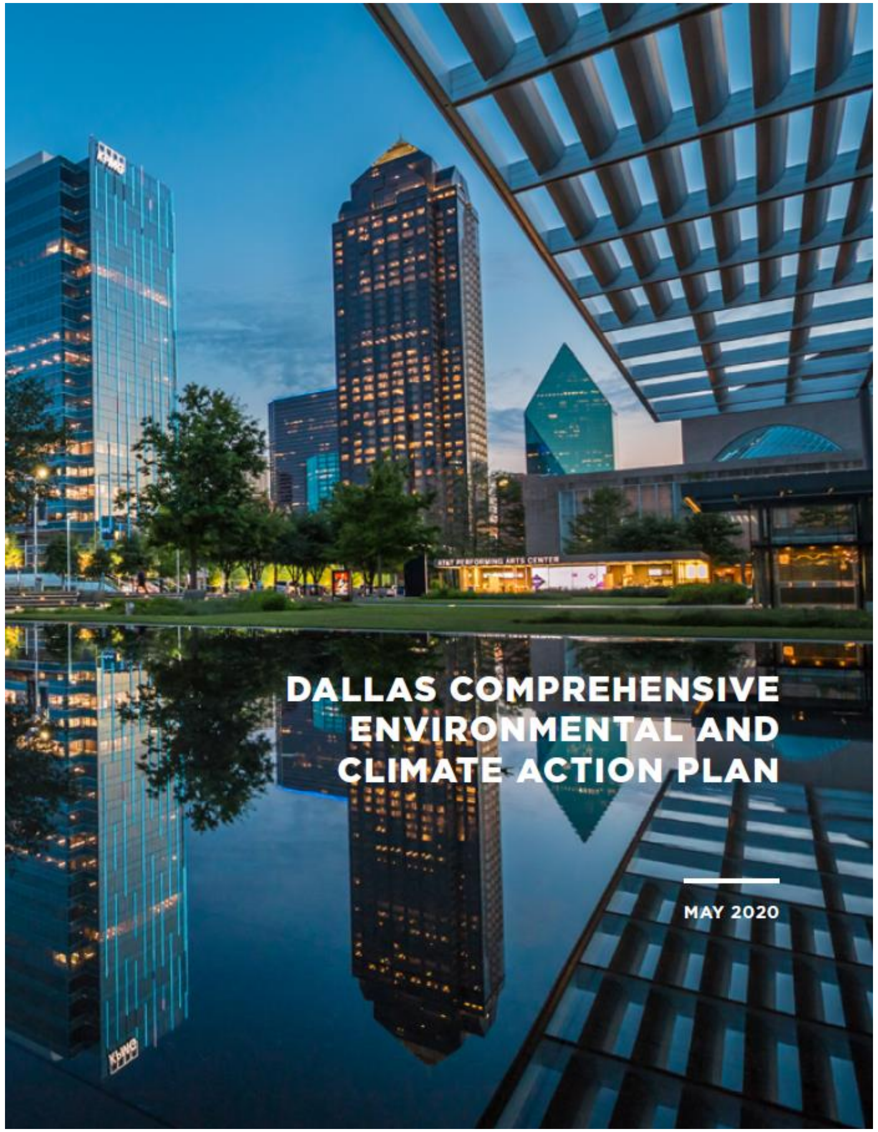
Dallas Fleet Electrification Goals



Dallas Comprehensive Environmental and Climate Action Plan (CECAP)

- The Intergovernmental Panel on Climate Change (IPCC) recommends **reducing GHG emissions to net zero by 2050** to limit the increase in global temperatures to below 1.5°C.
- The City of Dallas is **committed to meeting the international emission reduction targets** set by the Paris Agreement in 2016.
- The 2015 greenhouse gas (GHG) inventory reported that **35% of Dallas' GHG emissions come from transportation sector**.
- The CECAP provides a roadmap for the City to improve quality of life, **to reduce greenhouse gas emissions**, to prepare for the impacts of climate change, and to create a healthier and more prosperous community.

Fleet Electrification Considerations

- What are the overall goals of the Dallas fleet electrification plan?
- Where are the best opportunities for fuel reduction and emissions reduction?
- Which vehicle duty cycles are suitable for electrification?
- Which vehicles are eligible for electrification (i.e., non-emergency response or non-special purpose vehicles)
- Which vehicles are nearing retirement or overdue for replacement?
- Which vehicles have an electric model that's commercially available today?
- Which vehicles have dedicated parking locations suitable for charging equipment?
- Which communities or regions of the city stand to benefit the most from lower emissions and improved air quality?
- What are the vehicle-life economics and what factors influence economic payback and GHG savings

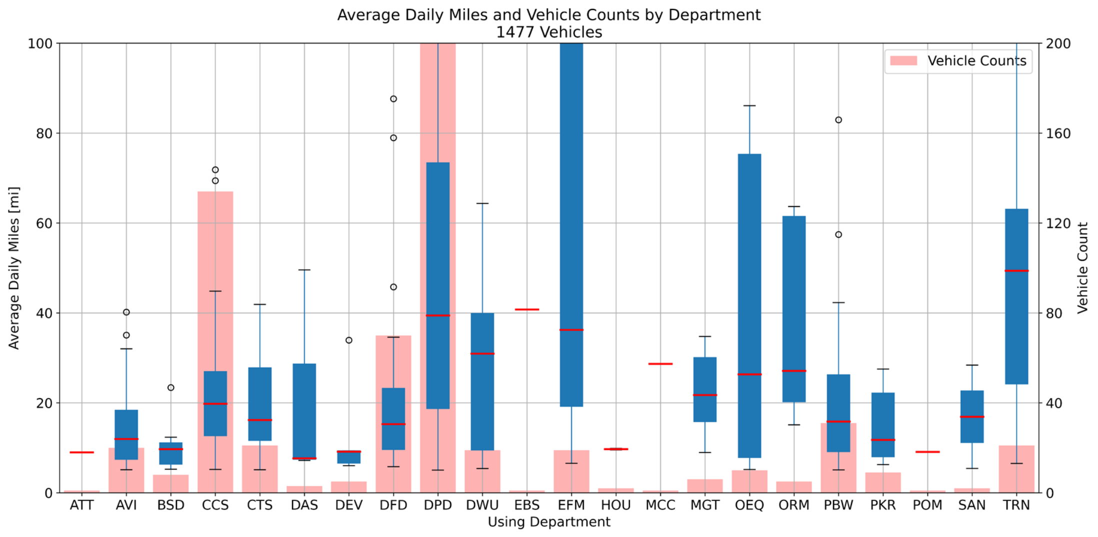
Data-driven Analysis Approach

Vehicle Inventory	• Number of vehicles by department • Vehicle class/type by department • Vehicle age
Vehicle Operation	• Annual vehicle miles traveled (VMT) by department and vehicle type • Estimated daily miles traveled per vehicle
Fuel/Energy Consumption	• Annual fuel consumption by department and vehicle type • Estimated daily energy consumption per vehicle
Vehicle Replacement Criteria	• Review of replacement eligibility criteria • Review of replacement ranking, year and cost by vehicle
EV Availability	• Alternative Fuels Data Center (AFDC) Advanced Vehicle Search tool • Review of commercially available EVs by vehicle class and type • MSRP values
EV and EVSE Economics	• Inputs from steps above feed VICE Economic Model (cost and operations) • Light-duty sedans and pickup scenarios evaluated • Parametric sweeps show impacts of key input parameters
GHG Impacts	• Data on regional energy generation energy and vehicle efficiencies • GREET Model to estimate GHG impacts of EV replacements • Combine VICE economics and GREET GHG to estimate cost of GHG offsets

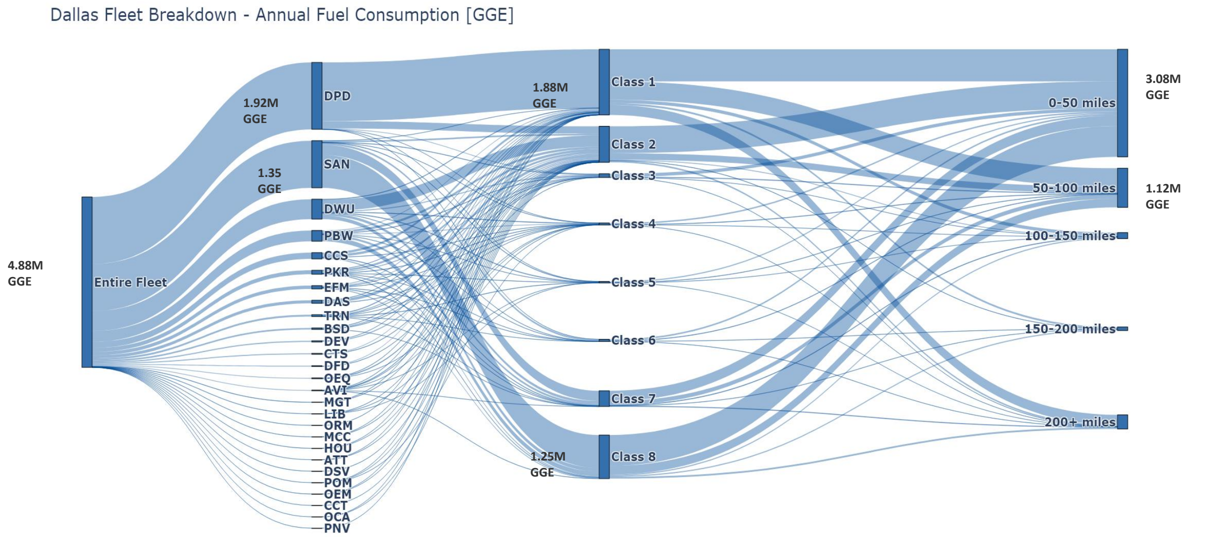
Dallas Fleet Electrification Process

- **Review of Established Transportation Energy Goals / Policies**
- **Dallas Fleet Inventory Energy Consumption and Usage**
  - Fleet inventory and usage statistics
  - ZEV model availability
  - Energy breakdown by vehicle types and departments
  - Vehicle energy requirements / duty cycle analysis
  - Fleet replacement criteria – vehicle age / mileage
  - Selection of priority electrification candidates
- **Infrastructure Requirements**
  - Priority charging locations
  - Vehicle dwell times and fleet parking locations
  - Utility rates / rate structures
- **Cost of Operation / Ownership Estimation**
  - Cost data collection (fleet) – fuel cost, electricity cost, maintenance
  - Cost data collection (market) – fuel cost, electricity cost, maintenance
  - Cost calculations – e.g., Vehicle Infrastructure Cash-Flow Evaluation (VICE) tool

Fleet Inventory Usage Statistics



Entire Fleet Energy Consumption by Department and Vehicle Type



Note: expanded versions of above figures provided in backup slides

Dallas Fleet Vehicle Usage

Dallas fleet inventory data reveals the number, size, and type of vehicles operated by each city department, as well as:

- Annual fuel consumption
- Average daily vehicle miles traveled (VMT)

Review of GPS data for select vehicle groups indicates that

- GPS daily VMT somewhat higher than estimated annual averages
- GPS data indicate that most vehicles have maximum daily driving distances well within the range of suitable replacement EVs

Vehicle age and anticipated replacement dates suggest many Admin Sedans and Light Duty Pickups have met replacement criteria

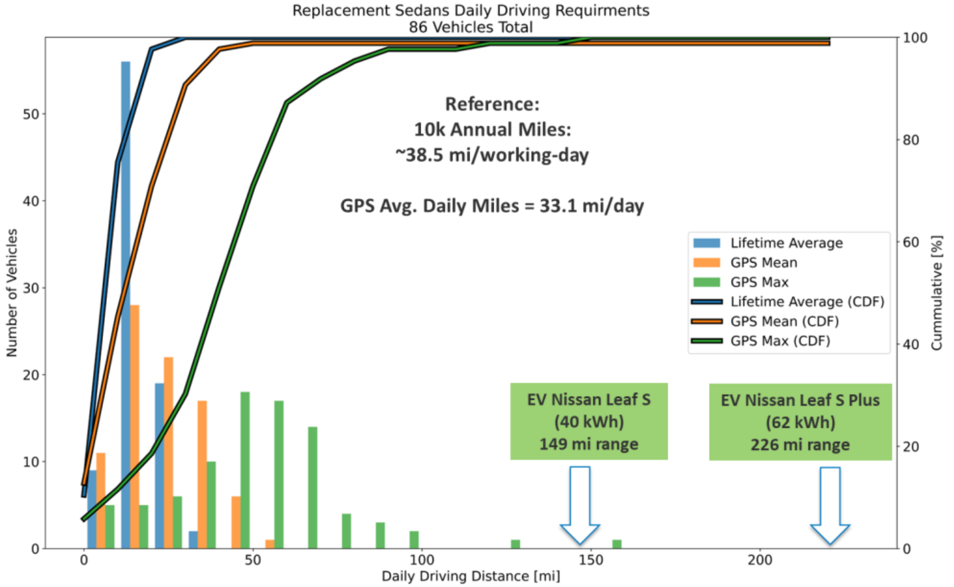
Key Takeaways: *Analysis of fleet inventory, usage statistics, and replacement criteria help to narrow the EV candidates.*

GPS data provides more detailed info on vehicle daily usage

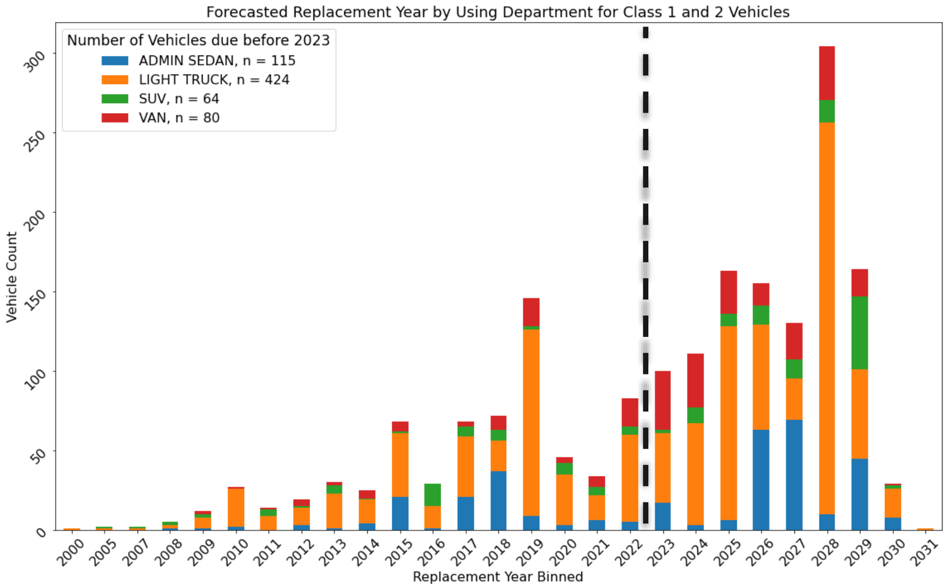
Candidates for replacement with EVs should be reviewed with the operating managers to ensure specific vehicle suitability – including maximum driving range requirements and energy used for loads during idle

Note: expanded versions of above figures provided in backup slides

Comparing GPS to Fleet Aggregate Statistics

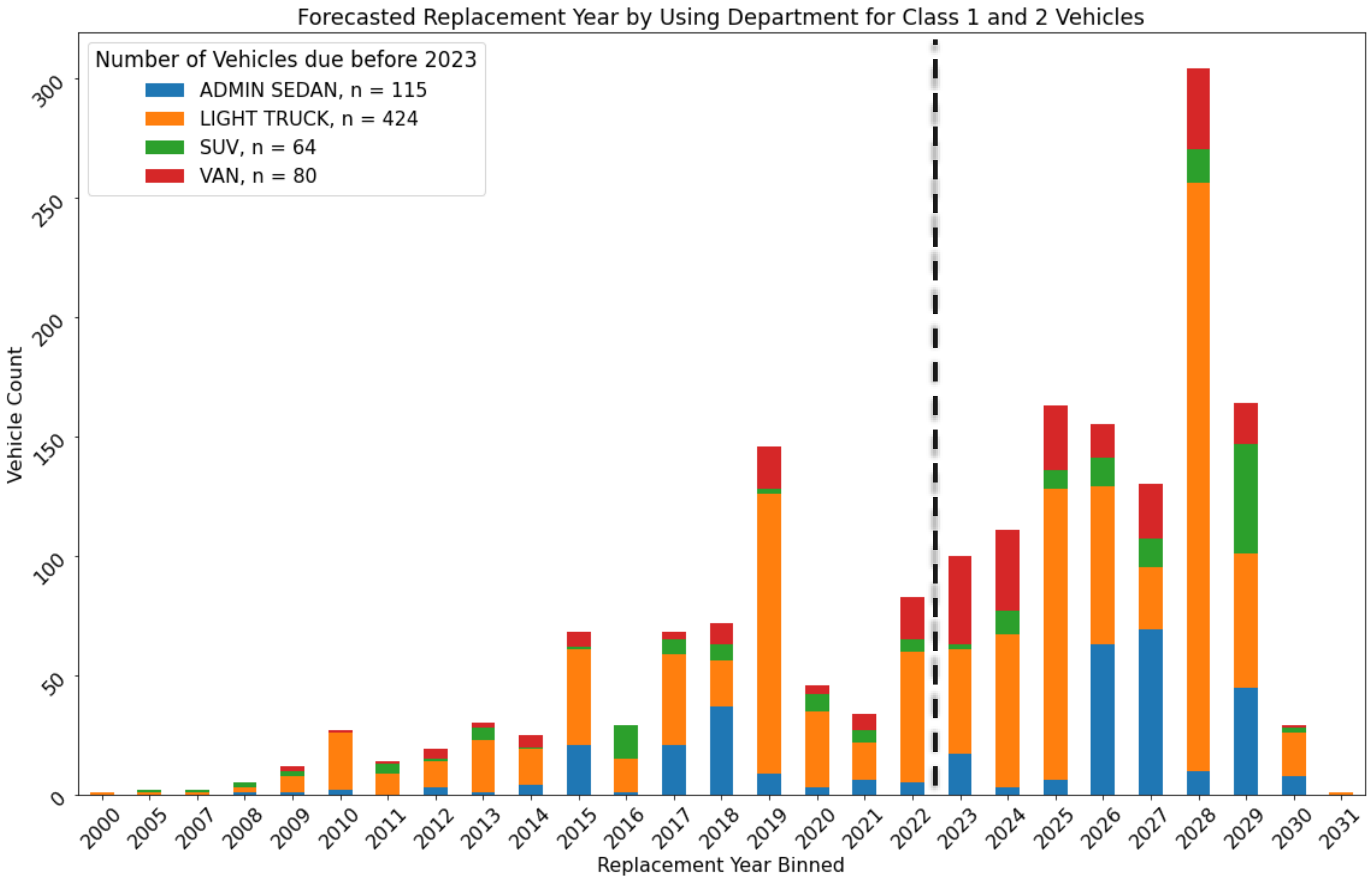


Vehicles Scheduled for Replacement by Type



Vehicle Replacement Schedule

- Dallas has established criteria for replacement/retirement of fleet vehicles, which determines forecasted replacement year
- There are nearly 700 class 1 & 2 vehicles in current fleet with scheduled replacements before 2023 (excluding DPD)
- Sizeable opportunities currently exist for replacement of Admin Sedans and Light Trucks with EV’s



Primary cost drivers for EVSE

- **Power level of unit (kW)**
  - Level 2 EVSE tend to be much cheaper than DCFC
- **Number of charging ports per unit**
  - Chargers with multiple connectors/charging ports tend to be cheaper ($/port)
  - Software can enable simultaneous or sequential vehicle charging
- **Mounting type (pedestal or wall-mount)**
  - Wall-mounted units tend to be cheaper than pedestal-mounted, for hardware and installation
- **Internet connectivity**
  - Networked EVSE—enabling mobile app connectivity, point-of-sale capability and other features—increases EVSE costs
- **EVSE location and number of units installed**
  - Will have a large impact on construction and installation costs
- **EVSE costs are variable and can be challenging to predict**
  - It is recommended to purchase and install only the minimum charging level and capabilities needed

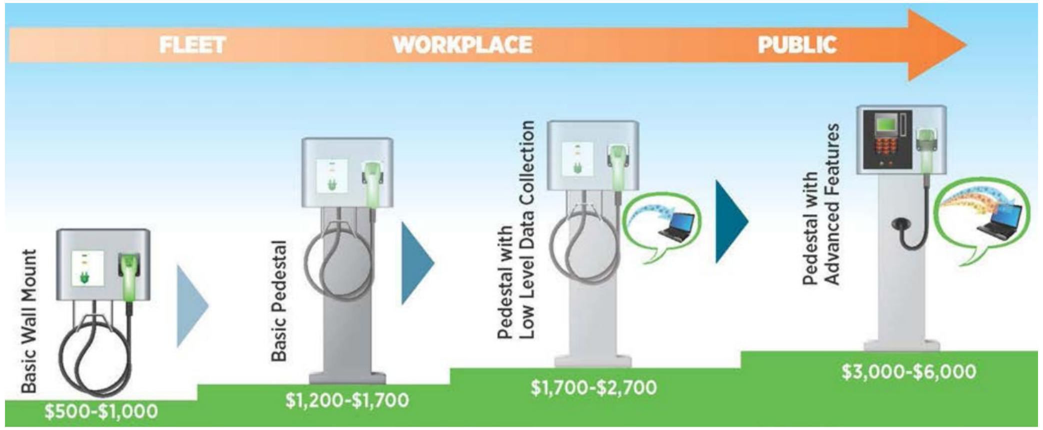
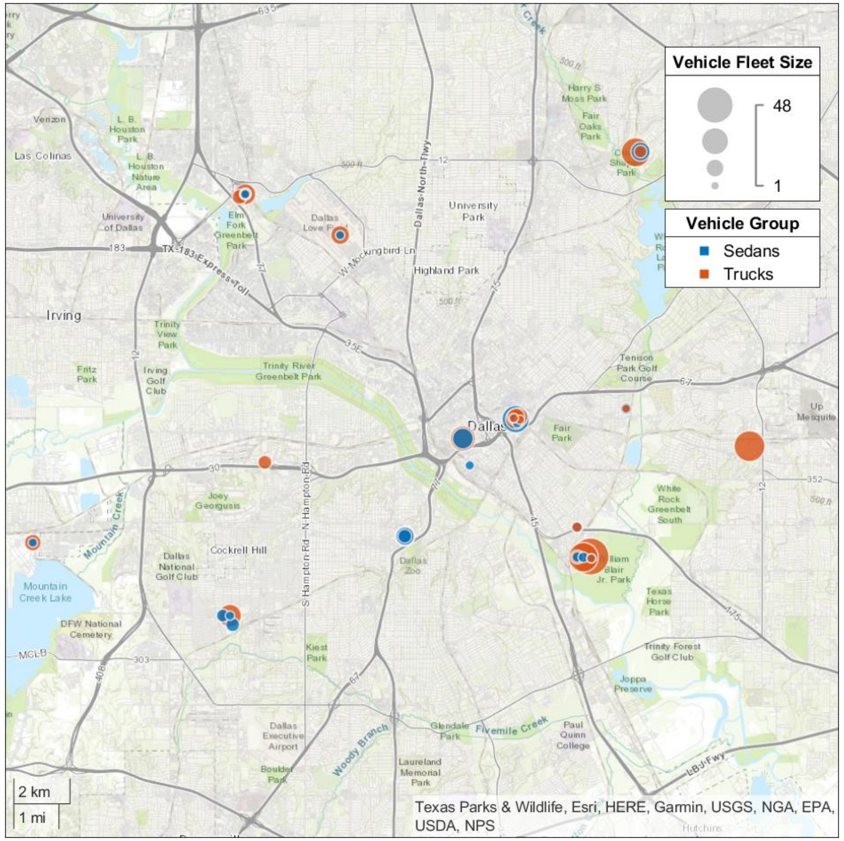


Figure 5. Ballpark cost ranges for different tiers of Level 2 EVSE units. *Image from Kristina Rivenbark, New West Technologies.*

Locations with sedans & light trucks

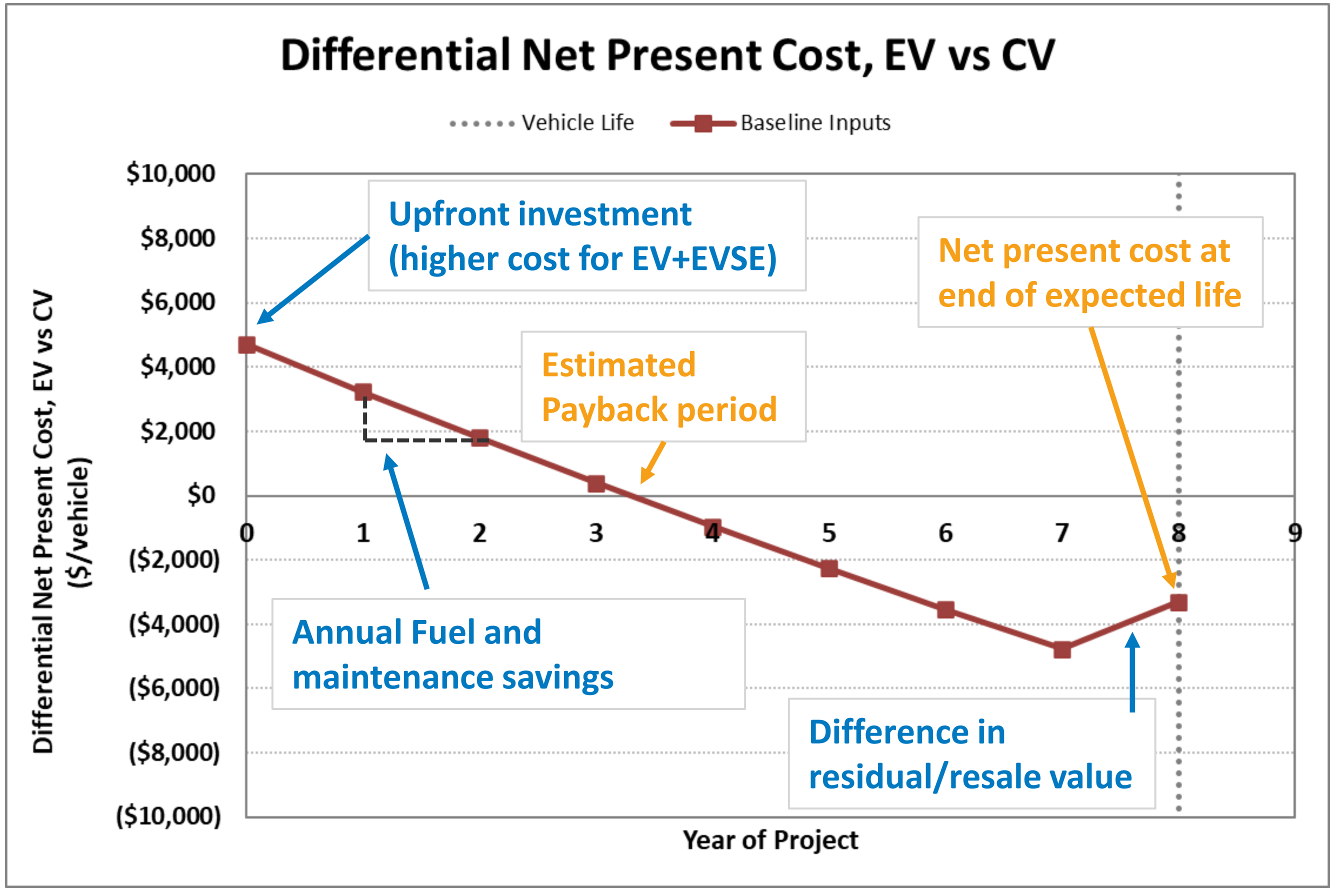


Vehicle and Infrastructure Cash Flow Evaluation (VICE) model Key Inputs & Outputs

General Input Parameters
Number of vehicles
Annual VMT (miles)
Expected vehicle lifetime (years)
Rate of return, discount rate

Vehicle-Specific Inputs	Conventional	Electric
Purchase cost ($)	✓	✓
Fuel efficiency (mpg, kWh/mi)	✓	✓
Fuel/electricity price ($/gal, $/kWh)	✓	✓
Maintenance costs ($/mi)	✓	✓
Residual/salvage value ($)	✓	✓
EVSE purchase cost ($)		✓
EVSE installation cost ($)		✓
Grants/rebates/tax incentives for EVs and EVSE ($)		✓

Example of VICE model results



Baseline Inputs & Parametric Sweeps
Light Duty Sedan

Parameter	Units	Conventional Vehicle	EV
Fleet size	#	10	
Annual VMT	miles	6,382	
Year/Make/Model		**2022 Honda Civic LX**	**2022 Nissan Leaf S**
Capital cost (MSRP)	$/vehicle	$23,365	$28,425
Fuel efficiency	mpg kWh/mi	34 mpg	112 MPGe 0.268 kWh/mi
Fuel price	$/gal $/kWh	$2.36/gal	$1.71/gal $0.052/kWh
Maintenance cost	$/mi	$0.187	$0.117
Salvage value	% of MSRP	~31%	~17%
EVSE cost	$/EVSE	n/a	$1,000 + $2,000
Rebates	$/vehicle	n/a	$0

Values from fleet vehicles to be replaced

Values for replacement vehicle options

Model inputs estimated from other data sources

Swept Parameters
(see backup slides)

EV Cost
- $28K vs. $23K (base)

EV Rebates
- $0 (baseline), $2.5K, 7.5K, 15K per vehicle

EVSE Cost
- $3K (baseline), $2K, $5K each

Daily VMT (miles/day)
- 24.5 miles, 38.5 miles, 46 miles

Gasoline Price
- $2.36/gal (baseline), $3/gal, $4/gal

Extended vehicle life was also projected
- 8 –year vs. 12-year

Dallas Fleet EV Economics Light-Duty “Administrative Sedans”

VICE Economic Model Results – Light Duty Sedans

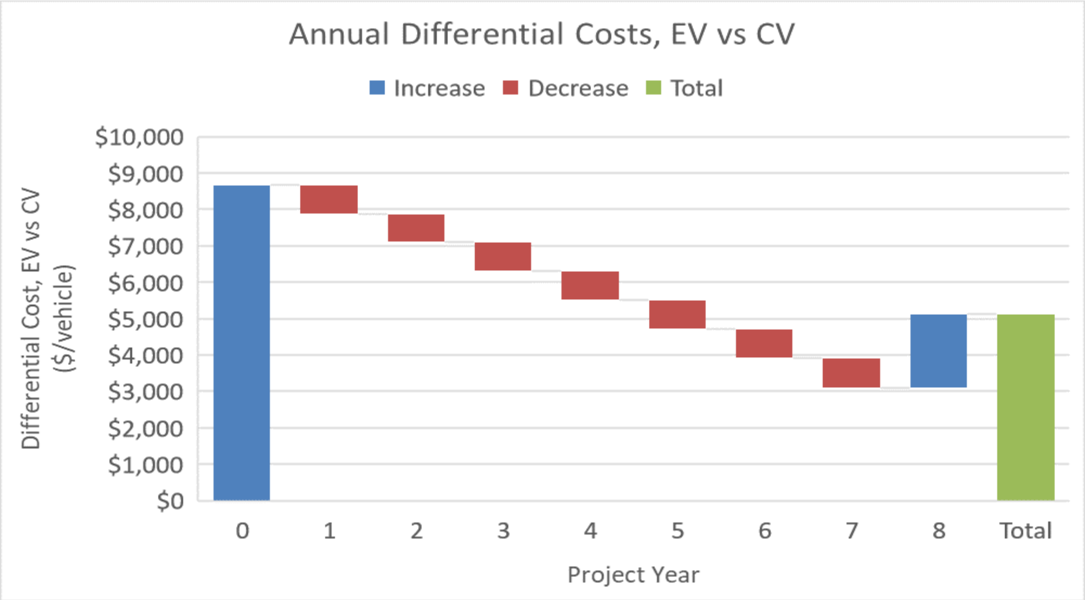
- The base 2022 Nissan Leaf Model S appears capable of meeting "most" driving range requirements at a lower price point – 40-kWh battery/149-mile EV range
- Baseline total net present cost at end of expected 8-year life = $4,345 per vehicle) – vehicle operation beyond year 8 continues to accrue savings
- Operational savings accumulate faster when replacing vehicles that are driven more – this can be done well within estimated Nissan Leaf S range of 149 miles

Scenarios to achieve lifetime “cost parity” include

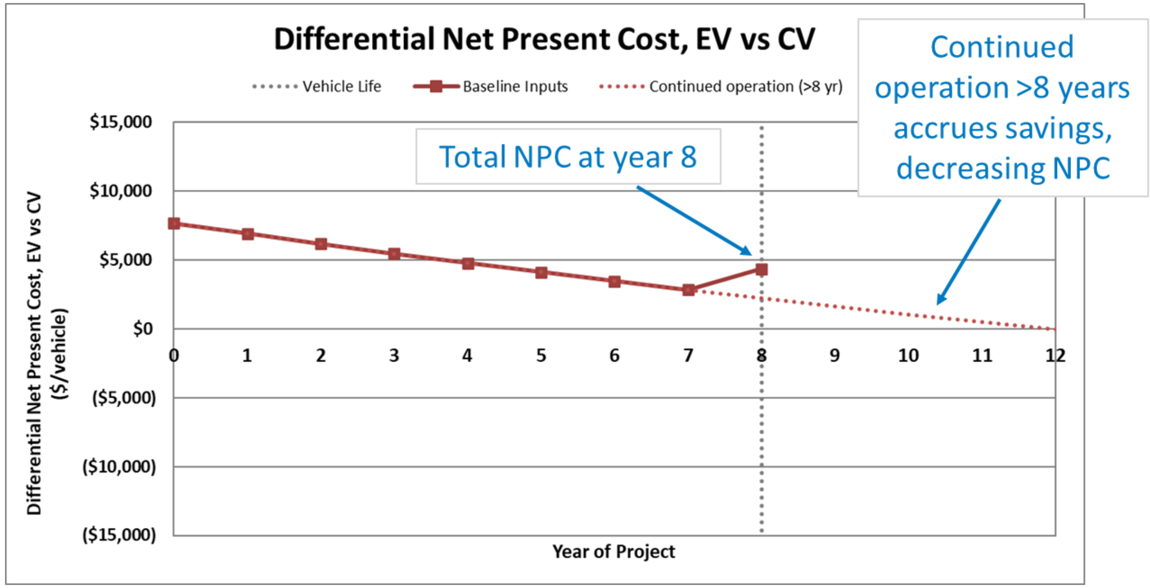
- Case 1: $2.5K EV rebate
- Case 2: Lower EVSE cost ($2.5K), higher gas price ($3/gal) and VMT (8K miles/year)

Note: expanded versions of above figures provided in backup slides

VICE Model Results – baseline lifetime costs & savings



VICE Model Results – lifetime cost differential



Baseline Inputs & Parametric Sweeps
Pickup Trucks

Values from fleet vehicles to be replaced

Values for replacement vehicle options

Model inputs estimated from other data sources

Parameter	Units	CV	EV
Fleet size	#	9	
Annual VMT	miles	7,731	
Year/Make/Model		**2022 Ford F-150**	**2022 Ford F-150 Lightning**
Capital cost (MSRP)	$/veh	$31,685	$41,669
Fuel efficiency	mpg kWh/mi	18 mpg	67 MPGe 0.426 kWh/mi
Fuel price	$/gal $/kWh	$2.36/gal	$1.71/gal $0.052/kWh
Maintenance cost	$/mi	$0.247	$0.154
Salvage value	% of MSRP	~31%	~18%
EVSE cost	$/EVSE	n/a	$1,000 + $2,000
Rebates	$/vehicle	n/a	$0

Swept Parameters
(see backup slides)

Daily VMT (miles/day)
- 30 miles (baseline), 38.5 miles, 46 miles

Gasoline Price
- $2.36/gal (baseline), $3/gal, $4/gal

Extended vehicle life was also projected
- 8 –year vs. 12-year

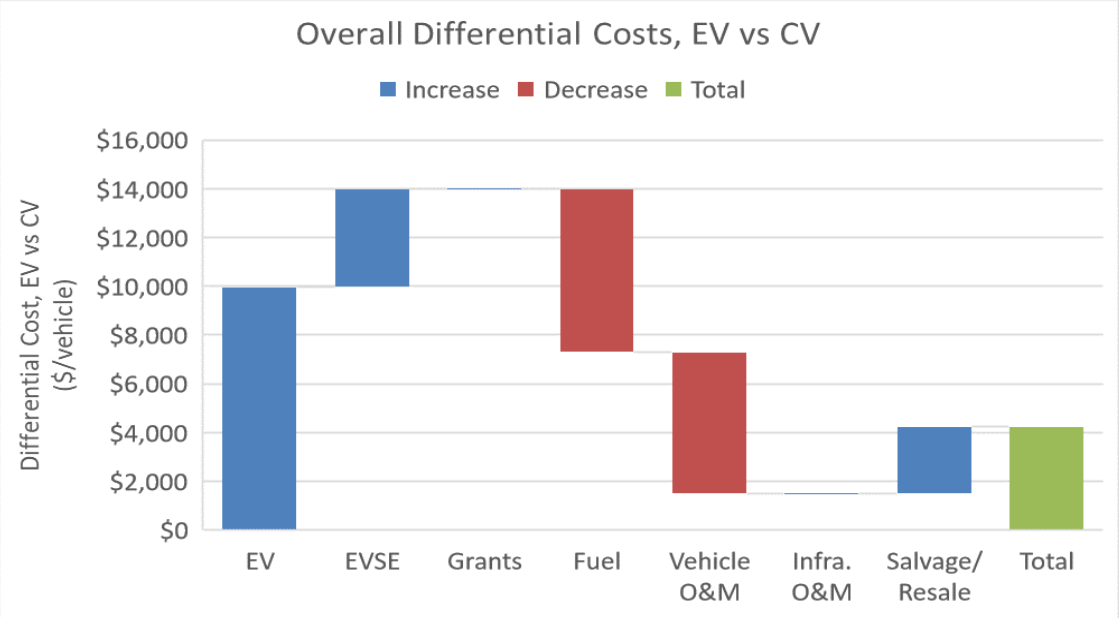
Dallas Fleet EV Economics
Light-Duty Pickup Trucks

VICE Economic Model Results – Light Duty Pickups

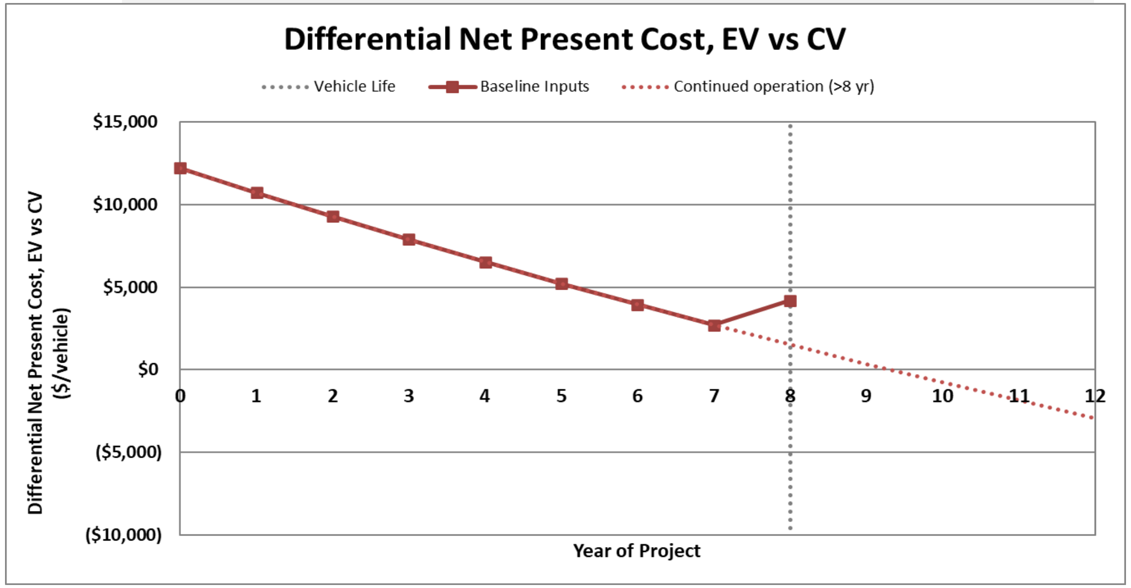
- The 2022 Ford F-150 Lightning Pro appears to be capable of meeting “majority" of driving range requirements at a lower price point – 98-kWh battery/230-mile EV range
- Baseline net present cost at end of 8-year life ~ $4,202 per vehicle – vehicle operation beyond year 8 continues to accrue savings
- Annual Operational savings accumulate faster for EV pickups than EV sedans – due to higher relative energy savings
- Operational savings accumulate faster when replacing vehicles that are driven more – this can be done well within estimated Ford F150 Lightning Pro EV driving range of 230 miles

Note: expanded versions of above figures provided in backup slides

VICE Model Results – baseline lifetime costs & savings



VICE Model Results – lifetime cost differential

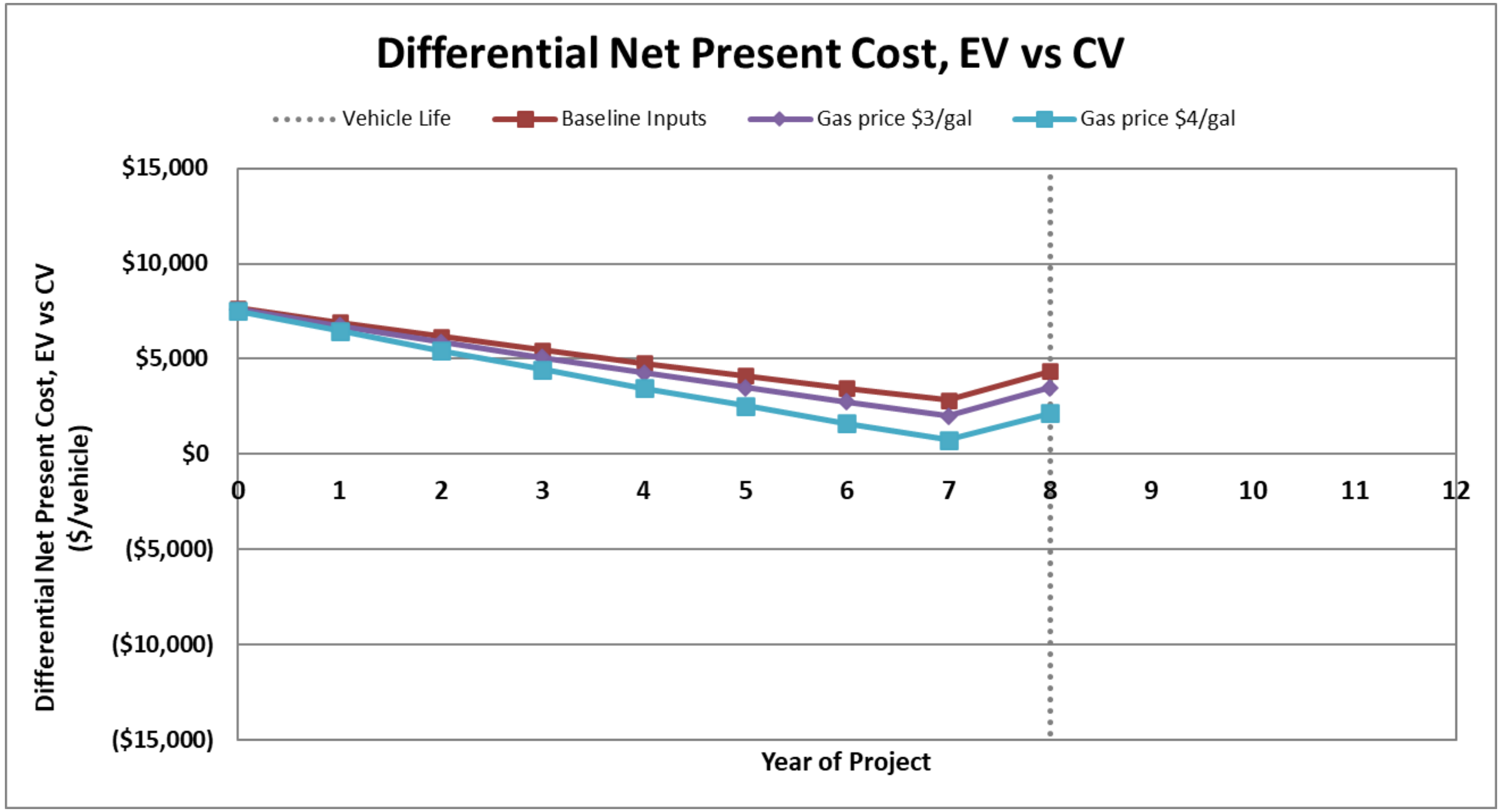


VICE Model Results – Impact of Fuel Prices

<u>Impact of gas price</u>

- Baseline gas price = $2.36/gal (2021 Dallas avg.)
- Gas price $3/gal represents small increase
- Gas price $4/gal represents larger increase (similar to current gas prices)

Takeaway: *Higher gasoline fuel prices (relative to electricity costs) impact rate of savings and payback period for the EV option*



<u>Electric Vehicle</u>

2022 Nissan Leaf S

<u>Conventional Vehicle</u>

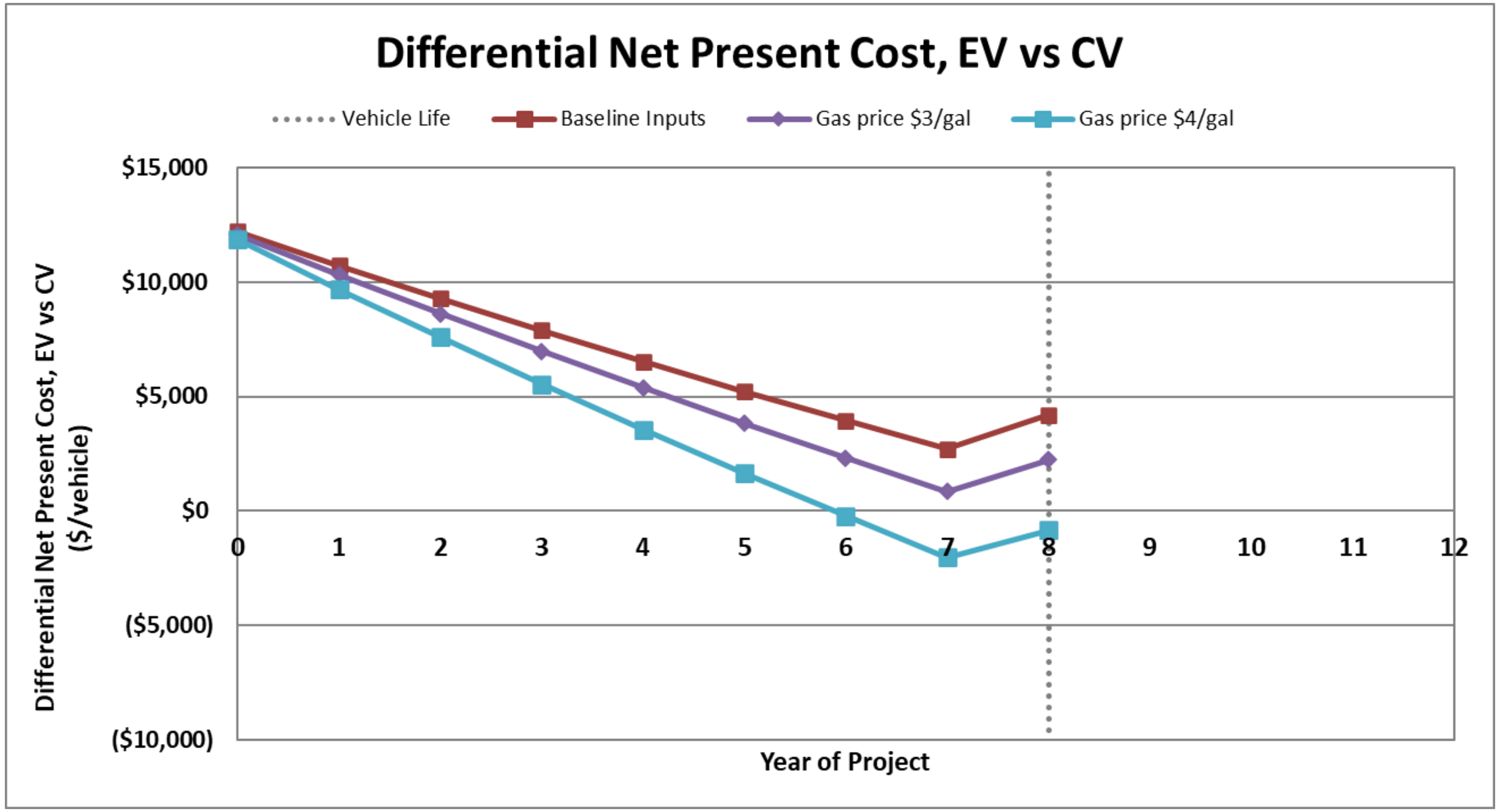
2022 Honda Civic LX

VICE Model Results – Scenario 2 (trucks)

Impact of gas prices

- Baseline gas price = $2.36/gal (2021 Dallas avg.)
- Gas price $3/gal represents small increase
- Gas price $4/gal represents larger increase (similar to current gas prices)

Takeaway: *Higher gasoline fuel prices (relative to electricity costs) impact rate of savings and payback period for the EV option*



Electric Vehicle

2022 Ford F-150 Lightning

Conventional Vehicle

2022 Ford F-150

VICE Model Summary

- The VICE model provides a comparison of project economics and investigate scenarios for a purchase of EVs and EVSE compared to a purchase of conventional vehicles
- Upfront project costs have a large impact on overall economics
  - Relative purchase price of EV compared to comparable CV
  - Equipment and installation costs of EVSE for EV fleet being purchased
    - Note: EVSE costs are highly variable depending on the specific equipment needs and unique circumstances of the charging location
  - The value of GHG emissions reductions and air quality improvements should be considered
- Financial incentives such as grants, rebates and tax credits can have a large impact on project economics
  - Numerous programs exist for federal and state funding for EVs and for EVSE
- EVs can accrue savings from lower per-mile fuel and maintenance costs compared to CVs, but these costs carry some uncertainty
  - Low fixed electricity price for Dallas is very advantageous for vehicle electrification
- Lead times for EVSE (procurement, permitting, site preparation/construction, installation) can be longer than lead times for EVs
  - Begin process to establish charging infrastructure to enable deployment of EV fleets

Estimation of Cost per ton GHG Offset

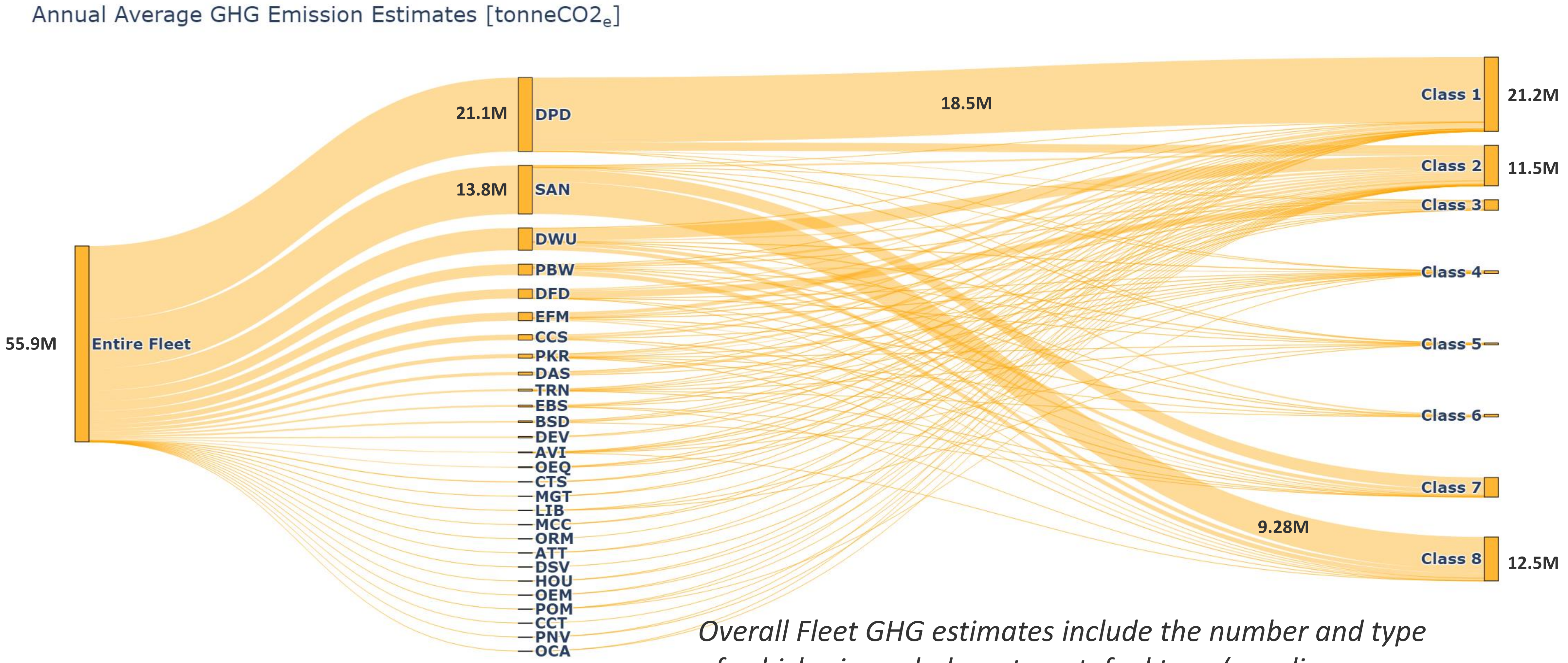
assuming zero-carbon "green" electricity

Parameter	Units	Baseline Scenario 1 (sedans)	Baseline Scenario 2 (light trucks)
VICE model total project cost per vehicle	$/vehicle	4,345	4,202
Lifetime emissions reduction (EV vs CV) per vehicle	metric ton CO_2e/vehicle	16.03	36.67
Project cost per metric ton CO_2e to achieve lifetime emissions reduction	$/metric ton CO_2e	271	114

- The VICE model estimates that purchasing EVs instead of CVs could reduce GHG emissions by
  - 16.03 metric tons CO_2e per light-duty sedan over an eight-year expected lifetime
  - 36.67 metric tons CO_2e per light-duty pickup truck over an eight-year expected lifetime
- Based on the per-vehicle lifetime costs baseline assumptions, GHG emissions reductions are estimated to be
  - $271 per metric ton CO_2e for the light-duty sedan scenario
  - $114 per metric ton CO_2e for the light-duty pickup truck scenario
- **Any improvement in EV cost will lower the cost to achieve GHG reductions**
  - Achieving EV ***cost parity*** (through grants or other means discuss previously) results in GHG emissions savings estimated above at no additional cost

Dallas Fleet Annual GHG Emission Estimates

(Excluding vehicles in fleet less than 1 year)



Overall Fleet GHG estimates include the number and type of vehicles in each department, fuel type (gasoline or diesel), vehicle efficiency, and annual fuel consumption

Recommendations/Next steps

1. **Deploy commercially available LD EV sedans and light trucks and charging infrastructure**
   – Consider factors from VICE model for each purchase decision to replace retired vehicles
   – Meet with individual departments to review EV replacement recommendations, charging infrastructure and review any special requirements
   – Place EVs in relatively high-mileage service (within EV range) to maximize payback
   – Apply for federal and state grants/rebates – working with DFW Clean Cities and others
   – Begin process to install EVSE as soon as possible (working with utility)
   – Track cost and performance data on EVs and EVSE to inform future purchase decisions

Recommendations/Next steps

2. **Test/demonstrate Medium- and Heavy-duty EVs in Dallas fleet service**
   – Medium- and heavy-duty vehicles consume a significant portion of energy within the fleet (e.g., class 8 refuse haulers)
   – MD/HD EVs are emerging – but in some case products/markets are not fully developed
   – Collect detailed in-use data on high priority fleet vehicles to characterize duty cycles and energy requirements to evaluate electrification potential
   – Hydrogen fuel cell vehicles may be suitable alternatives for vehicle types/vocations that are more challenging to replace with battery-electric vehicles

3. **Coordinate and seek lessons learned from others**
   – Clean Cities Coalitions – DFW Clean Cities and national experience
   – Transit industry – including DART
   – DFW Airport is developing similar ZEV strategies
   – Other municipal fleets operating EVs – e.g., refuse, police, fire

Thank You!

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We would like to respectfully acknowledge input and guidance from Dallas Fleet Management and* Office of Environmental Quality & Sustainability*, Dallas Environmental Commission, and DFW Clean Cities
- Donzell Gipson, Susan Alvarez, Lori Clark – and many other contributors

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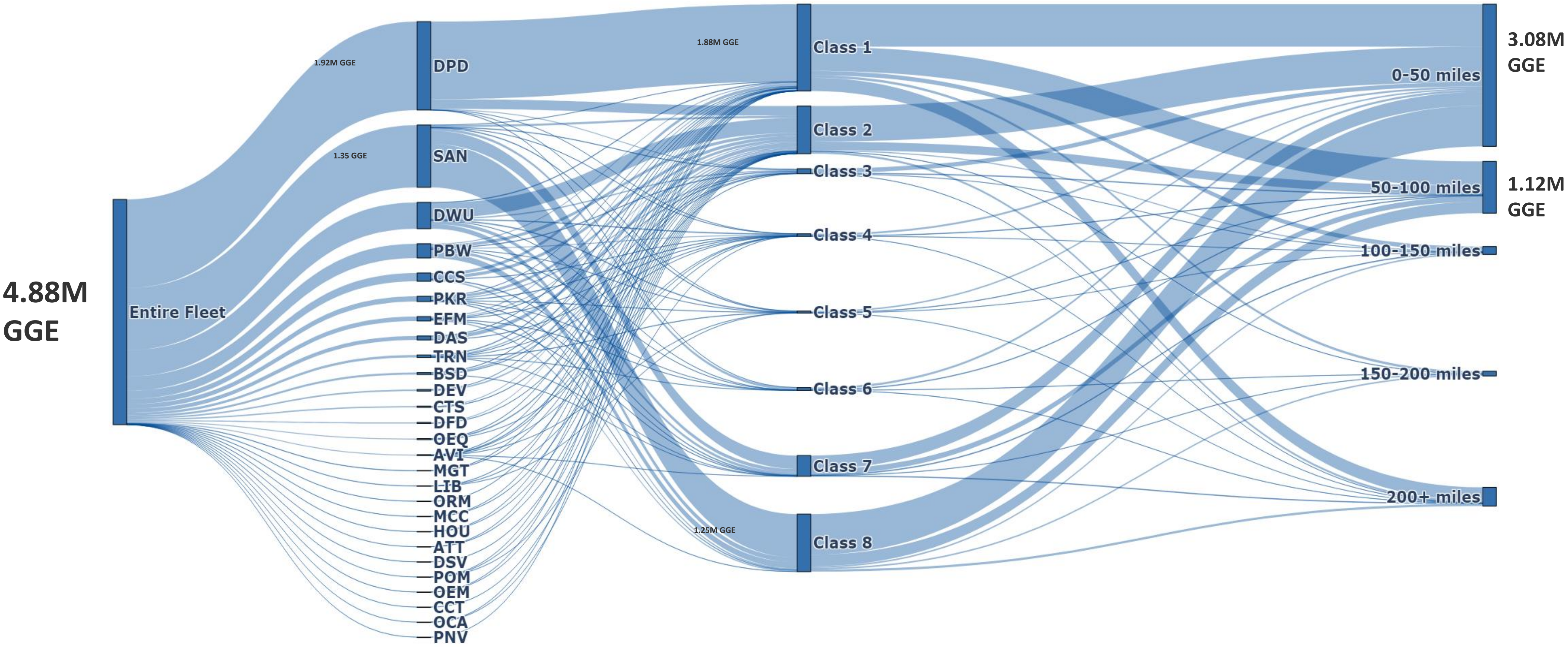
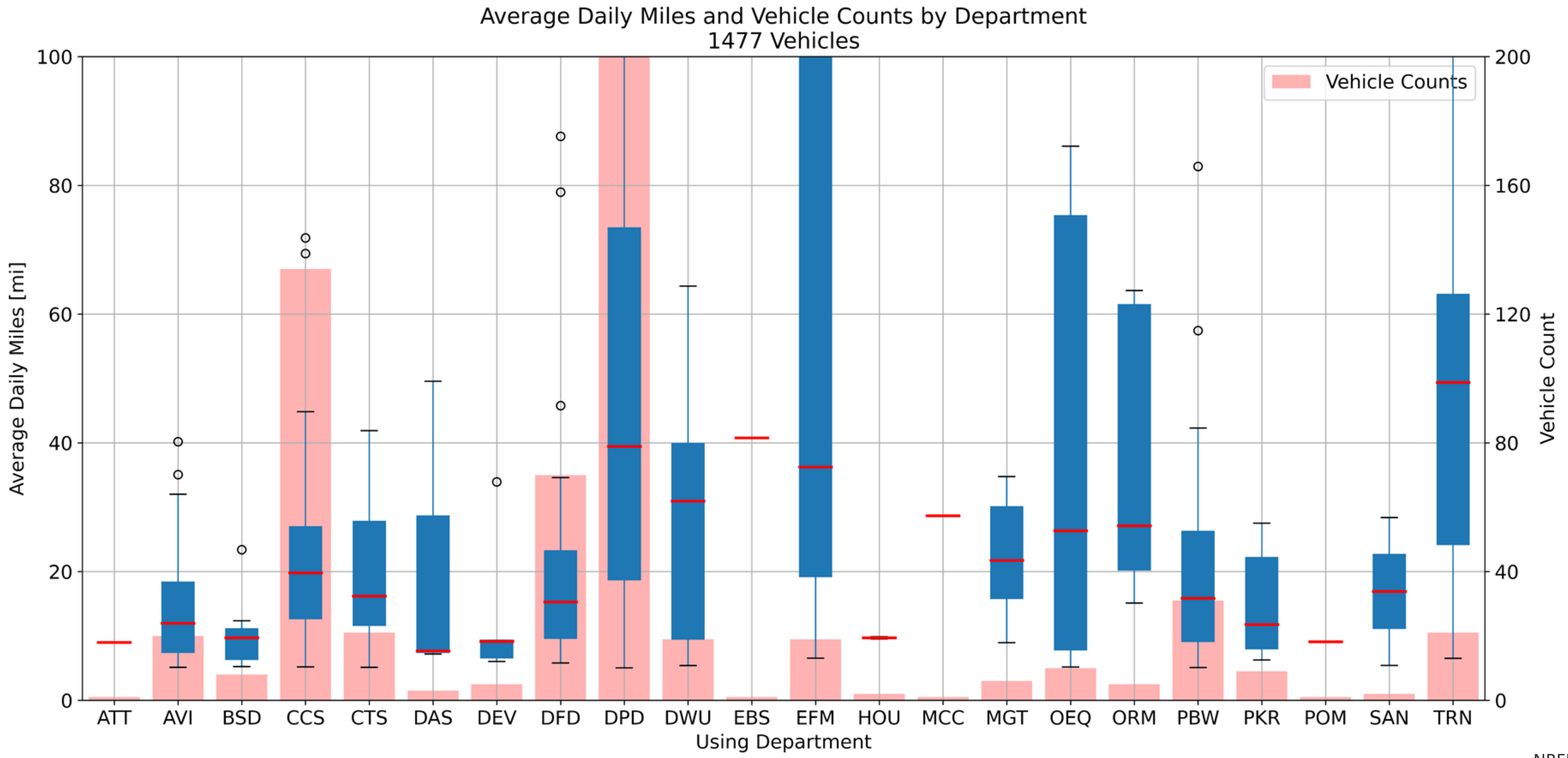
Backup Slides

Annual Energy Consumption by Department and Vehicle Type



Entire Fleet Annual Fuel Consumption → Annual Fuel Use by Department → Annual Fuel Use by Vehicle Weight Class → Annual Fuel Use by Daily Mileage Driven

Fleet Inventory Usage Statistics



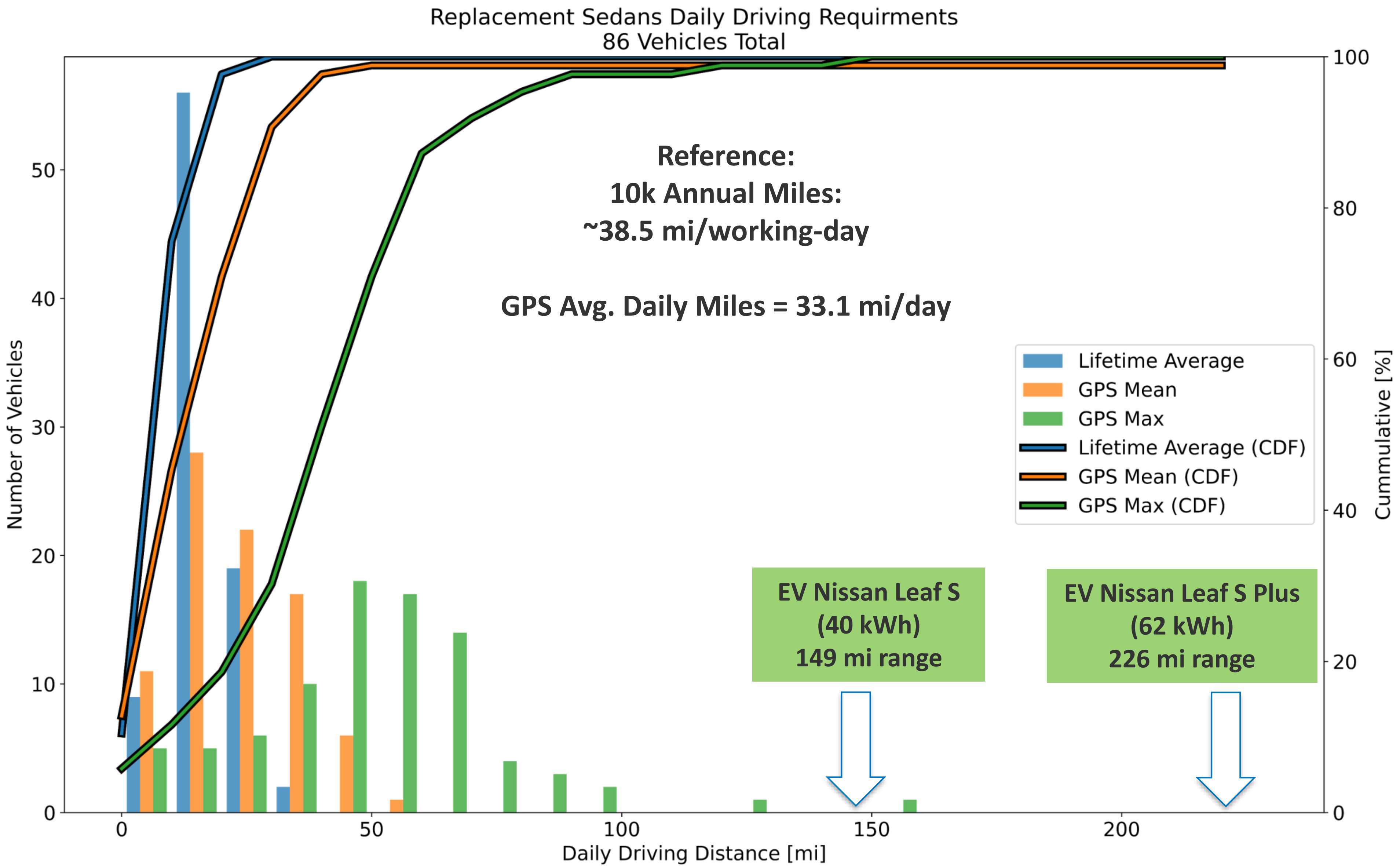
Comparing GPS Data to Aggregate Fleet Averages

– Admin Sedans –

Graph shows comparison of GPS daily driving distances to fleet average stats for 86 Admin Sedans scheduled for replacement (with GPS units

GPS average daily miles (orange) are somewhat higher than fleet aggregated data (blue)

Maximum daily miles traveled from GPS are higher than averages, but still within the driving range of Nissan Leaf EV

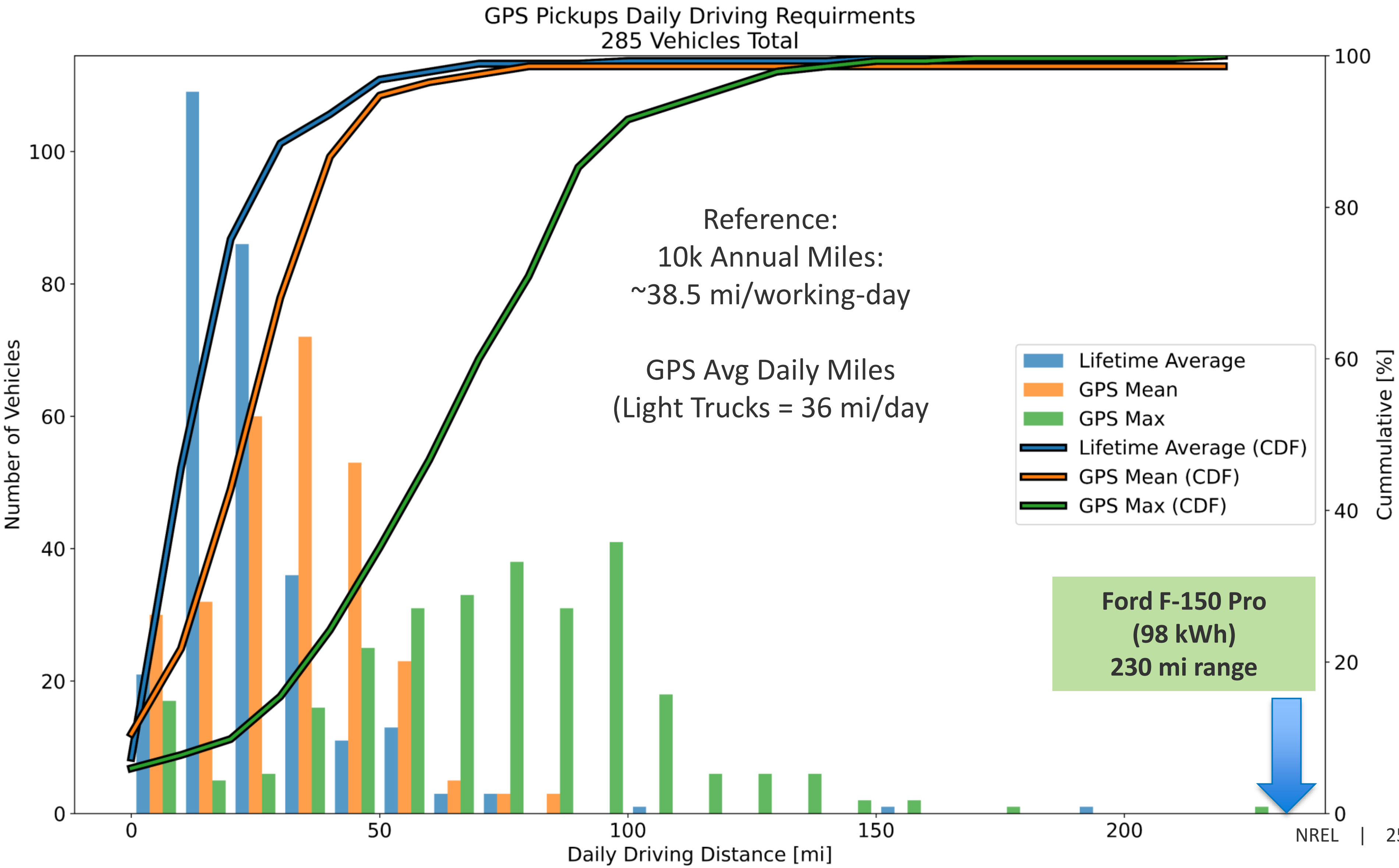


Comparing GPS Data to Aggregate Fleet Averages
– Light Trucks –

Graph shows comparison of GPS daily driving distances to fleet average stats for 285 Light Trucks scheduled for replacement (with GPS units)

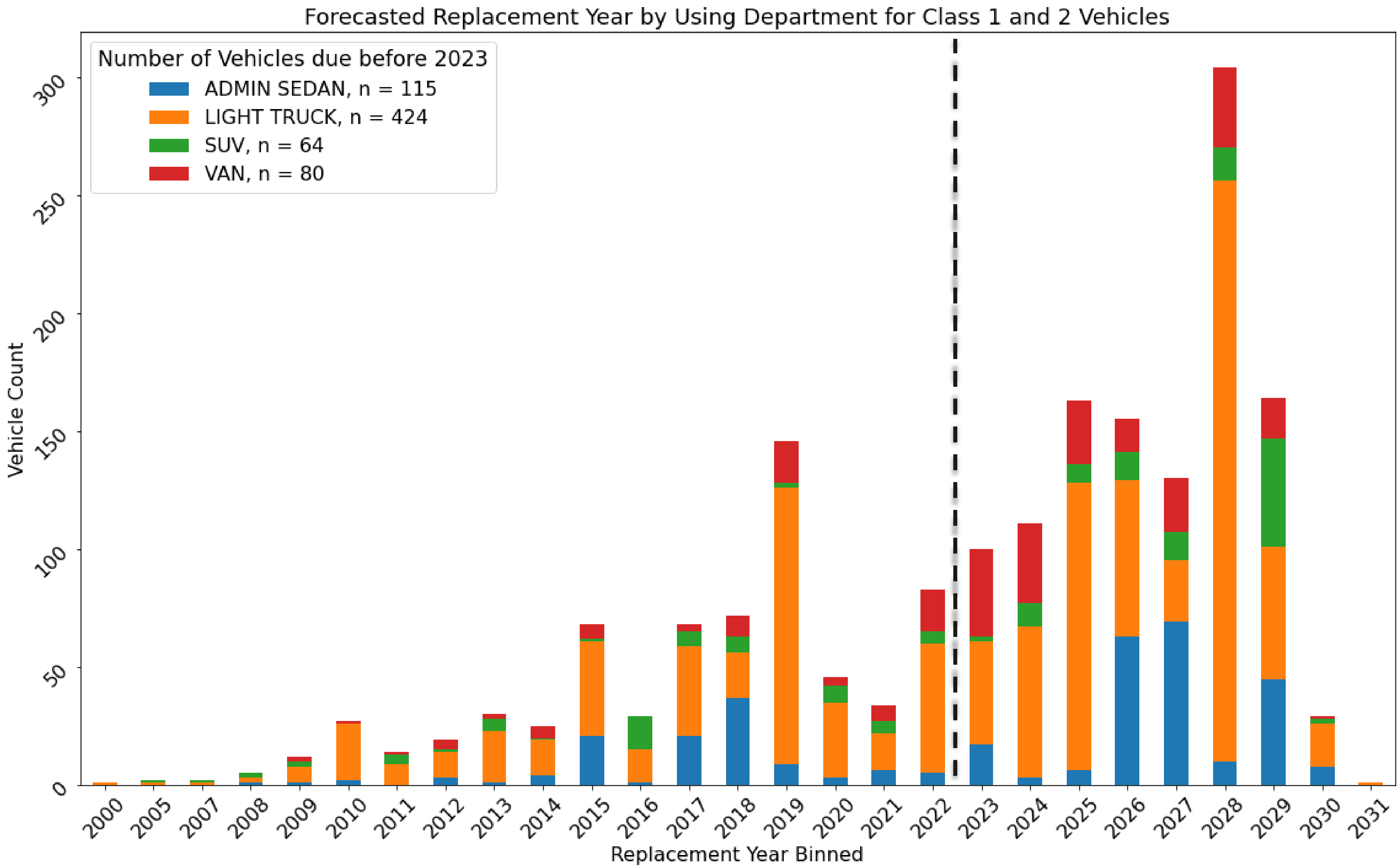
GPS average daily miles (orange) are somewhat higher than fleet aggregated data (blue)

Maximum daily miles traveled from GPS are higher than averages, but still within the driving range of Ford F150 EV



Dallas Fleet

Vehicles Scheduled for Replacement by Type



VICE Model Sources for Key Inputs

	Parameter	Units	Conventional Vehicle (CV)	Electric Vehicle (EV)
Values from fleet vehicles to be replaced	Fleet size	#	Size of subfleet (filtered from fleet inventory)	
	Annual VMT	miles	Average annual VMT of subfleet	
Values for replacement vehicle options	Year/Make/Model		MY 2022 CV	MY 2022 EV
	Capital cost	$/veh	MSRP	MSRP
	Fuel efficiency	mpg kWh/mi	EPA avg for MY 2022 CV	EPA avg for MY 2022 EV
Model inputs estimated from other data sources	Fuel price	$/gal $/kWh	Dallas fuel station 2021 average price	Dallas average electricity price
	Maintenance cost	$/mi	Average of subfleet	Estimated from ANL vehicle TCO report
	Salvage value	% of MSRP	Estimated from ANL vehicle TCO report	Estimated from ANL vehicle TCO report
	EVSE cost	$/EVSE	n/a	Estimated equipment + installation cost
	Rebates	$/vehicle	n/a	Assume $0

EVSE Cost Considerations

- EVSE costs are variable and can be challenging to predict
  - It is recommended to purchase and install only the minimum charging level and capabilities needed
- Many light-duty vehicles in the Dallas fleet have sufficient dwell time during non-working hours to utilize Level 2 chargers
  - Co-located, overnight parking
  - Some vehicles could share multiport chargers
- Dallas chargers likely will not need internet connectivity or point-of-sale system, as needed with public chargers
  - Could use RFID to restrict use to city employees

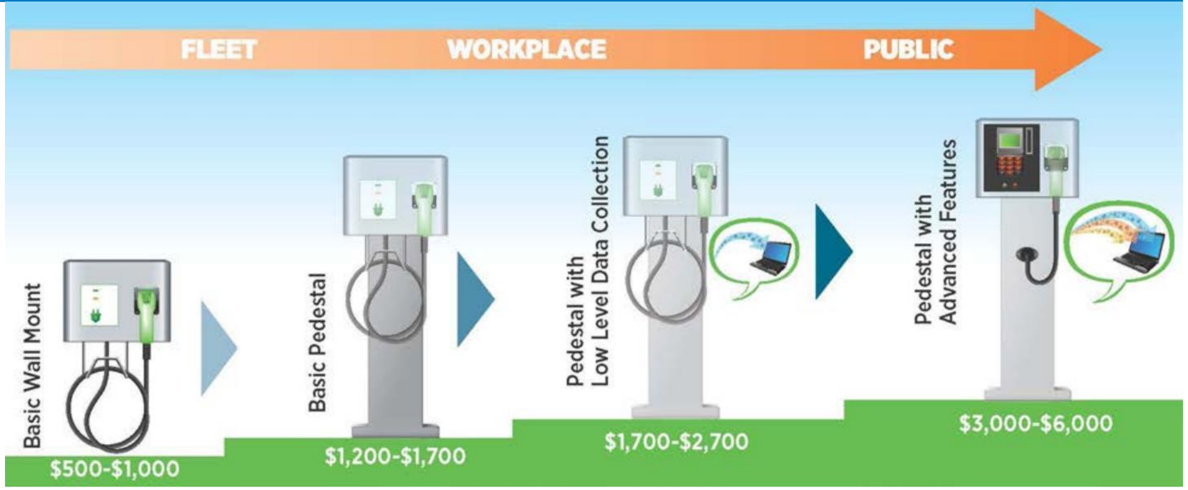
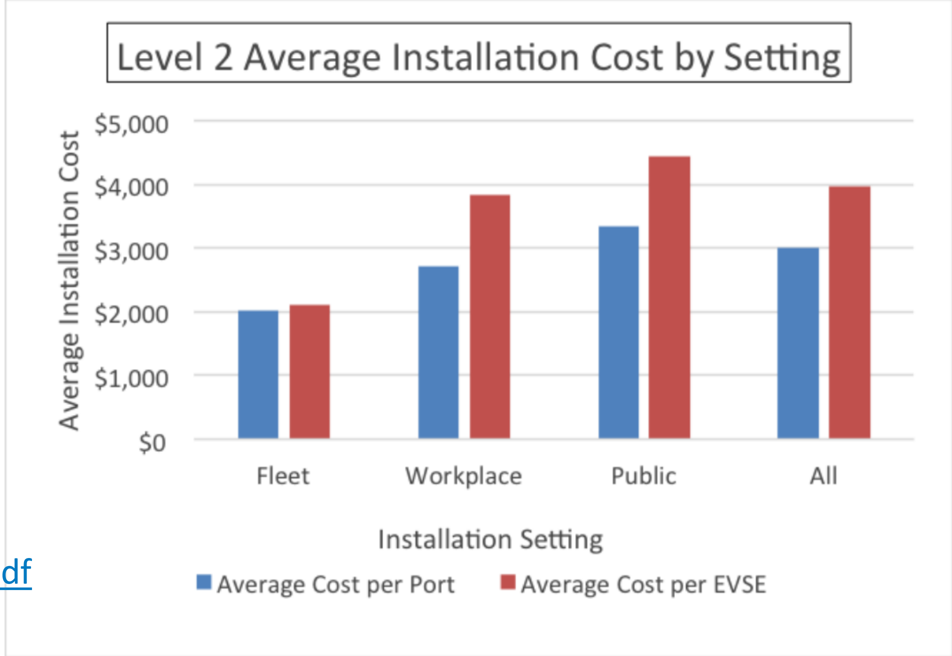
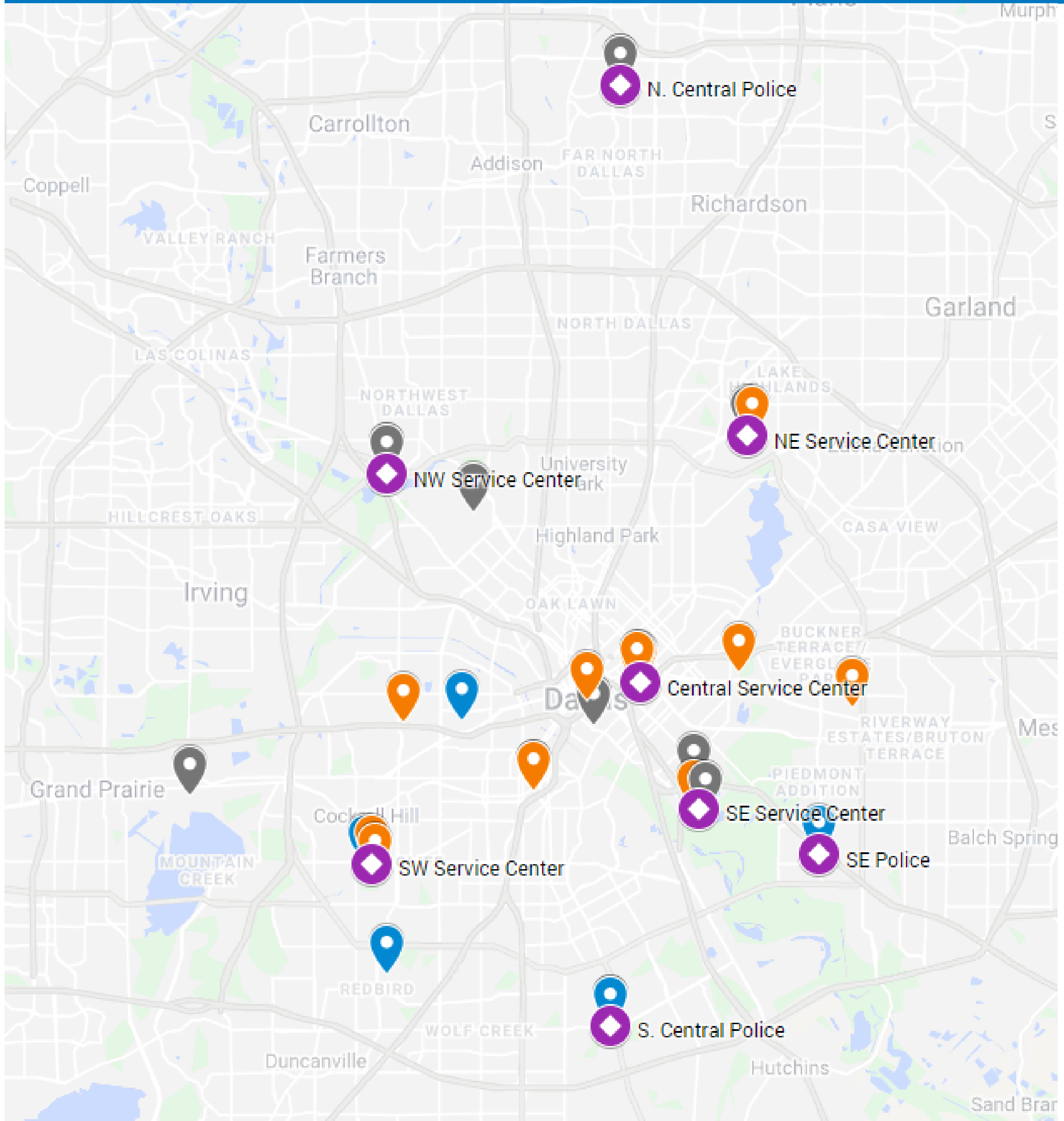


Figure 5. Ballpark cost ranges for different tiers of Level 2 EVSE units. *Image from Kristina Rivenbark, New West Technologies.*



https://theicct.org/sites/default/files/publications/ICCT_EV_Charging_Cost_20190813.pdf
https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

Dallas Parking & Fueling Locations



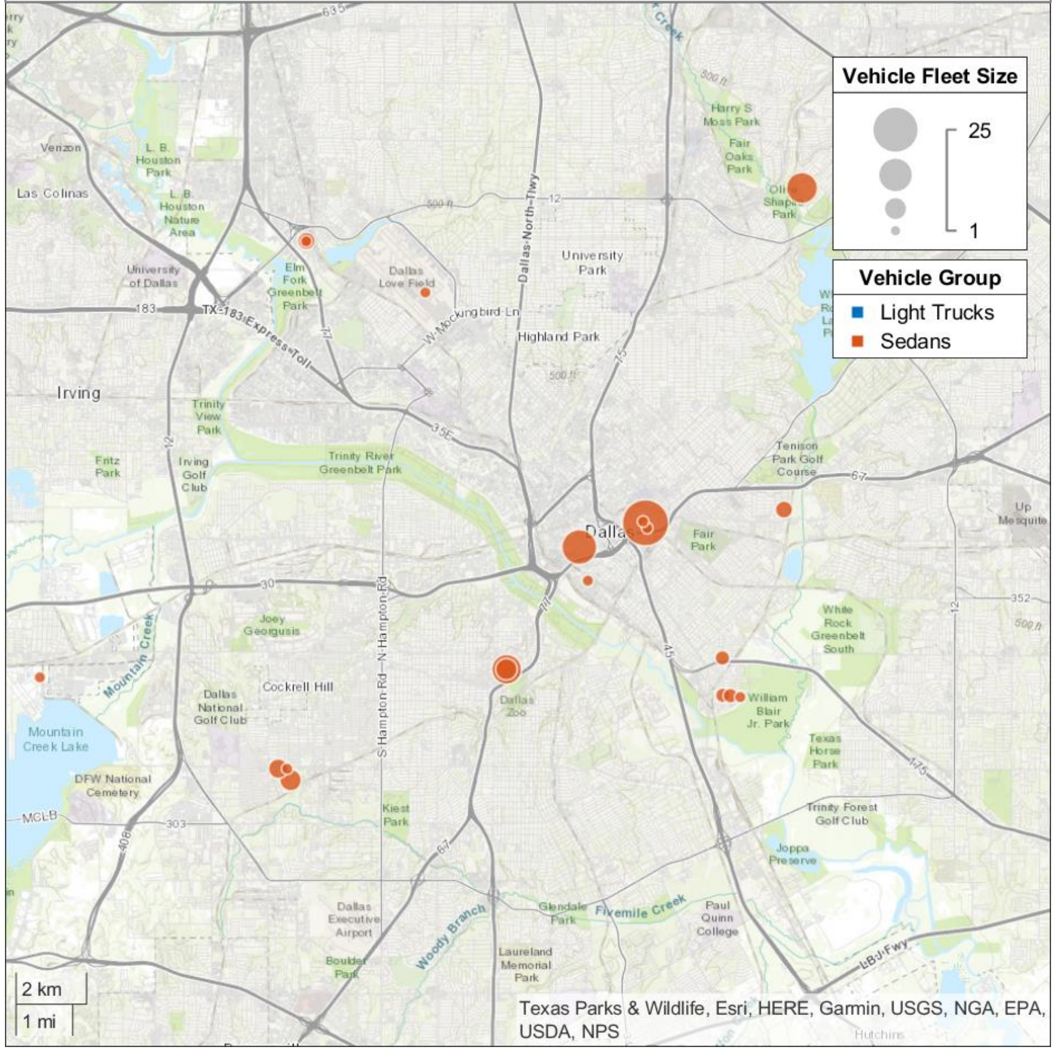
Parking location is an important consideration in selecting vehicles for EV replacement and installing EVSE

- Map shows fuel island locations and all parking locations listed in Dallas vehicle inventory
- Separated DPD vehicle locations from non-DPD locations
- Identified locations with 5 or more vehicles, for class 1 and for class 2

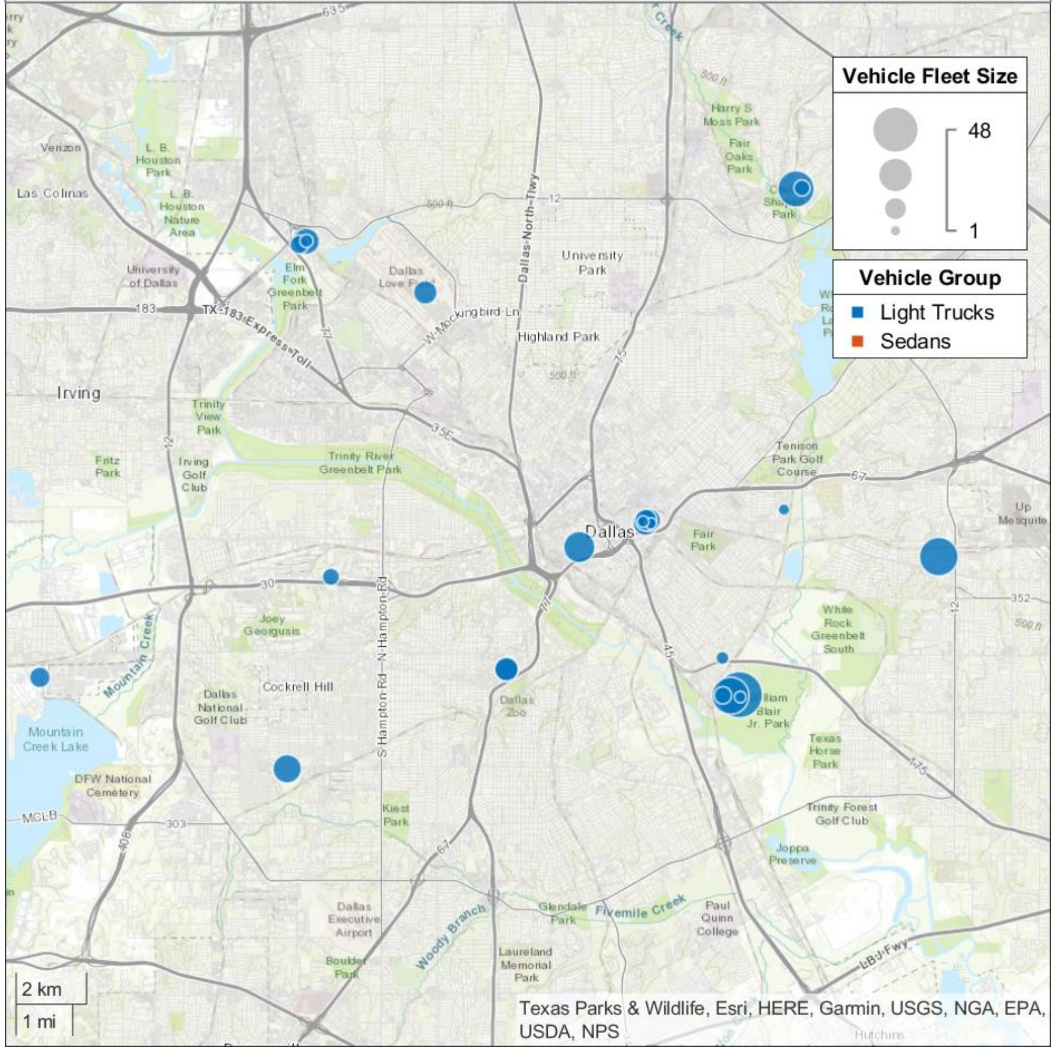
Purple pins – Fueling locations
Blue pins – DPD parking locations
Orange pins – all non-DPD parking locations
Gray pins – other parking (need additional info)

Parking Locations – Sedans & Light Trucks

Locations with sedans



Locations with light trucks



VICE Model Primary Inputs – Scenario 1

2022 Honda Civic	LX (base model)
MSRP [$]	$23,365
Fuel efficiency [mpg]	34

2022 Nissan Leaf	S (base model)	S Plus (upgrade)
MSRP [$]	**$28,425**	$33,425
ESS [kWh]	**40**	62
Range [mi]	**149**	226
Fuel efficiency [kWh/mi]	**0.268**	0.274
MPGe	**112**	104

https://www.caranddriver.com/honda/civic
https://www.caranddriver.com/nissan/leaf

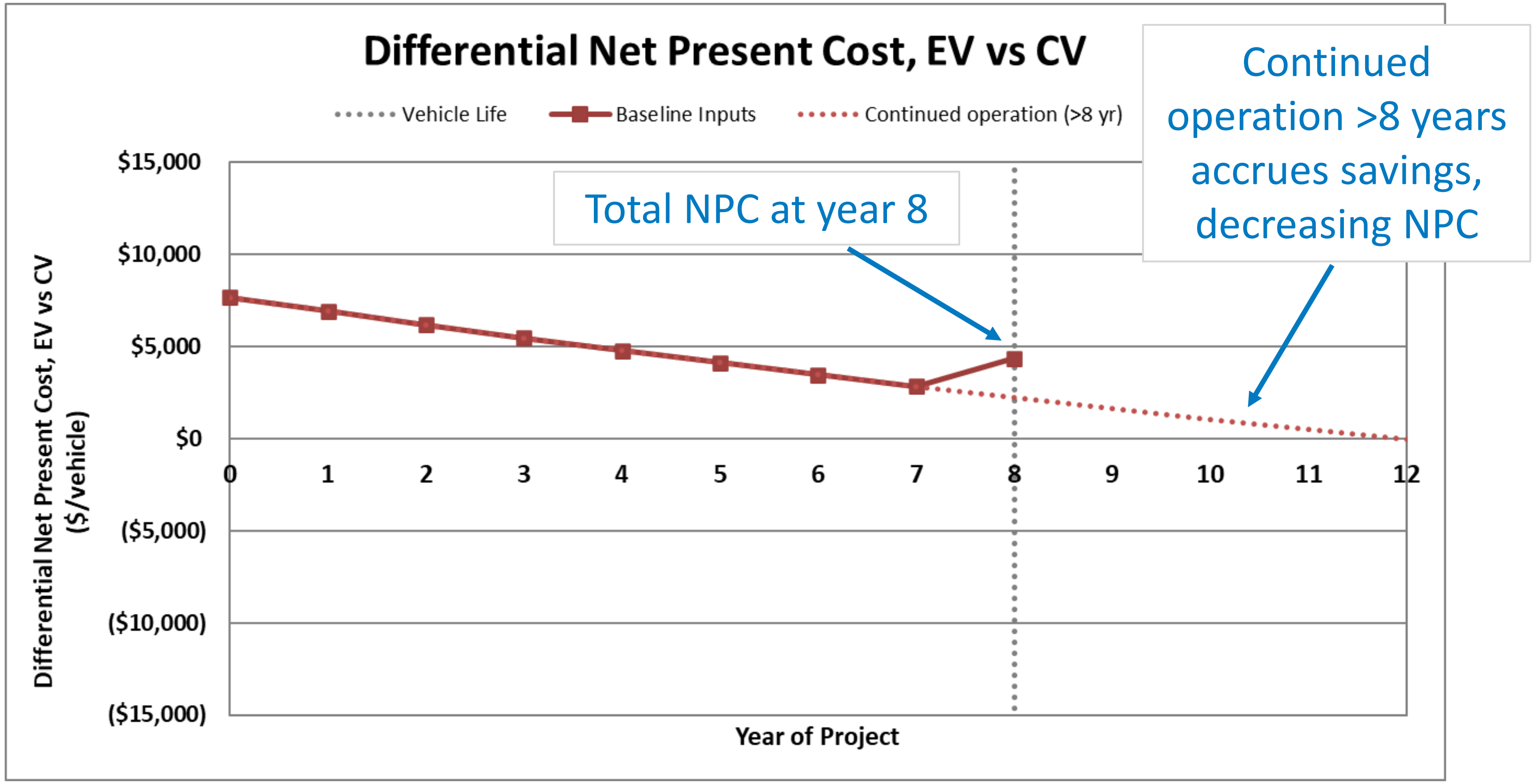
VICE Model Results – Scenario 1 (sedans)

"Baseline" inputs

- EV cost = $28,425 ea.
- EVSE cost = $3,000 ea.
- Rebates = $0
- Annual VMT = 6,382 mi
- Gas price = $2.36/gal

Key Points from baseline analysis:

- EV+EVSE upfront investment is ~$8k more than base sedan
- Total net present cost at end of expected life (year 8) = $4,345 per vehicle (additional cost for EV option)
- Current projections for EV end-of-life salvage value are lower than for conventional vehicle (net incremental cost)
- EV operation beyond year 8 continues to accrue savings



Electric Vehicle

2022 Nissan Leaf S

Conventional Vehicle

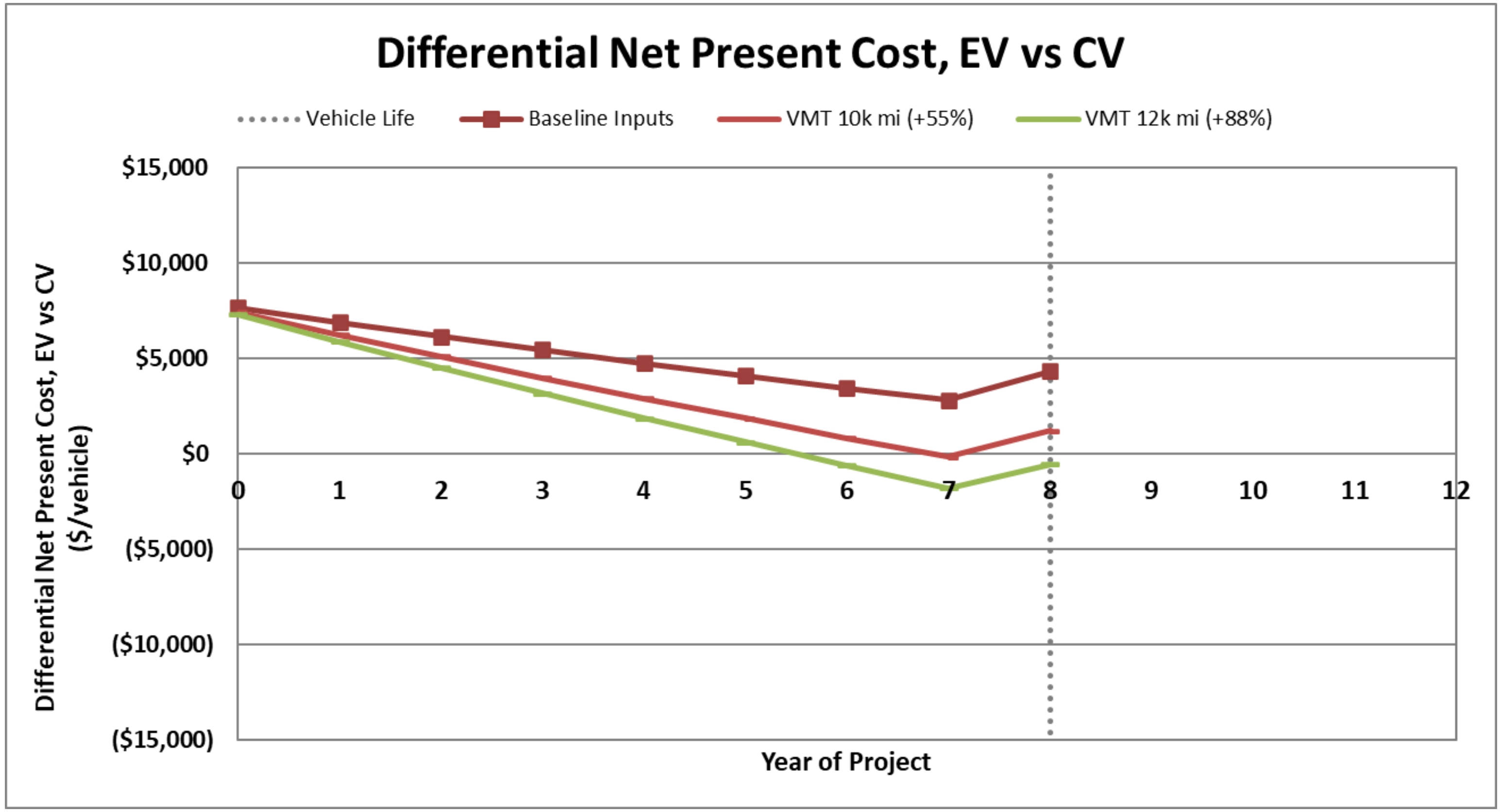
2022 Honda Civic LX

VICE Model Results – Scenario 1 (sedans)

Impact of annual vehicle miles traveled (VMT)

- Baseline VMT = 6,382 mi
  ~ 24.5 miles/day
- VMT 10k mi represents approx. 55% increase
  ~ 38.5 miles/day
- VMT 12k mi represents approx. 88% increase
  ~ 46 miles/day

Takeaway: *Operational savings accumulate faster when replacing vehicles that are driven more (well within estimated Nissan Leaf S range of 149 miles)*



Electric Vehicle
2022 Nissan Leaf S

Conventional Vehicle
2022 Honda Civic LX

VICE Model Primary Inputs – Scenario 2

2022 Ford F-150	XL (base model)
MSRP [$]	$31,685
Fuel efficiency [mpg]	18

2022 Ford F-150 Lightning	Pro (base model)	XLT (upgrade)
MSRP [$]	**$41,669**	$54,669
ESS [kWh]	**98**	131
Range [mi]	**230**	300
Fuel efficiency [kWh/mi]	**0.426**	0.437
MPGe	**70**	69

https://www.caranddriver.com/ford/f-150
https://www.caranddriver.com/ford/f-150-lightning

VICE Model Results – Scenario 2 (trucks)

<u>"Baseline" inputs</u>

- EV cost = $41,669 ea.
- EVSE cost = $3,000 ea.
- Rebates = $0
- Annual VMT = 7,731 mi
- Gas price = $2.36/gal

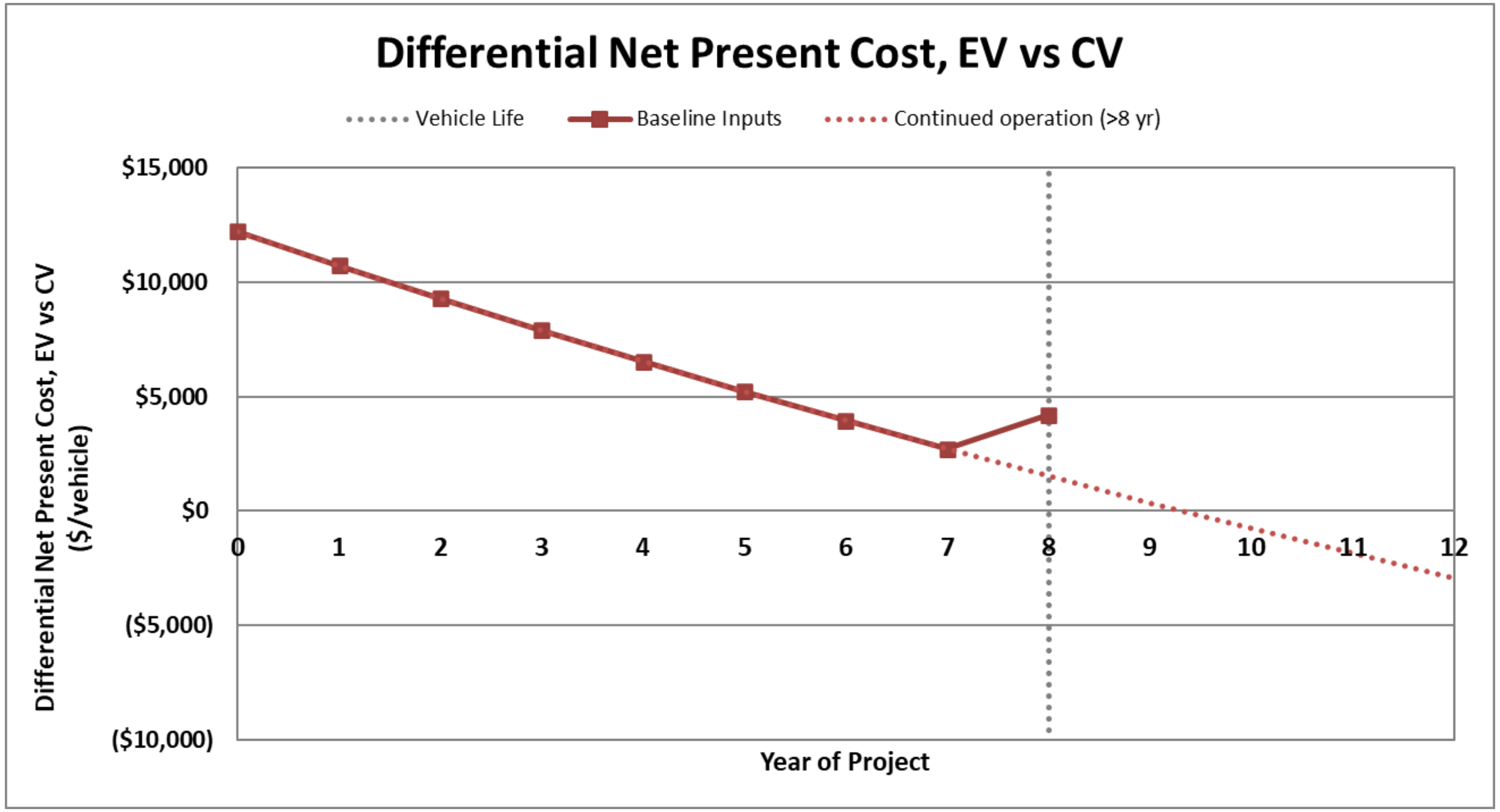
Key Points from <u>baseline</u> pickup analysis:

EV+EVSE upfront investment is ~$13k more than base Conventional Pickup

Total net present cost at end of expected life (year 8) = $4,202 per vehicle (additional cost for EV option)

Current projections for EV end-of-life salvage value are lower than for conventional vehicle (net incremental cost)

Vehicle operation beyond year 8 continues to accrue savings



<u>Electric Vehicle</u>

2022 Ford F-150 Lightning

<u>Conventional Vehicle</u>

2022 Ford F-150

VICE Model Results – Scenario 2 (trucks)

<u>Impact of annual vehicle miles traveled (VMT)</u>

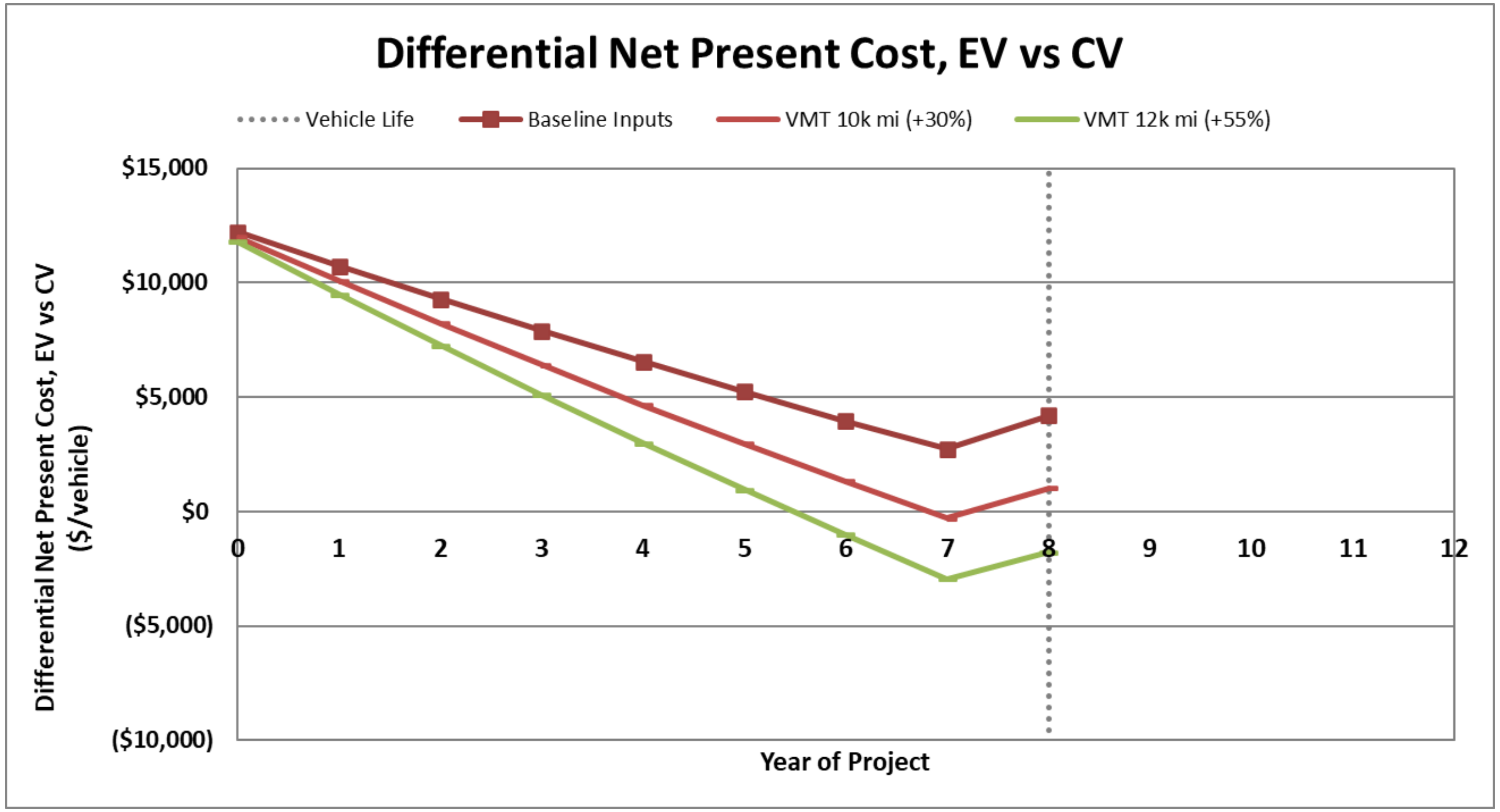
- Baseline VMT = 7,731 mi

  ~ 30 miles/day
- VMT 10k mi represents approx. 30% increase

  ~ 38.5 miles/day
- VMT 12k mi represents approx. 55% increase

  ~ 46 miles/day

Takeaway: *Operational savings accumulate faster when vehicles are driven more (well within estimated Ford F150 driving range of 230 miles)*



<u>Electric Vehicle</u>

2022 Ford F-150 Lightning

<u>Conventional Vehicle</u>

2022 Ford F-150

Estimation of Cost per ton GHG Offset

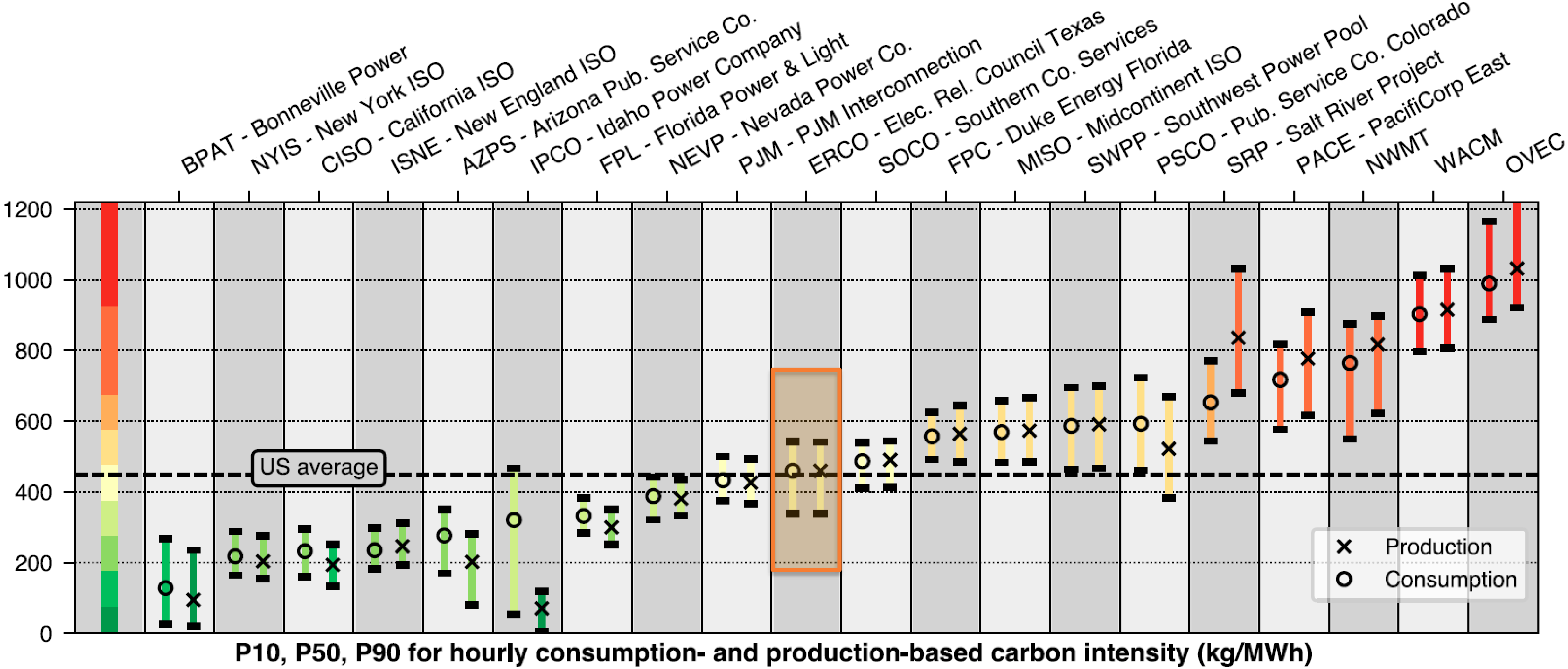
assuming Texas electric grid mix

Parameter	Units	Baseline Scenario 1 (sedans)	Baseline Scenario 2 (light trucks)
VICE model total project cost per vehicle	$/vehicle	4,345	4,202
Lifetime emissions reduction (EV vs CV) per vehicle	metric ton CO_2e/vehicle	8.93	23.33
Project cost per metric ton CO_2e to achieve lifetime emissions reduction	$/metric ton CO_2e	486	180

- The VICE model estimates that purchasing EVs instead of CVs could reduce GHG emissions by
  - 8.93 metric tons CO_2e per light-duty sedan over an eight-year expected lifetime
  - 23.33 metric tons CO_2e per light-duty pickup truck over an eight-year expected lifetime
- Based on the per-vehicle lifetime costs baseline assumptions, GHG emissions reductions are estimated to be
  - $486 per metric ton CO_2e for the light-duty sedan scenario
  - $180 per metric ton CO_2e for the light-duty pickup truck scenario
- **Any improvement in EV cost will lower the cost to achieve GHG reductions**
  - Achieving EV ***cost parity*** (through grants or other means discuss previously) results in GHG emissions savings estimated above at no additional cost

GHG Emissions Estimates

Carbon intensity of Texas electricity grid (ERCO) is very similar to US average, per 2016 analyzed data[1]



[1] https://www.pnas.org/doi/pdf/10.1073/pnas.1912950116

City of Dallas

Fleet Electrification Study Update

Environment and Sustainability Committee August 1, 2022

Donzell Gipson, Director
Equipment and Fleet Management
City of Dallas

Vincent Olsen, Assistant Director
Equipment and Fleet Management
City of Dallas

Presentation Overview

- Background/History
- Purpose
- Issues/ Operational or Business Concerns
  - Consultant Recommendations
  - Action Plan Update
- Strategies for EV Conversion and Deployment
- Future policy and operational decisions impacting fleet management

Background/History

Electrification of Fleet Assets

In support of CECAP adoption, an amendment approved in the FY2021 Budget provided funds for an electric vehicle feasibility study ($100k)

- On May 26, 2021, the City Council awarded a contract to the National Renewable Energy Laboratory (NREL) to conduct the study.

- NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. The Alliance for Sustainable Energy LLC., operates the NREL Laboratory.

- The study allows the City to develop the most effective and efficient policies and operational strategies for deployment and sustainment of electric vehicle technology in alignment with CECAP.

Background/History

Timeline:

- City Council Budget Amendment – September 2020
- Contract award to NREL – May 2021
- Study Kickoff - August 2021
- Briefed EVNS Committee in January 2022
- Briefed Environmental Commission in June 2022

Purpose

This briefing will:

- Provide an update on the EV study in response to NREL recommendations
- Provide a summary of activities in preparation for EV conversion
- Next steps

NREL Recommendations – Summary

- Implement VICE Model approach for each purchase decision
- Continue to test new technologies
- Benchmark from other agencies

Issues/Operational Concerns

Operational Concerns to address

- Develop Business Model/Policy
- Determine & Validate Vehicles for Conversion
- Install EV Infrastructure
- Purchase EV Vehicles
- Deploy & Monitor EV Vehicles (GPS install)
- EV Maintenance (in-house and third party)

Issues to Address:

- Range Anxiety/Fueling Accessibility
- Educate Operators
- Parking/Site Plan
- Reduce the total number of vehicles
- Greenhouse gas reductions

Strategies for EV Conversion and Deployment

Outline of EV Conversion and Deployment Strategies

- EV Infrastructure Funding Strategies
- EV Infrastructure Operations and Maintenance
- EV Vehicle Funding Strategies
- EV Conversion Selection Strategy with End Users
- Review for Replacement - Electric Vehicles
- Electric Vehicle Make and Model Strategy
- Electric Vehicle End User Migration Strategy
  - Motor Pool as EV Migration Strategy

EV Infrastructure Funding Strategies

Approved EV Charging Infrastructure Funding			
Funding Source	**Amount**	**Install/Equipment**	**Location**
NCTCOG - Call for Projects	$ 193,676.00	(2) DCFC Stations	SE Service Center
NCTCOG - Call for Projects	$ 182,658.00	(2) DCFC Stations	Central Service Center
FY22-23 Proposed Budget	$ 581,027.00	Level II & DCFC Stations	(various - citywide)
Total	**$ 957,361.00**		

Submitted Grant Applications for EV Charging Infrastructure Funding			
Funding Source	**Amount Requested**	**Install/Equipment**	**Location**
TCEQ	$ 338,932.36	(7) DCFC Stations	SW, NE, NW, - Service Ctr Jack Evans
TCEQ	$ 124,785.00	(30) Level II Chargers	CE, SW, NE, NW, SW, - Service Ctr Jack Evans
Total*	**$ 463,717.36**	*Projects total $927,434.71 (requires 50% cash)	

EV Infrastructure Operations and Maintenance

Turn-Key Strategy

Use a third-party supplier(s) to design, install, operate and maintain the City's EV infrastructure

- Telematics (software to provide fleet management data)
- Standardization
- Infrastructure that supports any vehicle make
- Opportunity for long-term partnership with proven supplier

EV Vehicle Funding Strategies

VICE Model Strategy

The City will annually evaluate replacement eligible vehicles that meet the EV conversion criteria and examine them within the VICE Model. (use existing fleet replacement budget)

The City will apply for grants that will offset capital outlay and align with the VICE Model.

Examples include:

Grant Opportunities for EV Vehicles	
Funding Source	**Description**
NCTCOG - Call for Projects	Grant pays for approximately 25-50% cost of vehicle purchases
TCEQ – TERP and VW	Grant pays for approximately 25-50% cost of vehicle purchases

EV Conversion Selection Strategy with End Users

Currently 500+ vehicles meet the initial study eligibility; however, only 76 are under consideration by departments for replacement

A decision tree or rubric will be used to determine/validate conversion of the 76 vehicles under initial review

Considerations	Concern/Comments
Replacement Eligible	Develop multi-year strategy as eligible vehicles become due for replacement
Request for replacement by End User	Policy to include use evaluation
Align with VICE Model	EV Study estimated $4,202-$4,375 gap between conventional and EV vehicle
Stakeholder Involvement	Executive Steering Committee (includes NCTCOG) Infrastructure Committee (includes TXU & Oncor) Education and Operator training (includes potential partnership with Tesla)
Charging Infrastructure Accessible	Logistics in timing, location, and demand
Validate Exceptions	Extended periods of Idling, significant energy consumption at job site
Green House Gases	Document emissions reductions

Review for Replacement – Electric Vehicles

Customer Department Engagement

Equipment and Fleet Management began meeting with departments in July 2022 to discuss the results of the Fleet Electrification study. Also, to evaluate the 76 vehicles under consideration for conversion.

NREL Recommendations:

Department Request Breakdown						
Department	**Total Vehicles**	**Sedan**	**SUV**	**Light Truck**	**Van**	**Other**
Building Services	7	2	0	2	3	0
Code Compliance Services	23	0	14	6	0	3
Public Works	15	0	1	13	0	1
Park and Recreation	12	0	1	2	6	3
Transportation	19	9	1	8	0	1
Total	**76**	**11**	**17**	**31**	**9**	**8**

Electric Vehicle Make and Model Strategy

EV Purchases

The City needs a mix of sedans, sport utility vehicles (SUV) and light duty trucks to conduct operations for successful service delivery.

Recommendations:

EV Vehicles			
Vehicle Type Choices	**Make/Model**	**Fueling**	**Mile Range**
Sedan	Nissan Leaf	100% BEV	149-226
SUV	Ford Escape Plug-In Hybrid	Gas/Electric	520 (37-38 electricity)
Light Duty Truck	Ford F-150 Lighting	100% BEV	230

Electric Vehicle End User Migration Strategy

EV Education and Awareness

The City needs to educate and inform end users on the safe use and operation of these vehicles to include the benefits to service delivery. Training of mechanics on EV maintenance will also be an important part of the migration strategy.

Recommendations:

EV Vehicles	
Plan	**Comments**
Ride and Drive Program	Allow end users to test drive Nissan Leaf, Ford Escape Plug-In Hybrid, and F-150 Lighting
Environmental Education	Benefits to the environment, efficiency, and life-time costs
EV Maintenance	Enhance existing training program and use third party suppliers
Pooling of Resources	Discuss the benefits of sharing vehicles to optimize use and reduce costs

Motor Pool as an EV Conversion Strategy

Assess "Admin" vehicles at each Service Center or Co-located parking of City fleet

- Evaluate use and examine for fleet reductions
- Convert remaining selection to EV
- Centralize the parking of these assets
- Use Key Valet structure for end user access to vehicles
- Monitor utilization via GPS

Future Policy & Operational Decisions

Demonstrations of EV

Until operational needs and electrification options align within public safety and heavy-duty vehicles and equipment, hybrid and compressed natural gas technologies are the prudent alternatives.

Electrification options and alternatives

- Mack Refuse EV Truck – One week pilot being planned for Sanitation Services
  - (Grant awarded for $776k – CNG) – Clean Diesel Grant - NCTCOG
- Ford Explorer – Hybrids - Police Patrol (purchased 11 and anticipated to go into service within the next 90 days)
- Ford EV cargo van pilot – Offered a trial period by local dealer
- San Antonio and Dallas County – "Learn from them"

Observation of EV Experiences

EFM will continue to monitor, research and benchmark the experiences, breakthroughs and lessons learned that impact the City's EV conversion plans.

Recent Articles & Big Picture Items:

- Electric Grid concerns

City of Waco pauses on transition of EV for its Police Department

- www.wacotrib.com/news/local/govt-and-politics/waco-city-council-to-vote-on-hybrid-police-cars-citing-issues-with-electric-models/article_39d1236a-ffd8-11ec-b3a3-037cd043bd1e.html

San Antonio Police testing Tesla, Ford electric cars for official use

- www.mysanantonio.com/business/article/San-Antonio-police-Tesla-ford-electric-cars-17261776.php

Dallas County officials look to electric vehicles for help

- https://www.keranews.org/government/2022-04-25/bad-air-climate-change-dallas-county-officials-look-to-electric-vehicles-for-help

Next Steps

- Continue work on action plan in response to consultant recommendations
- Continue to brief ENVS Committee on status of action plan
- Document Council feedback for development of future policy and operational plans
- Continue to look at emerging technologies like hydrogen and renewable natural gas to enhance the City's alternative fuel infrastructure

Fleet Electrification Study Update

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