Fleet Electrification Readiness

IBEW Alsip, IL
May 9, 2024

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NTEA
THE ASSOCIATION FOR THE WORK TRUCK INDUSTRY

GREEN WAYS 2GO

Oak Park

CONNELLY ELECTRIC

ARCADIS

POWERING CHICAGO
IBEW 134/NECA

GREEN DRIVES

IBEW Alsip, IL
May 9, 2024

Basics of EVs & Charging

Tim Milburn

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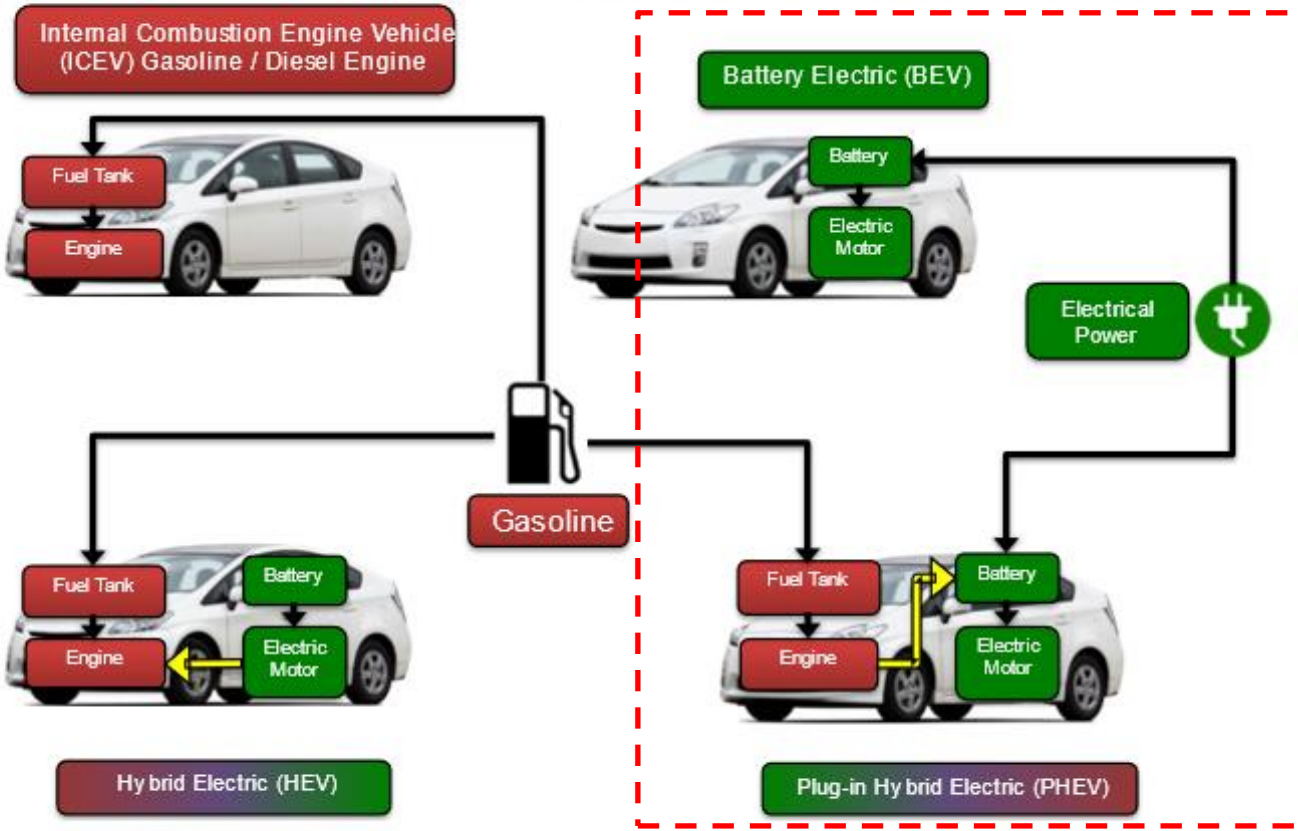
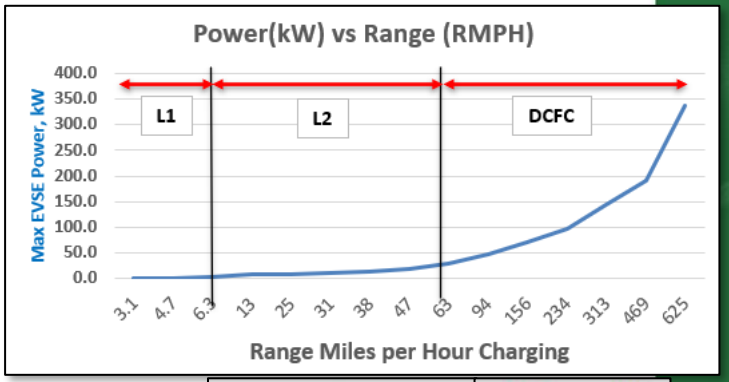
GREEN DRIVES

ICEV vs. HEV vs. BEV vs. PHEV



Standard charging power levels
EV Supply Equipment (EVSE = EV Charger)

- **AC Level 1**: (120 V)
  - Home/ mobile
  - **3 to 5 RMPH**
- **AC Level 2**: (208/240 V)
  - Home/ public/ workplace
  - **10 to 80 RMPH**
- **DC Fast Charging** (Level 3): (480+ V)
  - Public/ workplace / retail
  - **60 to 600 RMPH**



RMPH = Range Miles per Hour when charging

Charging Standards

- Now, all US EVs use standard AC & DC connectors except Tesla:
  - **AC**: SAE J1772
  - **DC**: Combo Charging Standard (CCS1)
  - **DC**: CHAdeMO (Japanese EV Standard)
- Tesla uses <u>one</u> connection for AC and DC
  - North American Charging Standard (NACS)
- Starting in 2025 – **<u>Migration</u>** to NACS
  - Major EV OEMs
  - Major EVSE vendors
  - CHAdeMO phasing out in new products
  - Goal: allow network of Tesla and US DCFCs to charge any EV (in time)
- Adaptors are /will be available to charge between standards


J1772


CCS


CHAdeMO


NACS


Adapters

EV Acceptance Rate

- ***Amount of power <u>on board</u> power management systems allow to pass to battery***
- ***Applies to AC and DC charging***
- Vehicle dependent

DC Fast Charging Data	Acceptance Rate, kW
Passenger EVs	
Chevy Bolt PEV	55
Nissan Ariya	130
Ford Mustang Mach-E	150
Audi e-tron	150
Hyundai IONIQ Long Range 2WD	220
Kia EV6 GT	233
Tesla Model 3	250
Tesla Model S Long Range	350
Lucid Air Grand Touring	350
Truck and Bus EVs	
PickUps	
Rivian	350
Ford F150 Lighting	350
Tesla Cybertruck	327
GMC Hummer	350
Chevy Silverado	350
MD Trucks	
Bolinger	
Mack MD Electric	80
Volvo MD	250
Semis	
Freightliner eCascadia	300
Tesla Semi	1000
Buses	
Proterra	450
Lion D	50

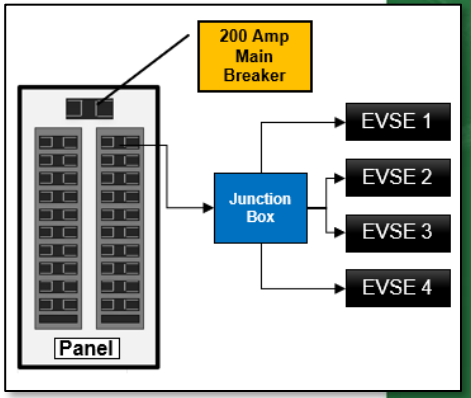
EV Charging and Range Factors

- ***Acceptance Rate***: vehicle dependent
- ***Delivery Rate:*** EVSE Dependent
  - AC Level 2: up to 19.2 kW
  - DC Fast Chargers – up to 200 kW
  - HP DC Fast Chargers – up to 350 kW
  - MPC DC Fast Chargers – up to 1 MW
- Rate determined by ***lesser*** of delivery or acceptance rate
- ***Range*** depends on EV battery size
  - Larger EVs take more energy per kWh
- Battery Thermal Management Systems
  - Key to longevity
  - Can get more miles per charge

DC Fast Charging Data	Acceptance Rate, kW	Battery size kwh	Range miles	Miles/kWh
Passenger EVs				
Chevy Bolt	55	65	238	3.7
Nissan Ariya	130	87	261	3.0
Ford Mustang Mach-E	150	88	255	2.9
Audi e-tron	150	76.6	252	3.3
Hyundai IONIQ Long Range 2WD	220	72.5	242	3.3
Tesla Model 3	250	57.5	236	4.1
Tesla Model S Long Range	350	71.4	364	5.1
Lucid Air Grand Touring	350	113	391	3.5
Truck and Bus EVs				
PickUps				
Rivian	350	98	315	3.2
Ford F150 Lighting	350	131	300	2.3
Tesla Cybertruck	327	122	340	2.8
GMC Hummer	350	213	381	1.8
Chevy Silverado	350	205	450	2.2
MD Trucks				
Mack MD Electric	80	240	230	1.0
Volvo MD Electric	250	360	280	0.8
Semis				
Freightliner eCascadia	300	438	230	0.5
Tesla Semi	1000	400	500	1.3
Buses				
Proterra	450	4000	700	0.2
Lion D	50	210	155	0.7

Energy Management Systems (EMS)

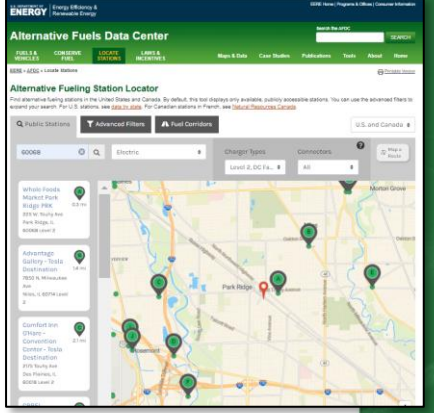
- Load or power management- manage amperage at EVSE, circuit, panel or facility
- Increasingly common – allows more EVSEs to be installed and share facility power
- Can allow launch of EV charging w/o service upgrade and minimize infrastructure costs

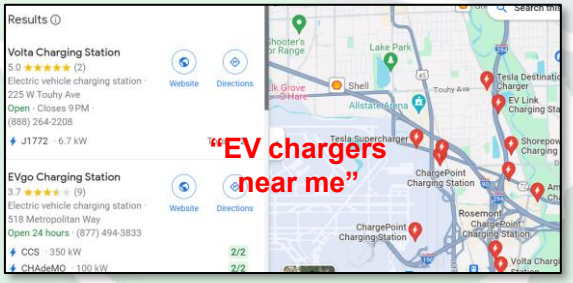


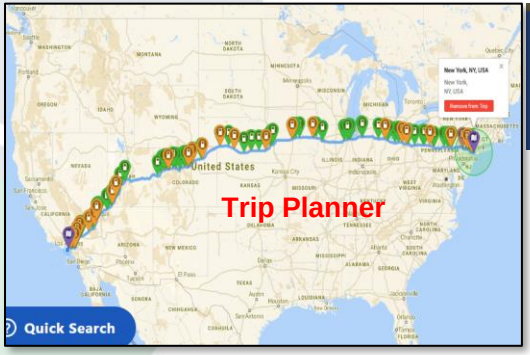
Finding EV Charging Stations

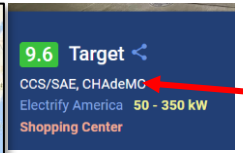
- Alternative Fuel Data Center Station Locator
- Plugshare
- Plugshare Trip Planner
- Google Maps – enter “EV Chargers near me”

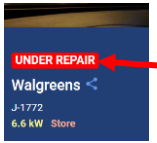
AFDC

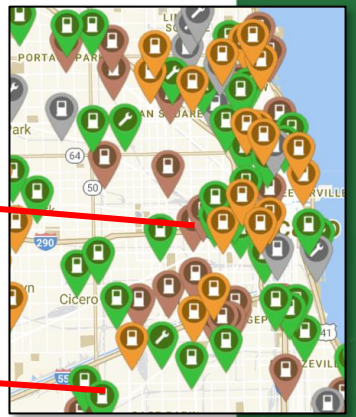












Plugshare

GREEN DRIVES

Business Planning for Fleet Electrification

IBEW Alsip, IL
May 9, 2024

Tim Milburn

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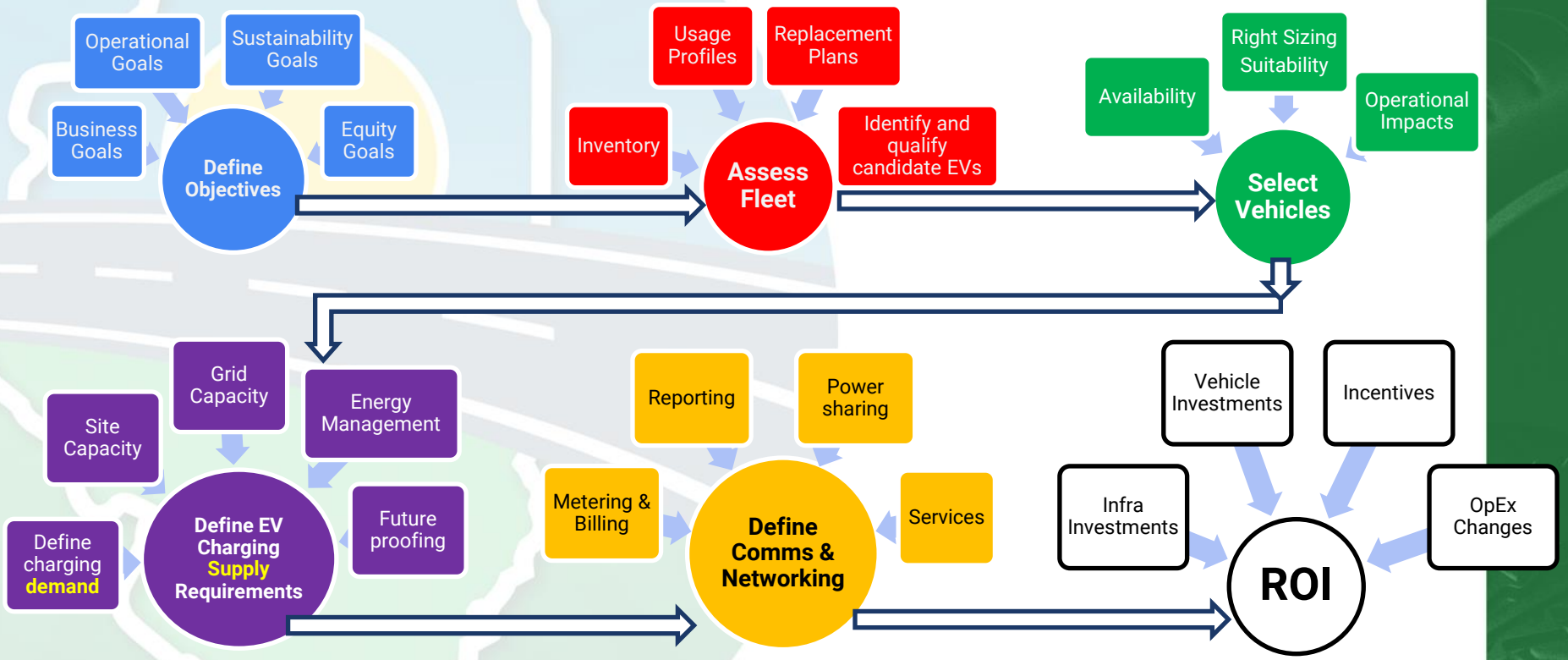
GREEN DRIVES

Fleet Stakeholder: Business Case Evaluation Steps



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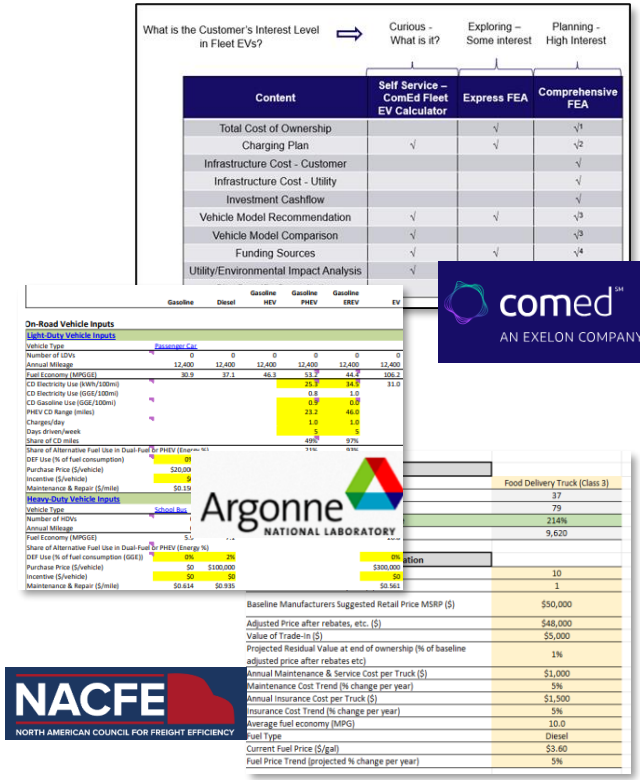
GREEN DRIVES

Business Case Evaluation Resources

- Fleet Assessment Tools
  - Contact ComEd EV Smart for free Fleet Electrification Assessment
  - AFLEET – US DOE at Argonne – Life Cycle Cost analysis, Emissions
  - North American Council for Freight Efficiency (NACFE) Medium Duty Trucks Total Cost of Ownership



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GREEN DRIVES

Fleet Assessments

- Vehicle inventory
- Usage profiles
- Replacement plans
- Goal: define candidate vehicles to replace

Vehicle Usage Data						Replacement Planning		
Vehicle Type	Date Entered Service	Days in Service	Annual Mileage	Actual Mileage Now	Location	Retirement Mileage	Remaining Lifetime in Miles	Estimated Years Useful Life
SUV	6/13/2016	2,885	18,345	145,000	WH1	125,000	(20,000)	(1.1)
Sedan	3/12/2016	2,978	13,482	110,000	HQ	100,000	(10,000)	(0.7)
Sedan	6/15/2016	2,883	20,763	164,000	WH2	150,000	(14,000)	(0.7)
Sedan	6/2/2013	3,992	9,417	102,999	WH2	100,000	(2,999)	(0.3)
Sedan	6/4/2013	3,990	8,782	96,000	HQ	100,000	4,000	0.5
Sedan	6/3/2016	2,895	17,105	135,666	WH1	150,000	14,334	0.8
SUV	9/12/2020	1,333	32,858	120,000	HQ	150,000	[illegible]	[illegible]
SUV	6/1/2016	2,897	11,251	89,300	WH2	100,000	10,700	1.0
Pickup	10/8/2011	4,595	10,724	135,000	HQ	150,000	15,000	1.4
Work Truck	8/3/2011	4,661	10,572	135,000	WH1	150,000	15,000	1.4
Work Truck	5/5/2016	2,924	9,776	78,315	WH2	100,000	21,685	2.2
Work Truck	1/14/2016	3,036	9,017	75,000	HQ	125,000	50,000	5.5
Sedan	10/13/2014	3,494	7,940	76,009	HQ	125,000	48,991	6.2
Sedan	6/5/2017	2,528	11,230	77,777	HQ	150,000	72,223	6.4
SUV	6/25/2011	4,700	7,688	99,000	WH1	150,000	51,000	6.6
Sedan	10/7/2016	2,769	9,886	75,000	HQ	150,000	75,000	7.6
SUV	6/5/2016	2,893	9,309	73,783	WH1	150,000	76,217	8.2
Van	6/4/2016	2,894	10,804	85,666	WH2	200,000	114,334	10.6

Vehicle Fuel Consumption and Cost										
Vehicle Type	Current MPG	Miles/ year	Applied Gallons/ year	Current Fuel Cost/ year	Annual DEF Consumption Gallons	Annual DEF Consumption COST	Annual Fuel + DEF Costs	Maintenance Cost/ Year	Other Costs/ Year	Total Cost per Year
SUV	20	18,345	917	$ 3,669	42	$ 122	$ 3,791	$ 190	$ 500	$ 4,481
Sedan	30	13,482	449	$ 1,573	-	$ -	$ 1,573	$ 79	$ 500	$ 2,152
Sedan	25	20,763	831	$ 2,907	-	$ -	$ 2,907	$ 145	$ 500	$ 3,552
Sedan	25	9,417	377	$ 1,318	-	$ -	$ 1,318	$ 66	$ 500	$ 1,884
Sedan	25	8,782	351	$ 1,229	-	$ -	$ 1,229	$ 61	$ 500	$ 1,791
Sedan	25	17,105	684	$ 2,395	-	$ -	$ 2,395	$ 120	$ 500	$ 3,014
SUV	18	32,858	1,825	$ 7,302	84	$ 244	$ 7,545	$ 377	$ 500	$ 8,423
SUV	18	11,251	625	$ 2,500	29	$ 83	$ 2,584	$ 129	$ 500	$ 3,213
Pickup	12	10,724	894	$ 3,575	41	$ 119	$ 3,694	$ 185	$ 500	$ 4,378
Work Truck	10	10,572	1,057	$ 4,229	49	$ 141	$ 4,370	$ 218	$ 500	$ 5,088
Work Truck	10	9,776	978	$ 3,910	45	$ 130	$ 4,041	$ 202	$ 500	$ 4,743
Work Truck	10	9,017	902	$ 3,607	41	$ 120	$ 3,727	$ 186	$ 500	$ 4,413
Sedan	25	7,940	318	$ 1,112	-	$ -	$ 1,112	$ 56	$ 500	$ 1,667
Sedan	25	11,230	449	$ 1,572	-	$ -	$ 1,572	$ 79	$ 500	$ 2,151
SUV	20	7,688	384	$ 1,345	-	$ -	$ 1,345	$ 67	$ 500	$ 1,913
Sedan	25	9,886	395	$ 1,384	-	$ -	$ 1,384	$ 69	$ 500	$ 1,953
SUV	18	9,309	517	$ 1,810	-	$ -	$ 1,810	$ 91	$ 500	$ 2,401
Van	18	10,804	600	$ 2,101	-	$ -	$ 2,101	$ 105	$ 500	$ 2,706
			11,954	45,437	331	$ 960	$ 46,397	$ 2,320	$ 8,500	$ 57,217

Fleet Assessments

- Vehicle inventory
  - Vehicle types and uses
  - Fuel type
  - Quantities
  - Other characteristics
- Usage profiles
  - Type of use (admin, payload, police/fire, emergency, delivery, snowplow, construction vehicle …)
  - Vehicle age / mileage / operating hours
  - Annual miles/hours of operation
  - Annual energy consumption (kWh, gallons)
  - Annual maintenance profile (cost, items, frequency)
  - Annual environmental outputs by vehicle
  - Special uses (PTO, pursuit, emergency…)
- Replacement plans
  - Maintenance history
  - Sort by age, miles, site
  - Experience
  - Budget
- Goal: define candidate vehicles to replace
  - Which ones can be electrified?

Vehicle Usage Data						Replacement Planning		
Vehicle Type	Date Entered Service	Days in Service	Annual Mileage	Actual Mileage Now	Location	Retirement Mileage	Remaining Lifetime in Miles	Estimated Years Useful Life
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Assess Operational Impacts

- Operational impacts for home-based recharging (differentials from current)
  - Parking locations
  - Parking /charging dwell time
  - Traffic flow for charging areas
  - Considerations for sharing EVSEs with public

- New considerations when changing to EVs
  - Define performance requirements
  - Logistics
  - Vehicle Range
  - Battery Capacities (kWh)
  - Temperature impacts
  - Effects of DCFC vs. L2 on battery life
  - AC /DC Acceptance Rates
  - Operations & Maintenance needs
  - Warranties

Assess Operational Impacts

- Operational impacts for home-based recharging (differentials from current)
  - Parking locations
  - Parking /charging dwell time
  - Traffic flow for charging areas
  - Considerations for sharing EVSEs with public

- New considerations when changing to EVs
  - Define performance requirements
    - Vehicle duty cycles, operating hours, etc.
    - Acceleration, Torque and Power
    - Space – storage space impacts
    - Weight - payload impacts
  - Logistics, duration and location (home/remote) of recharging vs. refueling
  - Vehicle Range
  - Battery Capacities (kWh)
  - Temperature impacts
  - Effects of DCFC vs. L2 on battery life
  - AC /DC Acceptance Rates
  - Operations & Maintenance needs
  - Warranties

Identify and Qualify Candidate EVs

- Based on replacement and sustainability strategies
  - Select replacement vehicle candidates and sites
  - Estimate near- and longer-term demand
  - Convert to energy demand for EVs
  - Estimate fuel and maintenance savings by changing
  - Identify operational changes & impacts

Vehicle Fuel Consumption and Cost					EV Alternatives			
Vehicle Type	Home Base Location	Total Cost per Year	Annual Miles	kwh/mile for EV version	Annual kWh	Average Daily kWh	Annual Energy Cost W/ Electricity	Annual Fuel Savings
SUV	HQ	$ 8,994	39,142	0.40	15,657	62.6	$ 2,349	$ 36,794
Sedan	HQ	$ 3,178	21,864	0.30	6,559	26.2	$ 984	$ 20,881
Sedan	HQ	$ 1,926	9,701	0.30	2,910	11.6	$ 437	$ 9,264
Sedan	HQ	$ 1,187	4,674	0.30	1,402	5.6	$ 210	$ 4,463
Sedan	HQ	$ 2,635	14,526	0.30	4,358	17.4	$ 654	$ 13,872
Sedan	HQ	$ 2,286	12,149	0.40	4,859	19.4	$ 729	$ 11,420
					35,746	143	$ 5,362	$ 96,694

Identify and Qualify Candidate EVs

Available Electric Vehicles

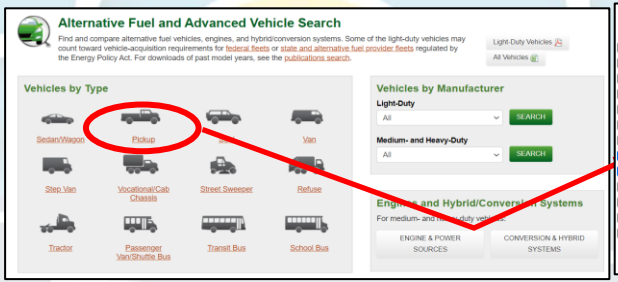
- Advanced Vehicle Search: AFDC – LINK
- Find EVs in Illinois (ComEd) – LINK
- Federal tax credit info – LINK
- Shop EVs by make, model, zip code (Plugstar) LINK
- EVs: Prices for EVs sold in the US (Car & Driver) LINK
- Compare EV choices Side-by Side: USEPA Fueleconomy.gov LINK
- Find Used EVs (Edmunds) – LINK

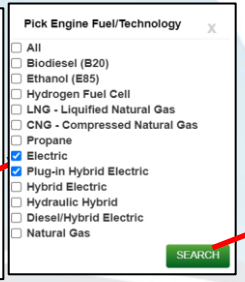
General EV Info

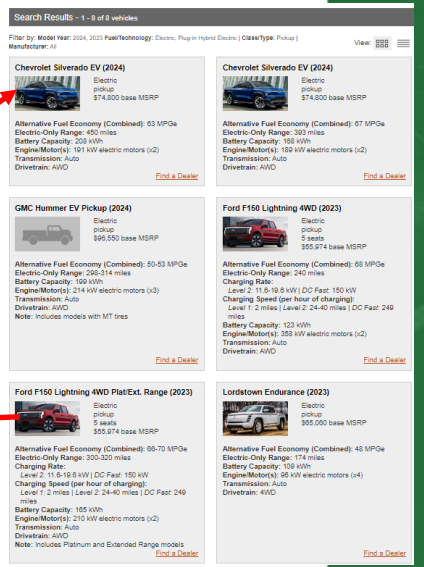
- Green Vehicle Guide (USEPA – LINK
- IEA Global Outlook EVs 2022 - LINK

GREEN DRIVES

Shopping for EVs:
AFDC Advanced Vehicle Search







As of 2023/2024 (Models)

- 101 Sedan/Wagon
- 104 SUVs
- 8 Pickups
- 4 Step Vans
- 15 Tractors
- 23 Cab Chassis
- 23 Vans & Shuttle Buses
- 32 Transit Buses
- 16 School Buses
- 31 Refuse Trucks
- 339 All models

Ford F150 Lightning 4WD (2023)

Electric
pickup
5 seats
$55,974 base MSRP

Alternative Fuel Economy (Combined): 68 MPGe
Electric-Only Range: 240 miles
Charging Rate:
Level 2: 11.6-19.6 kW | *DC Fast:* 150 kW
Charging Speed (per hour of charging):
Level 1: 2 miles | *Level 2:* 24-40 miles | *DC Fast:* 249 miles
Battery Capacity: 123 kWh
Engine/Motor(s): 358 kW electric motors (x2)
Transmission: Auto
Drivetrain: AWD

Find a Dealer

Additional Resources: EVs By Vehicle Vendor

USED EVs

Carmax LINK
Autotrader LINK
MYEV EV Marketplace LINK

PICKUPs SUVs

Rivian R1T LINK
Ford F-150 Lightning LINK
Bolinger B1 & B2 LINK
Lordstown Endurance LINK
Canoo LINK
Tesla Cybertruck LINK
GMC Hummer EV SUT LINK
Tata (India) LINK
Workhorse LINK
Chevy Silverado (2024) LINK

VANS / SHUTTLES

GEST Shuttle LINK
Brightdrop EV600 LINK
Arrival LINK
Lightning Motors LINK

MEDIUM & HEAVY-DUTY TRUCKS

Kenworth Electric (Class 6)
Tesla Semi (Class 8)
Daimler Freightliner eCascadia (Class 8) Trucks
BYD Class 6 to 8 Trucks
Lion Electric (Illinois) – Class 6 and 8 Trucks and Buses
Volvo Trucks
E-Trio Trucks

TECHNICAL INFORMATION

DC Acceptance Rate Data
AC EV Acceptance Rate Table
EVs: Miles per kilowatt hour List for AC Charging (eco cost savings.com) LINK

GREEN DRIVES

Identify Fleet Incentives

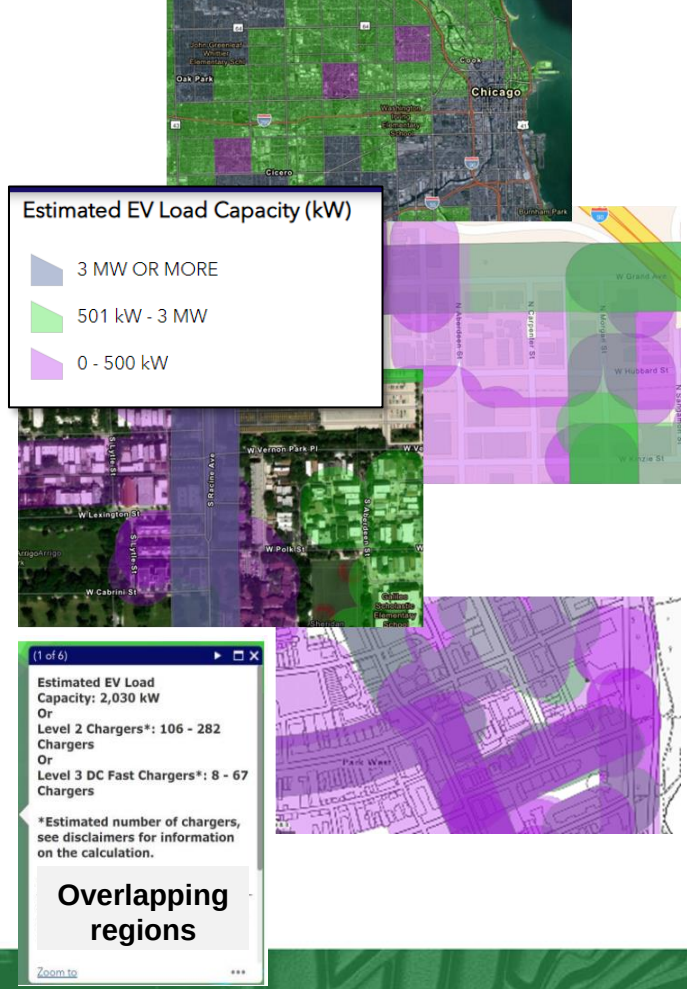
1. EVs – state, federal, local, utility
2. EVSEs – state, federal and local
3. EV charging infrastructure (“Make Ready”): state, federal, local, utility
4. Energy costs
    - Consumption and Peak demand
    - Rate choices:
        - Retail vs. Watt-hour, time of day
        - Franchise agreement for municipalities

Fleet Site Assessments

- Pick one site
- EV Charging Solution Decisions: **Supply** > **Demand**
  - **Demand Profile**
    - Max daily / annual power (peak demand, kW), consumption (kWhr/year)
    - Operational impacts related to EV recharge rates (range miles per hour connected) and daily range
    - Number of EVs, daily recharge miles
    - Define charging level (L2, DCFC), power (kW), number of EVSEs
  - **Supply Profile**
    - Site-specific assessment of current power availability
    - Confirm utility power capacity for new demand
    - Determine need for electrical service upgrade – how much, including future proofing?
    - Infrastructure
      - Locations of electrical panels relative to EV parking
      - Application of conduit distribution networks for branch runs (EV Capable, EV Ready, EVSE Installed)
    - Use of Energy Management Systems (load sharing) to optimize building power

Fleet Site Assessments

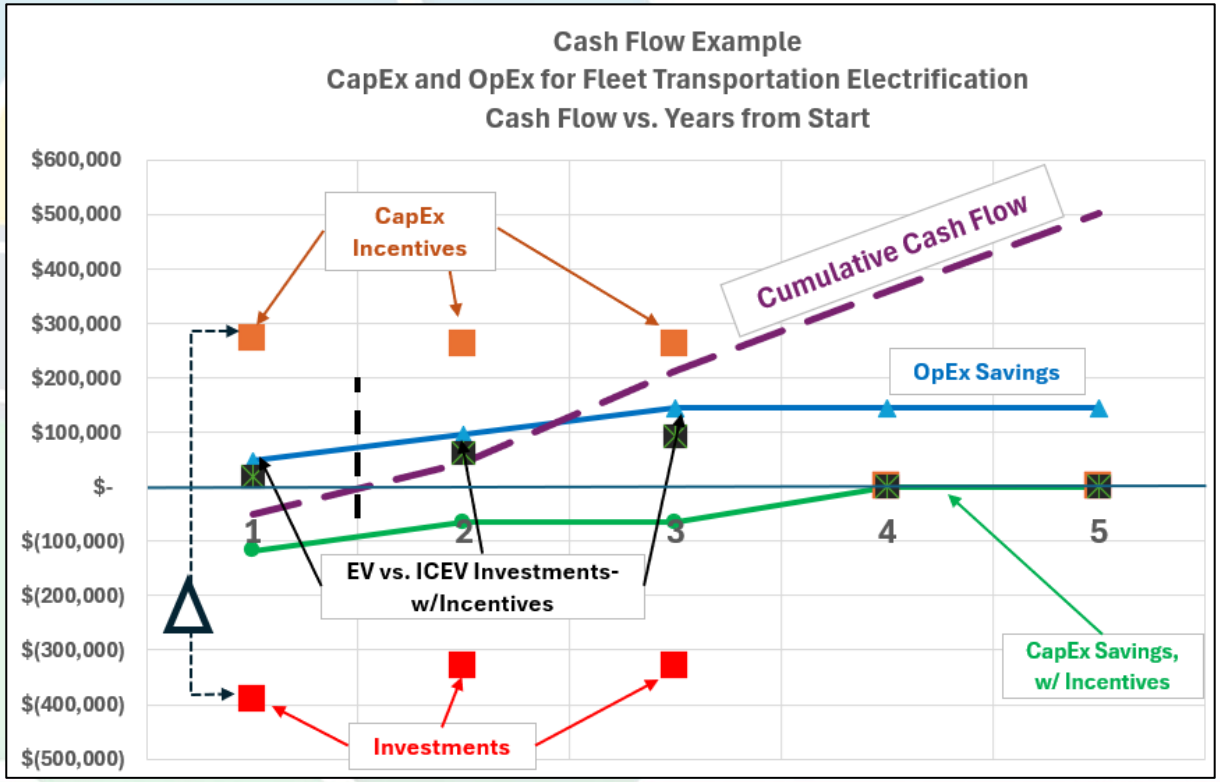
- Preliminary grid capacity assessment
  - ComEd EV Load Capacity Mapping Tool
    - Power ranges
    - Views
- Establish electric feeders near site
- Get help from ComEd
- Contact early in process



GREEN WAYS 2GO

GREEN DRIVES

Cumulative Cash Flow for EV Infrastructure Investments and EVs



EVs = Electric Vehicles
EVSE = EV Supply Equipment

EVCI = EV Charging Infrastruture
UI = Utility Infrastructure

Utility Perspectives

- Contact the utilities ***early in your planning***
- Make sure you consider electric supplies for any properties
  - Develop initial utility consumption and peak demand estimates
  - Property within reasonable distances
    - At peak demand capacities (distribution power)
  - Understand utility make ready needs and costs
  - Find out what the utility can do for you
  - Understand rate structures for your business plans
  - Consider future demand

Return on Investment Analysis: Fleet **Home Based** EV Charging

Variables: One-Time PROJECT COSTS

- **EVs and EVSE Planning**
- **Site Assessments**
- **Project Engineering**
- **Installation and commissioning**

Variables: One-Time CAPITAL EXPENSES

- **EV Charging Related Costs**
  - **New EVSEs**
  - **New EV charging infrastructure**
  - **Networking and communication hardware**
- **Facility Infrastructure Modifications**
  - Maintenance needs
  - Parking areas: resurfacing, traffic flow management, bollards, striping and signage

DIFFERENTIAL CAPITAL EXPENSES

- **Electric Vehicles vs. Alternatives (w/ Incentives)**

Variables: OPERATING EXPENSES

NEW OPERATING EXPENSES / REVENUES

- **Networking and communication costs ($/yr./port)**
- **Electricity Consumption (kWh/yr.)**
- **Demand Charges (peak kW each month)**
- **Electric Utility Infrastructure Costs**
- **Revenue generation**

DIFFERENTIAL OPERATING EXPENSES

- **O&M labor: current vs. new labor**
- **Energy Costs- petroleum vs. electricity**
- **Infrastructure Maintenance:** Regular and Major Maintenance
- **Vehicle Maintenance:** Regular and Major Maintenance
- **Insurance Costs**
- **EV warranty costs**
- **EVSE warranty costs**
- **Lease and finance charges**
- **Marketing costs**
- **Motor Vehicle Fuel and Use Taxes (state, federal, local), if not exempt**
- **Incentives**

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Cumulative Cash Flow for EV Infrastructure Investments, and EVs
Assumptions for Graph

	Year				
Assumptions	1	2	3	4	5
Number of Passenger Vehicles	4	4	4	0	0
Number of Medium Duty Vehicles	6	6	6	0	0
Costs of Passenger EV	$ (60,000)	$ (57,000)	$ (55,000)		
Costs of Medium Duty EVs	$ (100,000)	$ (95,000)	$ (90,000)		
Incentives per Passenger EVs	$ 12,500	$ 12,500	$ 10,500	$ -	$ -
Incentives per Medium Duty EVs	$ 30,000	$ 30,000	$ 30,000	$ -	$ -
Cost of Passenger ICEVs	$ (45,000)	$ (45,000)	$ (45,000)	$ -	$ -
Cost of MD ICEVs	$ (75,000)	$ (75,000)	$ (75,000)	$ -	$ -
% of Total Cost for Infrastructure Incentives	80.00%	80.00%	80.00%		
Total Cost for Infrastructure & EVSE	$ (390,000)	$ (328,000)	$ (328,000)	$ -	$ -
Total Incentives	$ 312,000	$ 262,400	$ 262,400	$ -	$ -
icture	$ (78,000)	$ (65,600)	$ (65,600)	$ -	$ -
$/gal	$ 4.00	$ 4.00	$ 4.00	$ 4.00	$ 4.00
$/kWh	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13

Capital Investments include EVCI, EVSE and utility work
CapEx Savings on Vehicles are Differentials between EV and ICE models with EV incentives
OpEx Savings on Vehicles are Energy Usage Differentials between EV and ICE models
Incentives on passenger EVs include federal tax credit and Illinois Rebate

Thank You

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