



WCX APRIL 9-11
2019
DETROIT

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Feasibility Analysis of Taxi Fleet Electrification

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Presentation Roadmap

1. Overview of taxi data
2. EVI-Pro model overview
3. Scenario definition
4. Results
5. Conclusions, Future Work

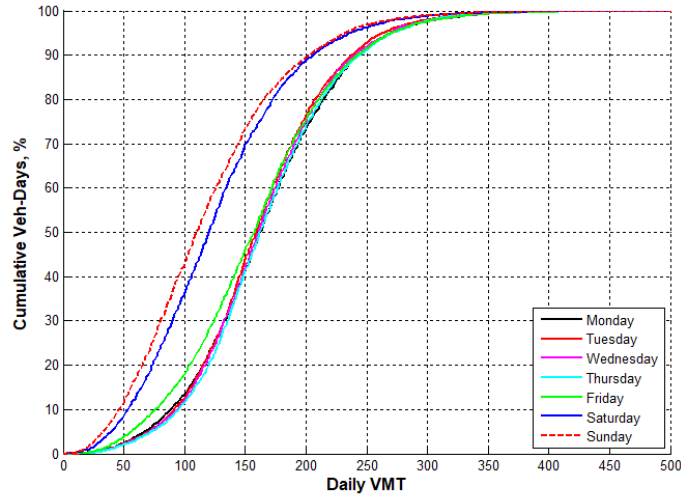
1) Columbus Yellow Cab (CYC) Data Summary

- 13 months of data (April 2017–April 2018)
 - Vehicle latitude, longitude, timestamp, unique ID, taxi meter
- Average of 146 unique vehicles in operation per month, 170 unique vehicles total
 - Annualized vehicle miles traveled (VMT) of 43,120 miles/year
- 840,000 thousand unique trips identified using meter field
- 4.9 million miles of driving, 35,112 unique vehicle-days



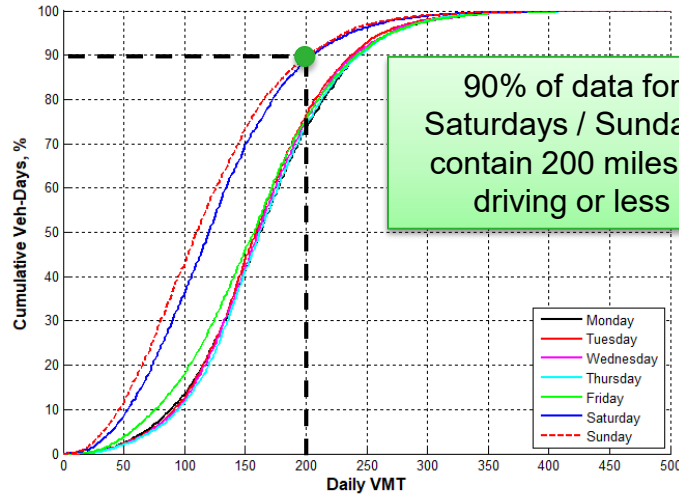
1) Columbus Yellow Cab (CYC) Data Analysis

Vehicle-day statistics vary significantly between weekday days and weekend days



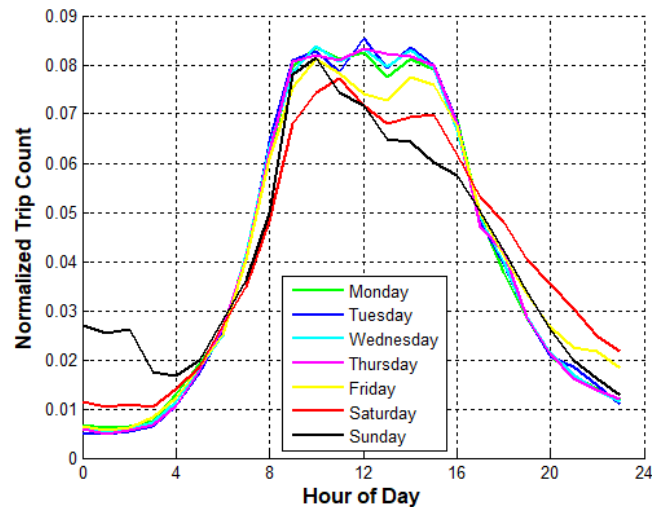
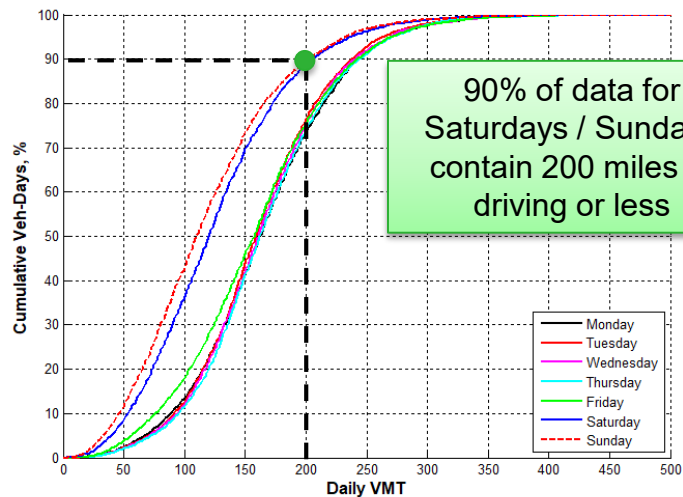
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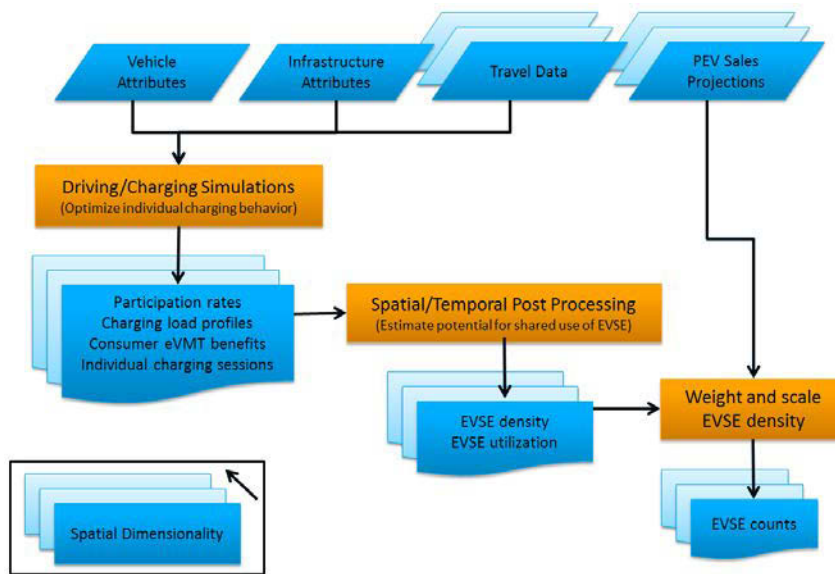
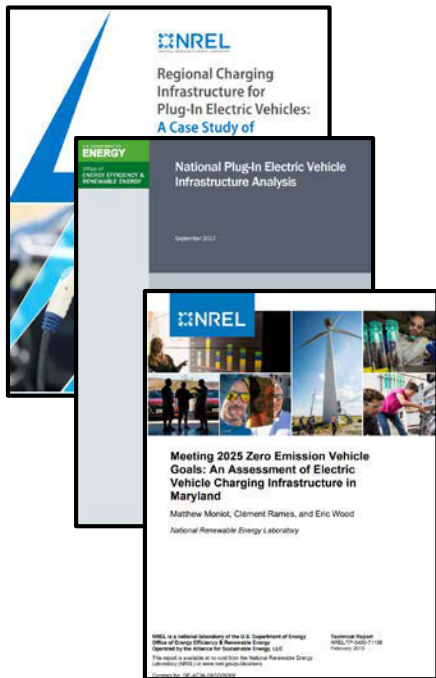


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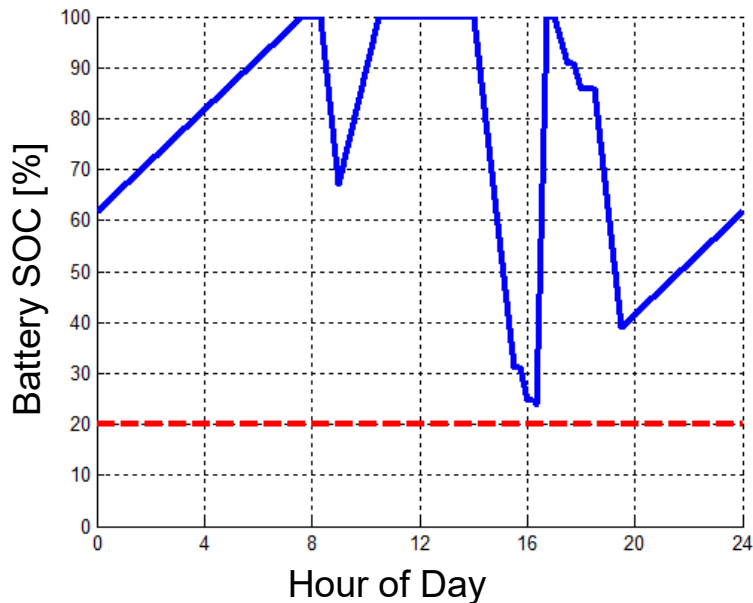


2) Electric Vehicle Infrastructure Projection Tool (EVI-Pro)



Developed through collaboration with the California Energy Commission and support from the U.S. Department of Energy's Vehicle Technologies Office.

2) EVI-Pro Overview, cont.



Vehicle-day metadata from travel data

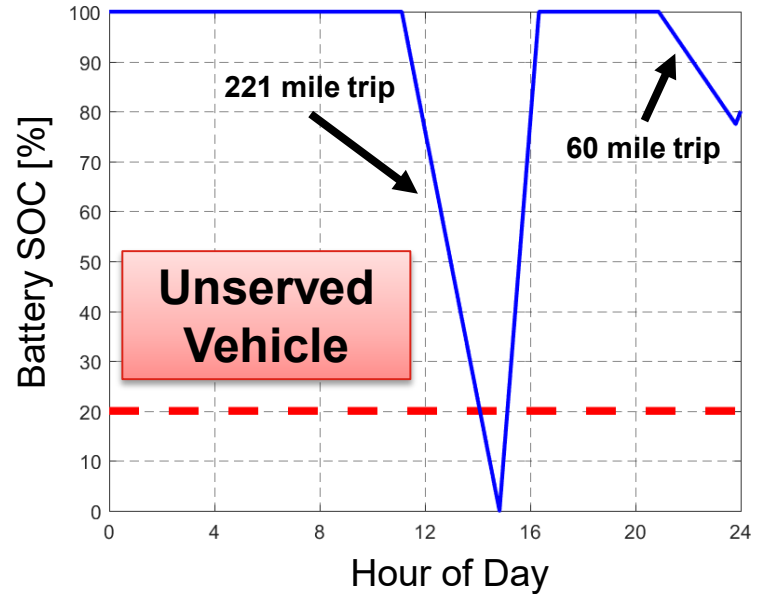
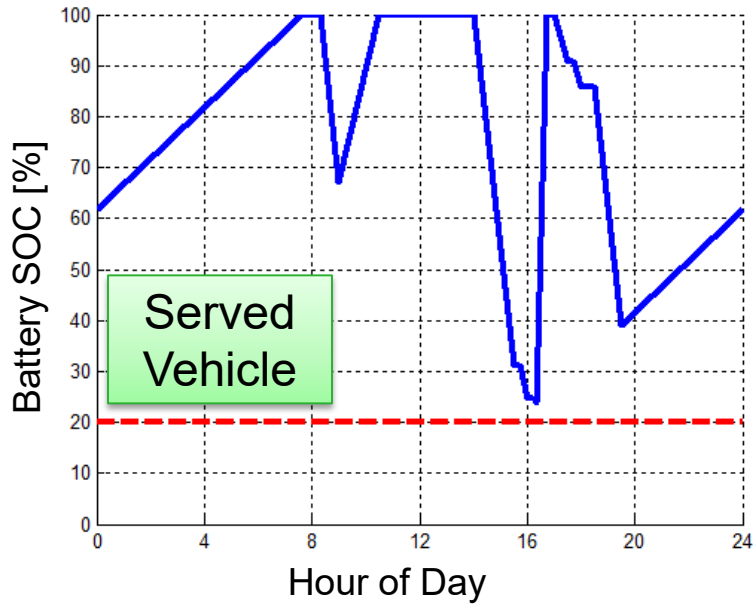
Destination	Departure	Arrival	Drive Miles	Dwell Hours	Simulated Charging *
Work	8:20 AM	9:00 AM	32.8	5.00	L2
Non-Res	2:00 PM	3:30 PM	68.9	0.25	---
Non-Res	3:45 PM	4:00 PM	6.3	0.25	---
Non-Res	4:15 PM	4:20 PM	0.9	0.67	DCFC
Non-Res	5:00 PM	5:30 PM	9.2	0.25	---
Non-Res	5:45 PM	6:00 PM	5.0	0.50	---
Home	6:30 PM	7:30 PM	46.8	12.83	L1

Determined by EVI-Pro ↑






Foundational assumption: Vehicle operation will be consistent in an EV. Existing travel behavior must be maintained

* L1: Level One Charging DCFC: Direct Current Fast Charging
L2: Level Two Charging






2) EVI-Pro Overview, cont.



3) Scenario Definition

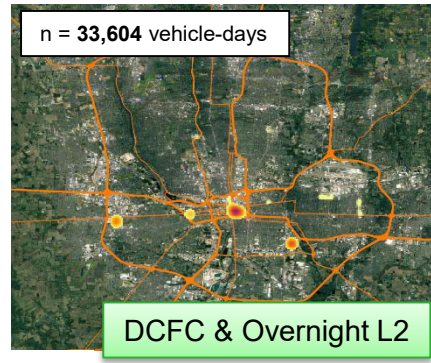
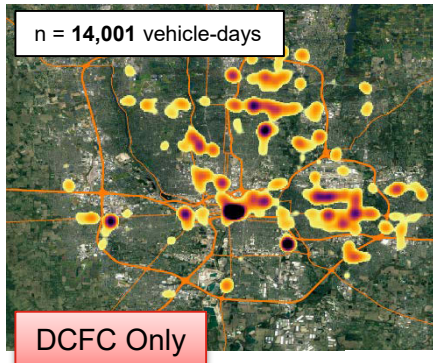
	“Yesterday”	“Today”	“Tomorrow”
	 Range: 100 miles DCFC Power: 50 kW	 Range: 250 miles DCFC Power: 50 kW	<p>?</p> Range: 400 miles DCFC Power: 400 kW
Public DCFC Only 			
 &  Overnight L2 Public DCFC			

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4) Infrastructure Sensitivity Results

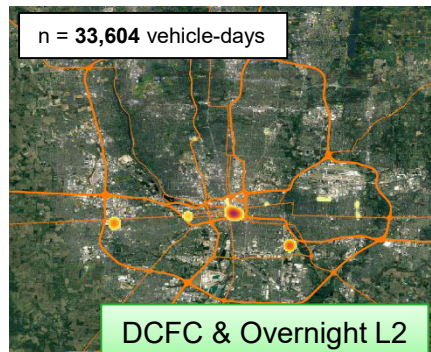
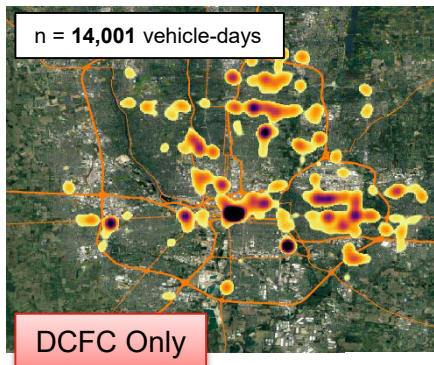
	Percent Vehicle-Days with >0 DCFC Events	DCFC events per vehicle-day
DCFC Only	100.0%	1.59
DCFC & Overnight L2	8.66%	0.13



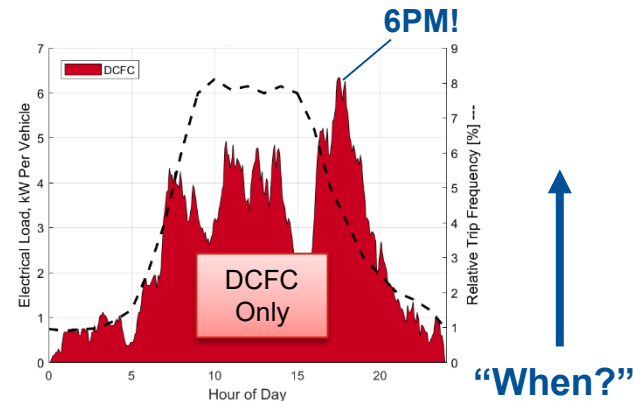
← “Where?” →

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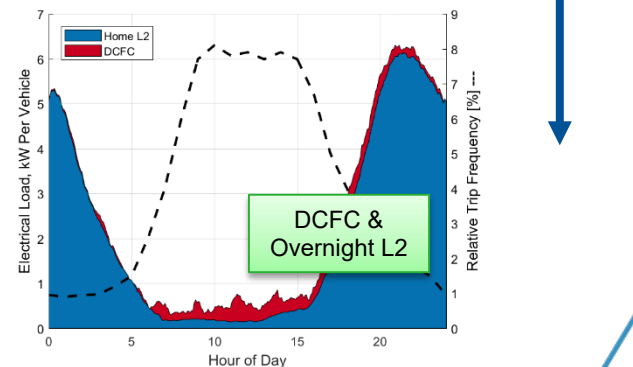
	Percent Vehicle-Days with >0 DCFC Events	DCFC events per vehicle-day	% of Total Vehicle Days Served
DCFC Only	100.0%	1.59	39.9%
DCFC & Overnight L2	8.66%	0.13	95.7%



← “Where?” →








↑ “When?”



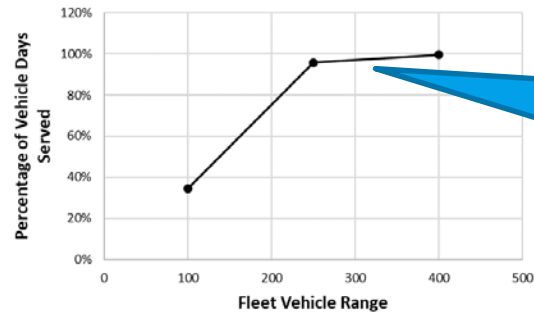
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4) Vehicle Sensitivity Results

	Vehicle Range (mi)	Charge Acceptance	Percent Vehicle-Days with >0 DCFC Events	DCFC events per vehicle-day	% of Total Vehicle-Days Served
“Yesterday”	100	50	64.8%	1.21	34.4%
“Today”	250	50	8.66%	0.13	95.7%
“Tomorrow”	400	400	4.88%	0.06	99.6%



Diminishing returns with respect to vehicle range!*

*Other considerations may also drive vehicle sizing

5) Infrastructure Sensitivity Results

- Taxi vehicles are *heavily* utilized – 43,000+ miles/year/vehicle
- Overnight charging access is essential
- Current vehicle offerings shown to be sufficient for large portion of vehicle-days
- Behavior must be “in the loop” with travel decision-making for challenging vehicle-days with limited infrastructure / vehicle parameters
- Analyze CYC EV taxi data
 - Compare simulated charging behavior
- Comparison to transportation network company operation – not discussed. Read the paper!



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Questions?

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