UA Summit®

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Hosted by Entergy

Distributed Energy Resource Optimization Technology for Electric Vehicles

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Transition to Decarbonized & Electrified Future

Volkswagen to stop selling combustion engines in Europe by 2035

EURACTIV.com with AFP — Jun 28, 2021 (updated: 9:55)

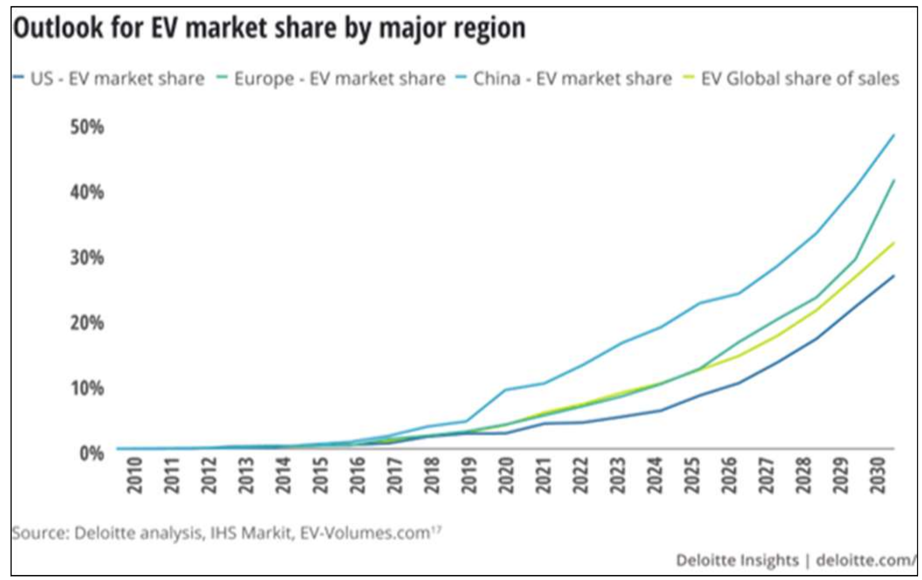
Ford Makes $29 Billion Commitment to Electric and Self-Driving Cars

The automaker, which starts producing the electric F-150 in 2022, announced it will invest heavily in the future of powertrains and mobility through 2025.

Honda US EV plans: Solid-state batteries later this decade, all EVs by 2040

General Motors Pledges a Zero-Emissions Light-Duty Vehicle Fleet by 2035

Biggest U.S. automaker will have 30 all-electric models by 2025 and zero out corporate emissions by 2040.



DER's Bring Many Challenges for Utilities

- NREL (2018):
  - "…the introduction of one PEV with Level 2 charging can reduce a typical residential transformer's expected life by about one order of magnitude (e.g. 10%)"
  - These impacts grow exponentially with additional L2 EVs on the same transformer
- Boston Consulting Group (2019):
  - "Utilities, depending on charging patterns, will need to invest between $1,700 and $5,800 in grid upgrades per electric vehicle through 2030"
  - For a utility with 1.5M customers with 30% penetration of EVs, this equates to $765M-$2.6B in potential incremental CAPEX

DEEP DIVE

Uncoordinated trouble? Electric vehicles can be a grid asset, but only with planning and investment

With more than 80% of vehicle charging done at the home, just a few vehicles on a street could cause issues for the power grid.

REUTERS

EV rollout will require huge investments in strained U.S. power grids

THE WALL STREET JOURNAL.

California Wants Cars to Run on Electricity. It's Going to Need a Much Bigger Grid

Residential & Fleet Charging Control Value

Reduces
- Peak Load
- Strain on Grid Assets

Technology for Control

Residential

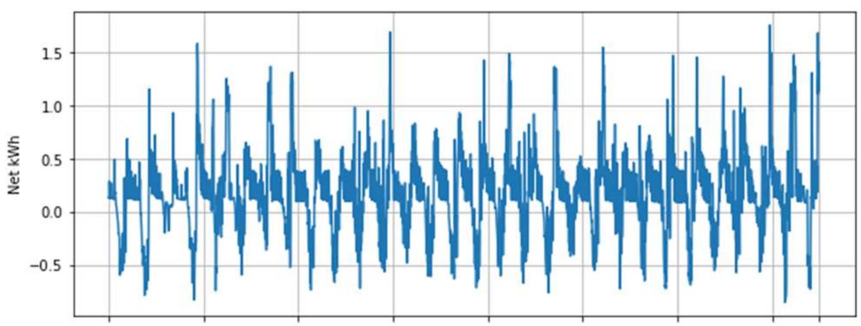
- Identify Charging Events
    - Telematics data – direct
    - AMI Data – indirect
- Predict Charging Behaviors
- Optimize Charging Experience
    - Schedule
    - Autonomous

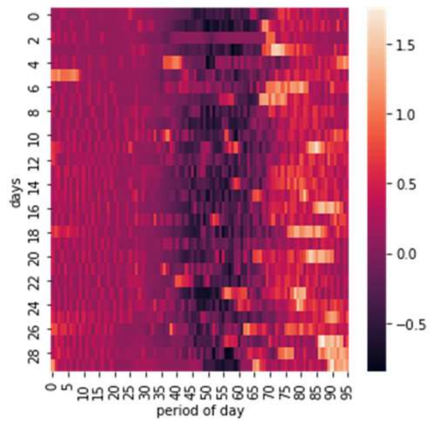
Fleet

- Measure Aggregate Fleet Charging
    - Charging station – direct
- Predict Charging Activities
- Optimize Charging Experiences
    - Schedule
    - Autonomous

Identify Charging Events

- Telematics
  - Opt-in by EV owners, benefits include state of charge, charge level, charge location
- AMI Data
  - Convolutional Neural Network (CNN) trained on "images" of historical AMI data





Optimization Model Basics

- Objective Statement – Function whose value is to be either minimized or maximized over the set of feasible alternatives
  - Utility N wants to reduce peak load by 10%
  - Utility N wants to increase revenue by 12%

- Decision Variables – Unknowns whose value is dependent upon a function or range of functions
  - Location/Feeder
  - Quantity of kWh

- Business Constraints – Restrictions on decision variables
  - EV Owner charging time preference
  - TOU Price
  - Transformer capacity

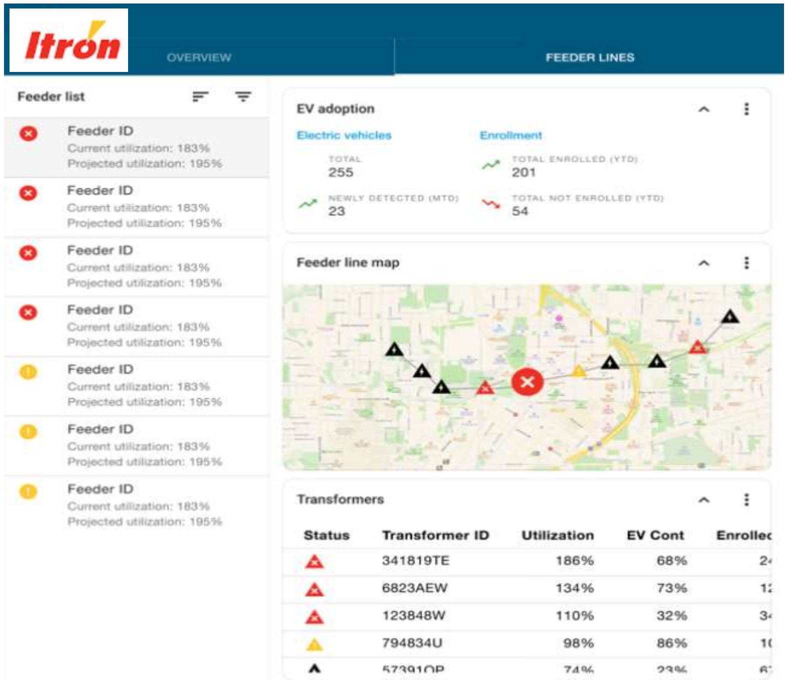
Optimization Model Additional Thoughts

- Objective
  - There can be multiple objective functions
  - Primary – Find a load distribution mix that maximizes TOU tiers
  - Secondary – Find a load distribution mix that minimizes over capacity on transformers
- Decision Variables
  - The more variables, the more combinations, the longer it takes to calculate
  - Be cognizant of number of variables if real-time results are required
- Business Constraints
  - The more constraints, the more precise the result set

Control Programs Rely on Optimization

Results from Optimization models that satisfy the objective functions can be used to throttle or stagger load.

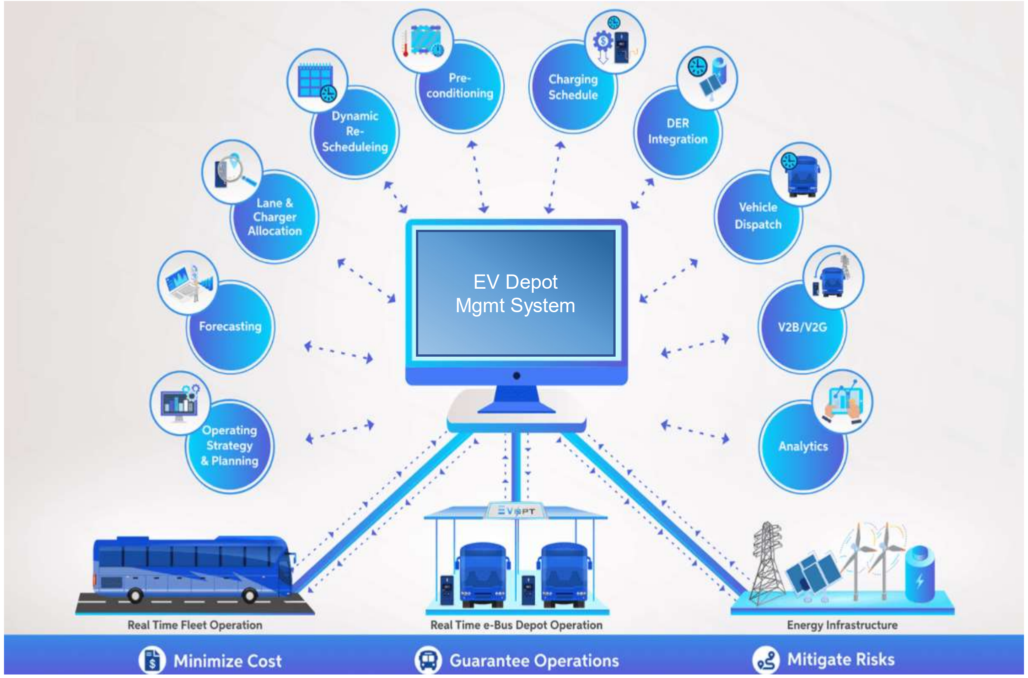
For Residential EV Charging Programs optimization can be an aggregate of a service area or targeted at various levels of the distribution network dependent upon the model constraints.



Fleet Control Programs

Manage EV charging schedules to ensure vehicles are charged when they need to be at the lowest price possible via optimization analytics

Dynamic re-scheduling based on forecasted operational needs at depots and across routes



THANKS FOR ATTENDING

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