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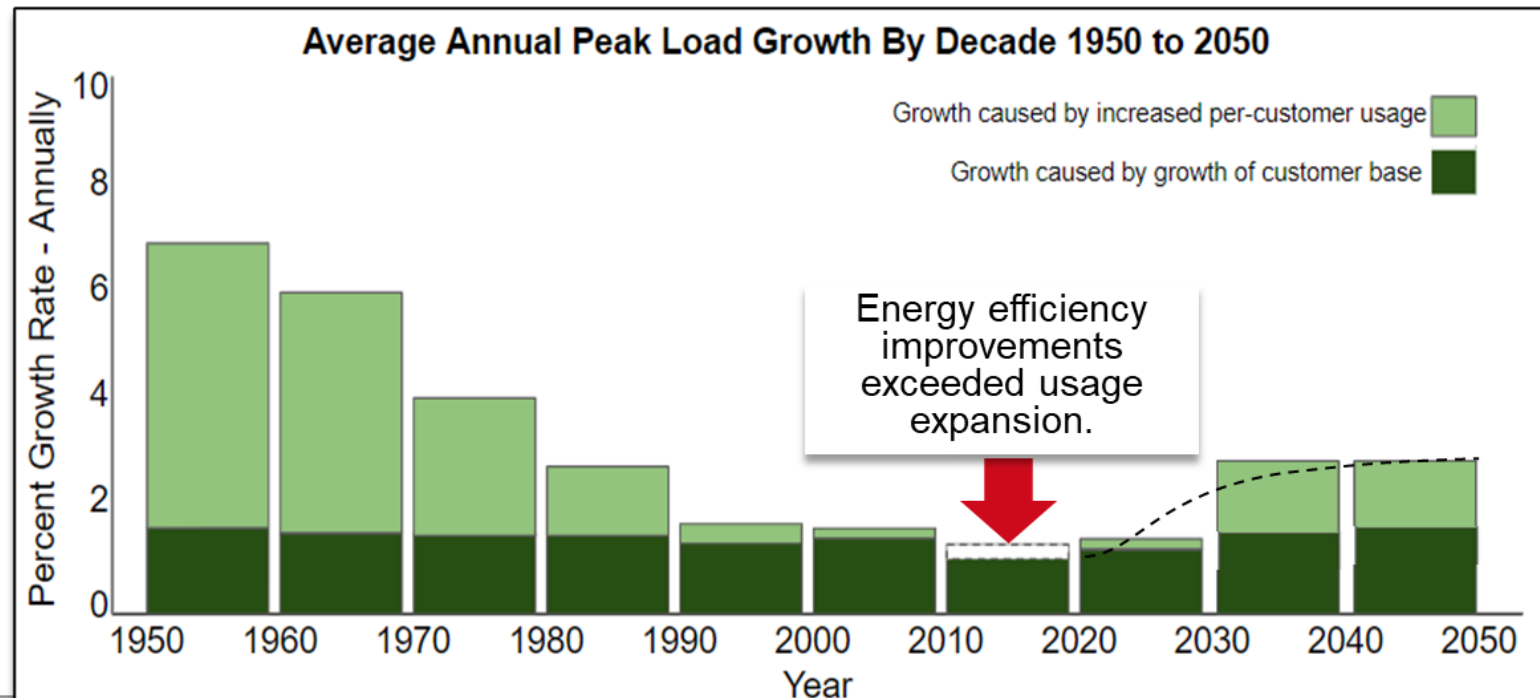
June 25, 2025

# Forecasting of Electrification and Data Centers



# The Power Industry's Double Challenge:

- More load growth than current planners have seen.
- Load growth of different character.
  - Increase due to increase in *per-capita usage*, rather than customer-base growth.





# This increase in growth is driven by:

## 1 Data center industry



- Data center industry is the Internet.
- It is exploding with growth with several different segments.
- Industry's locational and business priorities shifted.
- Some studies project it will use 25% of all energy by 2060.

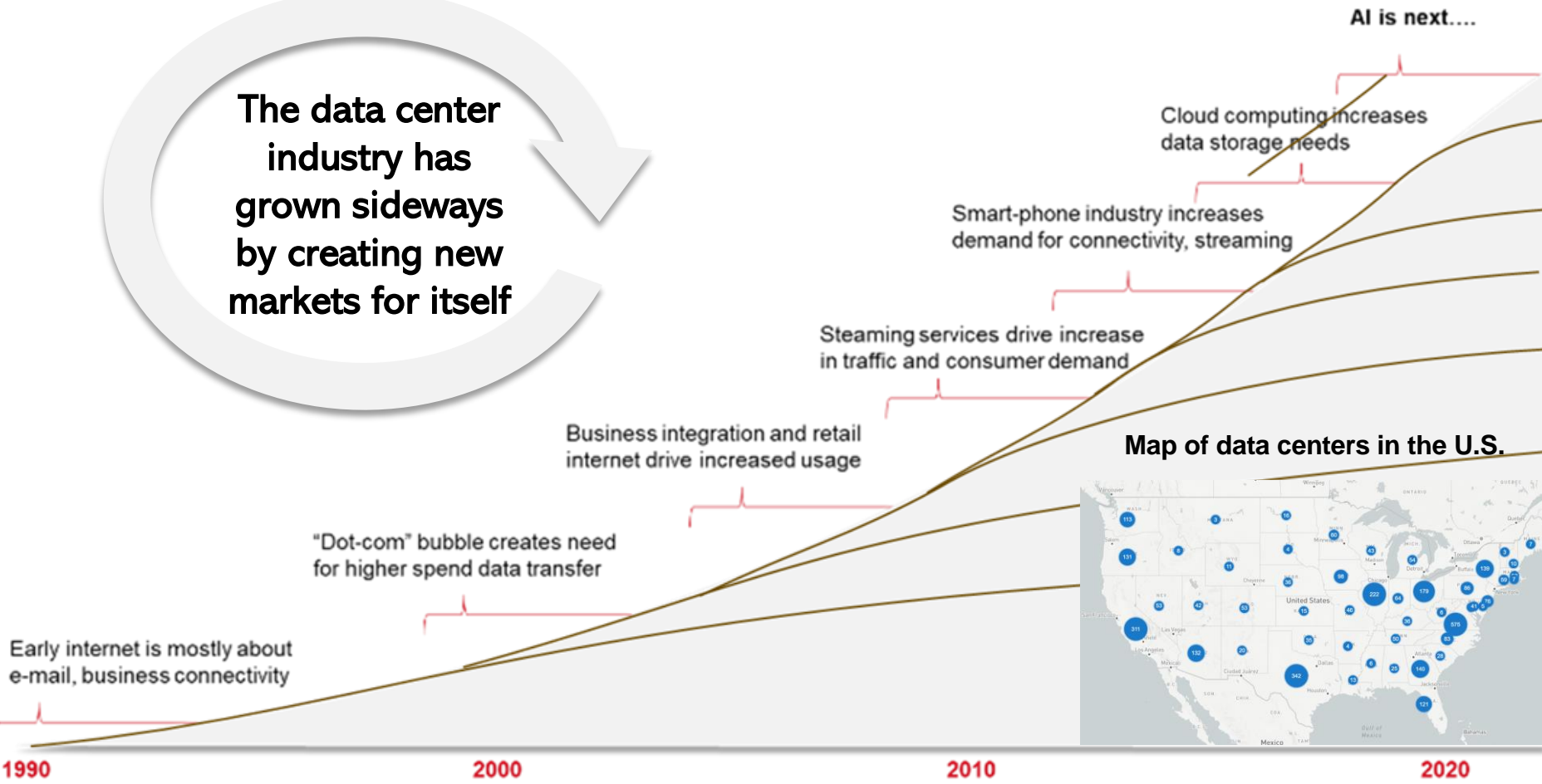
## 2 Electrification



- **Transportation electrification:** a shift to EVs, rail systems, and port facilities, etc.
- **Stationary electrification:** a trend toward more use of electricity for heating and industrial processes due to:
  - Technological advancement
  - Government policies and societal concerns



# Not One Industry



- Modeled as multi-segment industry, the data center industry creates new markets for itself
- A different market with different owners and business models:
- A different design architecture and operation.

*Analogous to petroleum industry in the mid-20th century growing into the petrochemical industry.*



# Data Center Forecast with Existing History

- **Analyze and forecast** load and growth historical trends by amount and location at the zonal, substation, or feeder level.
- **Define** load-curve shapes, breaking them into subcategories if needed.
- **Apply** locational, econo-demographic methods.
- **Develop** scenario-based forecasts when needed.
- **Ensure** a credible, transparent, and traceable methodology with solid technical credibility and a proven record of use.

We studied many scenarios, but they don't say much more than that

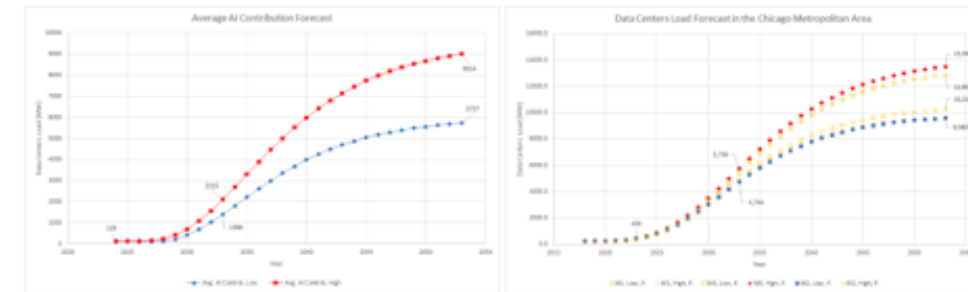
Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
National data	Local data	Hybrid	National data	Local data	Hybrid
Low AI	High AI	Low AI	High AI	Low AI	High AI

By 2033:

- Scenario 1; 4,744 MW (11 x 2023 load)
- Scenario 6; 5,736 MW (13 x 2023 load)

By 2053:

- Scenario 1; 9,582 MW (22 x 2023 load)
- Scenario 6; 13,494 MW (31 x 2023 load)



Where Will that Load Growth Be Located?

Several Different Spatial Allocation Scenarios were done.

The overall conclusion is basically that future data centers will probably locate near where current ones are being built. But our scenarios identified three areas of possible alternative growth: two shown here.

- Industrial zones along with high probability re-zoning potentials (e.g., agricultural land).
- Less than an hour drive from O'Hare airport.
- Other driving factors based on industry behavior and data centers deployment trends:
  - Available capacity
  - Proximity to transmission lines
  - Incentives





# Data Center Forecast with No Past History



Templating forecast based on similar regions with historical data and local factors.

Driving factors based on industry behavior and data centers deployment trends:

- Land use and zoning
- Incentives
- Available delivery capacity
- Proximity to transmission lines
- Proximity to airports

Driving factors for deployment trends and their relative weights:

Criteria	Factors
High weight	<ul style="list-style-type: none"><li>• Fiber connectivity</li><li>• Market size</li><li>• Cloud availability</li><li>• Power delivery</li><li>• Incentives</li></ul>
Medium weight	<ul style="list-style-type: none"><li>• Taxes</li><li>• Political stability</li><li>• Vacancy</li><li>• Development pipeline</li><li>• Sustainability</li><li>• Smart cities</li></ul>
Low weight	<ul style="list-style-type: none"><li>• Power cost</li><li>• Land price</li><li>• Environmental risk</li></ul>



# Data Center Modeling in Forecasts as well as in Siting and Operating (Load-Curve) Models

We use a categorization approach based on three basic dimensions to track and model 15 slightly to very different industry models.



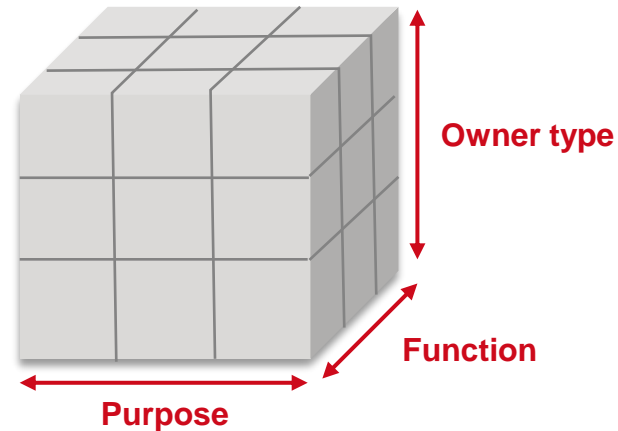
**Econometric and demographic**



**Societal consumer-business**



**Industry-specific reports**



*Using deep research and a data-driven reverse-engineered model of a segment's business model, location preferences, and growth aggressiveness.*

**Models to forecast growth:**

**Training set**

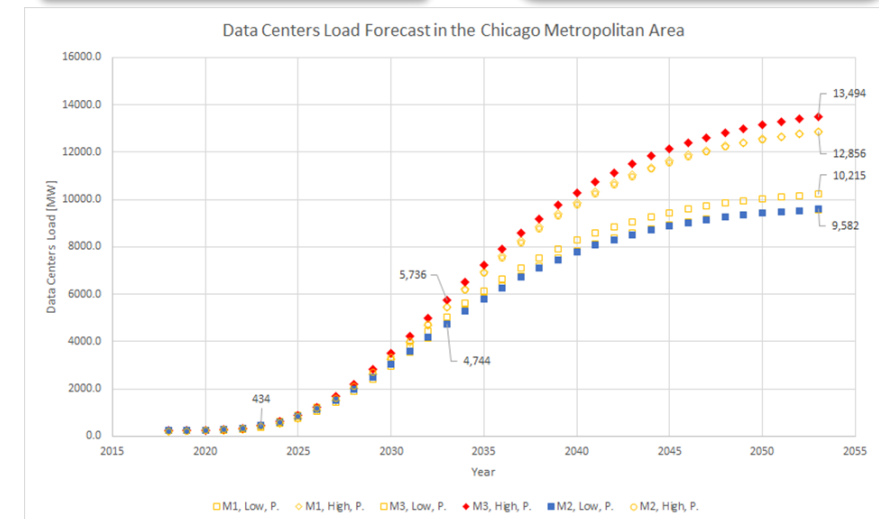
National data

Specific territory

Hybrid

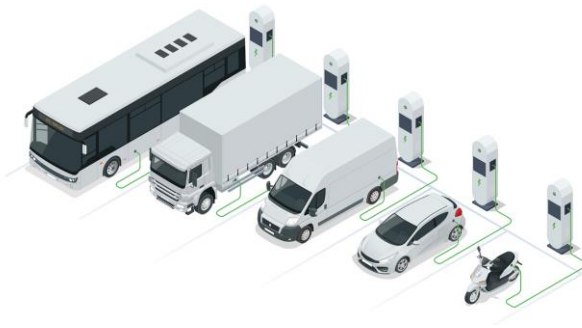
**Projections**

Applied to client territory





# Electric Transportation Forecast



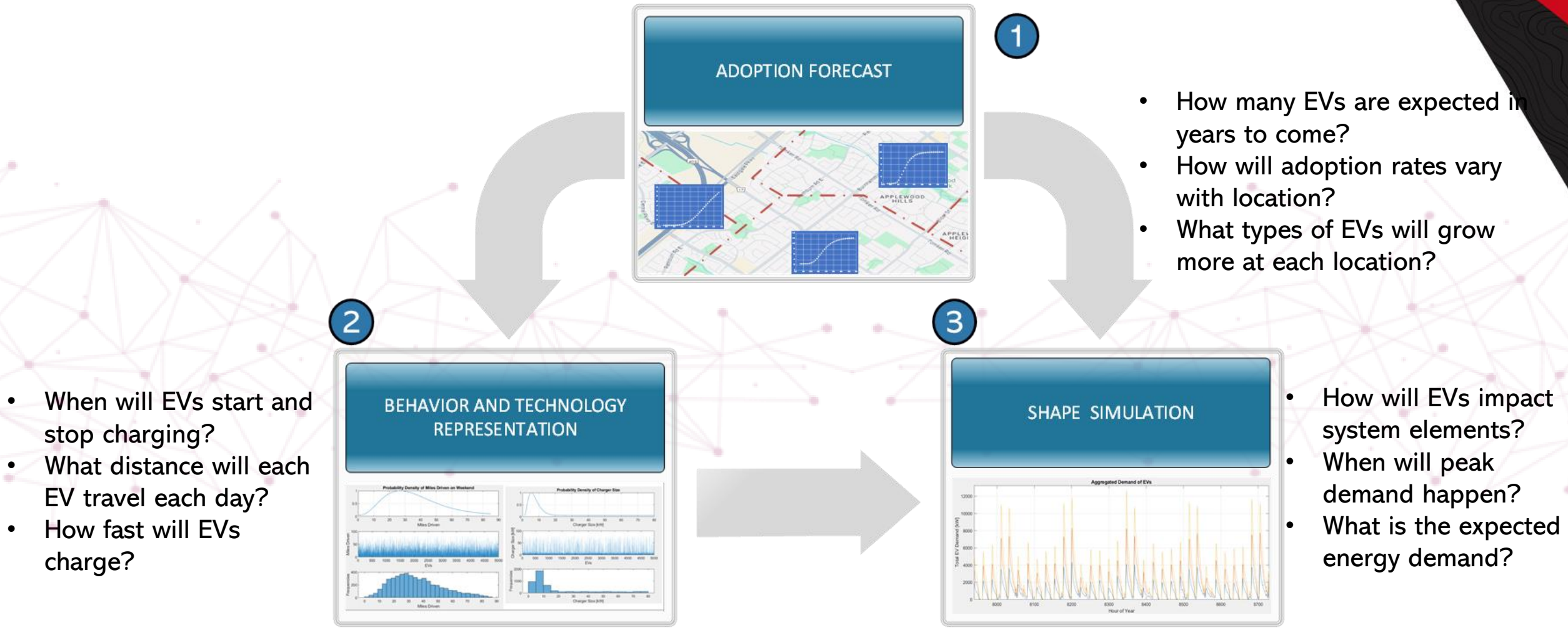
To analyze and forecast of the growth of electric transportation loads:

- *The four categories of EV forecasting must be considered.*

- 1 Light-duty vehicles**  
As an end-use load category across all residential and light and medium commercial customer classes, with sensitivity to several economic and demographic variables.
- 2 Public charging network (local)**  
As a new commercial customer type (think of it as the 21<sup>st</sup> century equivalent of gasoline filling stations), with retail-type sensitivities and interactions with other classes.
- 3 Public charging network (over the road)**  
As a new industrial customer type (think of it as the 21<sup>st</sup> century equivalent of truck-stop), with industrial sensitivities and interactions with the system “global model”.
- 4 Fleets (light-, medium-, and heavy-duty)**  
As either a new industrial customer type or as a new end-use within current industrial classes. Either one will work and there is not much difference between the two.



# LD Forecast



- When will EVs start and stop charging?
- What distance will each EV travel each day?
- How fast will EVs charge?

- How many EVs are expected in years to come?
- How will adoption rates vary with location?
- What types of EVs will grow more at each location?

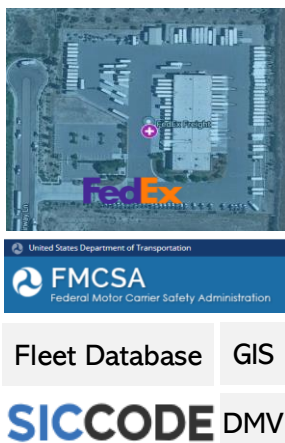
- How will EVs impact system elements?
- When will peak demand happen?
- What is the expected energy demand?



# MDHD Forecast

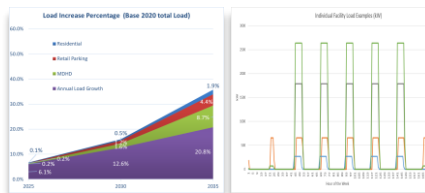


**Address** level bottom-up analysis to identify site locations

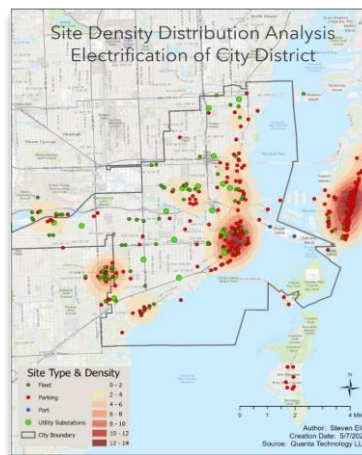


**Forecast** adoption and estimate loads

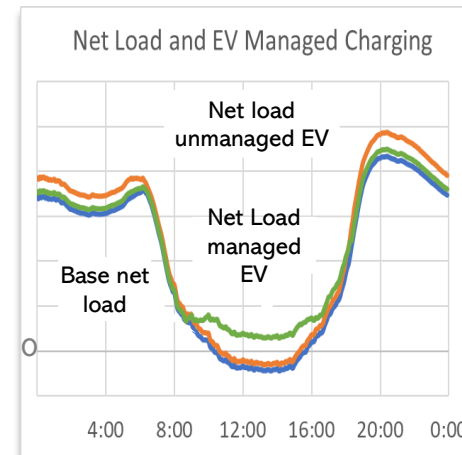
- Adoption curves
  - Regulations
  - Economics
- Scenario analysis
- 8760 load profiles



**Map** facility loads to feeder nodes, **Impact** analysis with hourly **Power Flow**



**Evaluate** mitigation options: managed charging, DERs, and infrastructure upgrades





# To wrap up:

## + Load forecasting is more complex and difficult.

Revisions needed to:

- Address the more complex per-capita consumption growth.
- Include study of several new “uncertainty modes” per-capita growth brings.
- Accommodate the higher growth rates that will be seen.

## + Planning is more complex, too, for the same, and other reasons.

T&D planning, and the forecasting behind them:

- Need more and different coordination of T&D.
- Must look/plan farther ahead.
- Need to change “data emphasis” and models to recognize several changes in our knowledge.

## + Middle-point coordinated T&D planning

T&D planning functions need to be better integrated:

- Mutual but transmission led planning of the substation level.
- Over a longer time-period than the lead time on T, D, DER, or NWA contract lifetimes.
- With certain characteristics.



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