EVs are here: Harnessing analytics to turbocharge electrification planning and EV detection

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Webinar

Alabama Power

E Source

POWERING WHAT'S NEXT

Thursday, October 26, 2023

Speaker introductions

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Moderated by:
Devon Grodkiewicz
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E Source

About Us

- **6,104** employees
- **5,891** retirees
- alabamapower.com
- powerofgood.com

30% Clean Energy

- NUCLEAR - 20%
- HYDRO - 7%
- OTHER* - 3%

Generation Mix

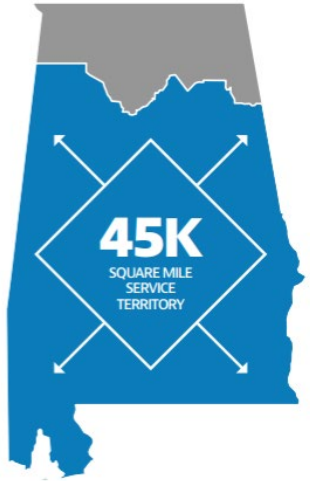
41% Coal

29% Natural Gas

Serving Our Customers

1.5 MILLION CUSTOMERS

=10K customers

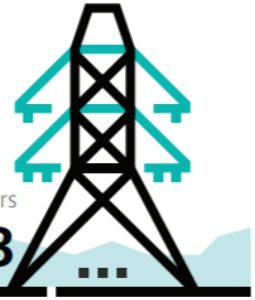


Power Delivery

Transmission
Towers: 10,237
Poles: 112,854

Distribution
Towers: 4
Poles: 1,458,978

Total Poles and Towers



1,582,073

85,586 miles
of power lines

TRANSMISSION
10,785 mi.

DISTRIBUTION
74,801 mi.

Our power lines would circle the world over three times.

The circumference of Earth is 24,901 miles.

Rethinking the Meter

EV Growth is Moving *Fast*

Annualized EV Growth Rate since 2015

50%

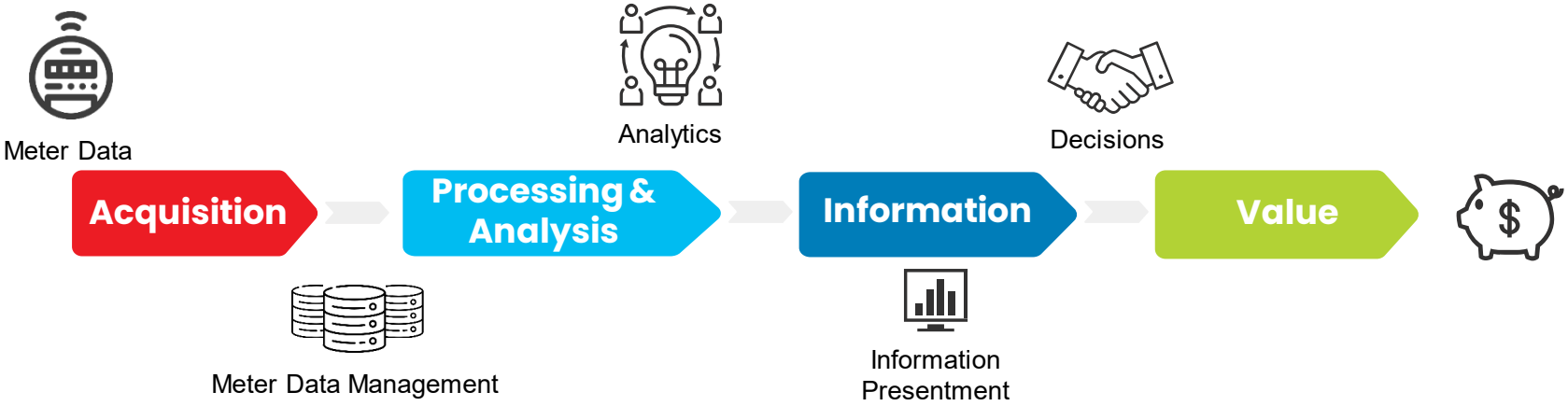
Source: World Resource Institute, What is the Growth Trajectory for Global EV Sales?, September 2021

EEI forecasts 26.4 million EVs on US roads by 2030.

Source: Electric Edison Institute, Electric Vehicle Sales and the Charging Infrastructure Required Through 2030, June 2022

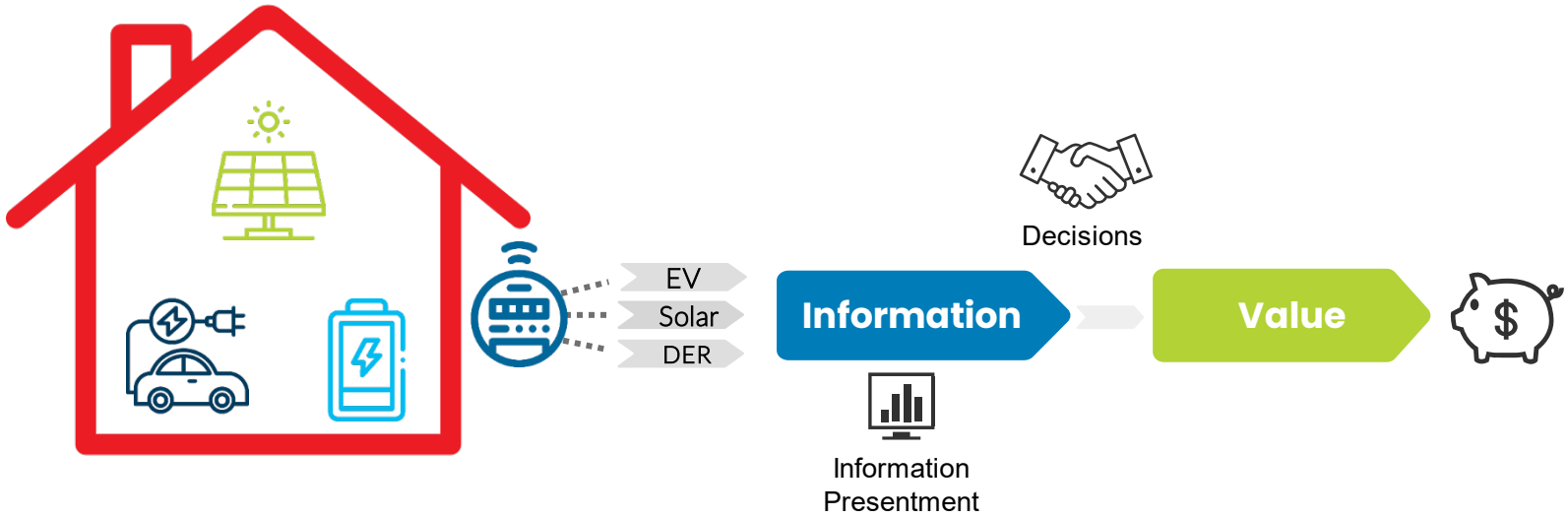
OEM EV Commitments total ~$1.2T

Centralized Analytics



AMI Energy Data Resolution

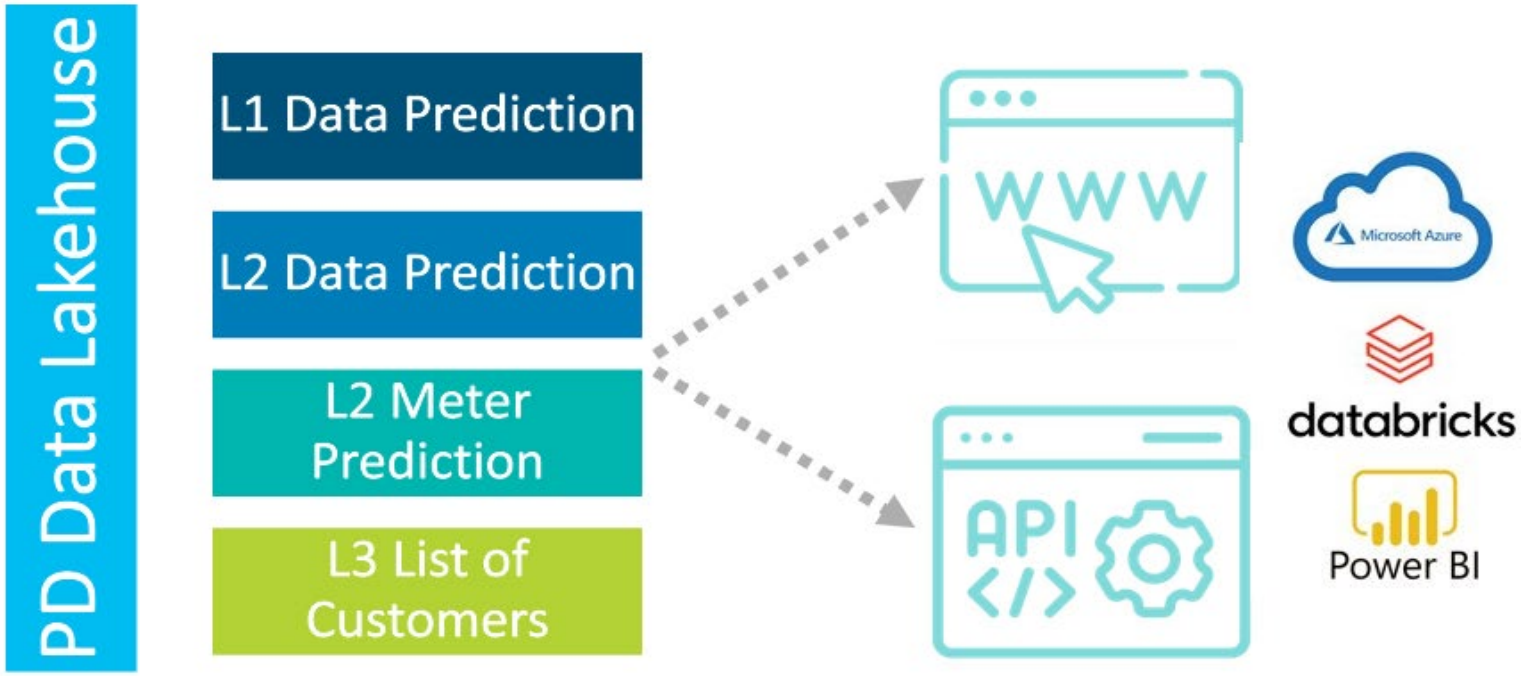
Grid-Edge Analytics



AMI Edge Analytics Use Cases

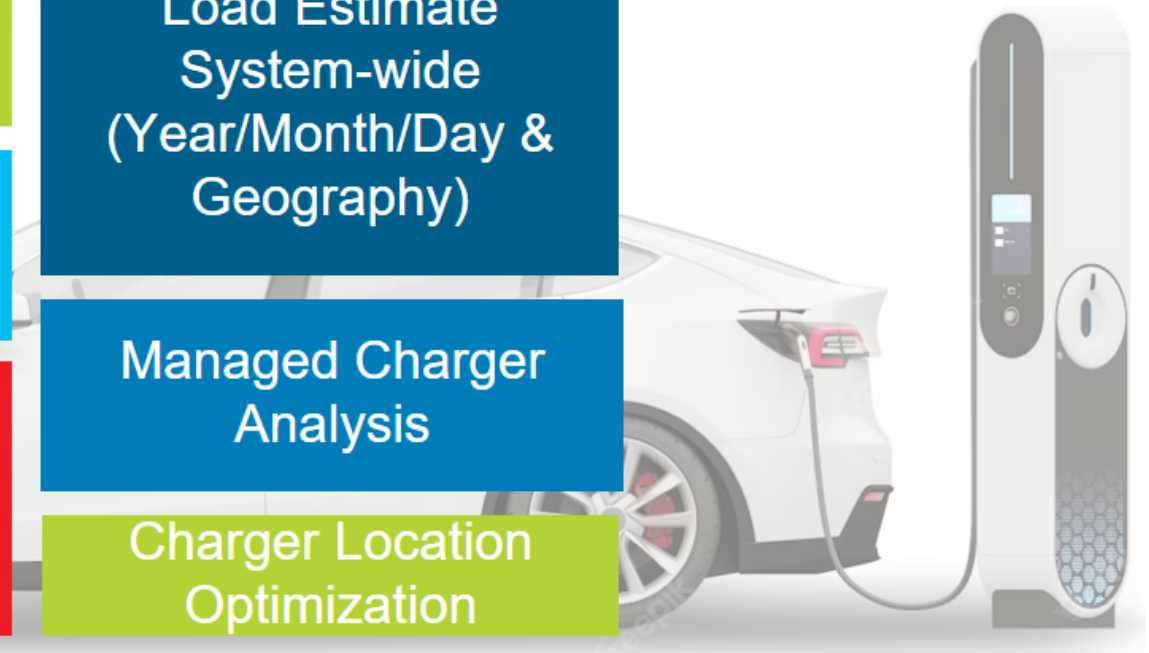
Customer	Distribution
• Load Disaggregation	• Fault Detection/Location
• AMI Anomalies	• Loose Neutral Detection
• EV Detection & Mgmt.	• Transformer Failure Prediction
• Solar Detection	• Momentary Analysis
• Revenue Protection	• Voltage Anomaly Models
• Managing DER	• Managing DER

AMI Edge Analytics Use Cases



EV Insights Enabled by AMI Data Lakehouse Architecture

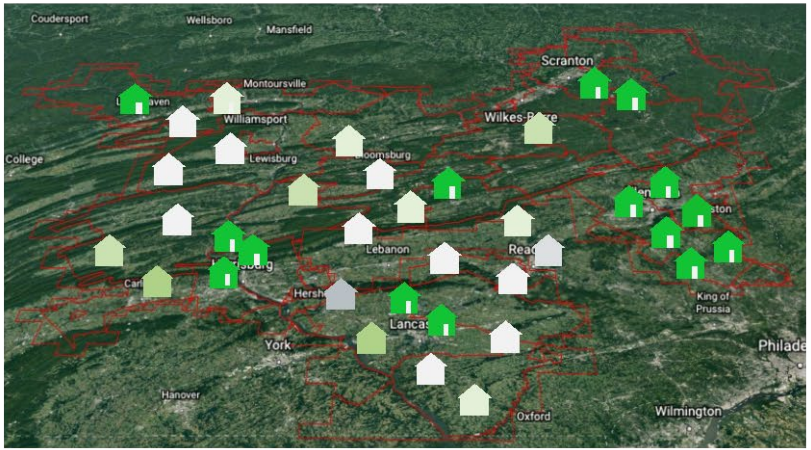
- Transformer Loading
- Load Estimate System-wide (Year/Month/Day & Geography)
- EV Rate Adoption Behavior Changes
- Managed Charger Analysis
- Usage Trends by Customer Demographic
- Charger Location Optimization



Analytical approach

Analytical approach—with ground truth

Target Model

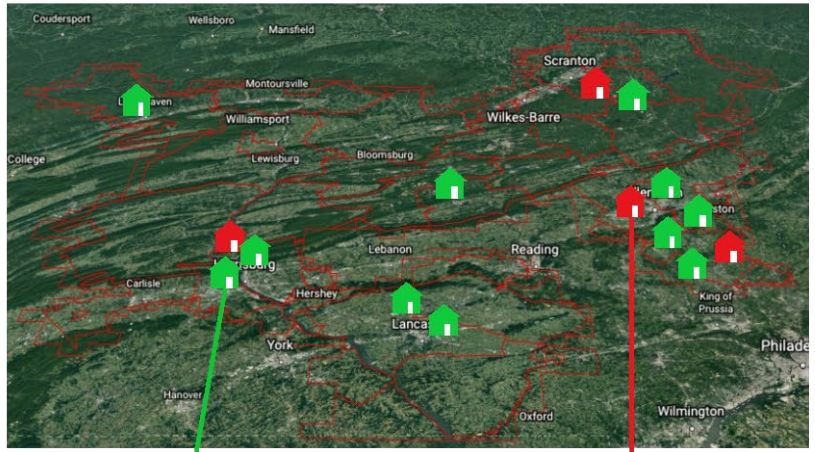


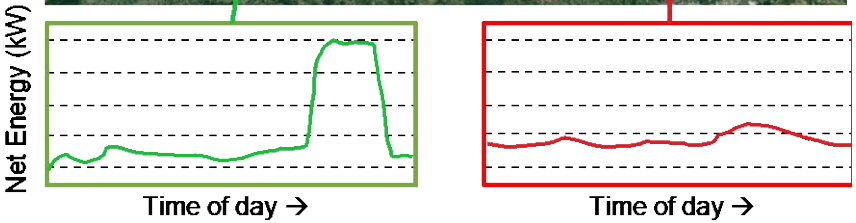
p = 0 — p = 1

Income: $55,000
Average monthly bill: $30
Property size: 650 sqft

Income: $105,000
Average monthly bill: $180
Property size: 2450 sqft

AMI Classifier Model

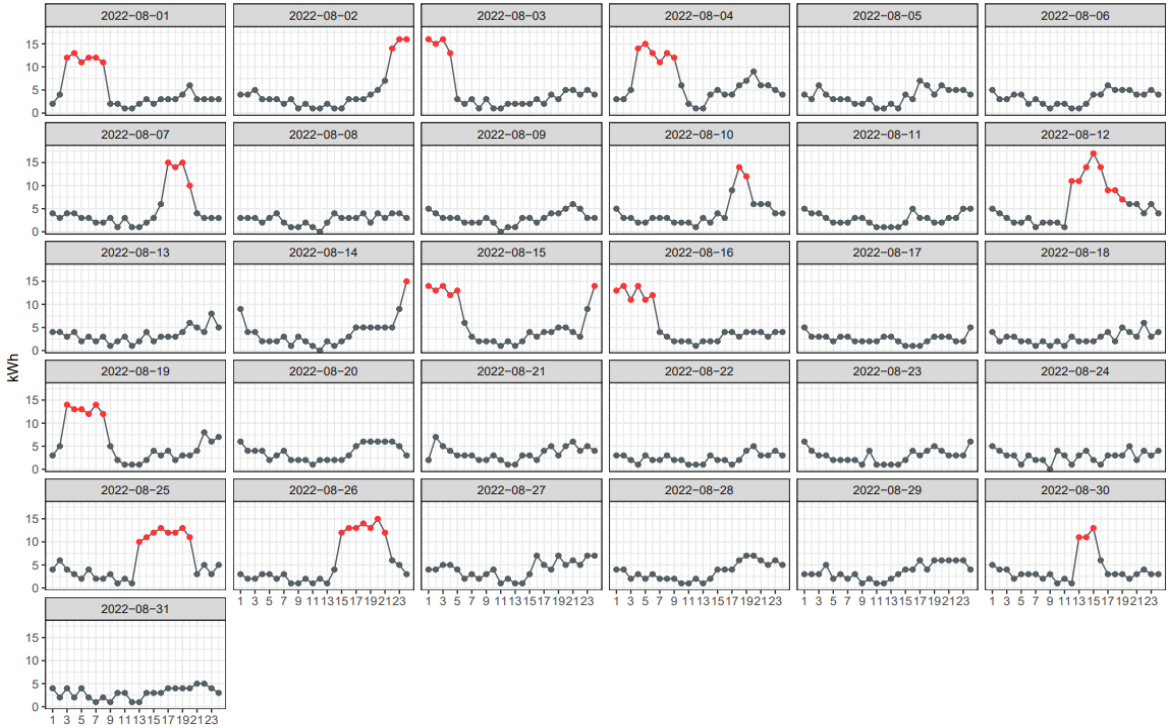




Challenge and solution

- **Challenges**
  - Initially no “ground truth” set of known customers with L2 chargers to train models with at APC
    - Later we had access to EV rate identifiers
  - AMI data needs to be screened and treated for model-readiness
  - Detection algorithm needs to scale: 50 billion 15-minute interval readings per year
- **Initial solution**
  - Apply flags for likely “bad data” readings to all AMI data
  - Compile daily load shapes from known L2 customers
  - Translate description of daily load shapes with L2 chargers into detection algorithm
  - Review results and refine algorithm

Level 2 charge detection approach

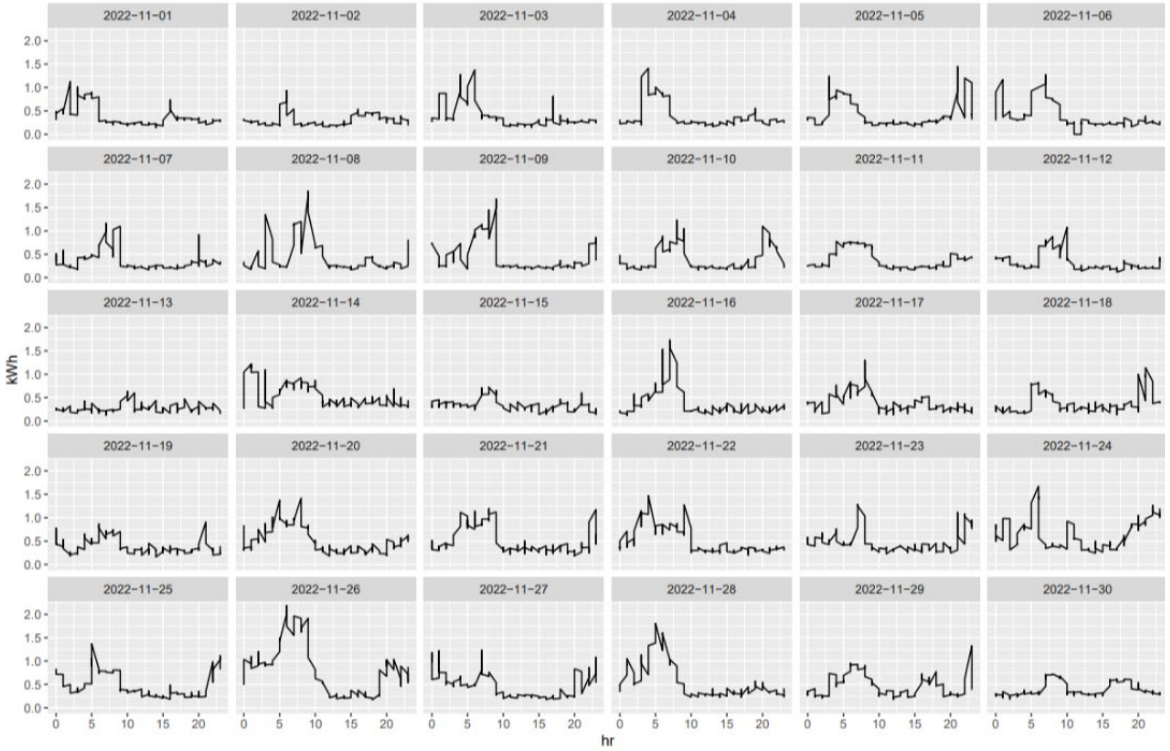


L2 charging attributes:

- Elevated step-change use over multiple hours
- Pattern is recurring
- Expect high instance rate of pattern in EV rate hours

This figure shows in red L2 charge periods detected for one customer over one month

What about Level 1 charging?



- L1 charging does not have as pronounced of a signal as L2
- 15-minute granularity useful for detection model training

EV L2 detection summary

Average charging event duration was 3.5 hours

Most of the charging detected occurred overnight

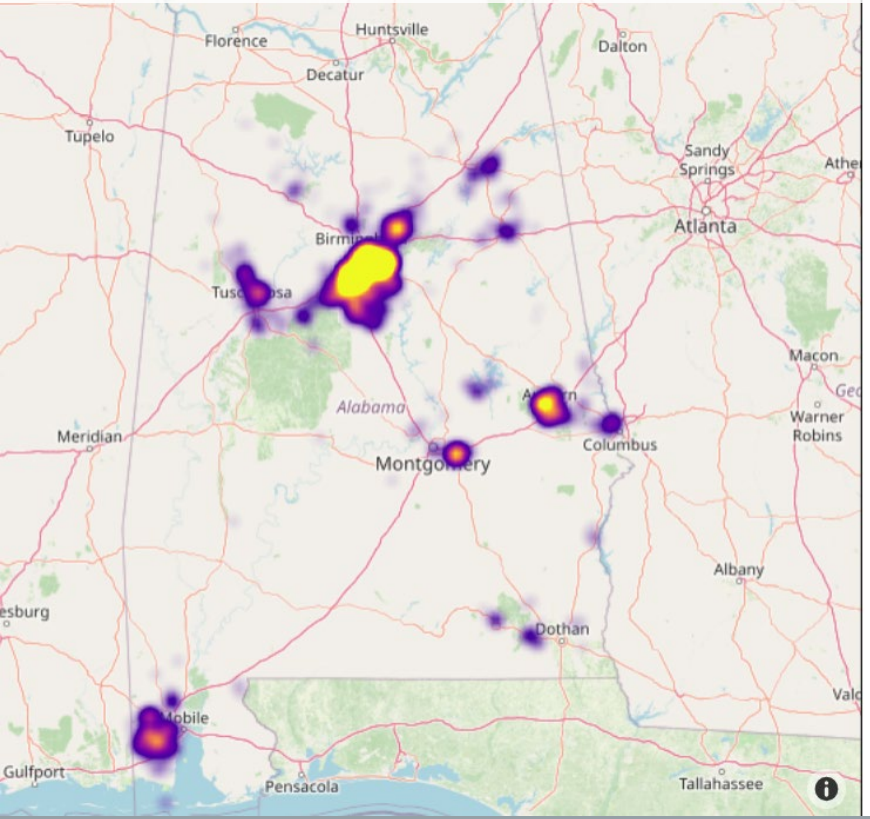
Charging events were distributed evenly across days of the week

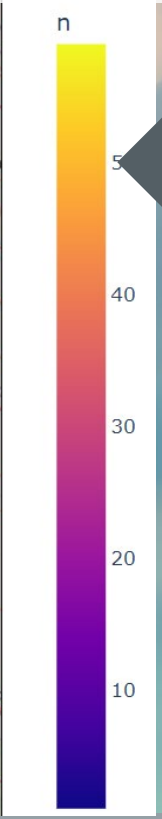
Charging was clustered in urban areas—particularly Birmingham

Detected L2 charging in 29% of meters enrolled in EV rate in 2022

Able to compare charging behaviors before and after enrollment in EV rate

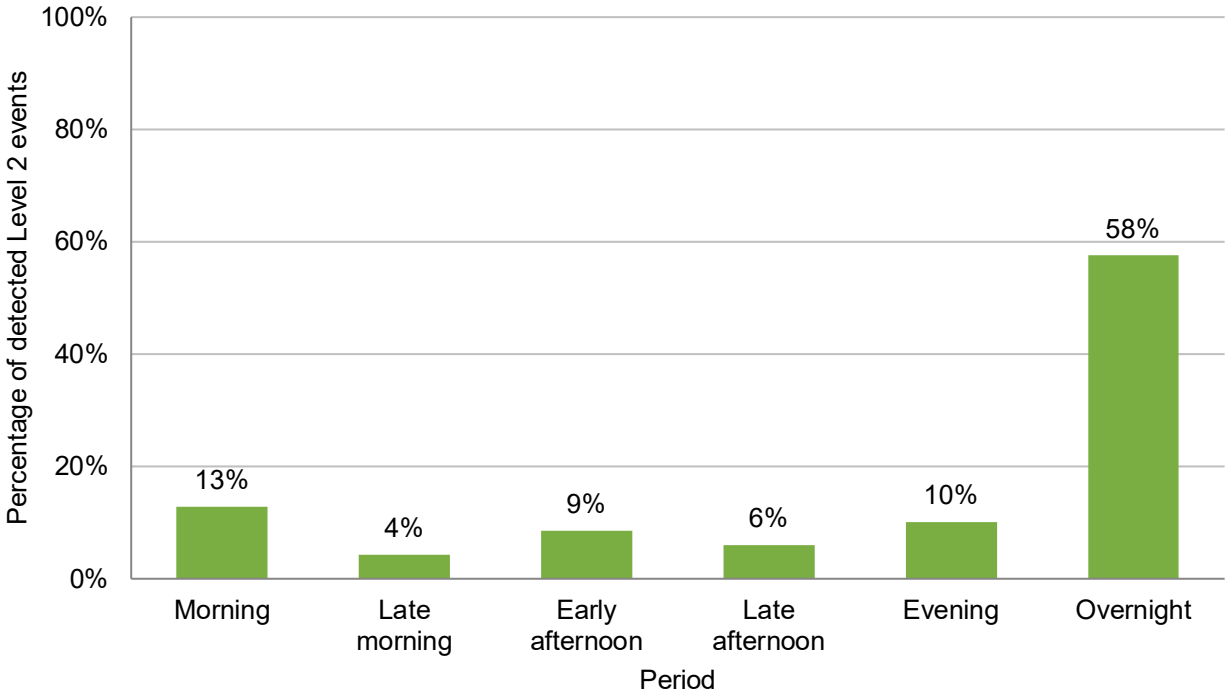
Level 2 charging hot spots in APC territory





Notable concentrations in more-urban areas

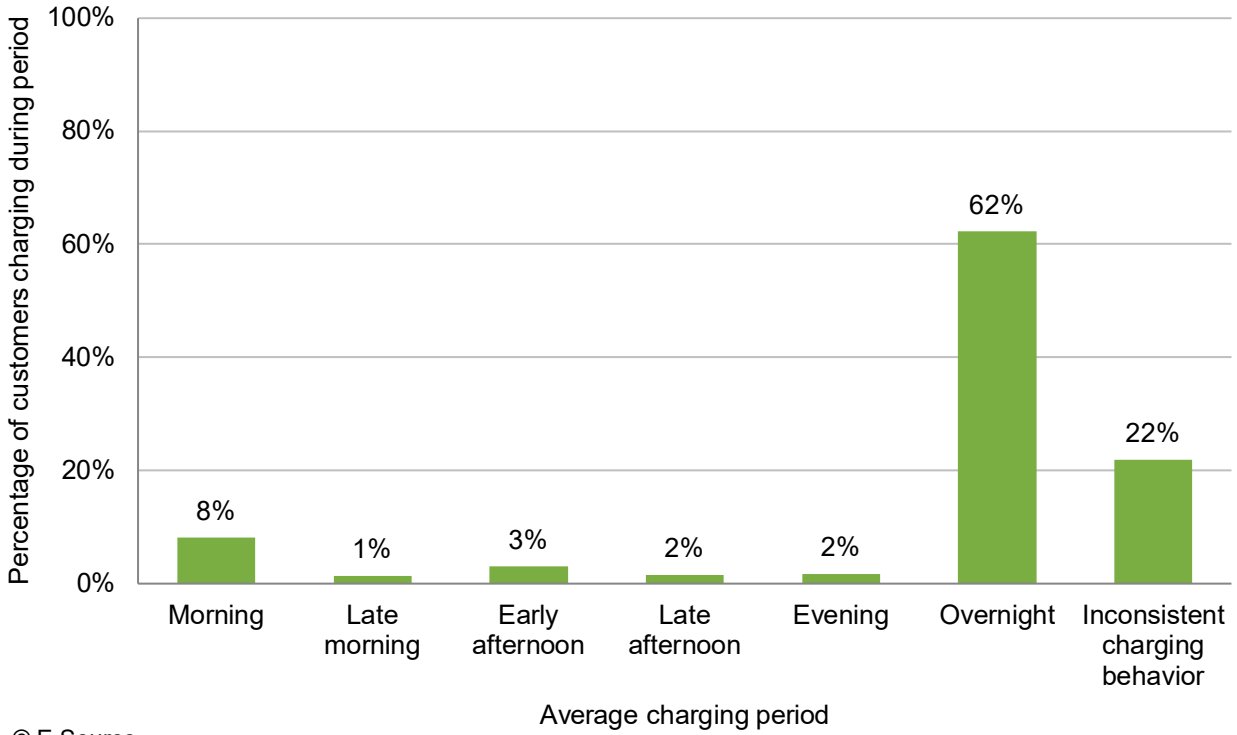
EV L2 detected events



- Almost 58% of the detected charging occurred overnight
- 25% of charging occurred during afternoon and evening hours

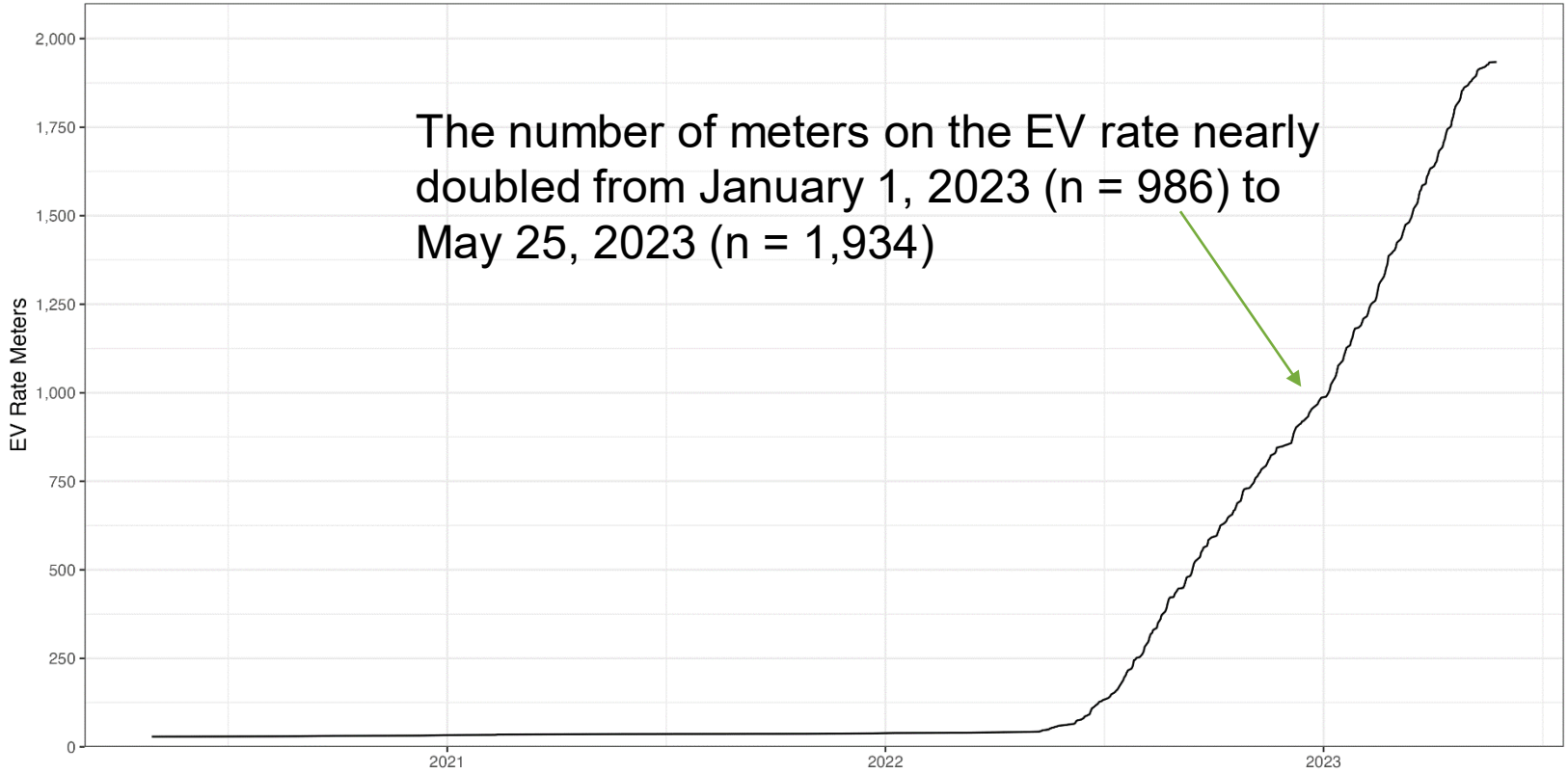
Period	Hours
Morning	5:00–9:00 a.m.
Late morning	9:00–11:00 a.m.
Early afternoon	11:00 a.m.–2:00 p.m.
Late afternoon	2:00–5:00 p.m.
Evening	5:00–9:00 p.m.
Overnight	9:00 p.m.–5:00 a.m.

EV L2 average charging periods events



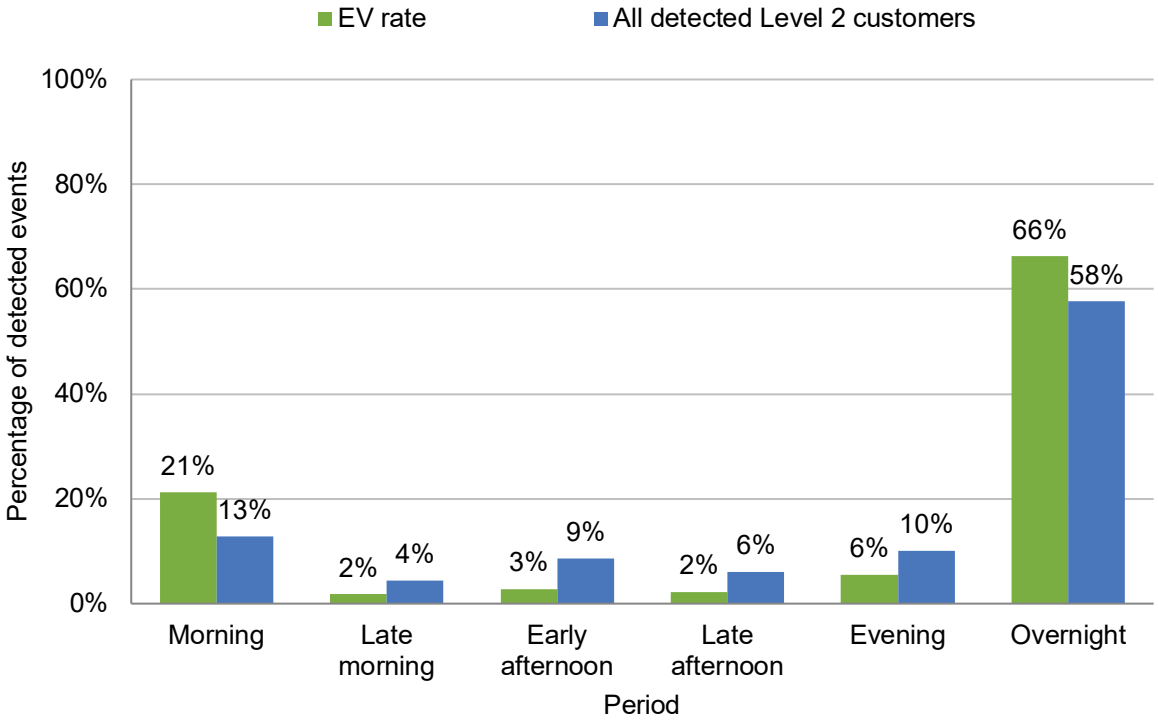
- 62% of customers detected typically charged during overnight hours
- 22% of customers exhibited inconsistent charging behavior (no time of day represented more than 50% of their charging)

EV rate enrollment growth



Source: Alabama Power Co.

L2 charging event times for EV rate customers



L2 customers on the EV rate charge more frequently overnight and in the early morning compared to those in the overall L2 population

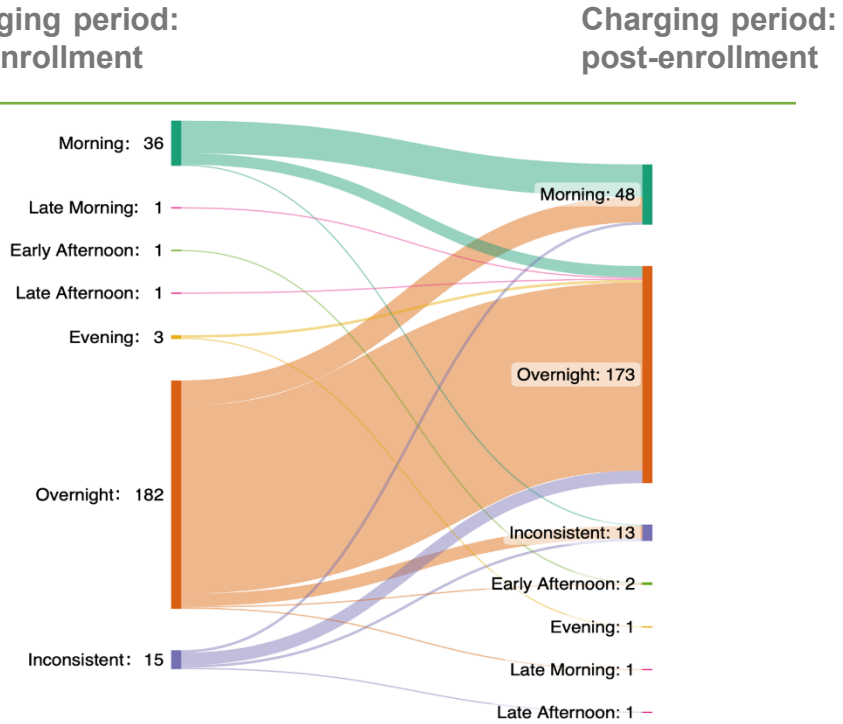
Period	Hours
Morning	5:00–9:00 a.m.
Late morning	9:00–11:00 a.m.
Early afternoon	11:00 a.m.–2:00 p.m.
Late afternoon	2:00–5:00 p.m.
Evening	5:00–9:00 p.m.
Overnight	9:00 p.m.–5:00 a.m.

Assessment of EV rate customers

- Expected to find EV rate enrollees without L2 charger detection because they may not use or own an L2 charger
- Reviewed AMI data of 704 EV rate customers not detected by the L2 detection algorithm and found that:
  - Several customers had little to no reads exceeding 7 kilowatt-hours
    - These were likely Level 1 charger customers
  - Some did not exhibit repeat charging behavior throughout the year
    - Gave us insights to refine our model to improve detection accuracy

Pre- and post-enrollment behaviors

- Most customers detected with L2 charging on the EV rate list through 2022 were already charging overnight, pre-enrollment
- After enrolling, 9 customers who primarily charged in the morning switched to primarily charging overnight
- After enrolling, 10 customers who exhibited inconsistent charging behavior switched to primarily charging overnight



Source: Alabama Power Co. **Note:** Average number of events per customer in calculations:

- Pre-enrollment: 48
- Post-enrollment: 27

What's next for APC?

What's next

- Moving model to production
  - Will operate on a regular two-week cadence for scanning APC AMI data for new EV charging events and provide output to various stakeholders
  - L1 charging detection to be layered into production system

Questions?

For more information

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