Using AI and Distributed Computing & Control to Manage EV Charging Loads

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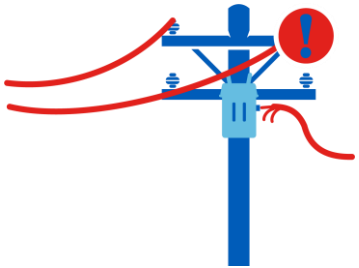
EV Charging and Distribution Utility Planning & Operations

Overview of competing dynamics in the current landscape

- EV charging is the largest source of electric load growth since air conditioning
- +38% growth in demand, +80 TWh/yr in consumption through 2050 (NREL, 2018)

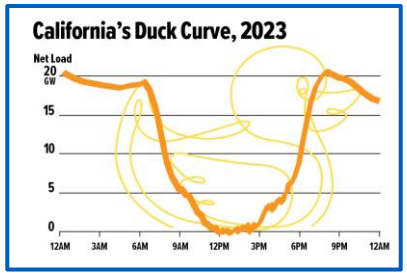


- Impacts of EV charging felt first and foremost exactly where distribution utilities lack visibility and control – service conductors, service transformers, and feeders
- Same assets are currently managed under a “run to fail” management paradigm

- Unlike solar PV or other resources, residential EV adoption occurs without interconnection agreements or any obligation to notify your utility

EV Charging and Distribution Utility Planning & Operations

Resulting challenges for distribution utilities



- Residential EV charging tends to exacerbate the duck curve at the system level
- Steeper ramp rates in early evening

- Utilities are largely blind to residential EV adoption and grid impacts until an unplanned outage occurs
- Compromised reliability

- Sub-optimal distribution CAPEX planning and spending
  - $50 billion in distribution infrastructure CAPEX needed to meet CA's EV goals
  - $15 billion just for secondary transformers and service conductor upgrades

Itron's Distributed Intelligence (DI) Platform

Solving grid management problems "at the edge" with AI and distributed computing & control

Each Itron RIVA meter has:

- **Linux computer**
  - Containerized application environment
  - Process 1-second streaming data
- **Peer-to-peer communications**
  - RF mesh
  - Power line carrier (PLC)
- **WiFi radio**

- **Examples of AI embedded in DI apps:**
  - Location Awareness
    - Meter-to-transformer
    - Meter-to-phase
  - Theft Detection
  - High Impedance Detection
  - Power Quality Monitoring
  - Anomaly Detection

Using Itron's DI Platform to Manage EV Charging

Creating visibility into residential EV adoption, charging behavior, and distribution grid impacts

DI apps:
- Load Disaggregation (AI)
- Location Awareness (AI)
- Transformer Load & Voltage Monitoring (P2P)

Outcomes:
- Enables managed charging programs to be locationally targeted to maximize grid value
- Enables grid planners to move beyond "run to fail" management paradigm

Managing residential EV charging to ensure grid reliability and maximize EV adoption and hosting capacity

DI apps:
- Location Awareness (AI)
- Transformer Load & Voltage Monitoring (P2P)
- Local control of EVSEs (WiFi)

Outcomes:
- Removes significant barriers to EV adoption for LMI customers
- Defers significant distribution CAPEX
- Protects grid reliability

ELECTRICIATION – SERVICE UPGRADES

Customer Experience

Today

- ~50% of customers have 100A panels which need immediate upgrade to 200A to serve Level 2 EV home charging
- Many of these customers will trigger service upgrades which can vary in cost from $3,000 to $50,000/site with 2-to-12 month durations
- Customers either don't buy or return an EV, charge on Level 1 outlets, or perform unpermitted work causing transformer failures

Future

- Customer logs in to PGE.com to view available connectivity options
- If mitigation is needed, customer can opt to use a listed EV charger which will coordinate with their service, avoiding panel/service upgrade

R&D and Business Enablement

1. **Web portal for customers to view service capacity**
   - Develop service planning rulesets to give customer view
   - Service planning coordinated options and escalations
2. **Customer service coordinated charging product**
   - Customer service limit – Work with manufacturers to coordinate local charging (e.g. via smart meter HAN or vehicle telematics)
   - Transformer limit – Coordinating locally amongst service points and meters for an aggregate limit

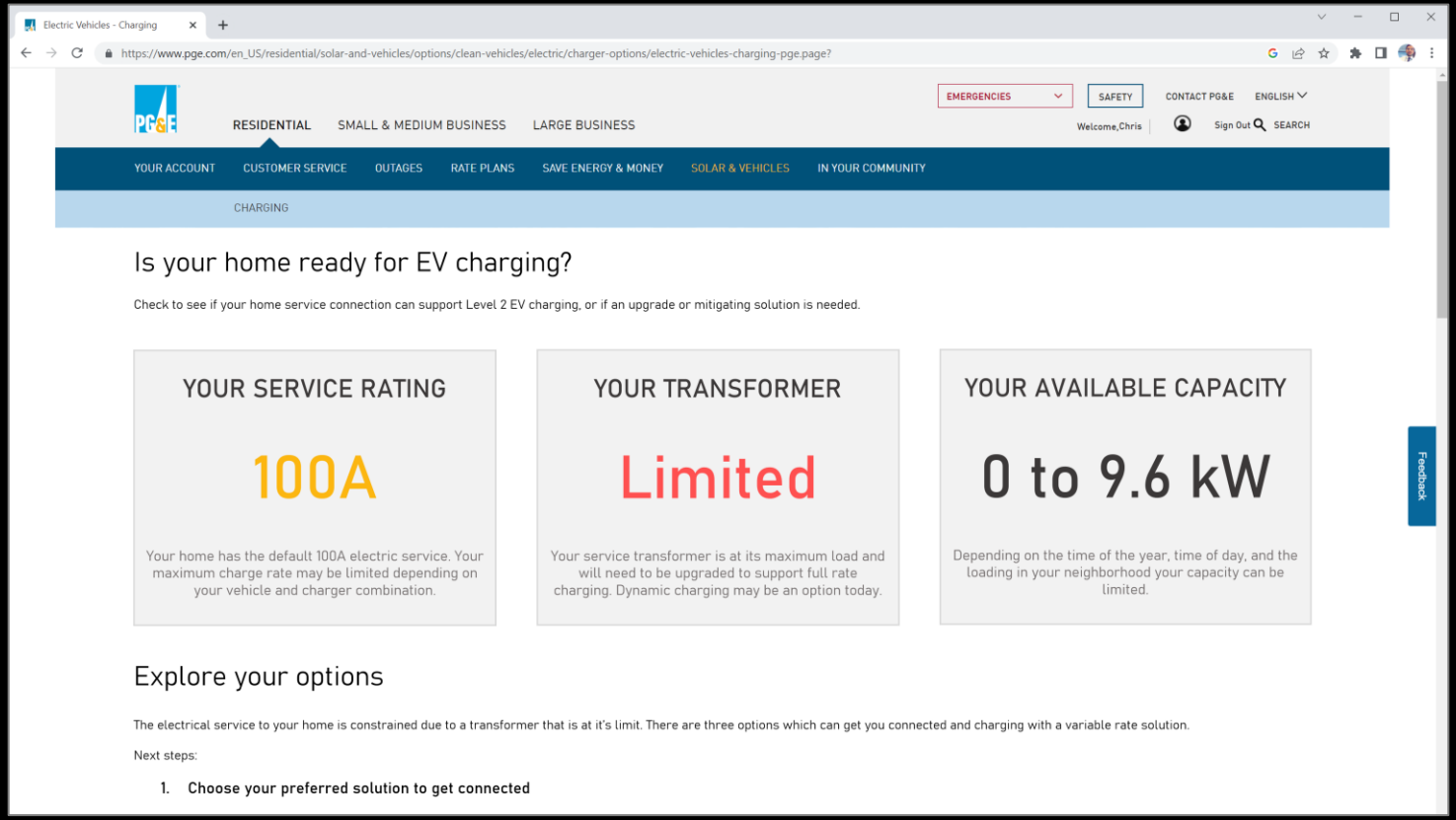
Neighborhood infrastructure can be sufficient *if* coordinated

Month -->	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	25.4	21.8	23.8	19.0	21.4	25.5	25.1	32.0	31.7	17.9	26.9	27.0
1	25.3	21.3	19.9	27.4	25.2	29.4	28.1	31.1	39.1	18.9	24.6	23.3
2	26.2	27.6	25.4	27.8	25.3	30.0	32.9	36.3	36.7	22.5	28.8	22.4
3	26.2	24.7	22.7	25.6	22.4	24.4	30.3	33.5	27.8	30.9	22.5	22.0
4	26.7	20.9	22.2	22.2	14.5	21.4	32.9	23.3	32.7	24.0	30.9	33.5
5	28.7	26.7	26.4	22.5	11.6	21.9	30.1	31.3	39.0	31.5	36.6	33.8
6	28.1	28.5	28.3	23.7	11.5	28.4	33.3	29.8	31.8	29.0	30.7	33.7
7	27.8	25.4	27.4	15.4	14.1	22.3	27.0	18.5	16.4	20.3	23.3	27.8
8	23.5	34.0	28.1	17.3	16.0	15.1	20.5	17.1	17.2	19.9	21.4	33.6
9	30.2	23.9	21.2	20.2	17.7	18.4	18.9	20.4	21.3	18.3	20.8	23.9
10	28.3	25.0	23.5	22.9	23.7	17.5	19.0	24.9	28.6	22.2	24.7	25.4
11	25.3	24.5	29.4	24.9	22.9	23.9	20.5	29.2	33.1	23.6	24.5	26.8
12	25.6	23.9	25.4	27.1	29.1	26.3	23.9	37.4	32.1	29.5	24.6	28.6
13	26.5	24.0	24.4	25.3	37.0	31.7	25.0	38.7	41.3	29.3	28.1	29.7
14	25.7	28.6	27.2	28.5	39.2	36.3	29.6	46.4	54.2	26.8	27.8	26.7
15	27.0	31.1	24.9	32.8	41.6	37.6	33.0	52.2	58.4	33.1	22.3	28.3
16	27.4	30.3	25.5	22.9	41.9	51.9	38.5	53.6	58.8	40.2	22.9	24.6
17	29.0	28.6	29.3	22.1	44.4	49.9	34.1	54.3	60.5	39.0	25.0	28.6
18	34.5	29.6	30.2	23.6	46.1	52.6	36.9	54.4	60.0	40.8	25.5	31.1
19	29.7	28.6	26.4	23.6	43.1	49.7	37.1	55.2	54.0	31.7	27.5	32.2
20	29.0	27.2	28.5	24.7	41.8	45.2	30.7	47.2	51.4	31.0	26.6	29.7
21	30.2	30.5	27.0	28.0	45.6	38.3	26.3	45.2	43.2	30.6	27.5	34.4
22	30.6	28.4	29.7	25.9	39.4	36.8	27.3	40.2	39.1	25.3	28.1	33.2
23	30.5	28.6	24.5	24.4	26.5	36.6	25.2	34.8	34.3	26.8	29.3	27.4
Nightly surplus	307	310	316	325	330	318	313	308	316	325	313	301
Commutes	**26.1**	**26.4**	**26.9**	**27.7**	**28.1**	**27.0**	**26.7**	**26.2**	**26.9**	**27.6**	**26.6**	**25.6**

- Transformer fails >60 kVA in Union City before adding EVs
- Nightly capacity surplus enough for 25.6 additional commutes
- Realistic opportunity will *balance load control and upgrades*

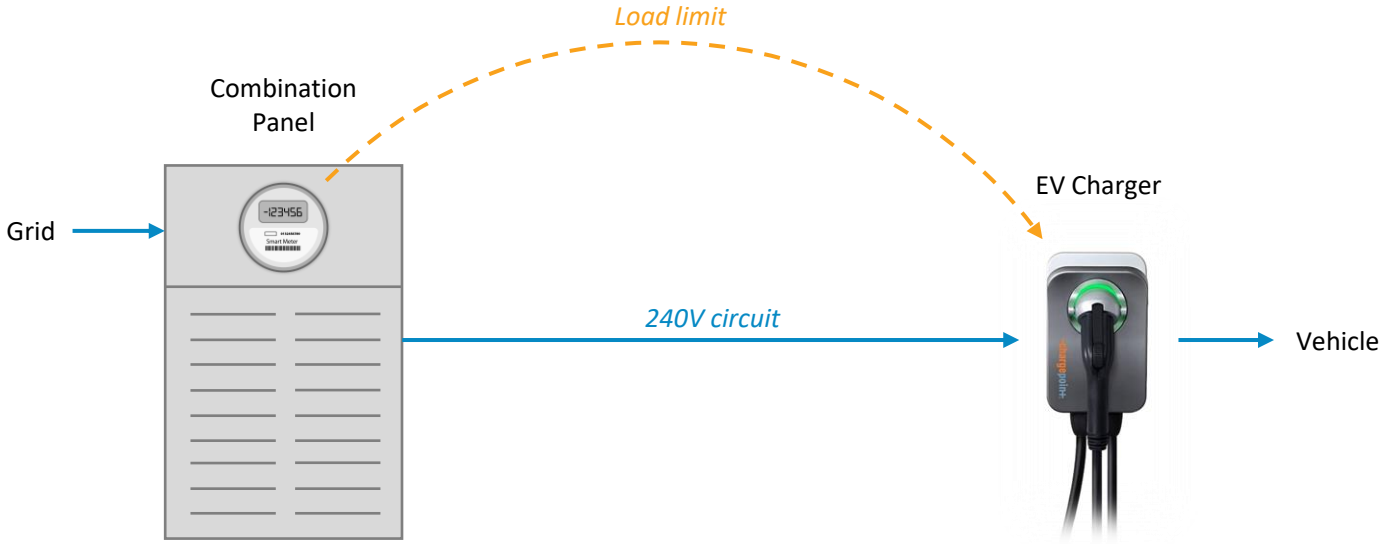
Success: Connect EV customers for <$1,000 within 1 month

POTENTIAL PATH



Integrated customer tools + technology can enable electrification

CONCEPTUAL SOLUTION



Meter

1. Store config from head end
2. Read site load
3. Read transformer load
4. Calculate load limit
5. Post load limit

Communications

1. Establish secure link
2. Transfer load limit

Charger

1. Poll load limit
2. Adjust output to under limit
3. Default to safe load if comms lost

Note: Charger for illustrative purposes only

Thank You

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