Fort Collins Utilities
Peak Partners programs

The (Ongoing) Journey from DERMS to Regional VPP

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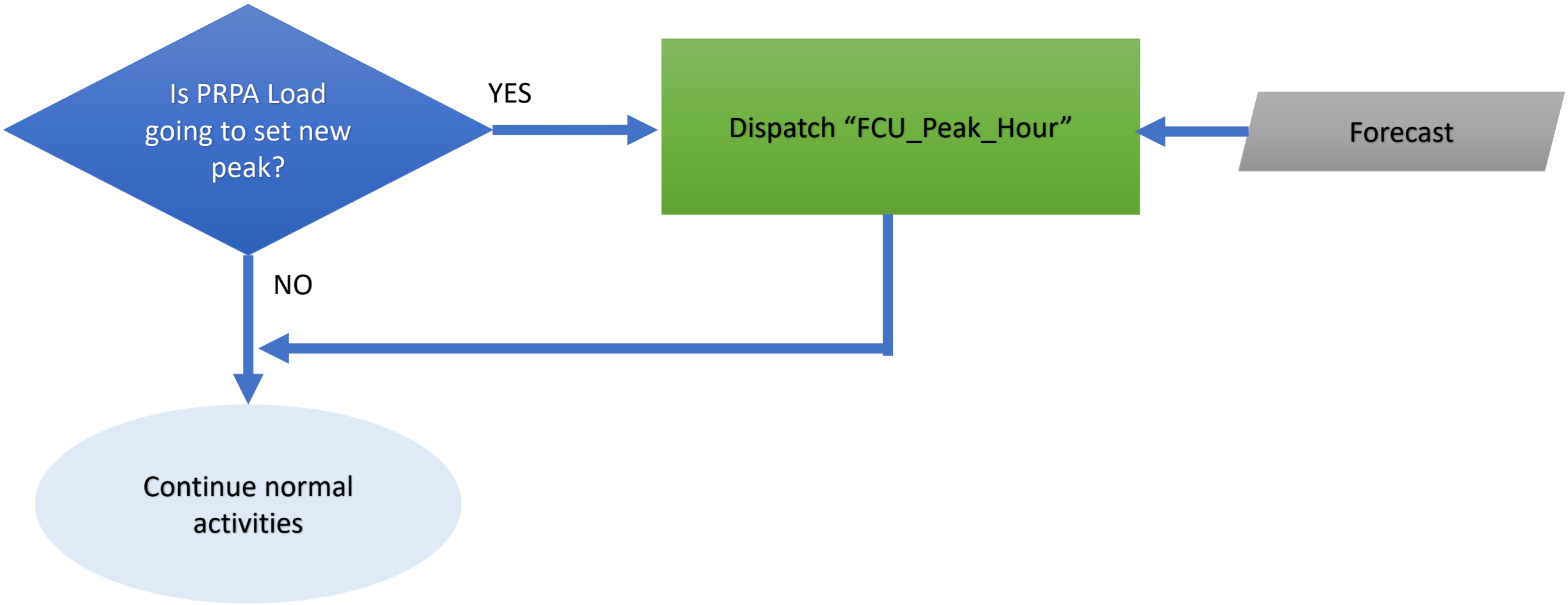
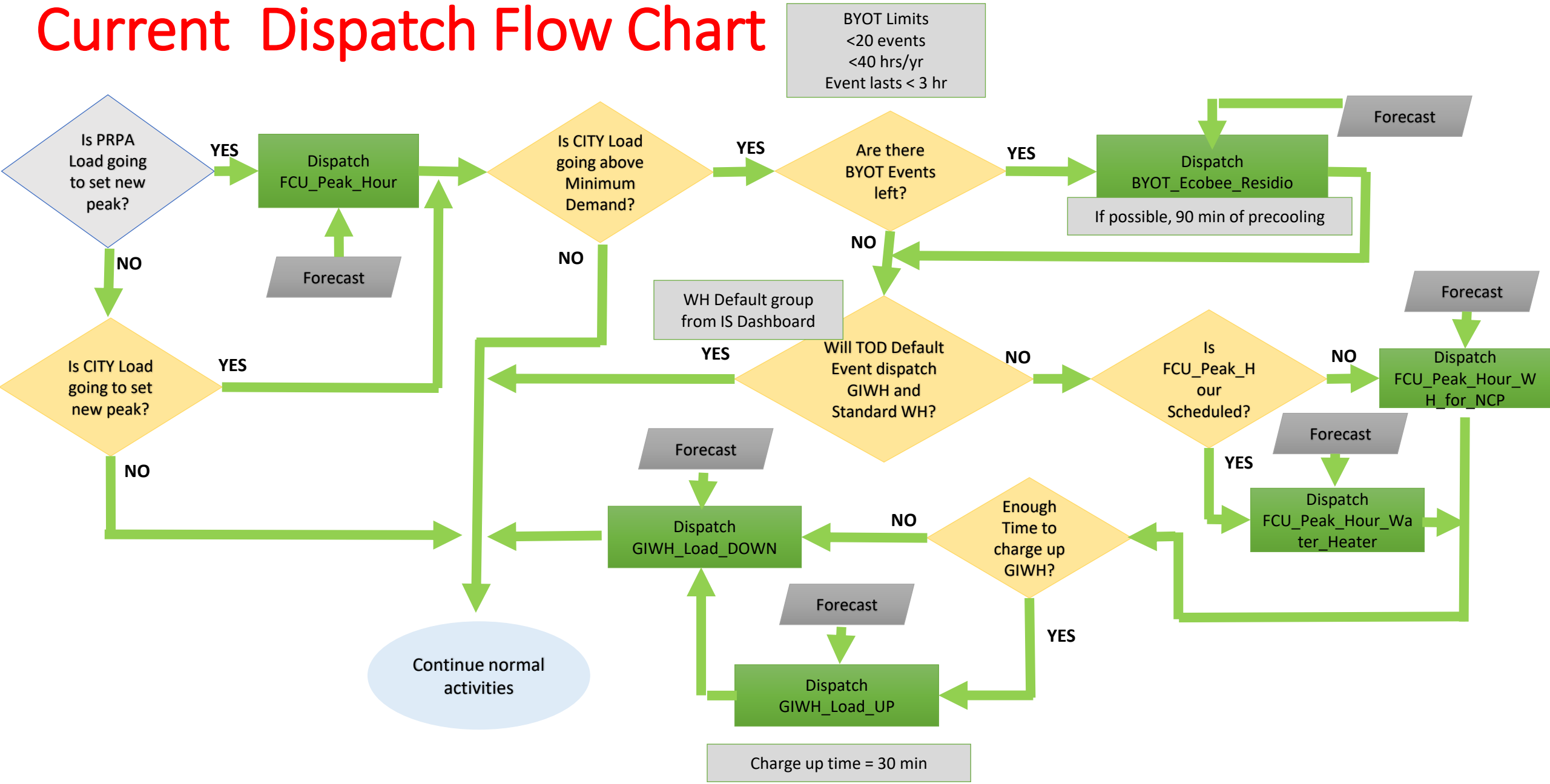
How we got here

- 1982-2000s
  - “Hot Shot” program for electric water heaters (one-way radio)
  - PRPA Demand Ratchet Savings (winter peaking)
- 2000s-2013
  - “Load Management” program for water heaters and HVAC (one-way radio)
  - PRPA Coincident Peak Savings (summer peaking)
- 2013-onwards
  - “Peak Partners” program for BTM resources
  - DERMS (IntelliSOURCE, originally Comverge now Itron)
  - PRPA Coincident Peak Savings
  - Grid flexibility services available now for upcoming organized market

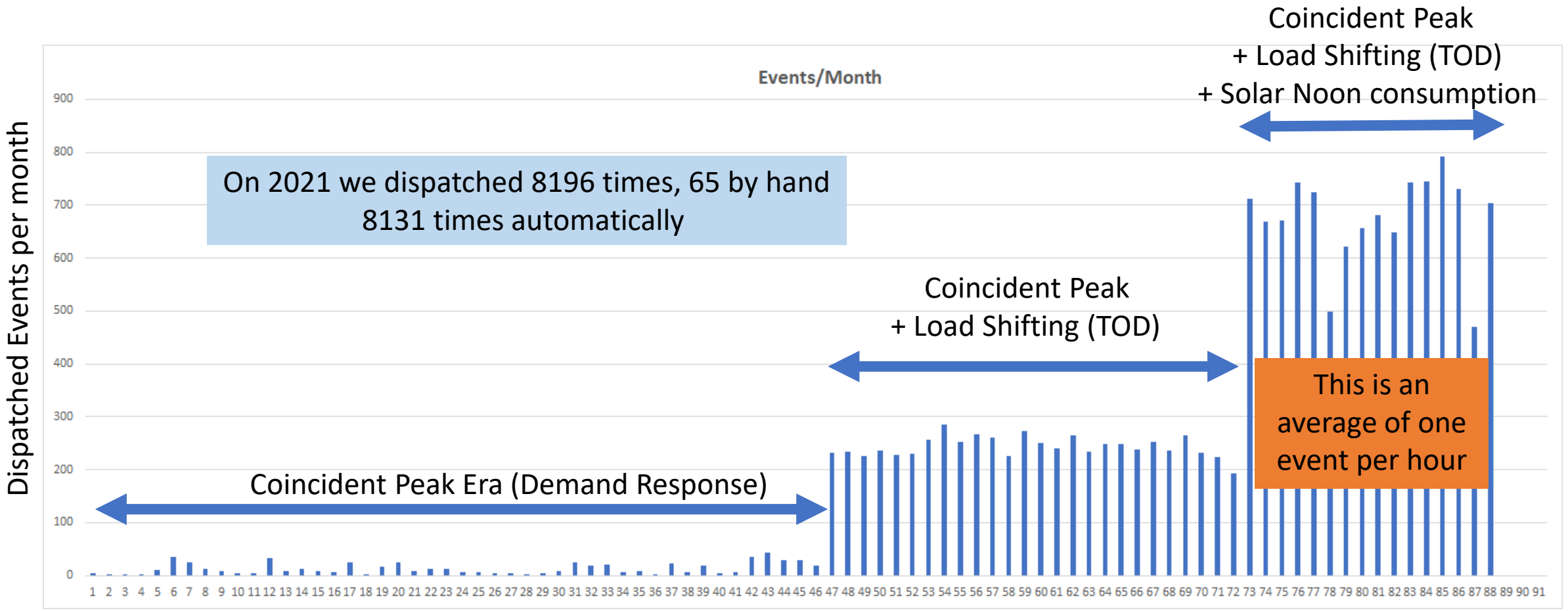
Old Flow Chart for Dispatch



Current Dispatch Flow Chart



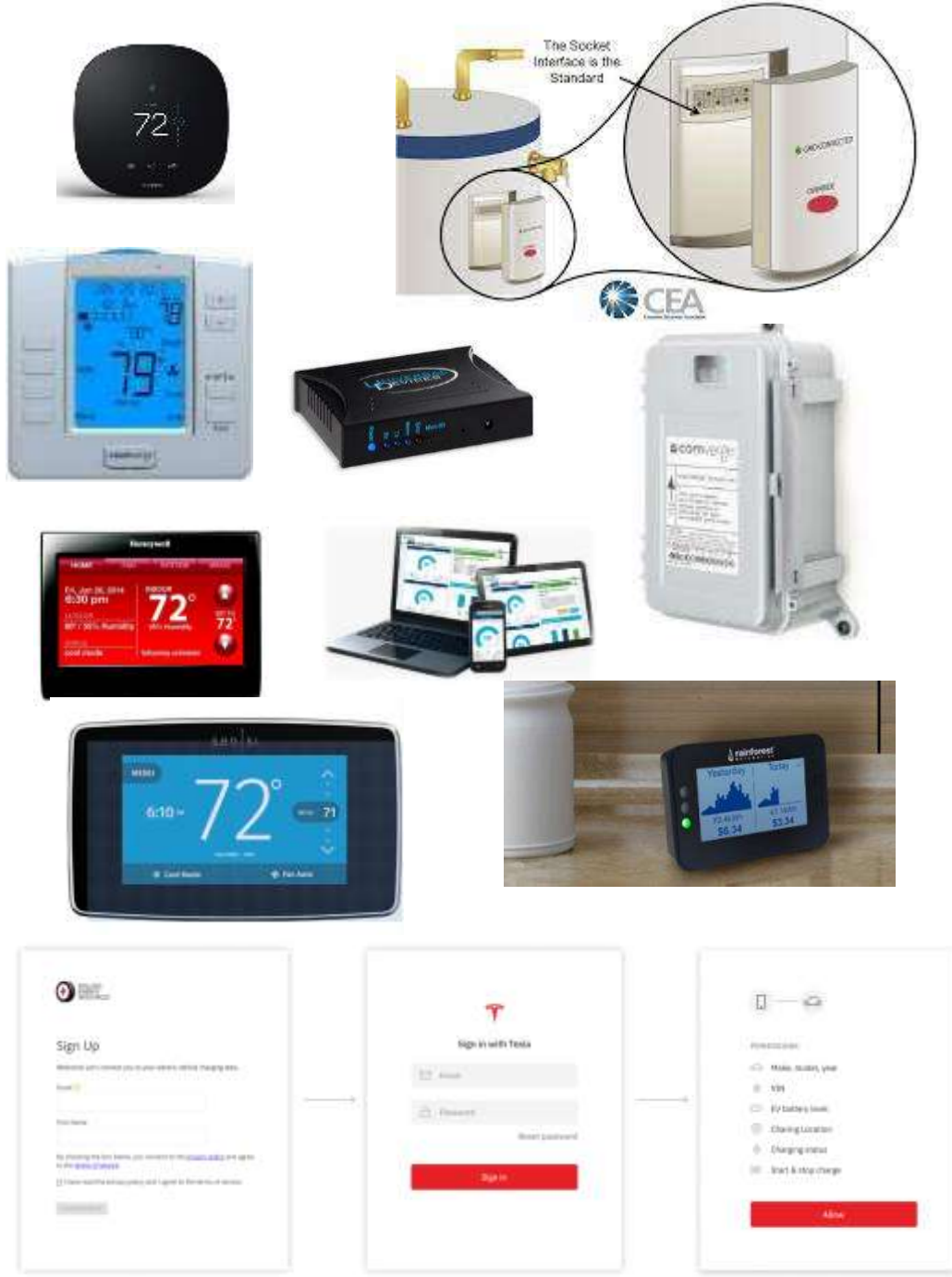
Evolution of IntelliSOURCE use frequency



2015 Oct 2018 Nov 2020 Mar 2022

Peak Partners Programs

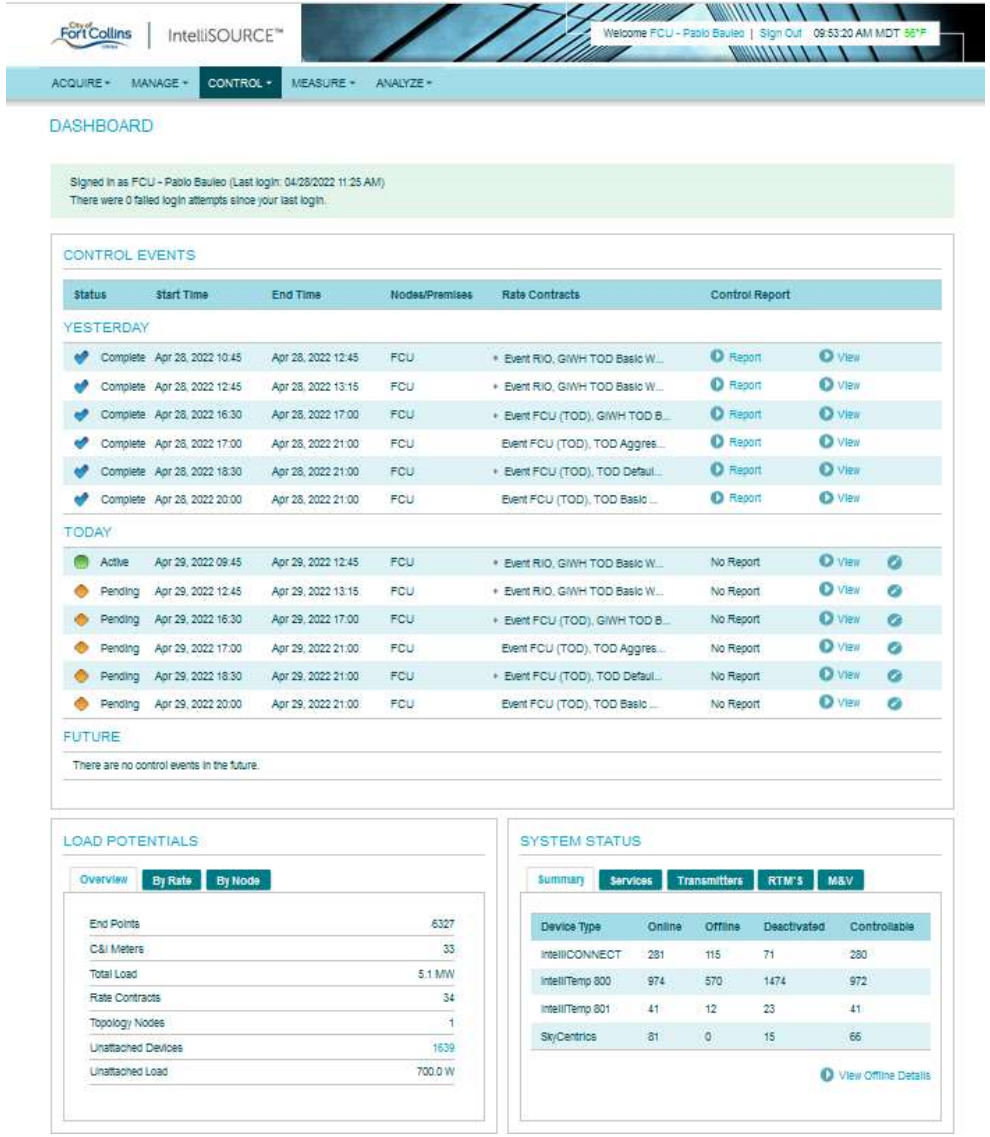
- Equipment/Interfaces
  - Wi-Fi thermostats
    - Direct Install and BYOT
  - Standard Electric water heaters
  - Grid Interactive Water Heater (Thermal Storage)
    - CTA-2045
  - Electric Vehicles (Charge Management)
  - OpenADR
    - Commercial & Industrial
  - IEEE 203.5 (offer in BFO 23-24)
    - Batteries and PV inverters
- About 3,500 homes and 7 large commercial
- -1.8/+2.4 MW of effective capacity
- Current functions
  - CP/NCP savings –impacted by MBD-
  - TOD Load shifting
  - Solar noon consumption



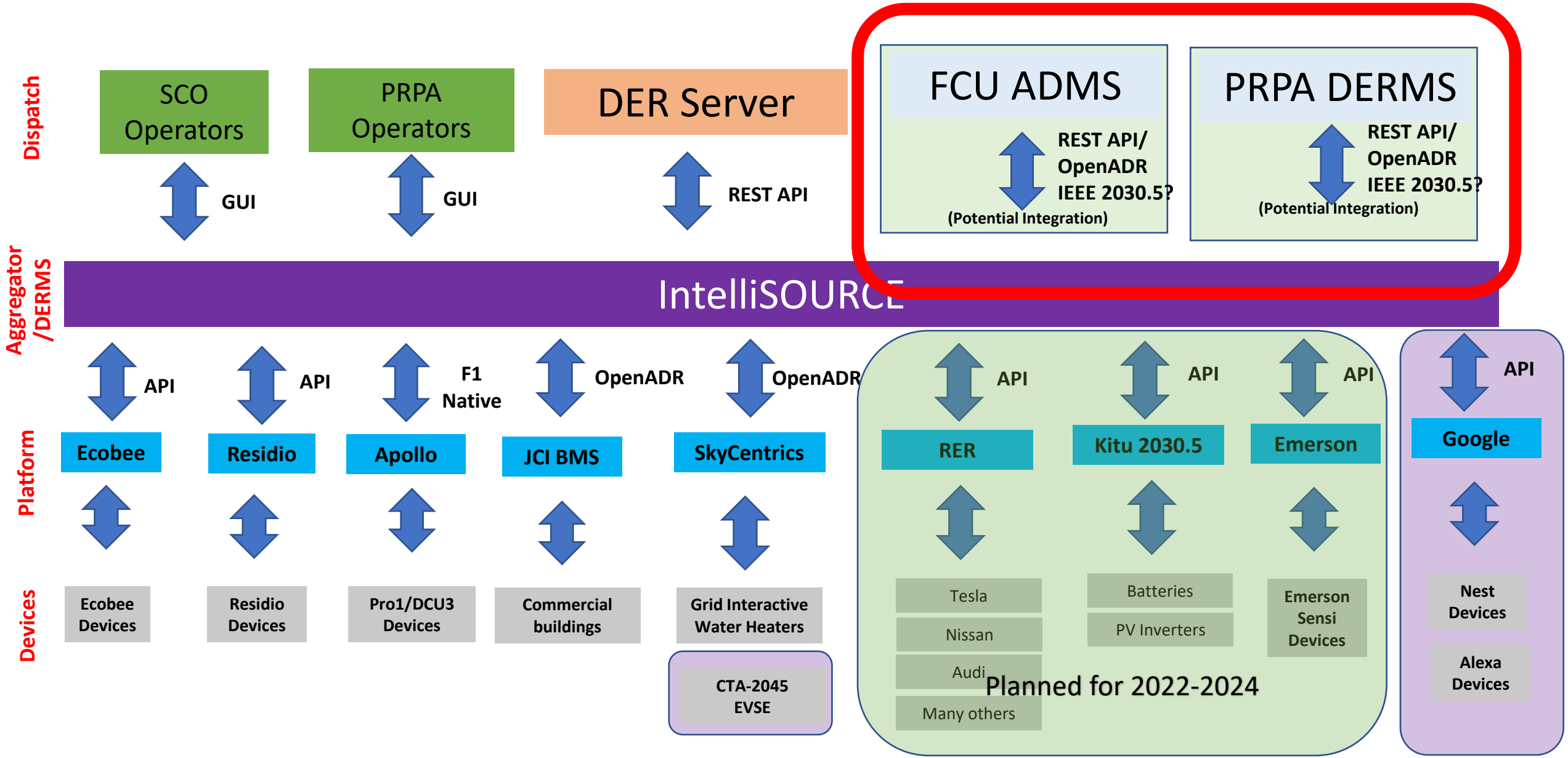
IntelliSOURCE (DERMS for Distribution Utilities)

IntelliSOURCE provides

- Work Orders: Installs, Repair, etc
- Inventory Management
- Auto-enrollment portal
- Case management
- Command and Control
- Two-way communication
    - Wi-Fi Thermostats (DI/BYOT)
    - Standard Water Heater
    - Grid Interactive Water Heaters
    - EV Telematics
- Forecast (load and resources)
- Monitoring and Verification

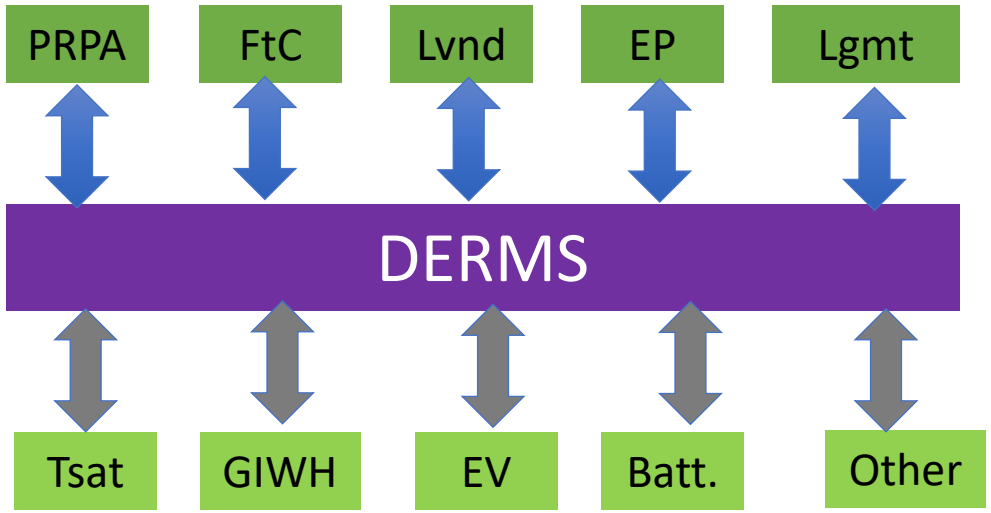


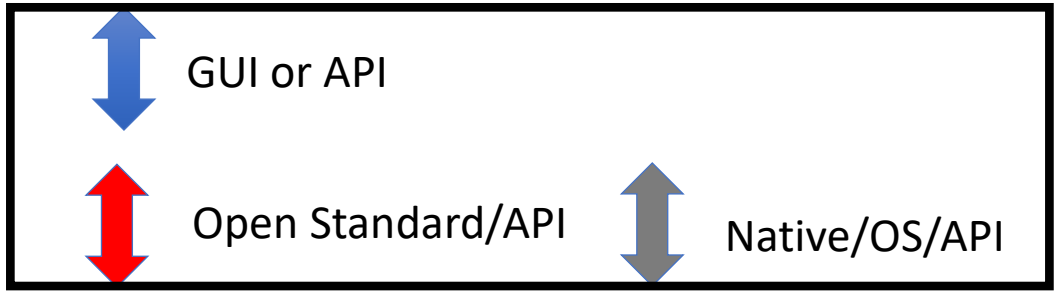
IntelliSOURCE - System Architecture



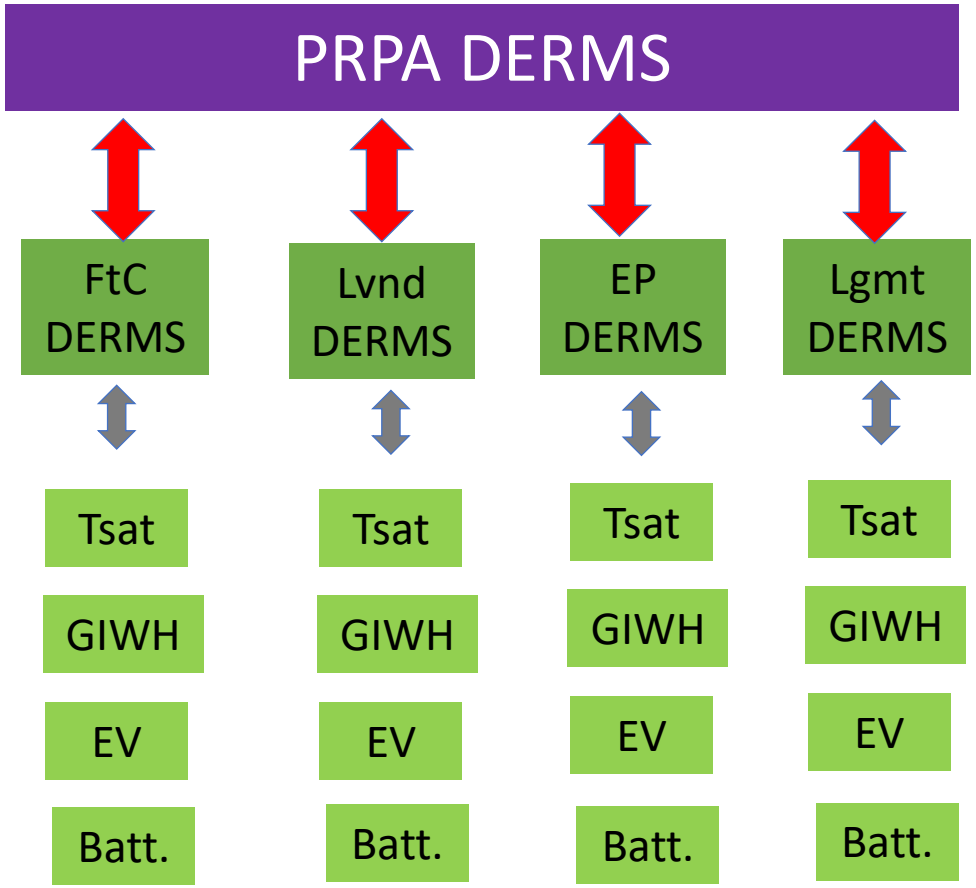
Some options on a regional DERMS/VPP

- All 5 Utilities with a single DERMS





Combination of DERMS



Thank you!

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Extra slides for general discussion

Future State

We anticipate integrated market in place

We anticipate renewable balancing will be needed

- System-wide (via EIM)
- Locally (duck curve in some feeders)

PRPA is planning a DERMS

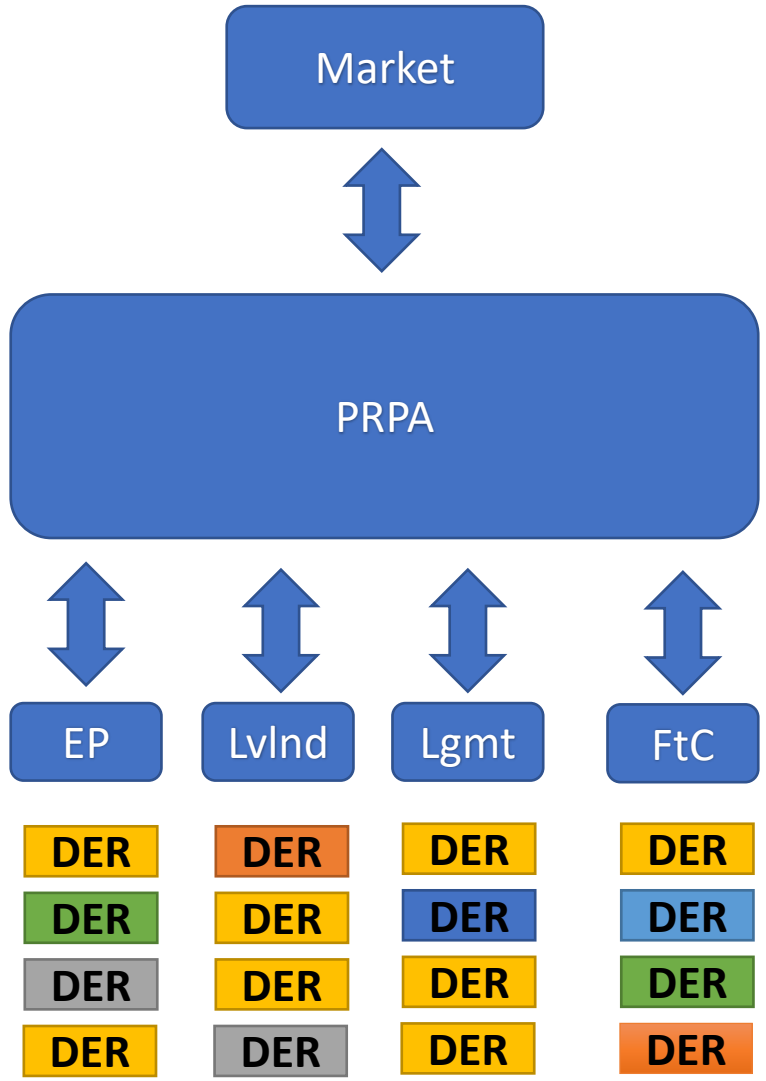
- Sister cities status is uncertain at this point

Opportunities

- Market participation by customers
- Integrated operations w/PRPA
- Lower (zero) carbon

Challenges

- DERMS/ADMS integrations (technical challenge)
- Hierarchical shared DER (who can call and when)
- Wholesale/retail rates mismatch



Different DER colors represent different types like EV, Tstat, GIWH, PV, Batteries, etc

Future State (detail)

Integrations will be needed across systems

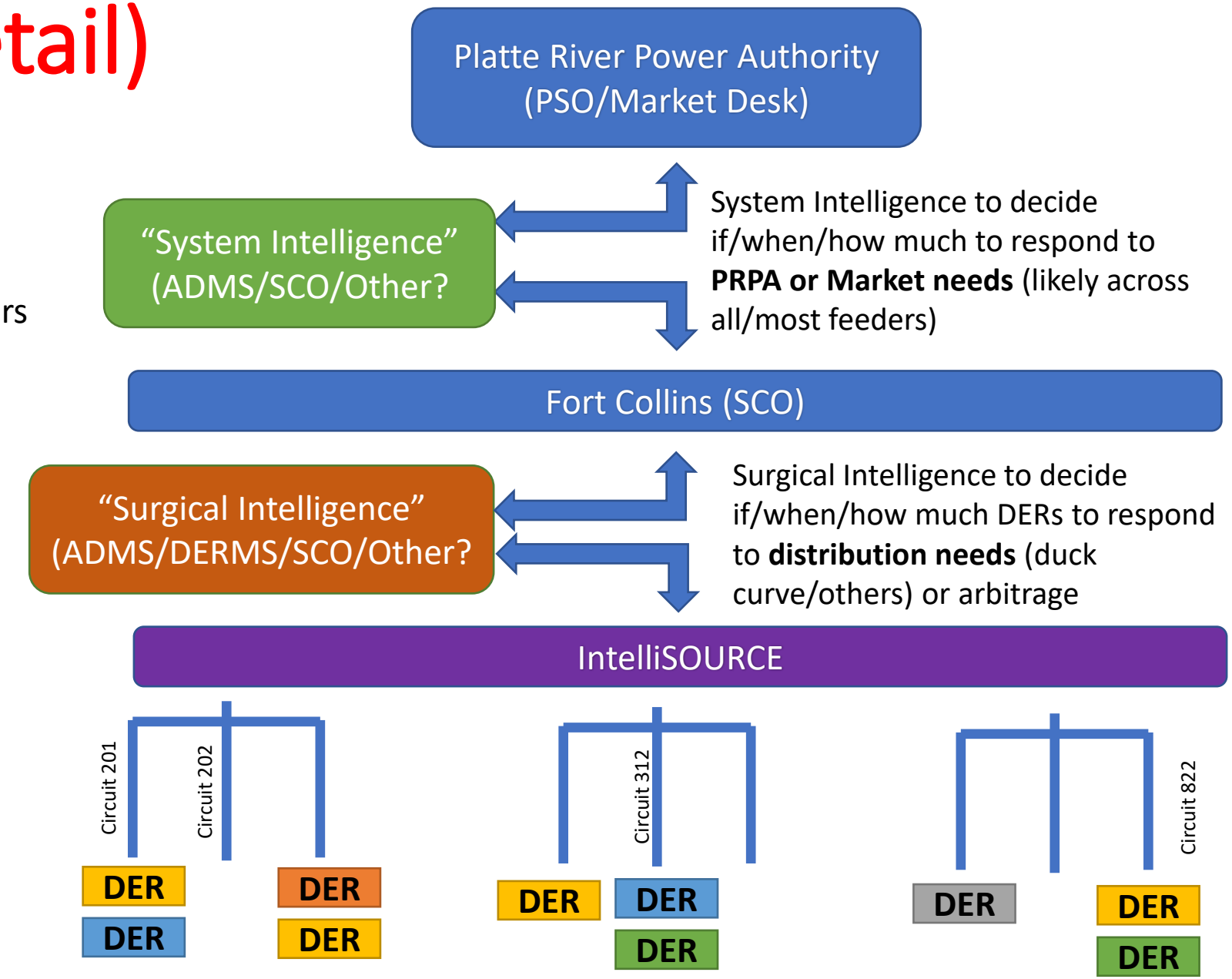
Intelligence (analytics) will be required

- Supervision of –some- decisions by operators
- Automation of dispatch for known cases

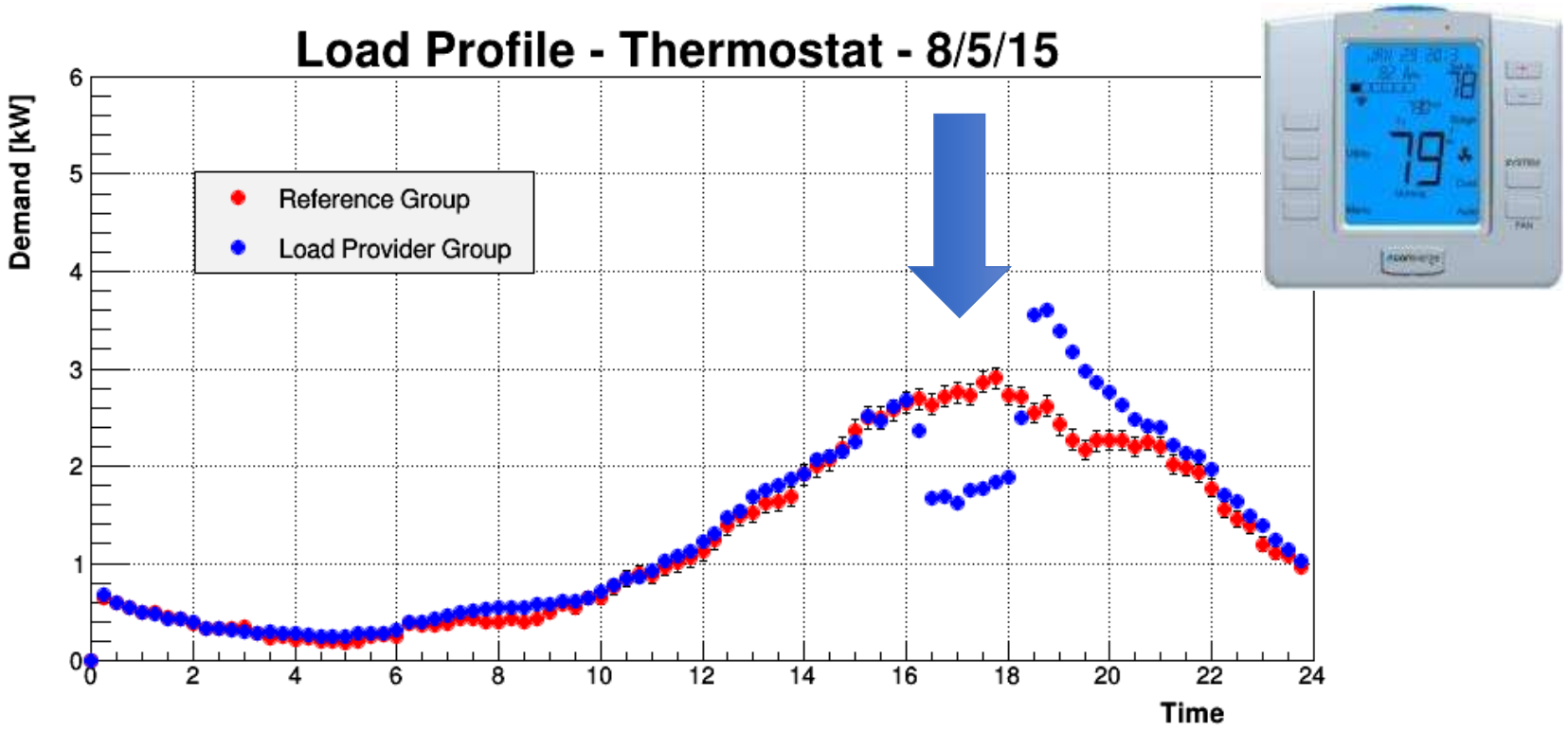
Expected use cases (not exhaustive)

- PRPA will want to increase/decrease usage across all feeders
  - FCU will respond with selected feeders depending on feeder conditions

- FCU will want to increase/decrease usage across selected feeders (or all)
  - Wholesale/Retail arbitrage
  - Duck curve
  - Underutilized DG (duck curve)



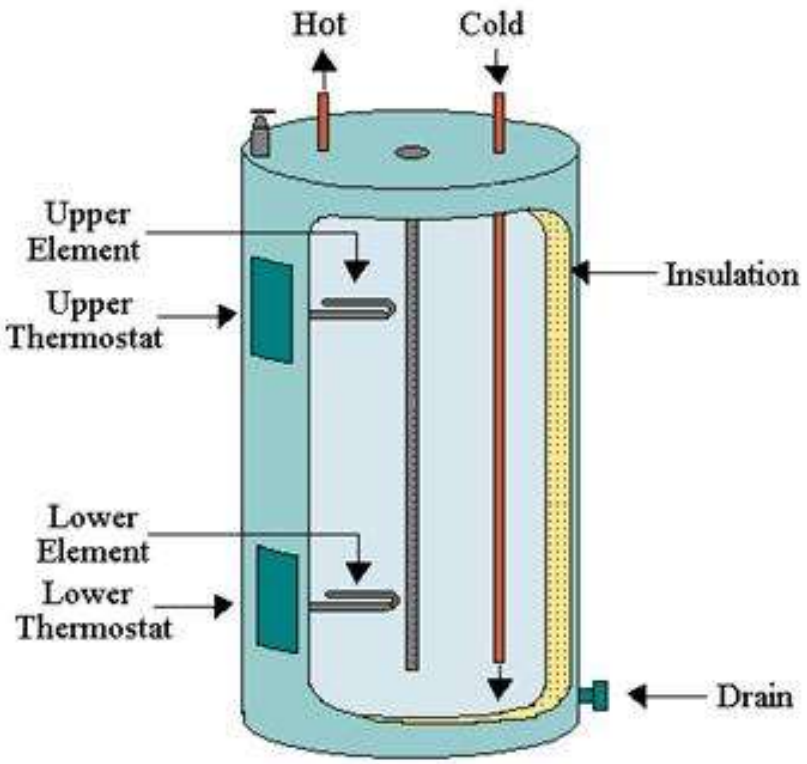
Thermostat Performance



Using AMI data for M&V – Average performance 1.3 kW/device

Total energy use for both groups is similar within 1%

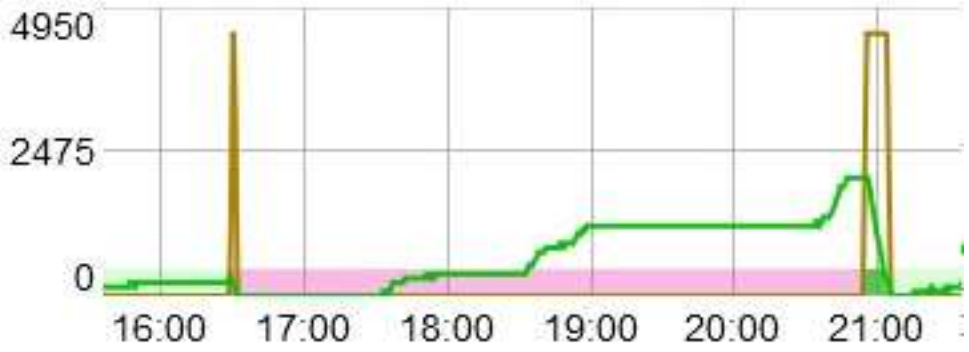
Electric Water Heaters and thermostat dead bands



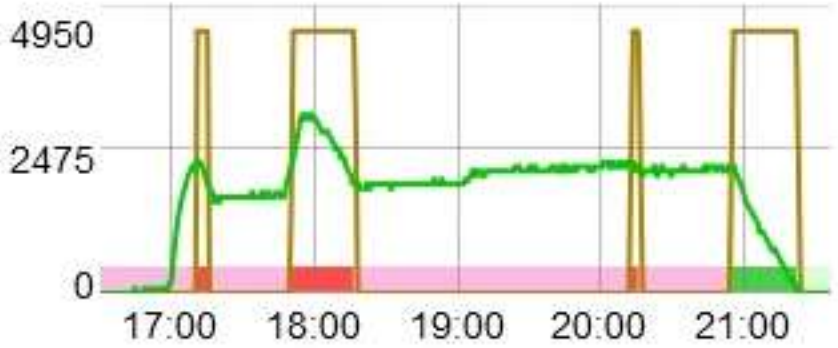
Electric Water Heater - Storage Type

- The water cools down before upper/lower elements kicks-in
  - It could be up to 10 deg F before kicks-in
- A less than 120F water heater has “capacity”
  - How much energy can be “stored” to reach 120F
- **G**rid **I**nteractive **W**ater **H**eater (GIWH)
  - Can “turn on” within the dead-band → “charge up”
  - Can “turn off” outside the dead band → “curtail”
  - Can “turn on” if about to run out of hot water
    - → unless grid emergency conditions

Individual GIWH Behavior During Events



- On-Peak Period from 17:00 to 21:00
- WH charged up at 16:30
- Water consumption during event
- WH fully charged up at 21:00
  - Shifted load about 2 kWh



» On-Peak Period from 17:00 to 21:00

» WH partial charges at 17:10 to 17:15; 17:45 to 18:15 and 20:15 to 20:20

» WH fully charge up at 21:00

- On-Peak consumption, about 1 kWh
- Off-Peak consumption, about 2 kWh
- Shifted load about 1 kWh

Hot water was available always