ALR RS1EV Study - FPLNW Installation Issue Analysis

Executive Summary

The ALR (Automated Load Research) system is experiencing **two distinct but related issues** with FPLNW (FPL Northwest) EV customer data in the RS1EV rate study. Both issues are likely caused by **problems in how meter/device changes are handled** in the EV data fetch queries.

Problem Statement

Issue #1: Significant Drop in Customer Count

Month	Customer Count	Change
April 2025	101	-
May 2025	57	↓44%
June 2025	33	↓42%
July 2025	27	↓18%
Aug-Oct 2025	34	stable
November 2025	40	slight increase

Expected Behavior: The rate study should be *increasing*, not decreasing in total customers.

Issue #2: Interval Data Stops After Device/Meter Changes

- When an EV device/meter is changed (replaced) for an FPLNW installation, the interval data **stops being fetched**
- Example: Customer 70003417 had interval data until device change on 11/18/25, then no data
- Pattern observed: **Every time there is a meter change, interval data stops**

Root Cause Analysis

The Core Problem: Time-Bounded Join Conditions

The SQL queries that fetch EV interval data use **time-bounded joins** between:

1. `ev_read_hist` (interval readings)
2. `ev_charge_box` (device/meter information)
3. `ev_site` (site/premise information)

Critical Join Condition in the interval data query:

```sql
JOIN billing_fpl_fplnw_consolidated.ev_charge_box CB
  on RH.charge_box_id = CB.charge_box_id
  and CB.connector_id = RH.connector_id
  AND CB.site_pk = RH.site_pk
  AND RH.read_strt_dttm BETWEEN CB.efct_strt_dttm AND CB.efct_end_dttm
```

What Happens When a Meter Changes

When an EV device is replaced:

1. **Old device record**: `efct_end_dttm` is set to the change date
2. **New device record**: `efct_strt_dttm` is set to the change date with a new `charge_box_id`

The Problem:

- Interval readings (`ev_read_hist`) continue to reference the **old** **`charge_box_id`**
- The join fails because:
  - Old device's `efct_end_dttm` has passed
  - New device has a different `charge_box_id` that doesn't match readings

Similar Issue in Meters Query (Process Order 6)

The meters definition query also has restrictive filters:

```sql
WHERE asset_status = 'Asset In-Service'
  AND sub_comp_cd = 1500
```

When a device is changed:

- Old device may no longer be "Asset In-Service"
- New device might not have proper `sub_comp_cd` set
- This causes the meter to not appear in the meters list

Why Both Issues Are Related

Issue #1 Cause (Customer Count Drop)

The `study_premise` table for rate studies pulls premises based on:

1. Matching ratecode
2. Having valid meter data
3. Passing validation checks

When meters aren't properly recognized due to device changes:

- Premises fail validation (logged in `error` table)
- They're excluded from the customer count
- The Study_Validation document confirms: *"We can see a high number of premises in the error table for FPLC-RS1EV... They are only failing because of something wrong in the code"*

Issue #2 Cause (No Interval Data)

The interval data fetch query (`mass_market_not_nm`, process order 13) requires:

```
sql

RH.read_strt_dttm BETWEEN CB.efct_strt_dttm AND CB.efct_end_dttm
```

After a device change:

- Historical readings still have the old `charge_box_id`
- The old device record has `efct_end_dttm` = change date
- Readings after the change don't match the new device's `charge_box_id`

Technical Details

Data Flow Architecture

```
Source Tables                ALR Processing                Output
─────────────────────────    ──────────────────────────    ──────────────

ev_site              →   meters (process 6)       →   study_premise
ev_charge_box        →   mass_market (process 12/13) →   fetch_results
```

```
ev_read_hist          →  validations          →  premise_usage
ev_trans_detail_fact  →  automatic_switching  →  active_premise
                      →  error
```

Key Tables Involved

Table	Purpose	Issue Impact
`ev_charge_box`	EV device/charger info with effective dates	Device changes create new records
`ev_read_hist`	Interval readings linked to `charge_box_id`	Readings may reference old device ID
`ev_site`	Site/premise mapping	Links devices to locations

Recommended Fixes

Option 1: Modify the Interval Data Join Logic

Current problematic pattern:

```sql
AND RH.read_strt_dttm BETWEEN CB.efct_strt_dttm AND CB.efct_end_dttm
```

Suggested fix approach: Instead of joining directly on `charge_box_id` with time bounds, join through `site_pk` and aggregate readings for all devices at that site:

```sql
-- Join on site_pk rather than requiring charge_box_id match
JOIN billing_fpl_fplnw_consolidated.ev_charge_box CB
  ON CB.site_pk = RH.site_pk
  AND CB.connector_id = RH.connector_id
  AND RH.read_strt_dttm BETWEEN CB.efct_strt_dttm AND CB.efct_end_dttm
```

Or use a more permissive approach that captures all readings for a site regardless of device changes.

Option 2: Fix the Meters Query Filter

Current:

```sql
```

```
WHERE asset_status = 'Asset In-Service' AND sub_comp_cd = 1500
```

Consider adding:

- Include recently decommissioned devices (for historical data)
- Handle null `sub_comp_cd` values for certain meter types

Option 3: Add Device Change Tracking

Create a mapping table that tracks device succession:

```
sql

old_charge_box_id → new_charge_box_id → site_pk → effective_date
```

This allows readings with old device IDs to be properly attributed after changes.

Verification Steps

1. **Query the error table** for FPLC-RS1EV to see specific error codes
2. **Check** `ev_charge_box` for the affected installations to see device change patterns
3. **Compare** `ev_read_hist.charge_box_id` vs current `ev_charge_box` records
4. **Verify timing** - the drop started May 2025, check what changed in source data then

Diagnostic Queries to Run

```
sql
```

```sql
-- Check errors for RS1EV study
SELECT errorcode, errormessage, COUNT(*)
FROM clr.error
WHERE studyid = 'FPLC-RS1EV'
GROUP BY errorcode, errormessage;

-- Check device changes for affected installations
SELECT site_id, charge_box_id, efct_strt_dttm, efct_end_dttm, asset_status
FROM billing_fpl_fplnw_consolidated.ev_charge_box cb
JOIN billing_fpl_fplnw_consolidated.ev_site s ON cb.site_pk = s.site_pk
WHERE s.site_id IN (/* affected installation numbers */)
ORDER BY site_id, efct_strt_dttm;

-- Check for orphaned readings after device change
SELECT RH.charge_box_id, COUNT(*) as reading_count, MIN(read_strt_dttm), MAX(read_strt_dttm)
FROM billing_fpl_fplnw_consolidated.ev_read_hist RH
LEFT JOIN billing_fpl_fplnw_consolidated.ev_charge_box CB
  ON RH.charge_box_id = CB.charge_box_id
  AND RH.read_strt_dttm BETWEEN CB.efct_strt_dttm AND CB.efct_end_dttm
WHERE CB.charge_box_id IS NULL
GROUP BY RH.charge_box_id;
```

Summary

Issue	Root Cause	Impact
Customer count drop	Meter data unavailable due to device change handling	Premises fail validation, excluded from study
No interval data after meter change	Time-bounded joins fail when `charge_box_id` changes	Historical and new readings not fetched

Primary fix needed: Modify the EV interval data fetch queries (process orders 12 & 13 in `fpl_daily.json`) to handle device changes by joining through `site_pk` rather than requiring exact `charge_box_id` matches with strict time bounds.