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 caused by **problems in how meter/device changes are handled** in the EV data fetch queries in `gulf_daily.json` (the config file used for FPLNW).

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 in `gulf_daily.json`

The SQL queries in `gulf_daily.json` (process orders 5 and 8) that fetch EV data use **restrictive joins** that break when devices are changed.

Problem Area #1: Meters Query (Process Order 5)

```sql
-- From gulf_daily.json, meters query (EV portion)
SELECT ... FROM billing_fpl_fplnw_consolidated.ev_charge_box cb
JOIN billing_fpl_fplnw_consolidated.ev_site S
  ON cb.site_pk = S.site_pk
  AND cb.prod_id = S.prod_id
  AND S.crnt_row_flag = true
WHERE asset_status = 'Asset In-Service'
  AND sub_comp_cd = 1600   -- FPLNW uses 1600, FPL uses 1500
```

Issue: When a device is replaced:

- The OLD device's `asset_status` may change from "Asset In-Service"
- The NEW device might have different/missing `sub_comp_cd` initially
- Result: **Meter doesn't appear in the meters list → premise fails validation**

Problem Area #2: Interval Data Query (Process Order 8 - `mass_market_gulf`)

```sql
-- From gulf_daily.json, mass_market_gulf query (EV portion)
SELECT ... FROM billing_fpl_fplnw_consolidated.ev_read_hist RH
JOIN billing_fpl_fplnw_consolidated.ev_site S
  ON RH.site_pk = S.site_pk
  AND RH.prod_id = S.prod_id
  AND S.crnt_row_flag = TRUE
JOIN billing_fpl_fplnw_consolidated.ev_charge_box CB
  ON RH.charge_box_id = CB.charge_box_id      -- ⚠️ PROBLEM: Requires exact match
  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  -- ⚠️ PROBLEM: Time-bounded
```

Issue: When a device is replaced:

1. **Old device record**: `efct_end_dttm` is set to the change date
2. **New device record**: Gets a NEW `charge_box_id`, `efct_strt_dttm` = change date

What breaks:

- Interval readings in `ev_read_hist` continue referencing the **OLD** **`charge_box_id`**
- The join on `RH.charge_box_id = CB.charge_box_id` fails because:
  - Old device: `efct_end_dttm` has passed (time bound fails)
  - New device: Different `charge_box_id` (ID match fails)
- Result: **No interval data returned for readings after the device change**

Why Both Issues Are Connected

The Chain of Failure:

```
Device Change Occurs
      ↓
Meters Query (Process 5) → Old meter filtered out by asset_status
      ↓                    New meter may have wrong/missing sub_comp_cd
Interval Query (Process 8) → Readings reference old charge_box_id
      ↓                      Time bounds exclude old device
                             New device ID doesn't match readings
Validation Process
      ↓
Premise fails: "NODATA" or "BILLDATA" error
      ↓
Written to error table, excluded from study
      ↓
Customer count drops
```

The Study_Validation document confirms this: *"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"*

Technical Details

Data Flow Architecture (FPLNW/Gulf)

```
Source Tables          ALR Processing          Output
```

```
ev_site          →  meters (process 5)      →  study_premise
ev_charge_box    →  mass_market_gulf (proc 8) →  fetch_results
ev_read_hist     →  validations             →  premise_usage
SAP HANA tables  →  mada (process 6)        →  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 with new IDs
`ev_read_hist`	Interval readings linked to `charge_box_id`	Readings continue to reference OLD device ID
`ev_site`	Site/premise mapping with `site_pk`	Could be used as stable join key

Key Difference: FPLNW vs FPL

- **FPL** uses `sub_comp_cd = 1500`
- **FPLNW** uses `sub_comp_cd = 1600`

Recommended Fixes

Fix 1: Modify the Interval Data Join Logic (Process Order 8)

Current problematic join:

```sql
JOIN ev_charge_box CB
  ON RH.charge_box_id = CB.charge_box_id  -- Requires exact ID match
  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
```

Suggested fix - Join through site_pk instead:

```sql
```

```
JOIN ev_charge_box CB
  ON CB.site_pk = RH.site_pk            -- Join by site, not device ID
  AND CB.connector_id = RH.connector_id
  AND RH.read_strt_dttm BETWEEN CB.efct_strt_dttm AND CB.efct_end_dttm
```

Or even simpler - remove the time constraint for the ID join:

sql

```
JOIN 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
  -- Remove: AND RH.read_strt_dttm BETWEEN CB.efct_strt_dttm AND CB.efct_end_dttm
```

Fix 2: Modify the Meters Query Filter (Process Order 5)

Current:

sql

```
WHERE asset_status = 'Asset In-Service' AND sub_comp_cd = 1600
```

Suggested - Include recently changed devices:

sql

```
WHERE (asset_status = 'Asset In-Service'
      OR (asset_status = 'Asset Removed' AND efct_end_dttm >= CURRENT_DATE - INTERVAL '90 days'))
  AND sub_comp_cd = 1600
```

Or better yet, ensure ALL devices for a site are returned:

sql

```
WHERE sub_comp_cd = 1600
  AND efct_end_dttm >= 'fetch_from_date'  -- Include any device active during fetch period
```

Fix 3: Alternative - Use Site-Level Aggregation

Instead of joining at the device level, aggregate readings at the site level:

sql

```sql
SELECT
  S.site_id as premiseid,
  'evmeter' as metertype,
  RH.read_strt_dttm,
  SUM(CASE WHEN lower(uom) = 'wh' THEN mrdg/1000 ELSE mrdg END) as mrdg,
  S.site_id as meterid,  -- Use site_id instead of charge_box_id
  1000 as channel,
  'kwh' as uom,
  15 as spi
FROM billing_fpl_fplnw_consolidated.ev_read_hist RH
JOIN billing_fpl_fplnw_consolidated.ev_site S
  ON RH.site_pk = S.site_pk
  AND RH.prod_id = S.prod_id
  AND S.crnt_row_flag = TRUE
WHERE lower(uom) in ('kwh','wh')
  AND rh.read_strt_dttm >= '{0}'::timestamp
  AND rh.read_strt_dttm <= '{1}'::timestamp + 1
  AND mrdg >= 0
GROUP BY S.site_id, RH.read_strt_dttm, uom
```

Diagnostic Queries to Run

sql

```sql
-- 1. Check errors for RS1EV study
SELECT errorcode, errormessage, COUNT(*)
FROM clr.error
WHERE studyid LIKE '%RS1EV%'
GROUP BY errorcode, errormessage
ORDER BY COUNT(*) DESC;

-- 2. Check device changes for FPLNW (sub_comp_cd = 1600)
SELECT s.site_id, cb.charge_box_id, cb.asset_status,
    cb.efct_strt_dttm, cb.efct_end_dttm, cb.sub_comp_cd
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 cb.sub_comp_cd = 1600
ORDER BY s.site_id, cb.efct_strt_dttm;

-- 3. Find "orphaned" readings (readings that won't join to current device records)
SELECT RH.charge_box_id, COUNT(*) as orphaned_readings,
    MIN(read_strt_dttm) as first_reading, MAX(read_strt_dttm) as last_reading
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
  AND RH.read_strt_dttm >= '2025-04-01'
GROUP BY RH.charge_box_id;

-- 4. Check specific affected installation (70003417)
SELECT s.site_id, cb.charge_box_id, cb.asset_status,
    cb.efct_strt_dttm, cb.efct_end_dttm
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 = '70003417'
ORDER BY cb.efct_strt_dttm;
```

Summary

Issue	Root Cause	Location	Impact
Customer count drop	`asset_status = 'Asset In-Service'` filter excludes changed devices	`gulf_daily.json` Process 5 (meters)	Premises fail validation

Issue	Root Cause	Location	Impact
No interval data after meter change	`charge_box_id` join + time bounds fail after device replacement	`gulf_daily.json` Process 8 (mass_market_gulf)	No readings fetched

Primary fix needed: Modify the EV queries in **`gulf_daily.json`** (NOT `fpl_daily.json`) to:

1. Join interval data through `site_pk` rather than requiring exact `charge_box_id` match with time bounds
2. Relax or remove the `asset_status = 'Asset In-Service'` filter for meters to include recently changed devices