



LEM Residential Data Dictionary PUBLIC

Cornwall Local Energy Market, Centrica plc

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Revision Control

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0	2020-11-23	David Kane	FINAL version, released to Dan Nicholls & David Parish at Centrica
1	2020-11-24	David Kane	FINAL version, remove confidentiality stamp, released to Dan Nicholls & David Parish at Centrica

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1. Introduction

This document summarises the datasets for the residential workstream of the Cornwall Local Energy Market [LEM] project, with several purposes;

- In the Data Dictionary section, the columns of each dataset are described
- In the Data Coverage Summary section, the coverage of datasets across the fleet is summarised
- In the Appendix A: PostgreSQL Create Code section, the CREATE scripts are provided for the database tables associated with each dataset

This document is intended for those who will manage and/or analyse the measurement, forecast and dimension datasets included in the dataset release.

This document complements the following documents:

- Description of residential metadata as captured in *“LEM Residential MetaData Summary Report”*
- Tables of daily data coverage per database table captured in *“LEM Resi Data Coverage.xlsx”*
- Tables of MetaData captured in *“LEM Resi MetaData Tables.xlsx”*

This document supports the analysis of site performance as presented in the document titled *“LEM Residential Fleet Self-Consumption Summary Report”*.

For a description of energy flows, refer to the document titled *“App & Meter Guidance for Cornwall LEM Residential Project Participants”*.

2. Data Dictionary

2.1 Overview

There are many datasets available, categorised as follows:

- Measurement Datasets
- Forecast Datasets
- Dimension Datasets

The **Measurement Datasets** include the following:

1. **t_msb1m: Sonnen data from MySonnenBatterie [MSB] portal, 1-min;** This consists of Energy and State of Charge data on a 1-minute basis, as calculated by the on-board energy manager within the Sonnen Battery controller from integration of 1-second power samples. The data is scraped from the MySonnenBatterie portal – which is accessible to consumers via a login – and is used to populate the Sonnen consumer smartphone app
2. **t_ims1m: Independent Monitoring System [IMS], 1-min;** This consists of Energy, Power, Grid Voltage, Grid Frequency & Grid Power on a 1-minute basis, as measured by an independent, multi-channel electrical meter using current transformers
3. **t_ims1s: Independent Monitoring System [IMS], 1-sec;** This consists of Power (PV, Grid, BESS) and Grid Frequency on a 1-second basis. This data is collected by an independent, multi-channel electrical meter using current transformers

The **Forecast Datasets** include the following:

1. **t_prodconsforecasts: Production & Consumption Forecasts from Sonnen, via Sonnen VPP;** These consist of average power values, per hour, for production & consumption. They are generated by Sonnen's consumer portal backend using historical averages for Consumption, and a mixture of historical averages and weather forecast data for Production. They were accessed by export from Sonnen's VPP
2. **t_weatherforecasts: Weather Forecasts from external provider, via Sonnen VPP;** This consists of hourly precipitation, solar irradiance and sunshine hours. The forecast are available at Post Code District level (i.e. TR12 3), and are typically updated twice per day (but this can vary between postcodes and over time)

There are several **Dimension Datasets**, as follows:

1. **t_sites: Site List;** This links the common site column (as used in all other tables), to BESS type BESS power/energy capacities, PV capacity and major load type
2. **Additional MetaData;** This consists of the metadata discussed in an accompanying report "*LEM Residential MetaData Summary Report*", where the schema for the Additional MetaData tables is captured in "*LEM Resi MetaData Tables.xlsx*". This MetaData is split by the time & means of data collection, as follows:
 - a. **Original Web Questionnaire;** completed by respondents from the original recruitment exercise - *results available for 66 sites*
 - b. **Desktop & Site Surveys, Design & System Costs;** completed by SunGift (Installation Contractor) on behalf of Sonnen (BESS Vendor) - *results available for 71 sites*
 - c. **Summary of EPC data;** data retrieved from the EPC register¹ completed by TLC - *results available for 75 sites*

¹ EPC Register (England & Wales), <https://www.epcregister.com/>, accessed October 2020

2.2 Measurement Datasets

2.2.1 *t_msb1m: Sonnen data from MySonnenBatterie [MSB] portal, 1-min*

The Sonnen MySonnenBatterie [MSB] Portal, 1-minute data table (t_msb1s) schema is presented in Table 1.

Value Name	Description	Unit	Example / Range
site	Unique, Anonymised Site ID	-	1, 2 ... 100
ts	Timestamp of reading	YYYY-MM-DD hh:mm:ss	2018-07-03 12:34:56. 123+0000
discharge_wh	The energy discharged from the battery	Wh	49983
charge_wh	The energy used to charge the battery	Wh	1234
consumption_wh	The energy consumption on the site	Wh	1234
production_wh	The energy from Solar PV system	Wh	1234
gridexport_wh	The energy exported to the grid	Wh	1234
gridimport_wh	The energy imported from the grid	Wh	1234
pvcharge_wh	The energy from Solar PV system that is diverted instantaneously to BESS charge	Wh	1234
pvcons_wh	The energy from Solar PV system that is used instantaneously for Consumption	Wh	1234
plexport_wh	The energy from Solar PV system that is spilled instantaneously to Grid Export	Wh	1234
griddischarge_wh	The energy from BESS discharge that is spilled instantaneously to Grid Export	Wh	1234
gridcharge_wh	The energy for BESS discharge that is supplied instantaneously by Grid Import	Wh	1234
gridcons_wh	The energy from Grid Import that is used instantaneously for Consumption	Wh	1234
consdischrge_wh	The energy from BESS Discharge that is used instantaneously for Consumption	Wh	1234
mismatch_wh	The energy mismatch from the above calculations (vs the “ground truth” of discharge, charge, consumption, production, gridexport, gridimport)	Wh	1234
soc	customer state of charge (this represents a restricted range (8%-100%, represented as 0%-100%) compared to absolute state of charge	%	78

Table 1: Sonnen MSB Portal 1-minute table schema (t_msb1s)

2.2.2 *t_ims1m: Independent Monitoring System [IMS], 1-minute data*

The Independent Monitoring System [IMS], 1-minute data table (t_ims1s) schema is presented in Table 2.

Value Name	Description	Unit	Example / Range
site	Unique, Anonymised Site ID	-	1, 2 ... 100
ts	Timestamp	YYYY-MM-DD hh:mm:ss	31/12/2018 23:59:00
gridimp_wh	Grid Import Active Energy	Wh	0 to 214783648
gridexp_wh	Grid Export Active Energy	Wh	0 to 214783648
bessimp_wh	BESS Charge Active Energy	Wh	0 to 214783648
bessexp_wh	BESS Discharge Active Energy	Wh	0 to 214783648
pvimp_wh	PV Generation Active Energy	Wh	0 to 214783648
pvexp_wh	PV StandBy Active Energy	Wh	0 to 214783648
majload_wh	Major Load Active Energy	Wh	0 to 214783648
grid_mv	Grid Voltage	mV	-250999 to 250999
grid_w	Grid Active Power	W	-30000 to 30000
bess_w	BESS Active Power	W	-30000 to 30000
pv_w	Solar PV Active Power	W	-30000 to 30000
majload_w	Solar PV Active Power	W	-30000 to 30000
grid_mhz	Grid Frequency	mHz	40000 to 59999
grid_mpf	Grid Power Factor	1/1000th's	-1000 to 1000

Table 2: IMS 1-minute table schema (t_ims1m)

2.2.3 *t_ims1s: Independent Monitoring System [IMS], 1-second data*

The Independent Monitoring System [IMS], 1-second data table (t_ims1s) schema is presented in Table 3.

Value Name	Description	Unit	Example / Range
site	Unique, Anonymised Site ID	-	1, 2 ... 100
ts	Timestamp	YYYY-MM-DD hh:mm:ss	31/12/2018 23:59:59
gridw	Grid Active Power	W	-30000 to 30000
bessw	BESS Active Power	W	-30000 to 30000
pvw	Solar PV Active Power	W	-30000 to 30000
gridhz	Grid Frequency	mHz	40000 to 59999

Table 3: IMS 1-second table schema (t_ims1s)

2.3 Forecast Datasets

2.3.1 *t_prodconsforecasts: Sonnen Production & Consumption Forecast data*

The Sonnen Production & Consumption forecasts table schema is presented in Table 4.

Value Name	Description	Unit	Example / Range
site	Unique, Anonymised Site ID	-	1, 2 ... 100
created_ts	The timestamp in UTC when this forecast was created	YYYY-MM-DD hh:mm:ss	2018-09-03 07:06:12
forecast_ts	The timestamp in UTC of the beginning of the forecast period	YYYY-MM-DD hh:mm:ss	2018-09-03 08:00:00
consumption	The forecast amount of consumption in Watts	W	501
production	The forecast amount of production in Watts	W	2069

Table 4: Sonnen Production & Consumption Forecasts table schema (*t_prodconsforecasts*)

2.3.2 *t_weatherforecasts: External Weather Forecast data captured by Sonnen*

The Sonnen Weather Forecasts table schema is presented in Table 5.

Value Name	Description	Unit	Example / Range
postcode	Post Code of the forecast, to the precision of district ²	-	TR12
created_ts	The timestamp in UTC when the forecast was fetched from the forecasting service	YYYY-MM-DD hh:mm:ss	2018-09-03 07:06:12
forecast_ts	The timestamp in UTC of the beginning of the forecast period	YYYY-MM-DD hh:mm:ss	2018-09-03 08:00:00
forecast_date	The date in UTC of the beginning of the forecast period	YYYY-MM-DD hh:mm:ss	2018-09-03
forecast_hour	The hour in UTC of the beginning of the forecast period	Hour	8
precipitation	The forecast amount of precipitation	mm	11
precipitation_probability	Precipitation probability	%	75
wind_direction	Wind direction in degrees. 0 is north, 90 is east, 270 is west.	°	342
wind_speed	The wind speed in knots.	kts	4
solar_radiation	Solar radiation in J/cm ²	J/cm ²	34
sunshine_duration	Sunshine duration in minutes	min	42

Table 5: Sonnen Weather Forecasts table schema (*t_weatherforecasts*)

² <https://www.mrs.org.uk/pdf/postcodeformat.pdf>

2.4 Dimension Datasets

2.4.1 *t_sites: Site List*

The IMS Site List (*t_sites*) table schema is presented in [Table 6](#).

Value Name	Description	Unit	Example / Options
site	Unique, Anonymised Site ID	-	1, 2 ... 100
besstype	BESS Type Eco 9.43 = ac-coupled, with existing Solar PV array + Inverter Hybrid 9.54 = dc-coupled, with new solar PV array	-	Eco 9.43, Hybrid 9.53
besskwh	BESS Energy Capacity	kWh	5, 7.5, 10
besskw	BESS Power Capacity	kW	2.5, 3.3
pvw	PV Power Capacity Eco 9.43: approximate ac-rating Hybrid 9.54: dc rating of Solar PV array	kW	0 to 4.6
postcode	Post Code of the forecast, to the precision of sector	-	TR12 3
majorload	Description of Major Electrical Load measured by IMS (as quantified by majload_wh and majload_w)	-	ASHP, GSHP, Night Storage Heater

Table 6: Site List table schema (*t_sites*)

2.4.2 *t_metadata: Additional MetaData by Site*

Please refer to the accompanying report “*LEM Residential MetaData Summary Report*” for a data dictionary of the metadata, and to the document “*LEM Resi MetaData Tables.xlsx*” for the schema for the Additional MetaData tables.

3. Data Coverage Summary

3.1 Row Count & Sizes

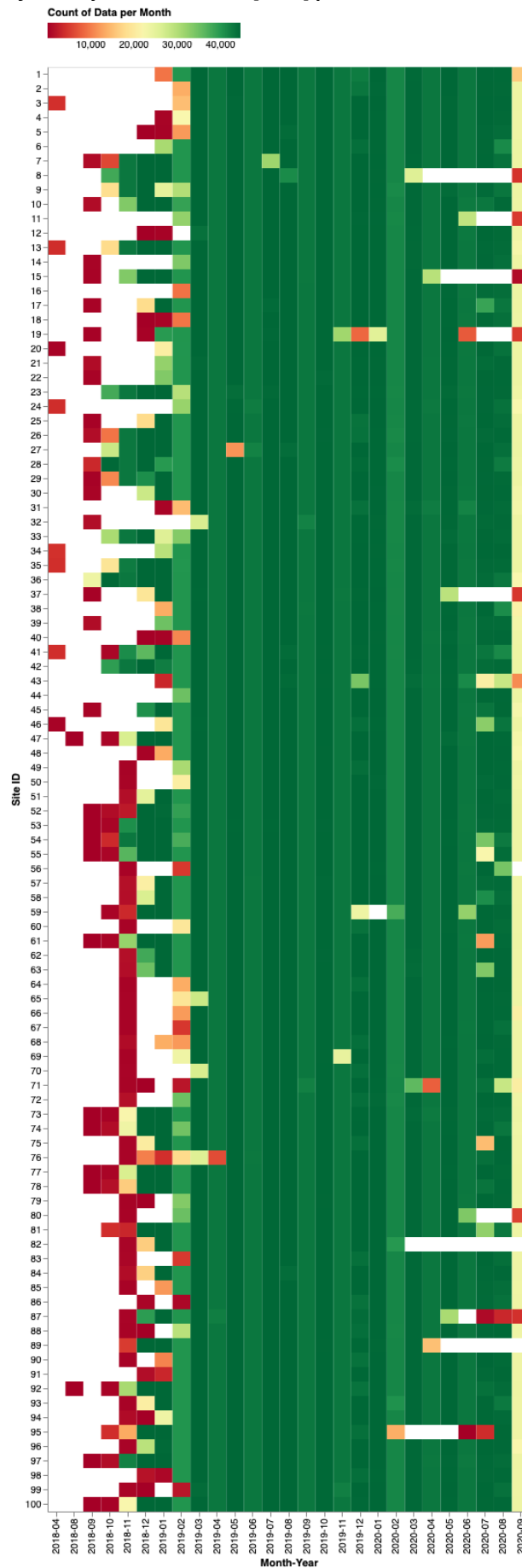
The row count, table size and compressed archive size for each table in the database schema is presented in Table 7.

Table Name	Row Count	Uncompressed Table Size Total (Data/Index)	Compressed Table Size Total	Compressed BZ2 Size
t_sites	100	3kB	-	-
t_ims1m	60,199,828	6.5GB (4.7/1.8GB)	0.6GB	0.6GB
t_ims1s	2,813,846,468	185GB (137/48GB)	9.1GB	13GB
t_msb1m	87,892,940	13GB (8.5/4.5GB)	1.9GB	5GB
t_prodconsforecasts	7,453,985	0.6GB (0.4/0.2GB)	112MB	28MB
t_weatherforecasts	5,677,882	0.6GB (0.4/0.2GB)	82MB	32MB

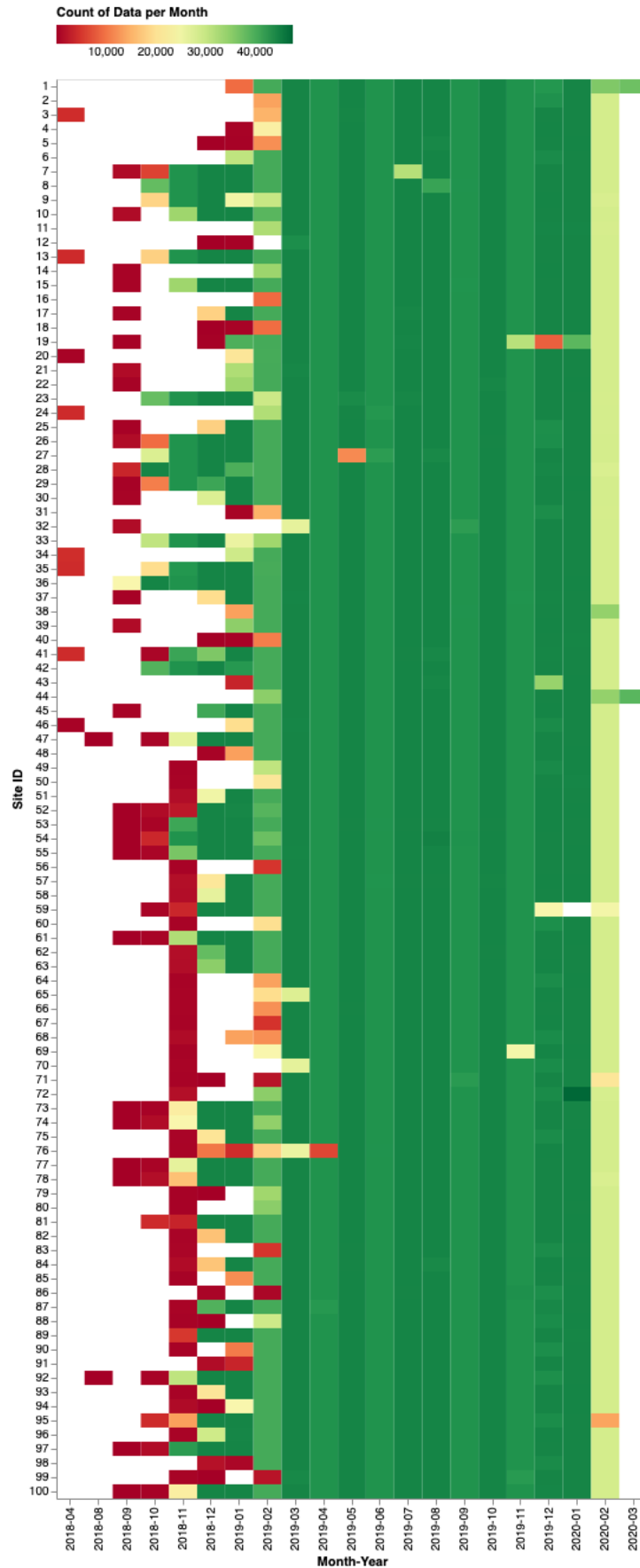
Table 7: table row counts & sizes

3.2 Coverage Heatmaps

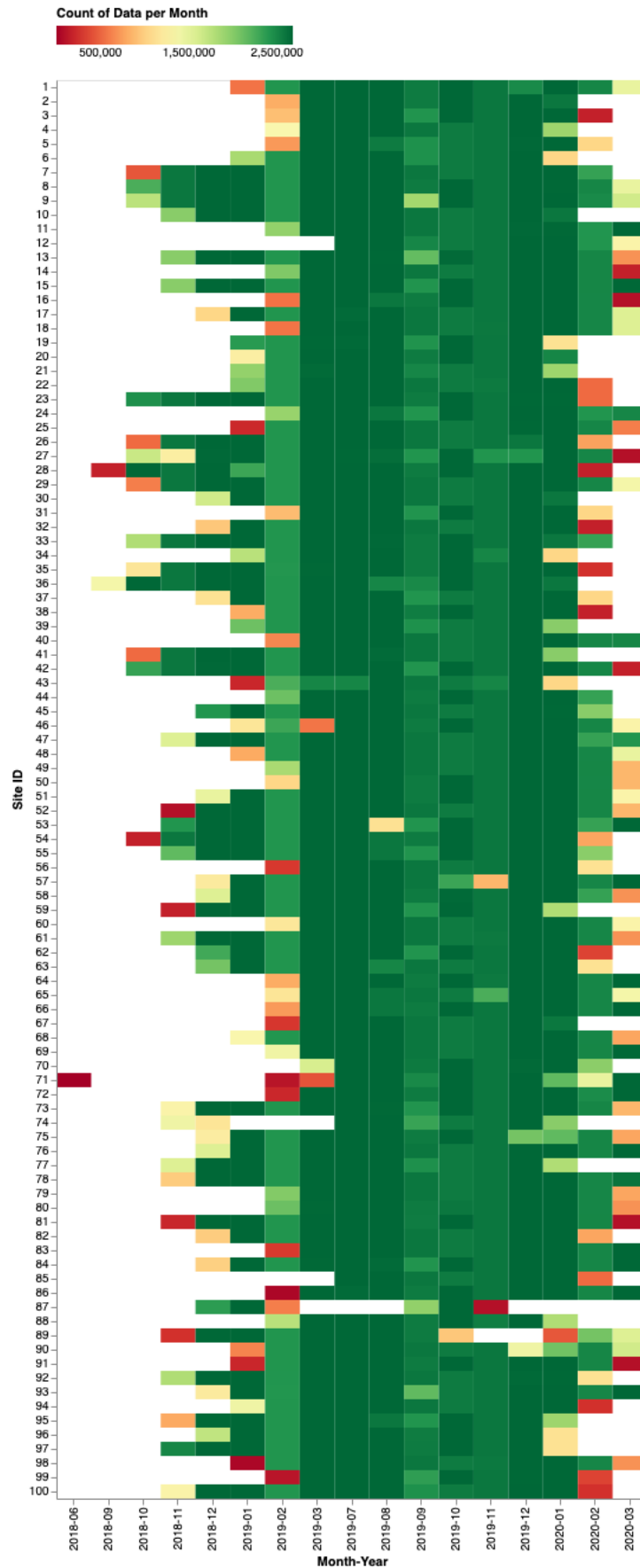
3.2.1 *t_msb1m: Sonnen data from MySonnenBatterie [MSB] portal, 1-min*



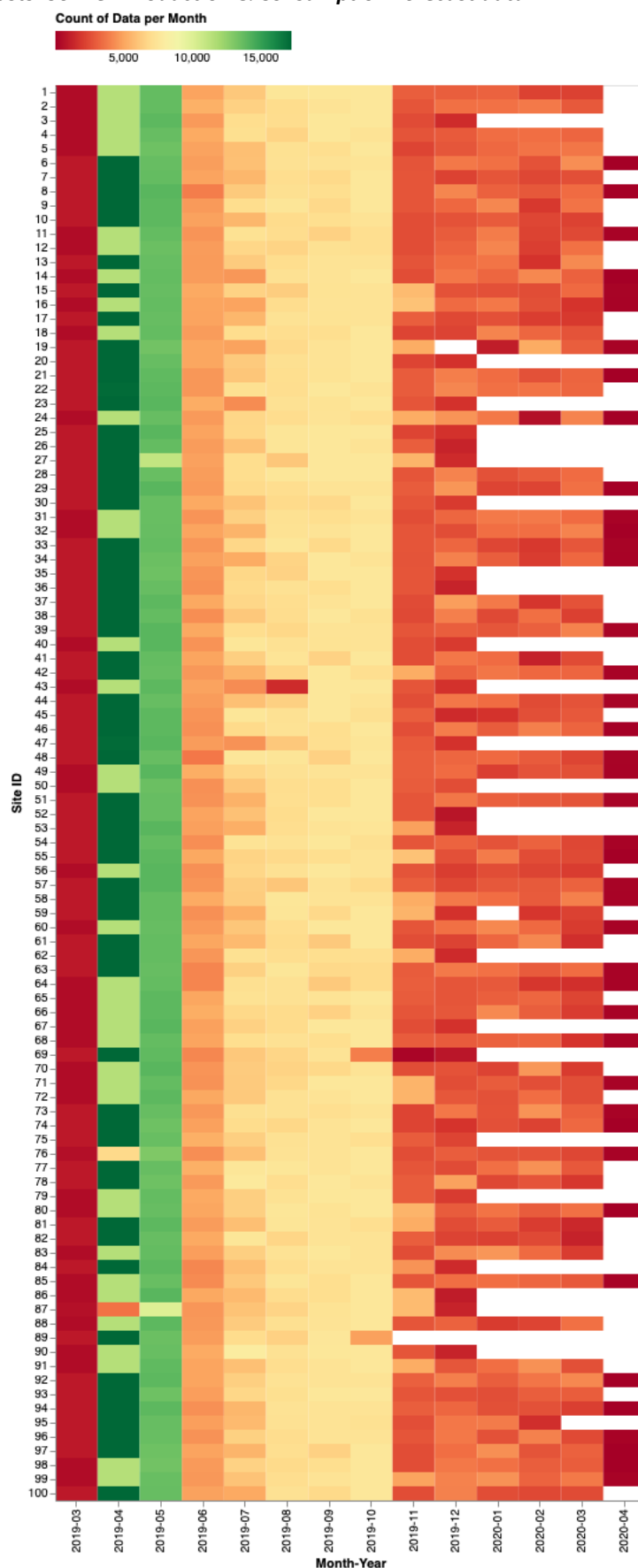
3.2.2 *t_ims1m: Independent Monitoring System [IMS], 1-minute data*



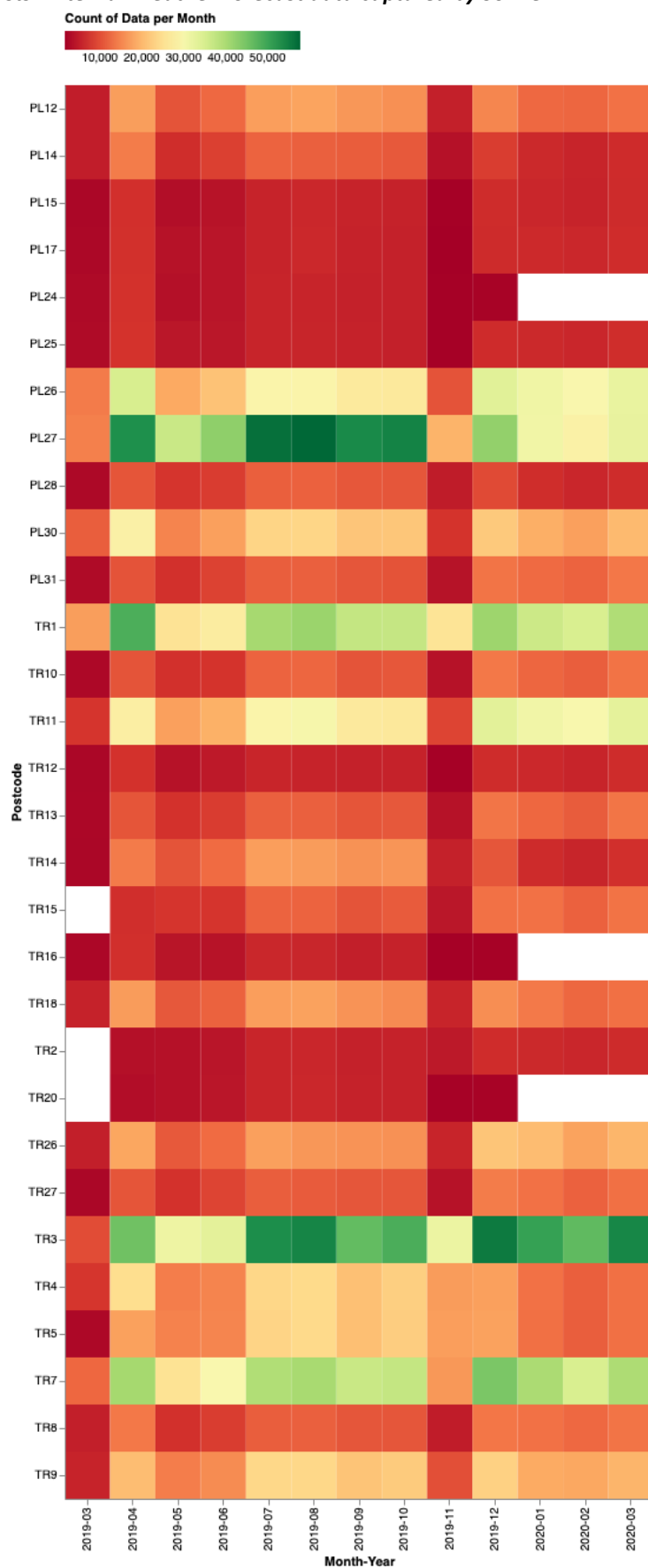
3.2.3 t_ims1s: Independent Monitoring System [IMS], 1-second data



3.2.4 t_prodconsforecasts: Sonnen Production & Consumption Forecast data



3.2.5 *t_weatherforecasts: External Weather Forecast data captured by Sonnen*



A Appendix A: PostgreSQL Create Code

A.1 Measurement Datasets

A.1.1 *t_msb1m: Sonnen data from MySonnenBatterie [MSB] portal, 1-min*

```
1. CREATE TABLE public.t_msb1m
2. (
3.     ts timestamp with time zone NOT NULL,
4.     site smallint NOT NULL,
5.     soc smallint,
6.     discharge_wh real,
7.     charge_wh real,
8.     production_wh real,
9.     consumption_wh real,
10.    gridexport_wh real,
11.    gridimport_wh real,
12.    pvcharge_wh real,
13.    pvcons_wh real,
14.    pvexport_wh real,
15.    griddischarge_wh real,
16.    gridcharge_wh real,
17.    gridcons_wh real,
18.    consdischarge_wh real,
19.    mismatch_wh real
20.)
```

A.1.2 *t_ims1m: Independent Monitoring System [IMS], 1-minute data*

```
1. CREATE TABLE public.t_ims1m
2. (
3.     ts timestamp with time zone NOT NULL,
4.     site smallint NOT NULL,
5.     grid_w smallint,
6.     bess_w smallint,
7.     pv_w smallint,
8.     majload_w smallint,
9.     grid_mpf smallint,
10.    grid_mhz integer,
11.    grid_mv integer,
12.    gridimp_wh integer,
13.    gridexp_wh integer,
14.    bessimp_wh integer,
15.    bessexp_wh integer,
16.    pvimp_wh integer,
17.    pvexp_wh integer,
18.    majload_wh integer
19.)
```

A.1.3 *t_ims1s: Independent Monitoring System [IMS], 1-second data*

```
1. CREATE TABLE public.t_ims1s
2. (
3.     ts timestamp with time zone NOT NULL,
4.     site smallint NOT NULL,
5.     gridw smallint,
6.     bessw smallint,
7.     pvw smallint,
8.     gridmhz integer
9.)
```

A.2 Forecast Datasets

A.2.1 *t_prodconsforecasts: Sonnen Production & Consumption Forecast data*

```
1. CREATE TABLE public.t_prodconsforecasts
2. (
3.     created_ts timestamp with time zone,
4.     forecast_ts timestamp with time zone NOT NULL,
5.     site smallint,
6.     consumption real,
7.     production real
8. )
```

A.2.2 *t_weatherforecasts: External Weather Forecast data captured by Sonnen*

```
1. CREATE TABLE public.t_weatherforecasts
2. (
3.     postcode character varying COLLATE pg_catalog."default",
4.     created_ts timestamp with time zone,
5.     forecast_date date,
6.     forecast_hour smallint,
7.     precipitation smallint,
8.     precipitation_probability smallint,
9.     wind_direction smallint,
10.    wind_speed smallint,
11.    solar_radiation smallint,
12.    sunshine_duration smallint,
13.    forecast_ts timestamp with time zone NOT NULL
14. )
```

A.3 Dimension Datasets

A.3.1 *t_sites: Site List*

```
1. CREATE TABLE public.t_sites
2. (
3.     site smallint,
4.     besstype character varying COLLATE pg_catalog."default",
5.     besskwh numeric,
6.     besskw numeric,
7.     pvkw numeric,
8.     postcode character varying COLLATE pg_catalog."default",
9.     majorload text COLLATE pg_catalog."default",
10.    installdate date
11. )
```