LOAD COMPOSITION UPDATE

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WECC MODEL VALIDATION SUBCOMMITTEE – SEPTEMBER, 2023

LOAD COMPOSITION FACTORS

Season	Hour	Zone/Type	Seven Load Composition Factors								
Enter Day (1=normal summer, 2=hot summer,3=cool summer,4=shoulder, 5=winter)	Enter Hour (Pacific Time)	PSLF LID	Motor A	Motor B	Motor C	Motor D	Power Electronic	DG	Static PF	Static P Resistive	Static P Current
1	16	NWC_RES	0.07	0.09	0.05	0.15	0.16	0.00	-0.999	0.38	0.11
1	16	NWC_COM	0.16	0.11	0.04	0.06	0.22	0.00	-0.996	0.18	0.22
1	16	NWC_MIX	0.13	0.12	0.07	0.08	0.18	0.00	-0.998	0.24	0.18
1	16	NWC_RAG	0.16	0.10	0.14	0.08	0.14	0.00	-0.999	0.27	0.11
1	16	NWV_RES	0.07	0.13	0.04	0.30	0.14	0.00	-0.999	0.22	0.10
1	16	NWV_COM	0.17	0.13	0.04	0.11	0.22	0.00	-0.994	0.12	0.21
1	16	NWV_MIX	0.14	0.14	0.06	0.16	0.18	0.00	-0.997	0.15	0.17
1	16	NWV_RAG	0.16	0.12	0.14	0.16	0.13	0.00	-0.999	0.18	0.10
1	16	NWI_RES	0.10	0.14	0.04	0.35	0.12	0.00	-0.998	0.17	0.09
1	16	NWI_COM	0.23	0.12	0.05	0.13	0.20	0.00	-0.993	0.08	0.19
1	16	NWI_MIX	0.18	0.14	0.06	0.18	0.16	0.00	-0.996	0.12	0.16
1	16	NWI_RAG	0.18	0.13	0.14	0.18	0.12	0.00	-0.999	0.15	0.10
1	17	RMN_RES	0.06	0.09	0.05	0.17	0.20	0.00	-0.999	0.34	0.09
1	17	RMN_COM	0.15	0.11	0.04	0.07	0.24	0.00	-0.996	0.18	0.20
1	17	RMN_MIX	0.12	0.12	0.07	0.10	0.20	0.00	-0.998	0.23	0.16
1	17	RMN_RAG	0.12	0.11	0.14	0.10	0.17	0.00	-0.999	0.26	0.10

WECC LCM

Load Composition Factors are calculated for each zone/type based on selected season and hour of day

Uses Rules of Association mapping from end-use to load composition factors

DEFINING LOAD TYPES

Example: NWC_RES

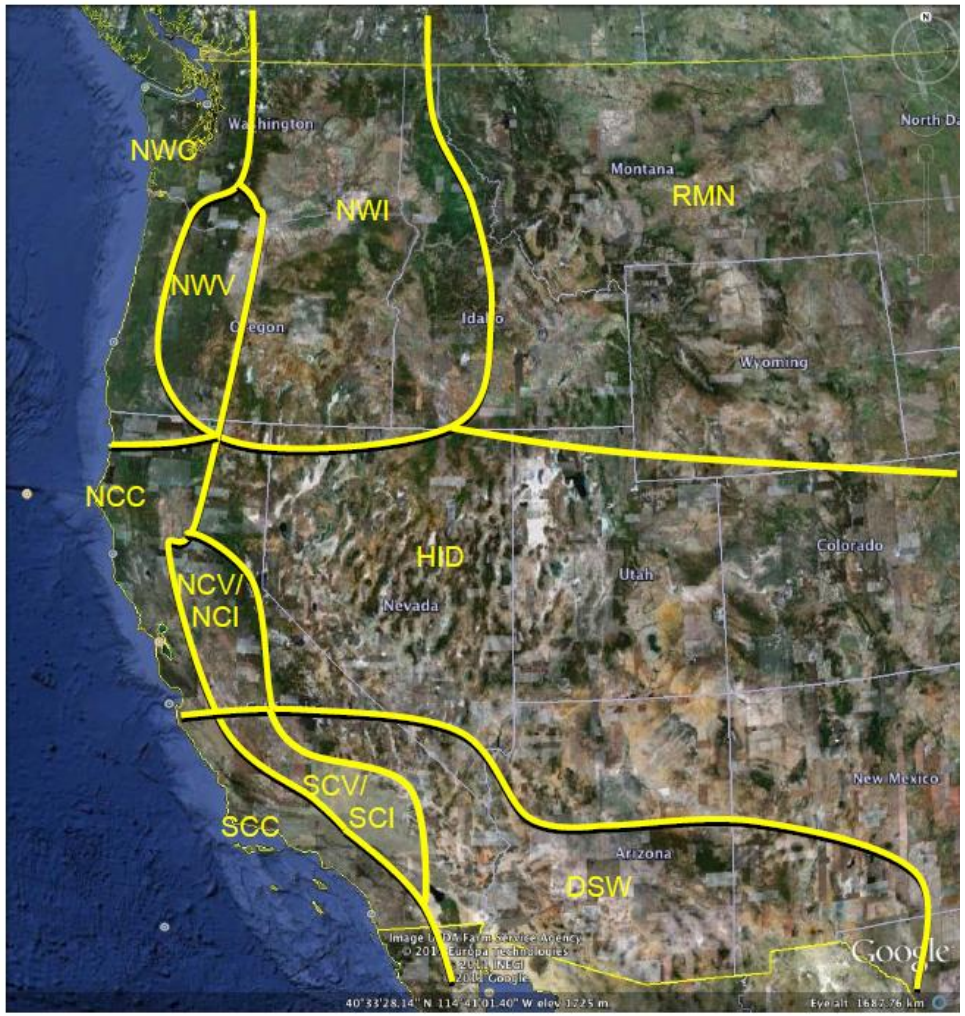
NWC

- Region/Location of load
- Selected from pre-defined list of climate zones/regions

RES

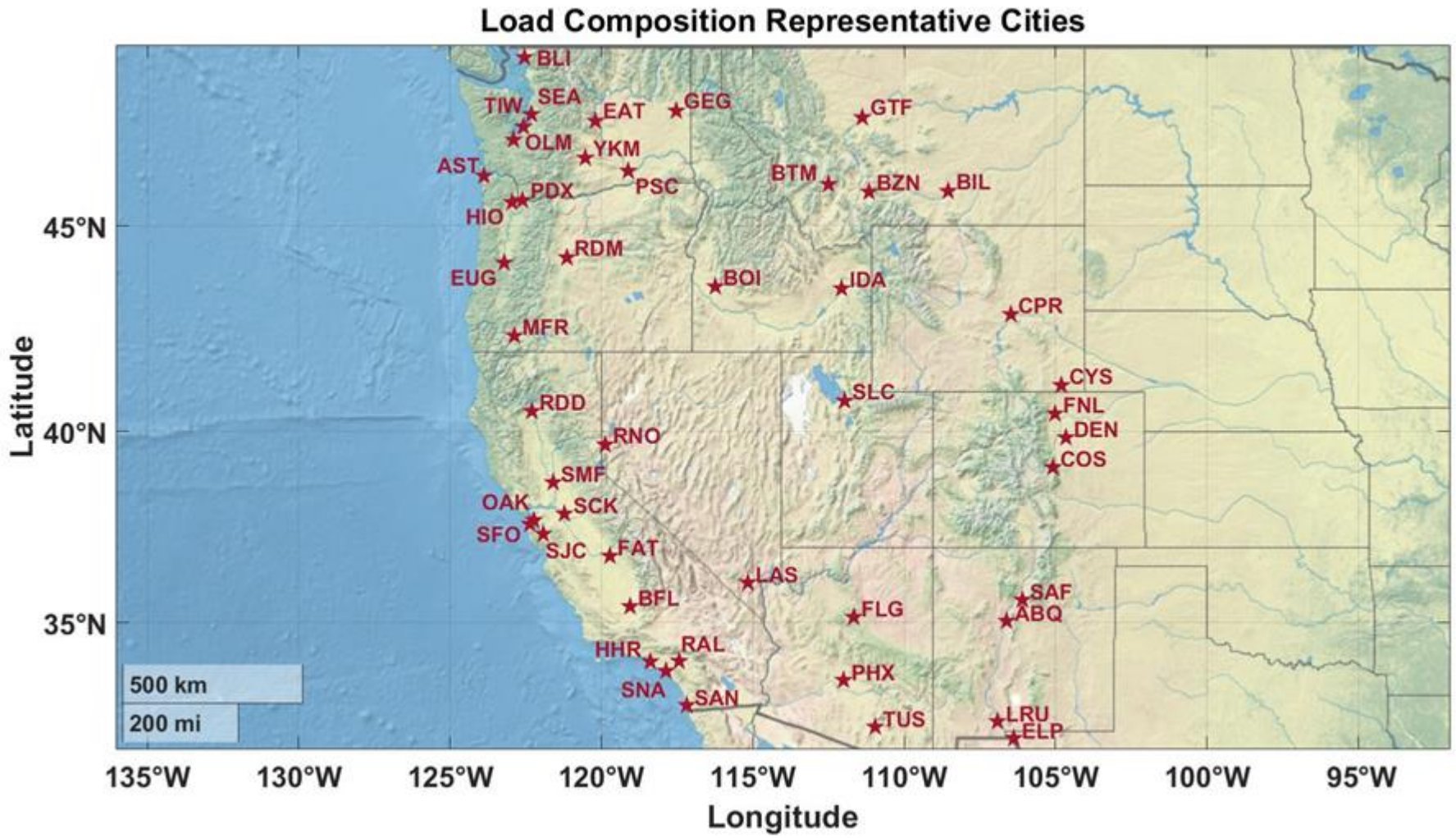
- Load type, building stock
- One of four default types:
  - RES – suburban residential
  - COM – downtown commercial
  - MIX – split residential and commercial
  - RAG – rural/agricultural

LCM CLIMATE ZONES



ID	Climate Zone	Representative City
NWC	Northwest Coast	Seattle, Vancouver BC
NWV	Northwest Valley	Portland OR
NWI	Northwest Inland	Boise, Tri-Cities, Spokane
RMN	Rocky Mountain North	Calgary, Cheyenne
NCC	Northern California Coast	Bay Area
NCV	Northern California Valley	Sacramento, Fresno
NCI	Northern California Inland	
SCC	Southern California Coast	LA, San Diego
SCV	Southern California Valley	LA, San Diego
SCI	Southern California Inland	LA, San Diego
DSW	Desert Southwest	Phoenix, Riverside, Las Vegas
HID	High Desert	Salt Lake City, Albuquerque, Denver, Reno

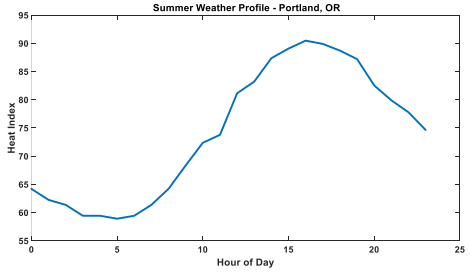
PROPOSED WECC REPRESENTATIVE CITIES



48 proposed representative cities vs. 12 LCM climate zones

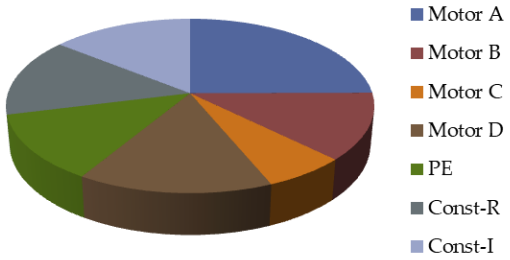
WECC LOAD COMPOSITION

Feeder	% Residential	% Commercial
RES	80%	20%
COM	20%	80%
MIX	50%	50%
RAG	80%	20%



- Location/ Region
- Feeder Composition
- Weather Profiles

Load Composition Engine



Load composition generated for all combinations of 48 cities, 4 feeder types, 3 seasons

REPRESENTATIVE CITY ANALYSIS

- Calculate a cumulative difference between load composition factors for each city pair, for all 12 cases (3 seasons, 4 feeder types at peak load times (light load for Spring)
- Example:

Portland – Summer at Hour 18

Feeder	MA	MB	MC	MD	PE	StatR	StatI
RES	0.112	0.159	0.049	0.252	0.077	0.293	0.058
COM	0.118	0.302	0.064	0.029	0.276	0.136	0.076
MIX	0.187	0.228	0.048	0.107	0.119	0.215	0.097
RAG	0.121	0.167	0.046	0.255	0.077	0.279	0.057

Seattle – Summer at Hour 18

Feeder	MA	MB	MC	MD	PE	StatR	StatI
RES	0.103	0.164	0.054	0.155	0.081	0.373	0.070
COM	0.098	0.314	0.056	0.020	0.271	0.159	0.082
MIX	0.163	0.236	0.045	0.065	0.120	0.261	0.110
RAG	0.113	0.176	0.052	0.148	0.083	0.360	0.069

$$
\begin{aligned}
Diff = {} & |MA_{RES1} - MA_{RES2}| + |MB_{RES1} - MB_{RES2}| + |MC_{RES1} - MC_{RES2}| \ldots \\
& + |MA_{COM1} - MA_{COM2}| + |MB_{COM1} - MB_{COM2}| + |MC_{COM1} - MC_{COM2}| \ldots \\
& + |MA_{MIX1} - MA_{MIX2}| + |MB_{MIX1} - MB_{MIX2}| + |MC_{MIX1} - MC_{MIX2}| \ldots \\
& + |MA_{RAG1} - MA_{RAG2}| + |MB_{RAG1} - MB_{RAG2}| + |MC_{RAG1} - MC_{RAG2}| \ldots
\end{aligned}
$$

- Repeat for all three seasons (Winter at hour 8, Spring at hour 4), calculate total difference across all pairs

REPRESENTATIVE CITY ANALYSIS

CITY	Albuquerque	Astoria	Bakersfield	Billings	Bellingham	Boise	Butte	Bozeman
Albuquerque	**0.000**	4.659	1.801	3.439	4.648	2.853	2.977	3.068
Astoria	4.659	**0.000**	5.774	3.035	1.935	3.565	3.450	3.343
Bakersfield	1.801	5.774	**0.000**	4.211	5.583	3.500	3.775	3.880
Billings	3.439	3.035	4.211	**0.000**	1.756	1.054	0.733	0.833
Bellingham	4.648	1.935	5.583	1.756	**0.000**	2.444	2.204	2.073
Boise	2.853	3.565	3.500	1.054	2.444	**0.000**	0.959	0.816
Butte	2.977	3.450	3.775	0.733	2.204	0.959	**0.000**	0.703
Bozeman	3.068	3.343	3.880	0.833	2.073	0.816	0.703	**0.000**

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REPRESENTATIVE CITY ANALYSIS

Most similar city pairs

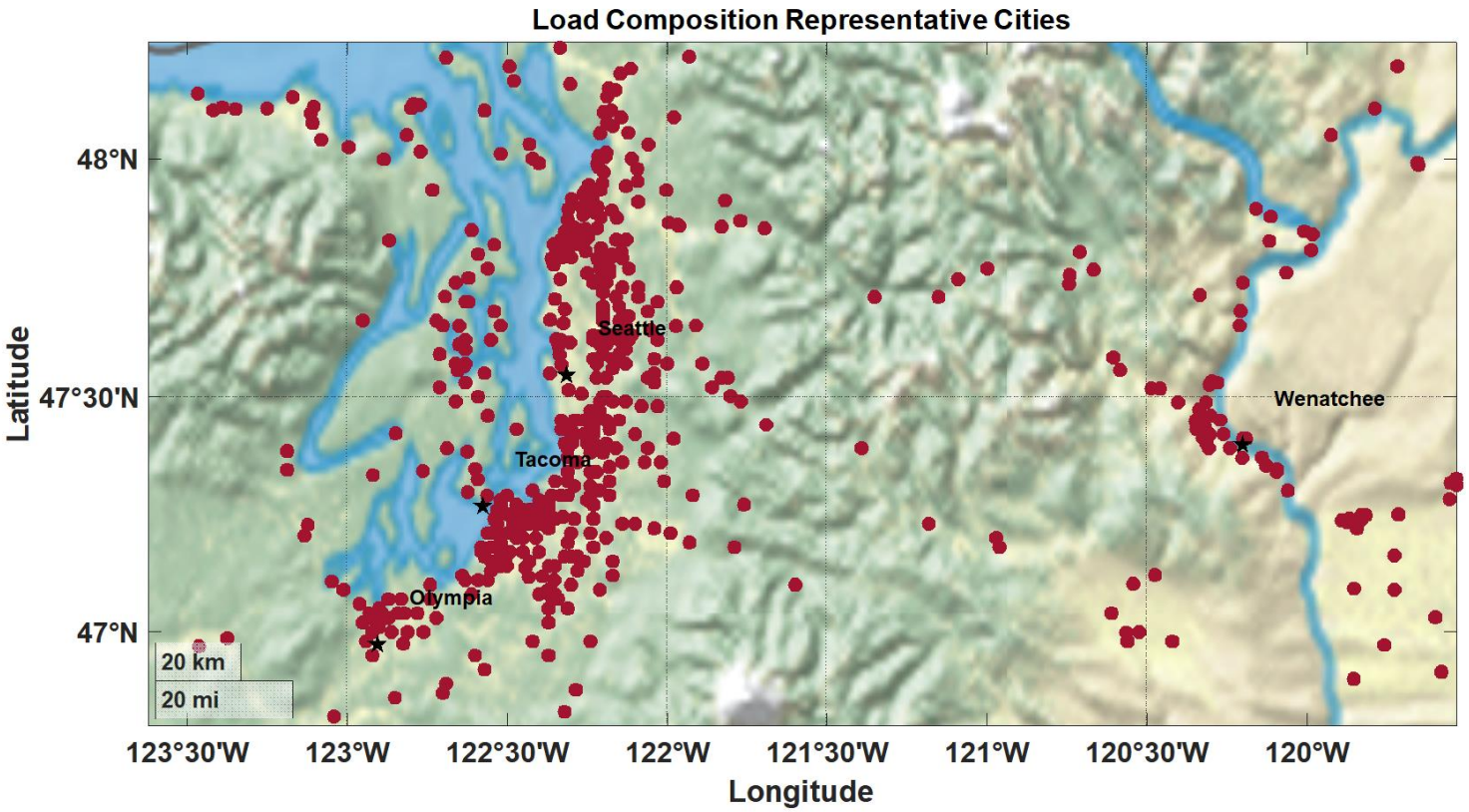
CITY 1	CITY 2	Difference
Boise, ID	Redmond, OR	0.224
Casper, WY	Denver, CO	0.399
Wenatchee, WA	Spokane, WA	0.454
Eugene, OR	Medford, OR	0.484
Las Cruces, NM	Santa Fe, NM	0.497
Medford, OR	Portland, OR	0.516
Stockton, CA	Sacramento, CA	0.526
Bakersfield, CA	Fresno, CA	0.541
Eugene, OR	Portland, OR	0.549
Bozeman, MT	Idaho Falls, ID	0.600

Least similar city pairs

CITY 1	CITY 2	Difference
Snohomish, WA	Phoenix, AZ	8.0747
Snohomish, WA	Las Vegas, NV	7.6889
Phoenix, AZ	San Francisco, CA	7.5597
Phoenix, AZ	Oakland, CA	7.3732
Bellingham, WA	Phoenix, AZ	7.2393
Las Vegas, NV	San Francisco, CA	7.2339
Snohomish, WA	Tucson, AZ	7.0598
Las Vegas, NV	Oakland, CA	7.013
Astoria, OR	Phoenix, AZ	6.9634
Bellingham, WA	Las Vegas, NV	6.8609

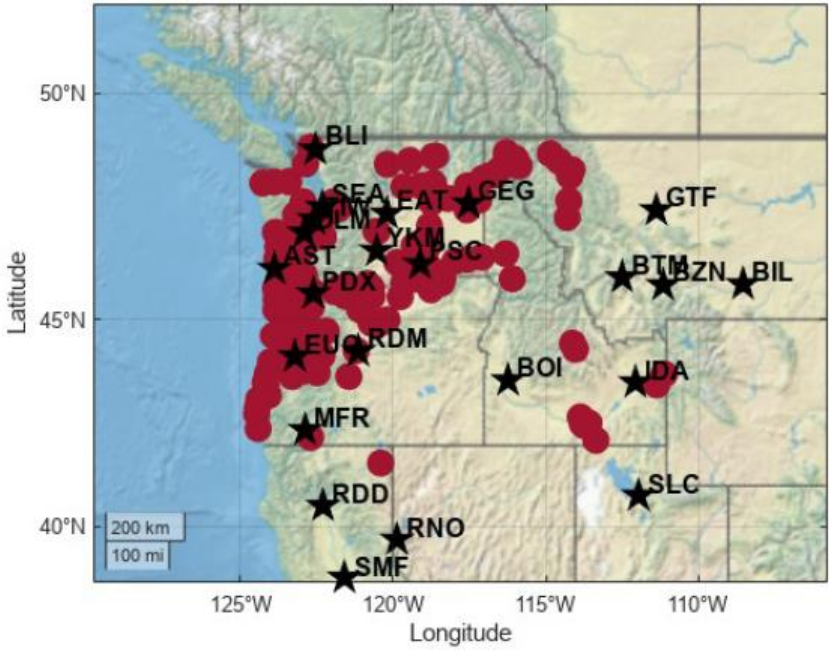
MAPPING LOADS TO REPRESENTATIVE CITIES

- Need to map every load bus/station to a representative city (rather than a climate zone)
  - E.g., DSW_RES → PHX_RES or LAS_RES
- As a starting point, this can be done using latitude and longitude of station relative to representative airport locations, using basic distance formulas
  - Initial mapping can be validated by regional entity/utility
  - Requires latitude and longitude of every station



MAPPING REPORT

Bonneville Power Admin



Bus Number	Bus Name	Load Model Group (Current Load Definition)	Nearest City (Calculated Nearest City)	Distance (mi)	New Load Group (Proposed Load Definition)
629094	[redacted]	RMN_RAG	Great Falls, MT	134.40	GTF_RAG
408570	[redacted]	NWI_MIX	Spokane, WA	51.40	GEG_MIX
402190	[redacted]	<undefined>	Portland, OR	68.20	N/A
402170	[redacted]	NWI_IND	Portland, OR	68.20	NWI_IND
400150	[redacted]	NWV_MIX	Eugene, OR	39.90	EUG_MIX
66765	[redacted]	HID_MIX	Idaho Falls, ID	111.60	IDA_MIX
66763	[redacted]	HID_MIX	Idaho Falls, ID	120.70	IDA_MIX
66495	[redacted]	HID_MIX	Idaho Falls, ID	49.40	IDA_MIX
66470	[redacted]	HID_RES	Idaho Falls, ID	35.20	IDA_RES
61950	[redacted]	NWI_MIX	Idaho Falls, ID	111.00	IDA_MIX
60842	[redacted]	NWI_MIX	Idaho Falls, ID	109.50	IDA_MIX
60838	[redacted]	NWI_MIX	Idaho Falls, ID	111.50	IDA_MIX
60838	[redacted]	NWI_MIX	Idaho Falls, ID	111.50	IDA_MIX
60832	[redacted]	NWI_RAG	Idaho Falls, ID	107.50	IDA_RAG
60832	[redacted]	NWI_RAG	Idaho Falls, ID	107.50	IDA_RAG
60832	[redacted]	NWI_RAG	Idaho Falls, ID	107.50	IDA_RAG
60832	[redacted]	NWI_RAG	Idaho Falls, ID	107.50	IDA_RAG

This mapping is completed for all 247 owners defined in the WECC base case

CURRENT ISSUES

- Missing latitude and longitude
- Missing economic use (load model group) information

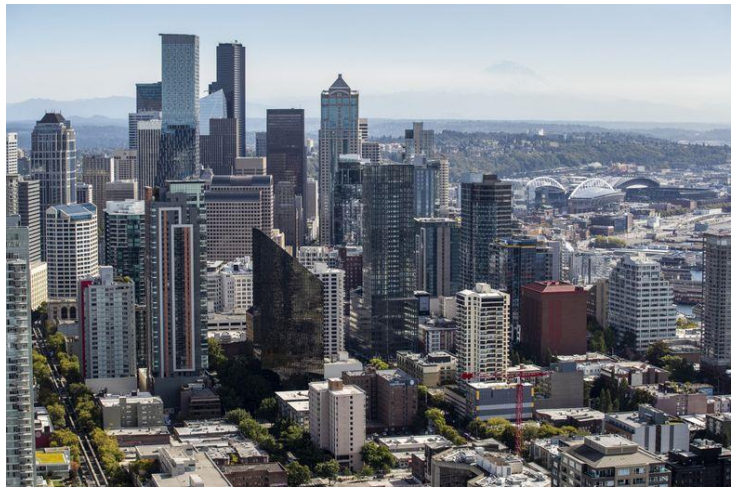
Total Busses:	15156
Total Lat/Long Found:	10058
Total Lat/Long Missing:	5098
Total Load Model Group Found:	11161
Total Load Model Group Missing:	3995

CURRENT ISSUES

- Incorrect load model group information
- Example: Woodland, WA

- Contains a load identified as "COM"

"COM" load



NOT "COM" load

CONTACT INFO

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