Grid-Interactive Efficient Buildings

What goes into delivering a GEB?

September 2024

WSP

Schneider Electric

PRESENTATION SCOPE

Presenters

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PRESENTATION SCOPE

OBJECTIVE

How do we take the next steps to design and deliver GEBs?

AGENDA

Why?

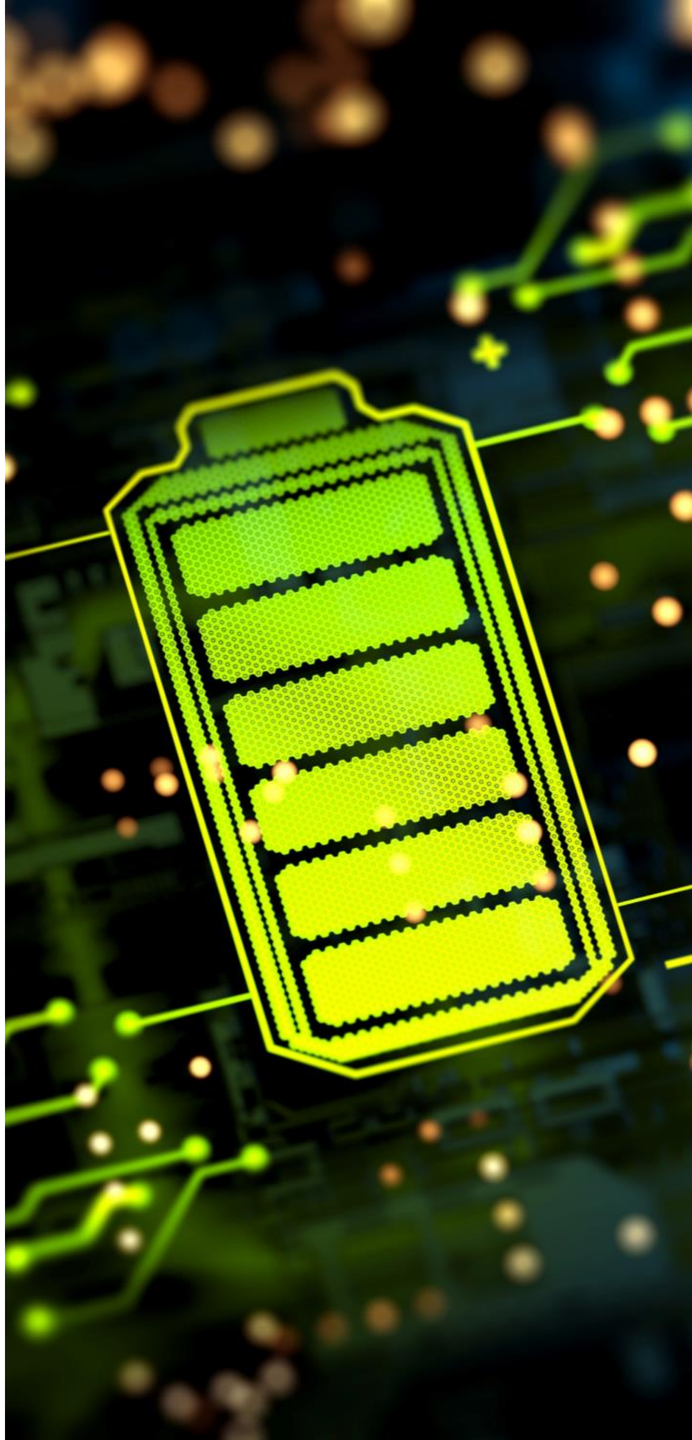
- Today's Grid
- Resilience & decarbonization
- The Future Grid

What?

- GEBs
- DERs
- Microgrid

How?

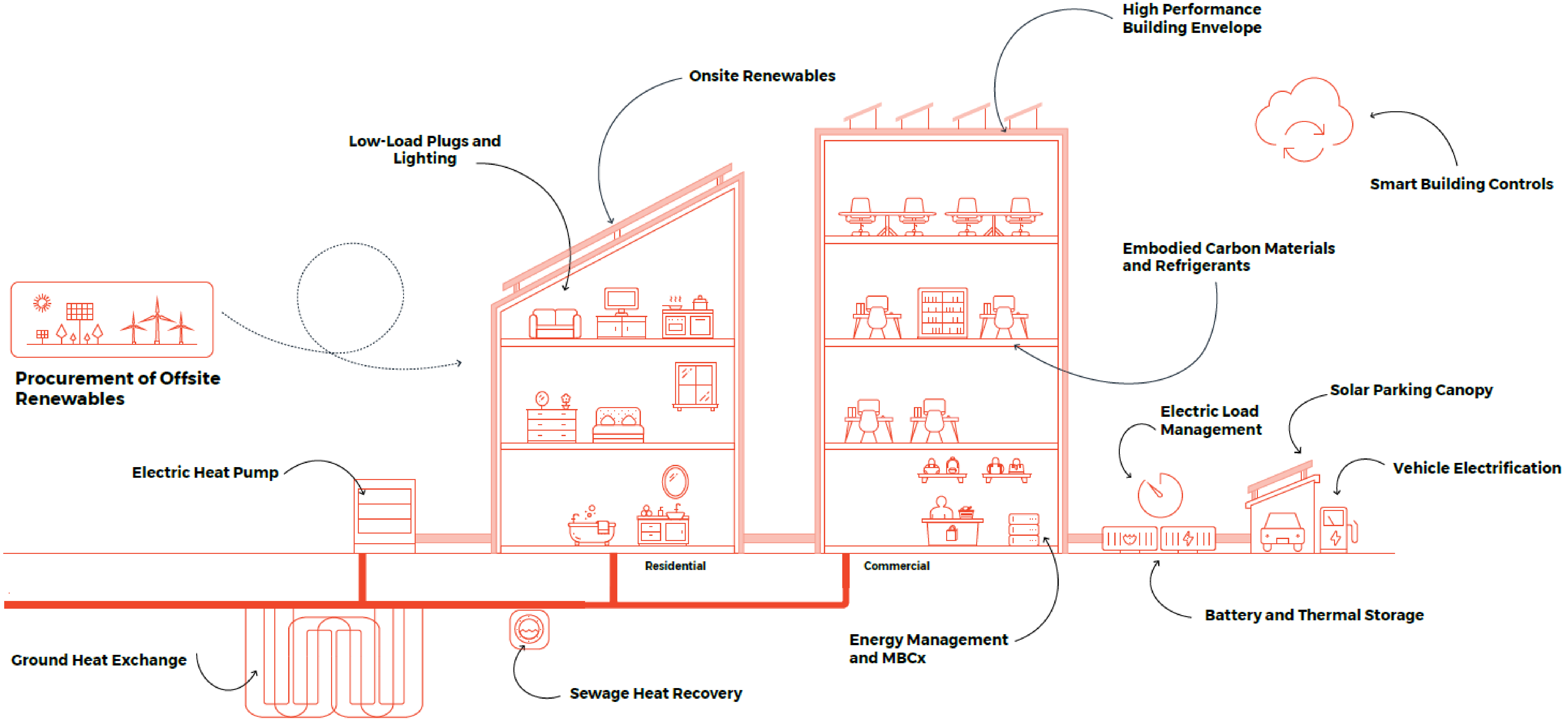
- Goals and Objectives
- Design Approach
- Electrical Infrastructure
- Controls
- Integration & Delivery
- The Business Case
- What's next?



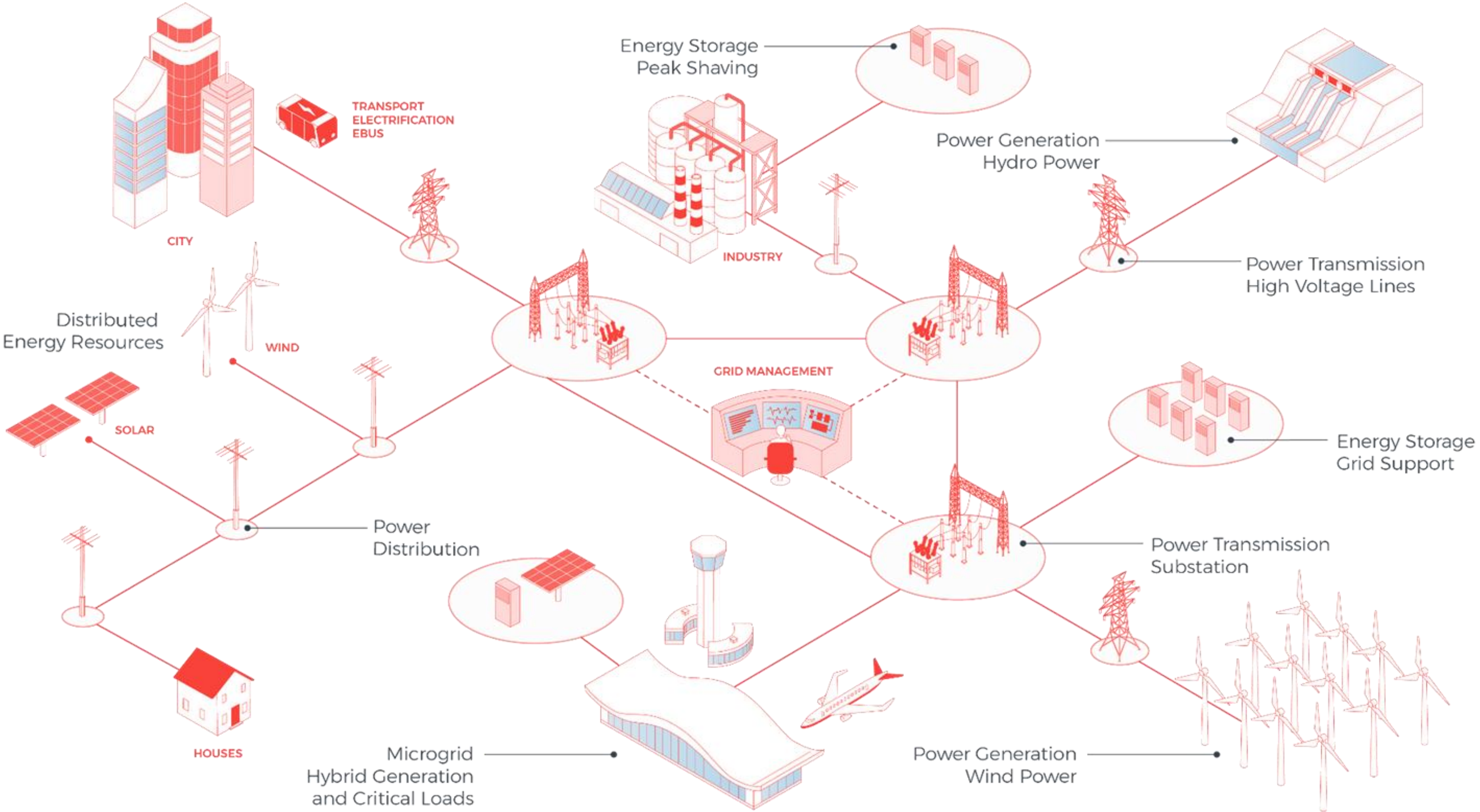
Why?

Grid Interactive & Efficient Buildings

What does a future, decarbonized building look like?



What does a future, decarbonized grid look like?



Electricity Grids Are Expected to Get Cleaner

Electricity CO2 Emissions by State from 2022 - 2050

Carbon Intensity

High (900 kg/MWh)

Low (0 kg/MWh)

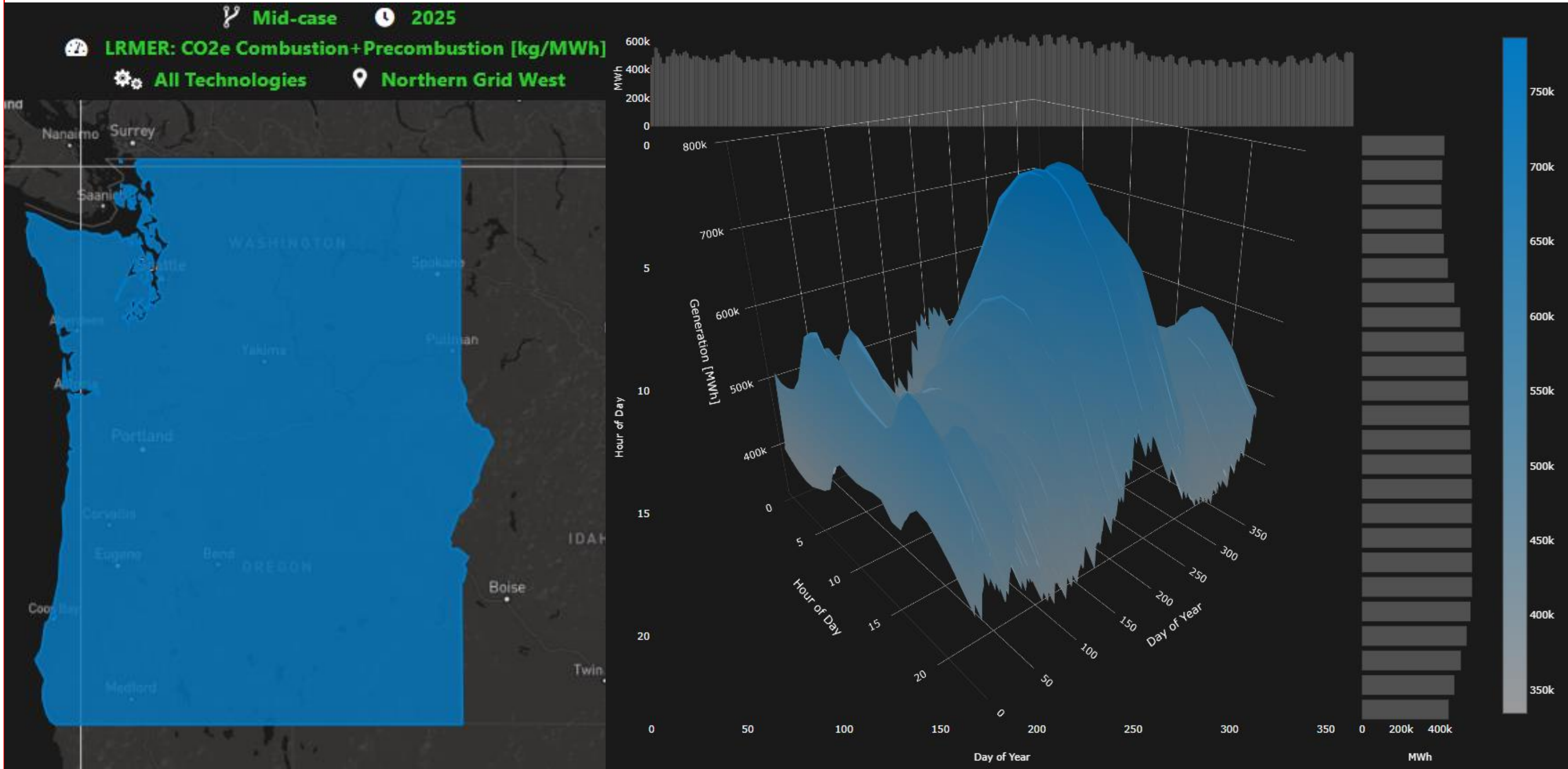
STATE		2022	2024	2026	2028	2030	2032	2034	2036	2038	2040	2042	2044	2046	2048	2050
KY	-71%	873	812	804	801	791	577	560	560	531	524	497	424	350	286	[illegible]
IN	-45%	776	691	694	704	673	655	635	634	615	613	609	597	527	491	429
WY	-70%	761	777	783	713	721	570	582	582	529	478	436	409	392	344	230
MO	-39%	759	765	762	647	625	624	622	621	613	600	577	573	503	445	462
UT	-26%	746	663	671	684	683	687	672	682	630	639	646	635	660	604	551
NM	-80%	627	637	646	652	620	588	540	330	305	[illegible]	[illegible]	189	144	129	128
OH	-45%	574	588	593	573	567	521	496	489	482	475	431	422	396	410	314
WI	-38%	571	583	592	589	586	522	506	492	494	479	453	406	412	415	354
CO	-57%	567	573	533	498	464	452	434	424	411	379	342	279	[illegible]	[illegible]	[illegible]
WV	-57%	553	648	626	610	508	419	294	281	208	202	180	170	223	[illegible]	[illegible]
MI	-66%	520	464	468	457	329	322	317	319	301	298	278	278	[illegible]	191	176
ND	-70%	489	500	534	512	471	462	484	429	377	321	328	293	[illegible]	161	148
IA	-65%	488	487	482	476	475	442	447	450	311	318	306	233	209	198	170
KS	-73%	459	399	421	406	367	354	356	349	320	[illegible]	282	122	133	147	122
AR	-18%	406	380	414	411	378	371	365	365	362	354	356	348	338	340	333
MS	-82%	376	331	382	350	283	226	220	225	198	163	131	127	200	111	67
AL	-29%	376	389	398	398	394	386	385	385	370	360	354	345	308	300	[illegible]
DE	-95%	372	323	133	112	98	93	99	112	112	98	104	98	32	34	19
TN	-52%	361	350	319	325	260	270	270	267	273	276	275	276	277	182	173
NC	-61%	359	386	382	374	354	343	335	329	303	292	218	202	159	170	140
AZ	-46%	356	337	334	295	273	[illegible]	[illegible]	[illegible]	226	228	221	210	197	195	194
PA	-17%	355	329	348	354	348	346	386	389	383	370	343	312	317	274	294
FL	-57%	355	399	408	402	346	320	305	289	[illegible]	212	175	162	158	146	151
NE	-74%	352	354	369	293	286	225	318	[illegible]	[illegible]	156	168	161	130	114	91
LA	-2%	321	311	303	300	[illegible]	270	274	276	278	282	284	285	312	312	313
TX	-66%	318	291	277	[illegible]	[illegible]	226	224	211	197	181	156	158	142	115	107
MN	-82%	316	333	282	270	227	[illegible]	157	155	158	158	168	132	116	77	58
RI	-89%	312	169	106	100	84	83	75	65	50	44	36	31	36	34	34
NV	-39%	294	309	296	286	[illegible]	[illegible]	[illegible]	[illegible]	220	214	219	218	194	180	179
OK	-91%	287	[illegible]	217	174	175	160	157	157	121	86	93	58	40	41	27
MT	-35%	281	442	457	456	455	436	424	359	331	[illegible]	225	205	199	197	182
GA	-46%	277	345	379	364	295	[illegible]	227	[illegible]	184	189	182	171	126	138	149
VA	-100%	274	217	185	183	178	167	151	153	149	133	123	119	0	0	0
IL	20%	[illegible]	271	[illegible]	233	222	236	230	231	228	234	[illegible]	279	283	357	304
SC	-65%	[illegible]	284	294	215	166	168	160	154	135	120	108	104	95	95	87
MA	-92%	[illegible]	226	161	140	119	119	118	105	91	83	78	38	38	34	19
CT	18%	223	218	201	189	189	183	177	216	203	203	206	193	293	[illegible]	[illegible]
NJ	-4%	223	204	200	186	174	170	169	169	188	185	208	207	220	217	215
NY	-60%	184	125	105	89	84	81	73	81	91	80	80	80	76	74	74
CA	-67%	174	157	136	121	105	104	101	94	88	83	73	63	60	59	58
MD	-9%	162	171	166	155	128	124	126	144	166	148	130	110	108	115	147
ME	-62%	156	153	111	83	90	92	87	114	87	96	111	94	97	87	59
SD	-98%	145	168	181	183	154	131	149	89	46	37	36	5	4	2	3
OR	-71%	107	109	90	81	79	77	74	62	50	52	62	47	45	42	31
ID	168%	61	60	59	56	57	51	115	174	121	125	126	162	171	171	162
WA	-84%	27	53	29	20	20	19	18	14	13	12	13	11	11	7	4
NH	-97%	14	14	10	9	11	9	9	7	7	1	0	1	1	1	0
VT	100%	0	0	0	0	0	0	0	50	73	81	91	89	86	87	80

Source: NREL Cambium data set, Mid-case scenario

Grid-Interactive Efficient Buildings

PNW Grid Today

2023 NREL Cambium Mid-Case Set Data
NW, 2025, Average Emissions – 242 kg of CO2 / MWh



PNW Grid Today

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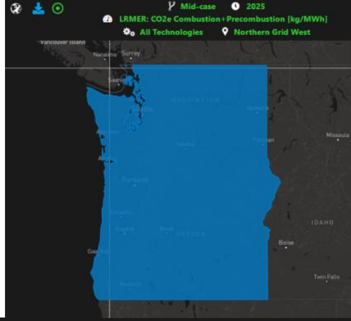

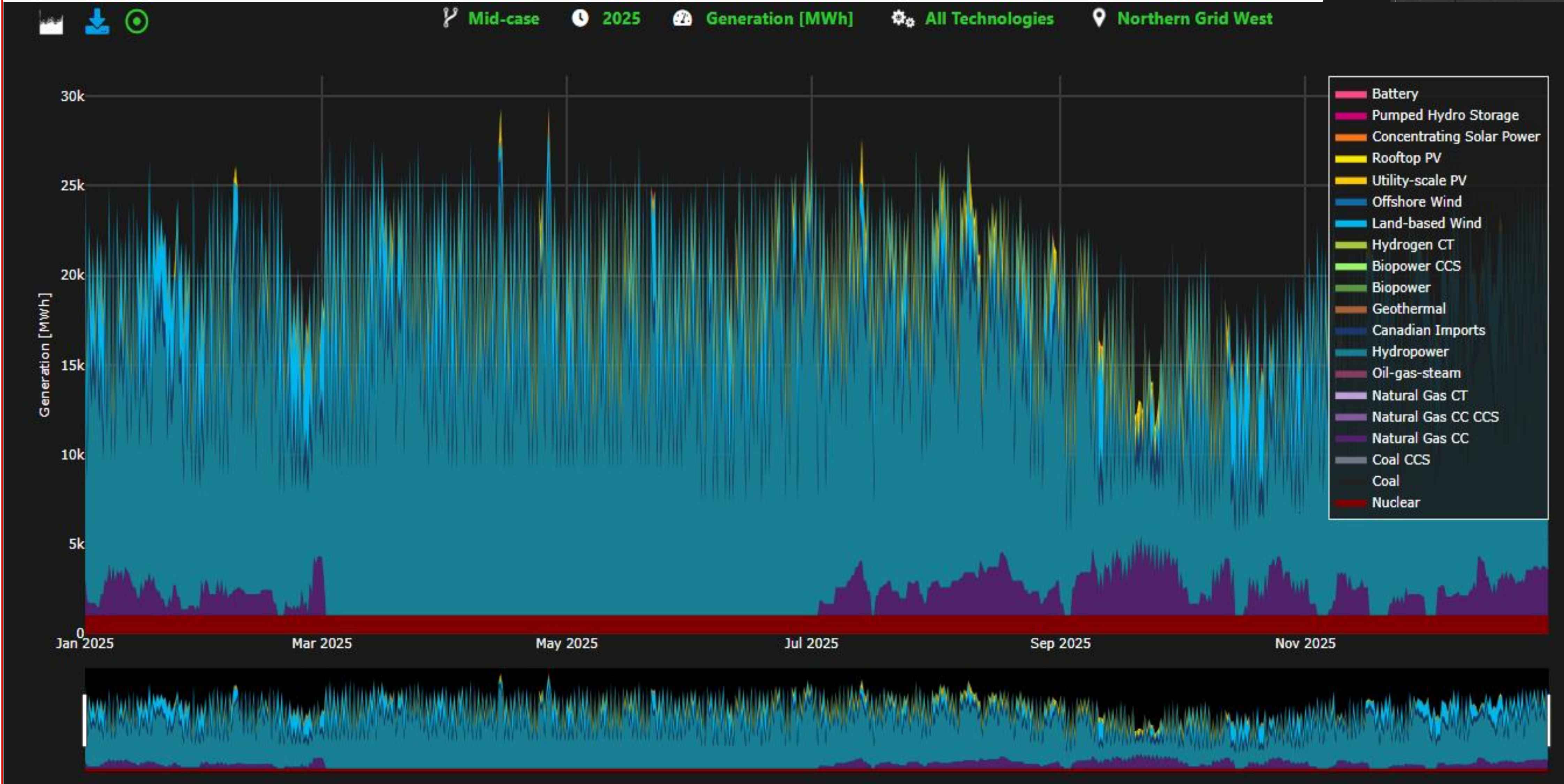

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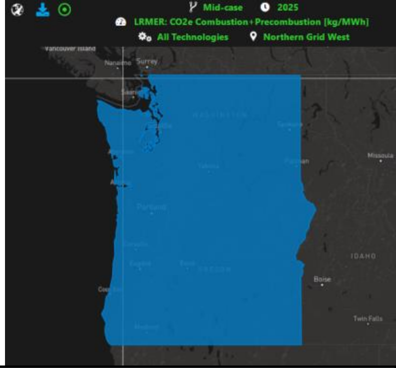
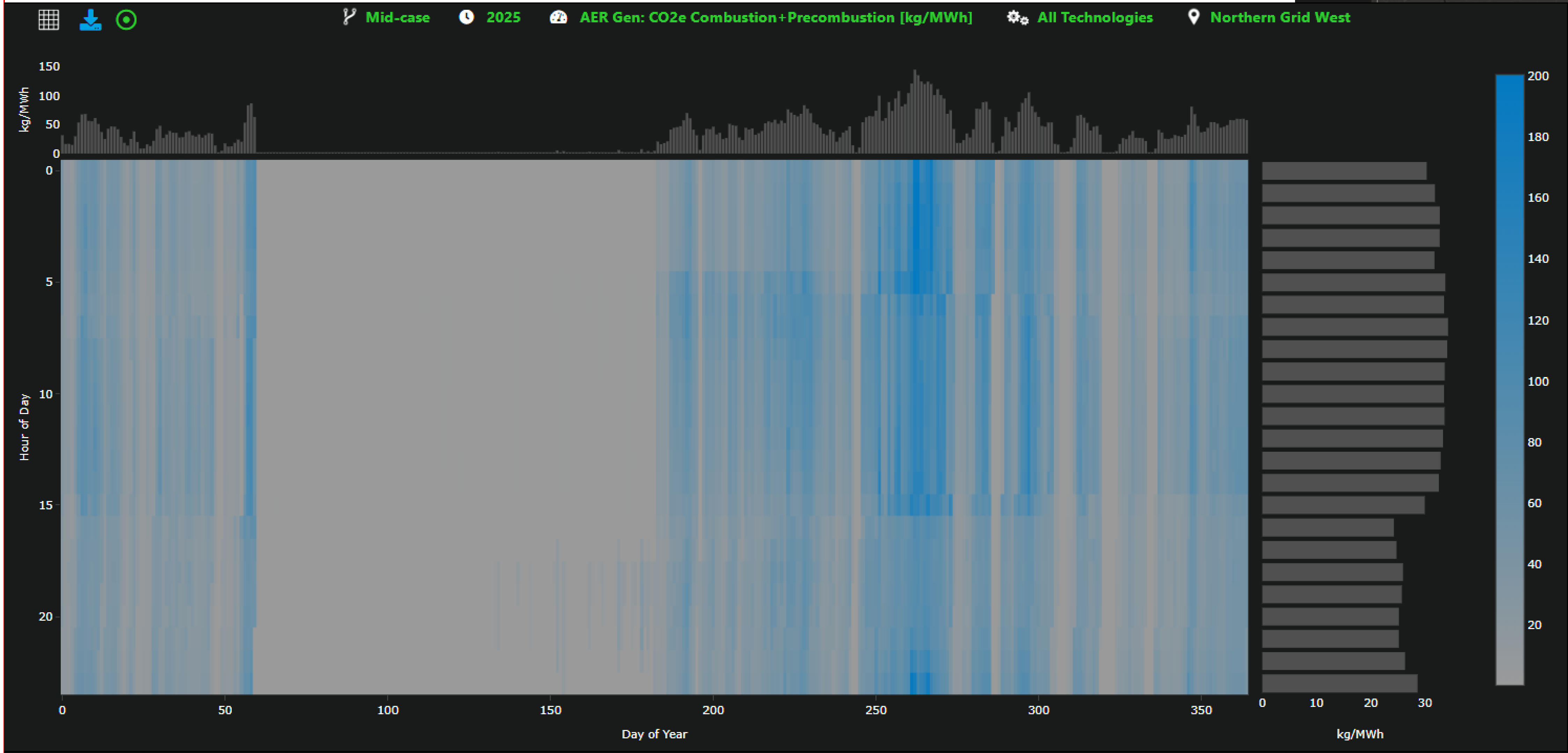
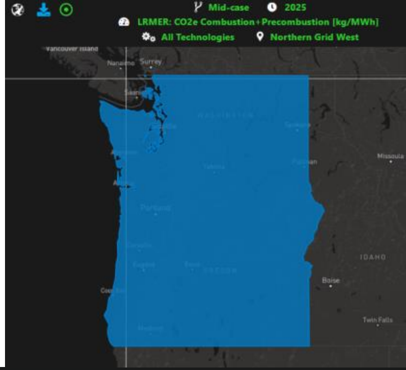
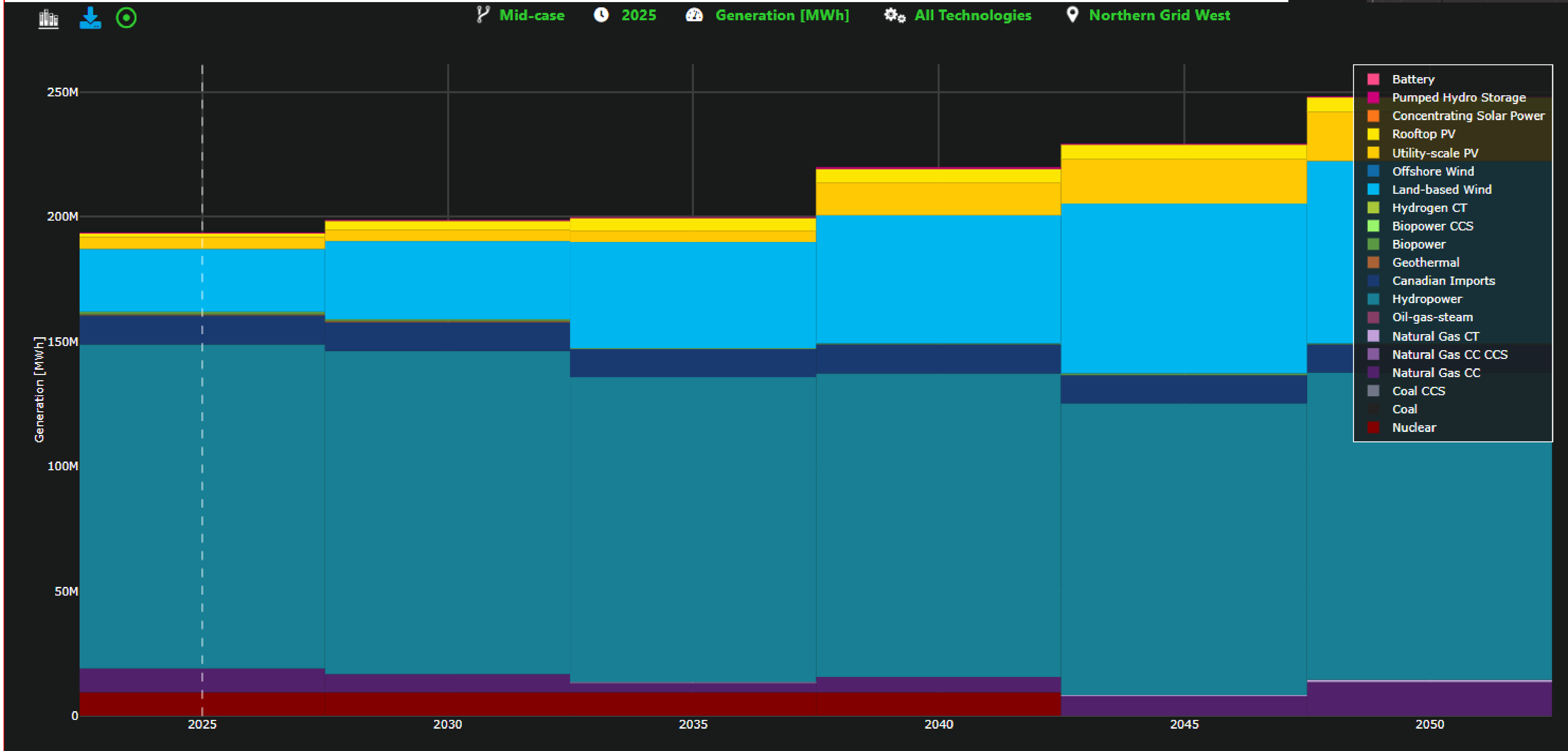




PNW Grid Projections





Oregon & PGE Context

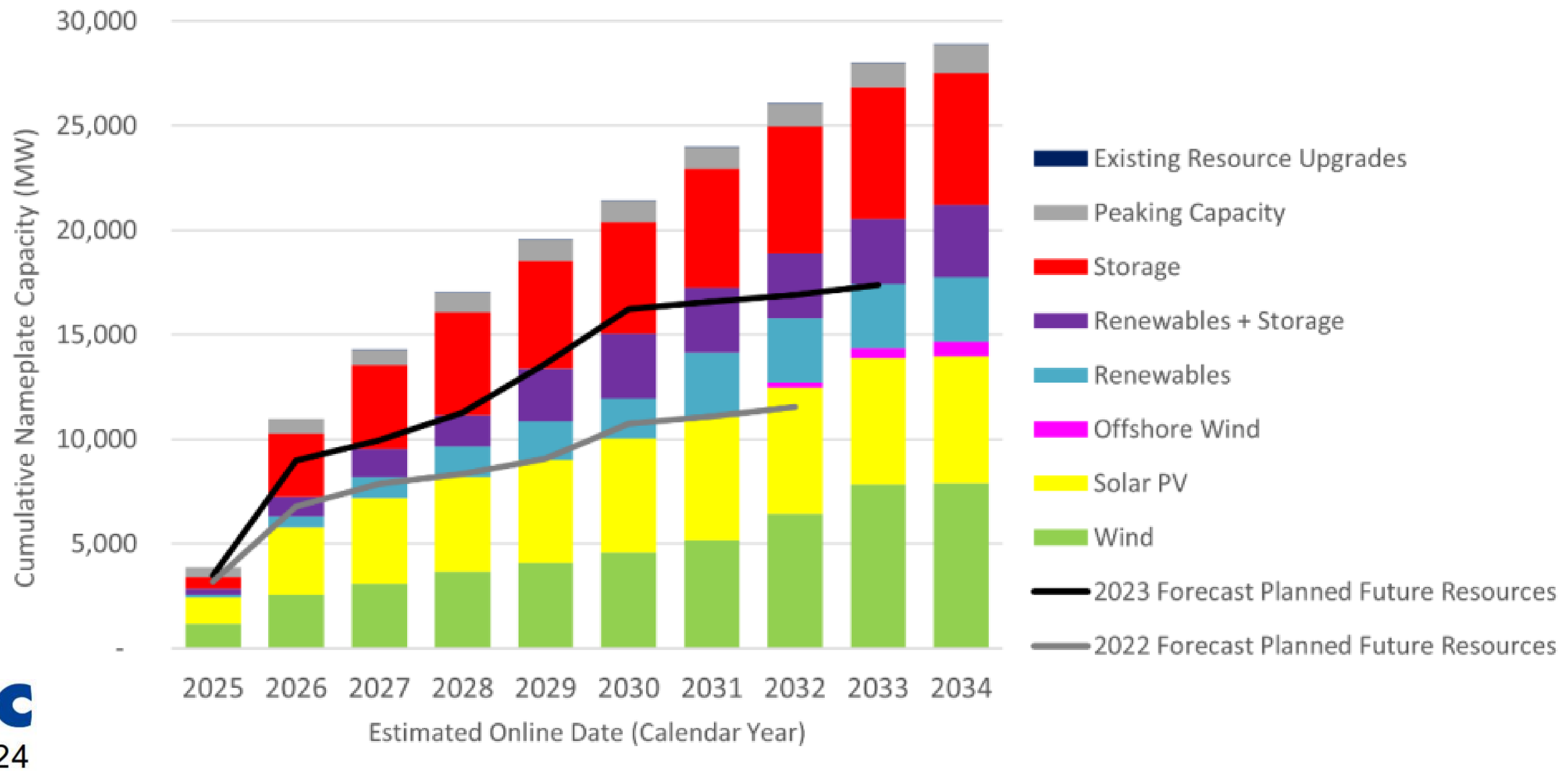
OREGON NEWS

Demand for electricity in Northwest projected to grow 30% in decade, triple previous estimates

by By Alex Baumhardt - Oregon Capital Chronicle — on May 2, 2024

OREGONLIVE The Oregonian

Northwest data centers' electricity use could more than double, imperiling climate goals

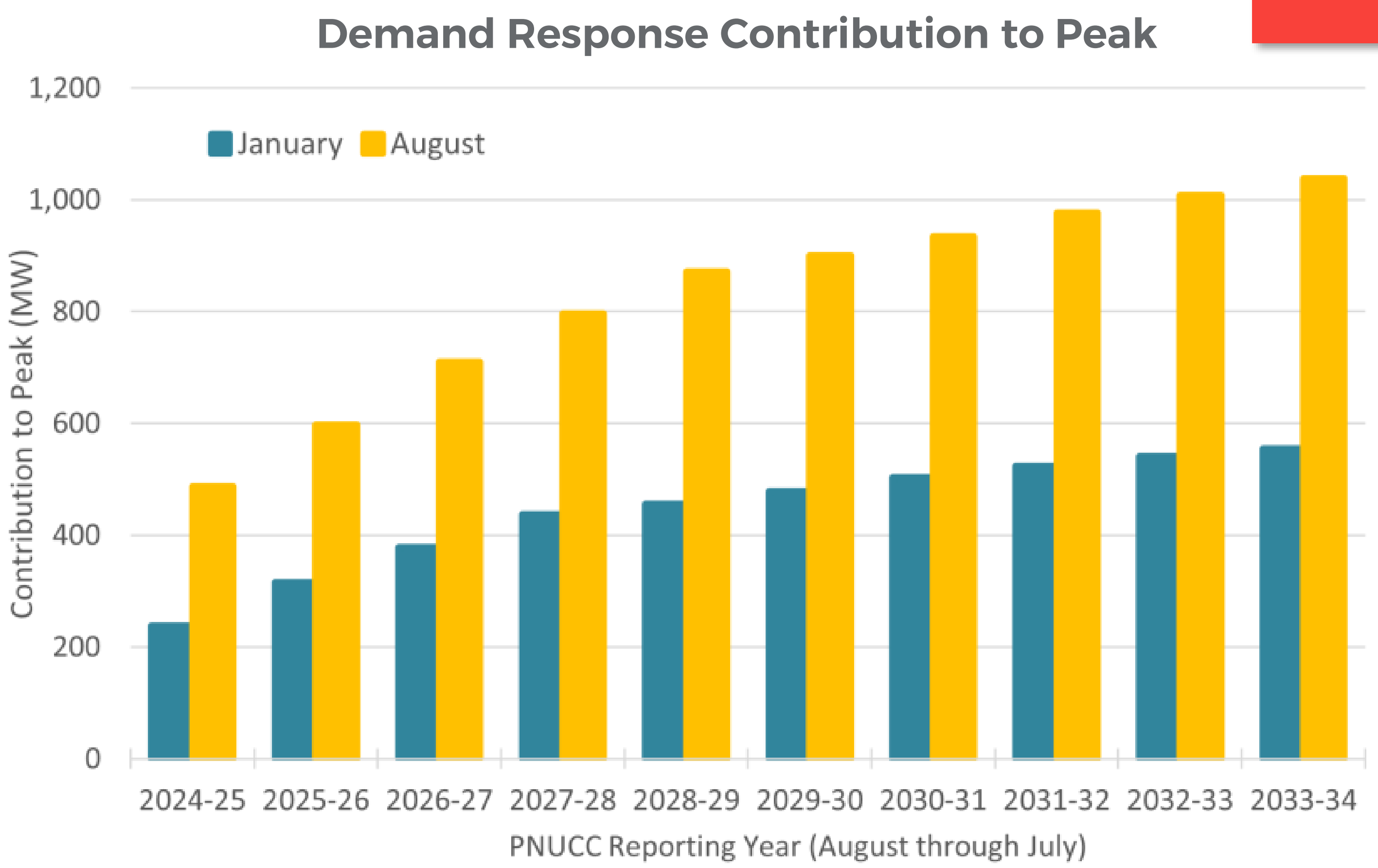


PNUCC
May 2024

Oregon & PGE Context

PGE customer actions resulted in the largest electricity demand-shift in company history during multi-day heat wave

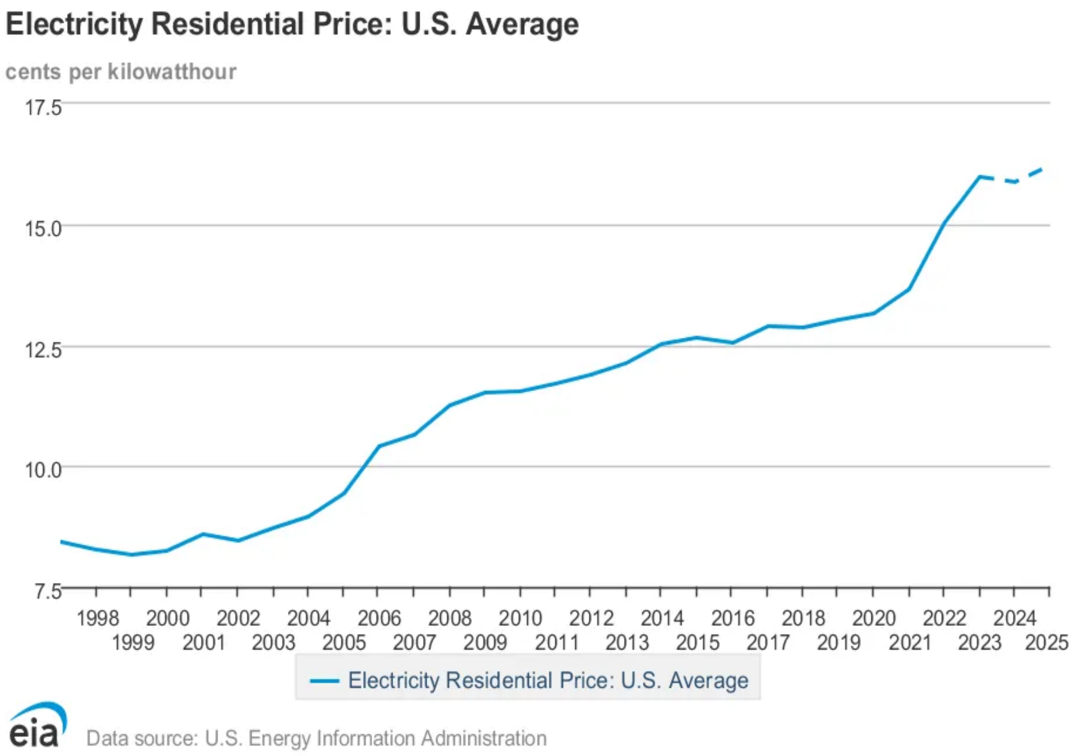
109 MW Reduced, 4 hours

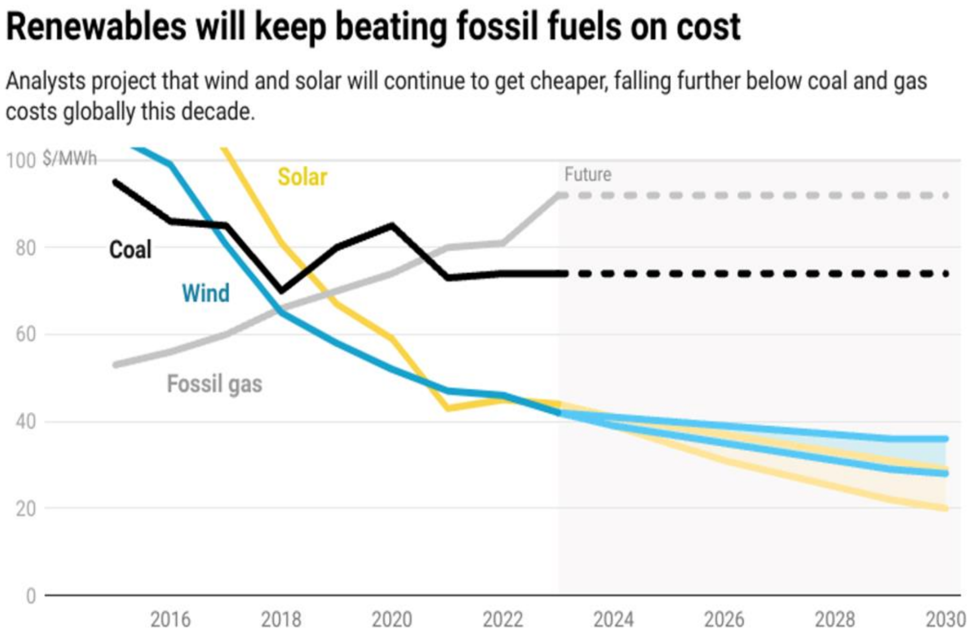


PNUCC
May 2024

Oregon & PGE Context

PGE raised rates 18% in 2024, and is projected to raise it by 7% or more next year. NW gas is also projecting an 18% increase next year.





Credit: RMI via Canary Media

Grid-Interactive Efficient Buildings

Grid-Interactive Efficient Buildings

The Oregon Capitol, framed by cherry blossoms last week, is considered by engineers to be seismically unsafe.
Mason Trinca for The New York Times

The New York Times

The Why…

Usefulness of Performance Metrics

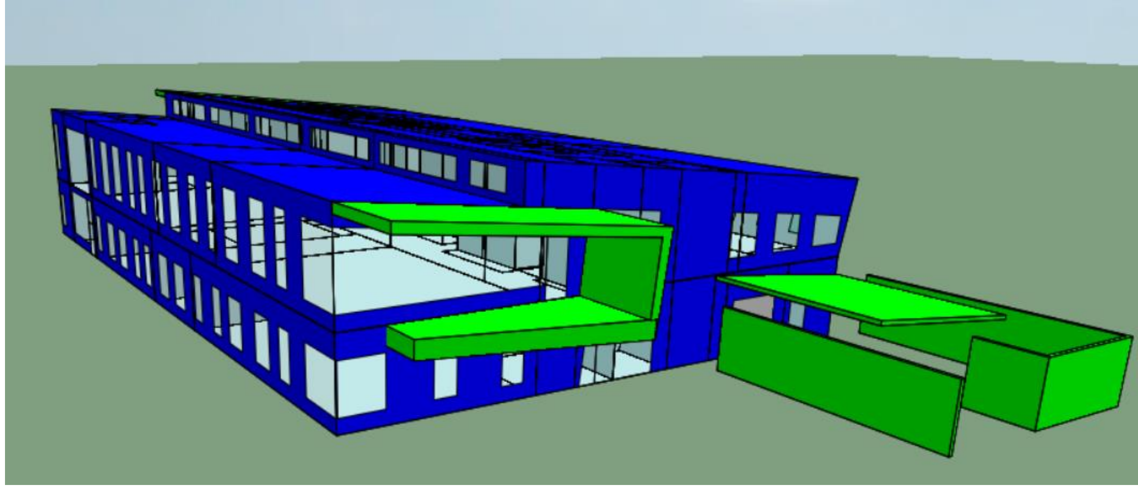
USRC BUILDING RATING SYSTEM	SAFETY	DAMAGE	RECOVERY
★★★★★	Blocking exit paths unlikely	Minimal Damage (<5%)	Immediate to Days
★★★★	Serious injuries unlikely	Moderate Damage (<10%)	Within days to weeks
★★★	Loss of life unlikely	Significant Damage (<20%)	Within weeks to months
★★	Isolated loss of life	Substantial Damage (<40%)	Within months to a year
★	Loss of life likely	Severe Damage (40%+)	More than a year

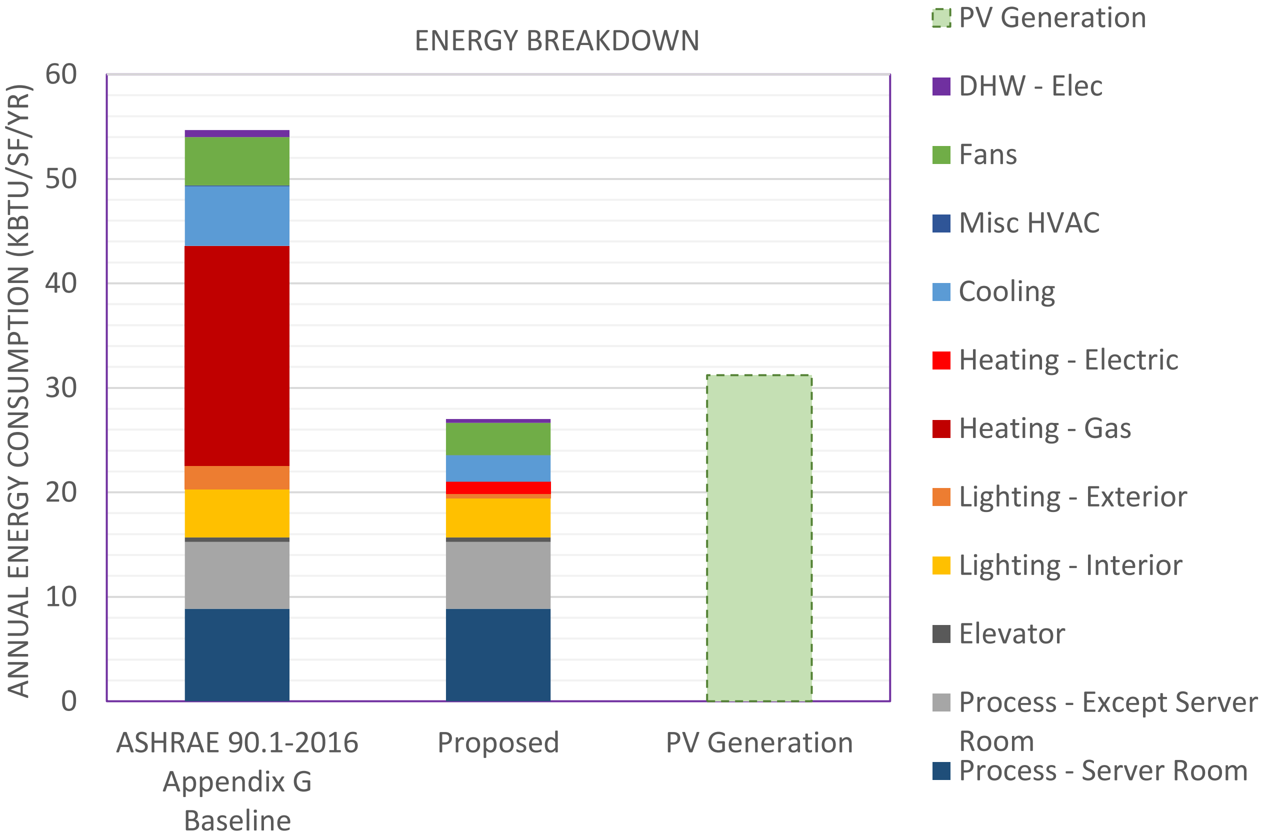
RESILIENCE DESIGN

CODE LEVEL DESIGN

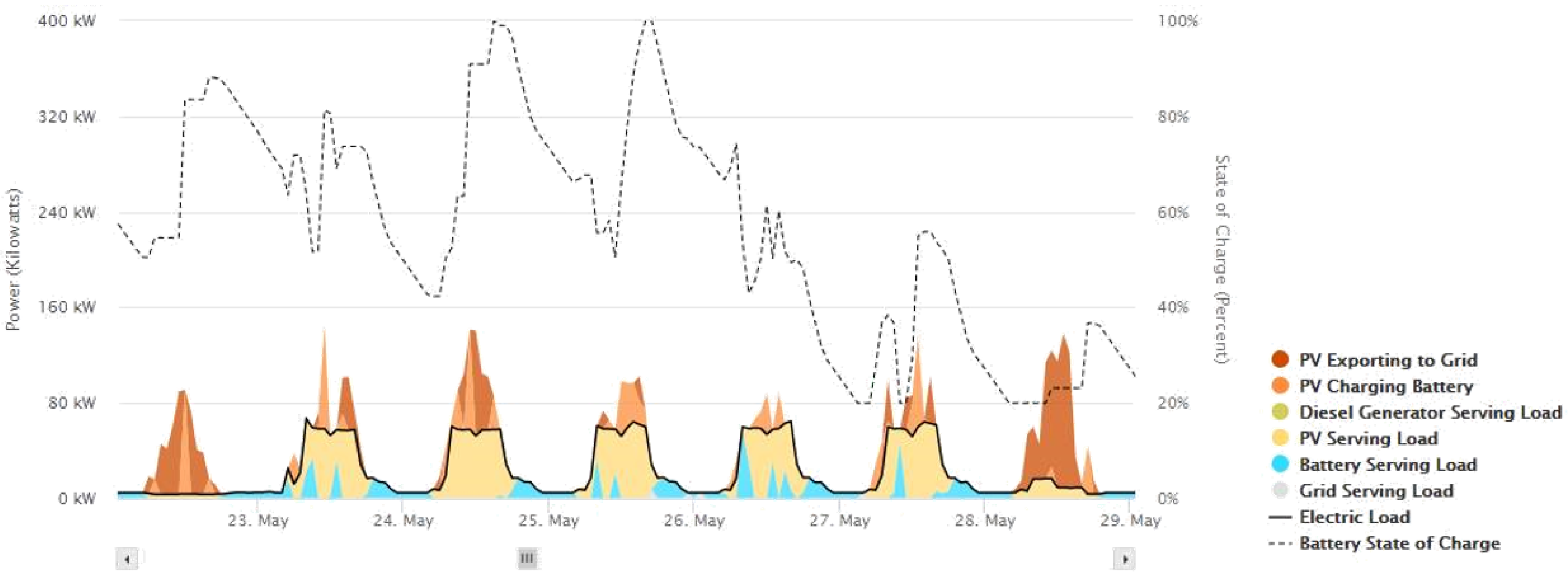
Efficiency is Resilient

- Plug load optimization through purchasing
- Passive design to maximize daylight and mixed mode operations
- All electric design during normal operation
- VRF Heat Pump System
- Server room to radiant floor heat recovery
- DOAS with best available heat recovery
- Designed for NZE operation with a 239kW PV Array





Modeling For Resilience



OREGON
STATE
TREASURY

The New York Times

wsp

What?

Grid Interactive & Efficient Buildings

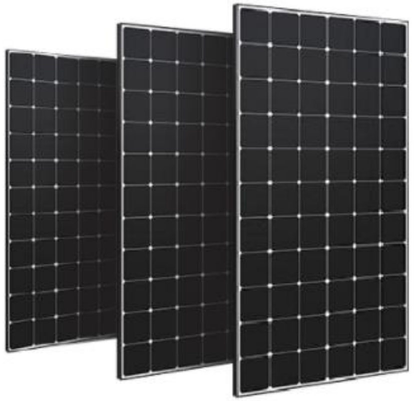
What is a Grid-Interactive Efficient Building?

“ A grid-interactive efficient building (**GEB**) is an energy-efficient building that uses smart end-use equipment and/or other onsite DERs to provide demand flexibility while co-optimizing for energy cost, grid services, and occupant needs and preferences, in a continuous and integrated way. “

wsp

GEB Features

- Battery Energy Storage System (BESS)
- Microgrid Controller
- Diesel Generator
- Solar PV Array
- Flexible building loads
  - Heat pumps, setpoints, critical loads



OREGON STATE TREASURY

What is a Distributed Energy Resource?

Distributed energy resources (**DER**s) are small, modular energy technologies capable of receiving a signal and modifying the electrical load on the grid by generating, storing, or adjusting demand.

DER

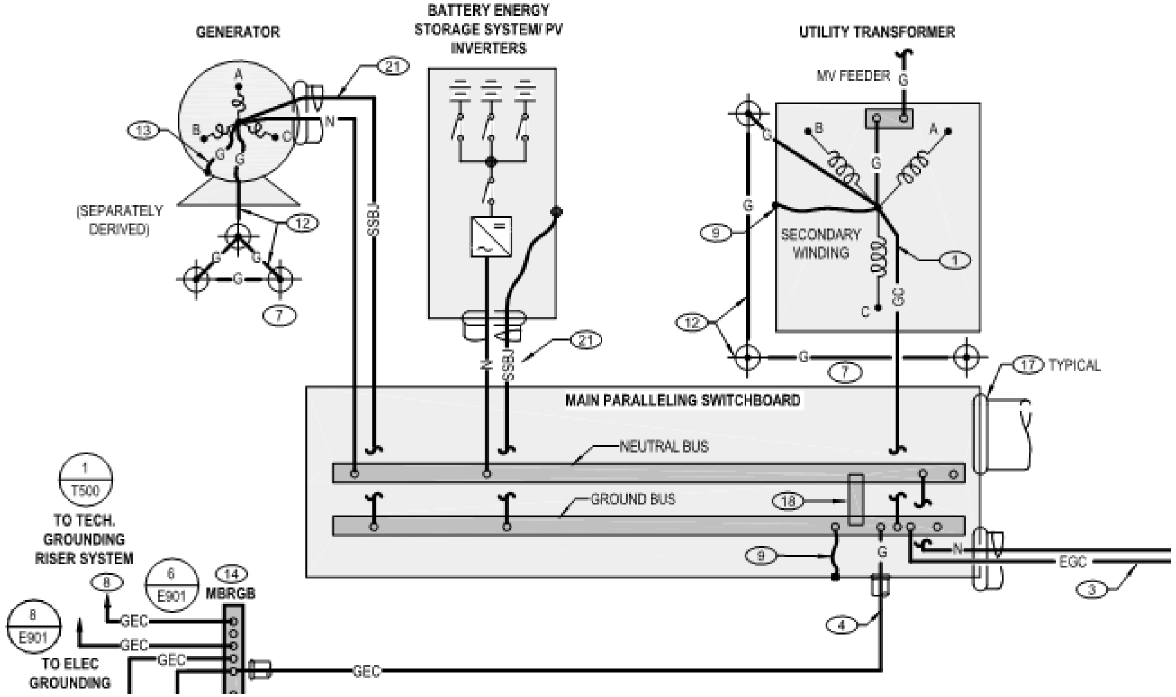
Distributed Energy Resources

Proven Technologies

- Solar PV
- Generators
- Microgrids
- Small scale renewables (wind, hydro, solar-thermal)
- EV charging
- Battery storage
- Thermal storage

Emerging Technologies

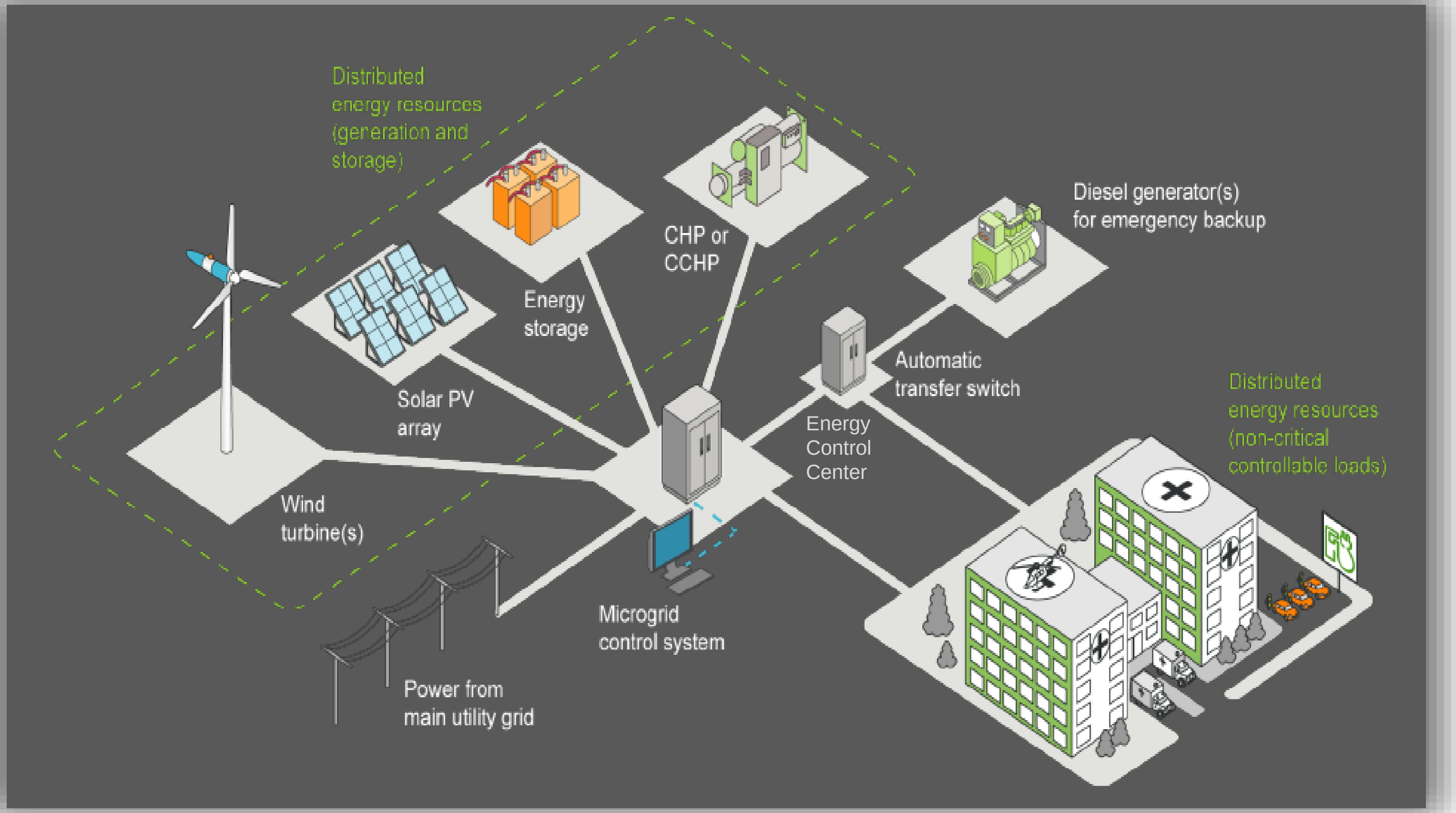
- Hydrogen (fuel cell, or generators)
- SMR Nuclear
- Ice storage
- Phase change
- Demand response
- V2G
- VPPs

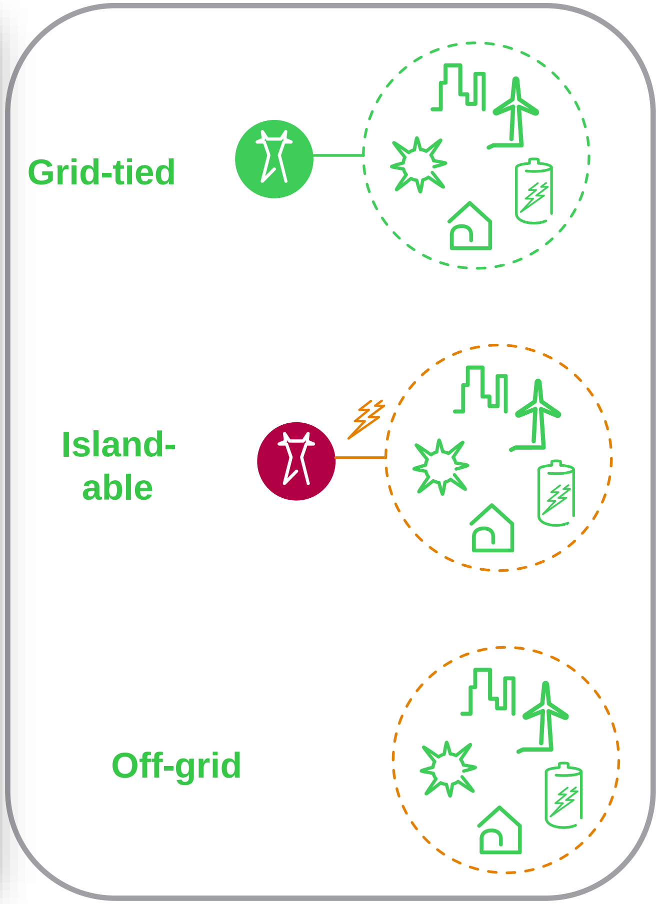


What is a Microgrid?

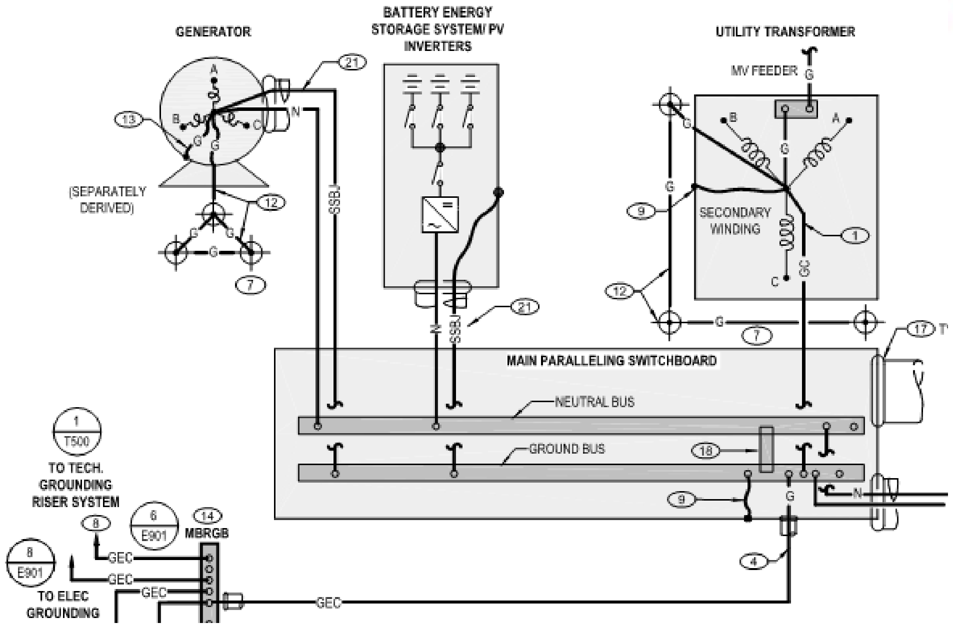
“A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and is capable of islanding. “

Microgrid

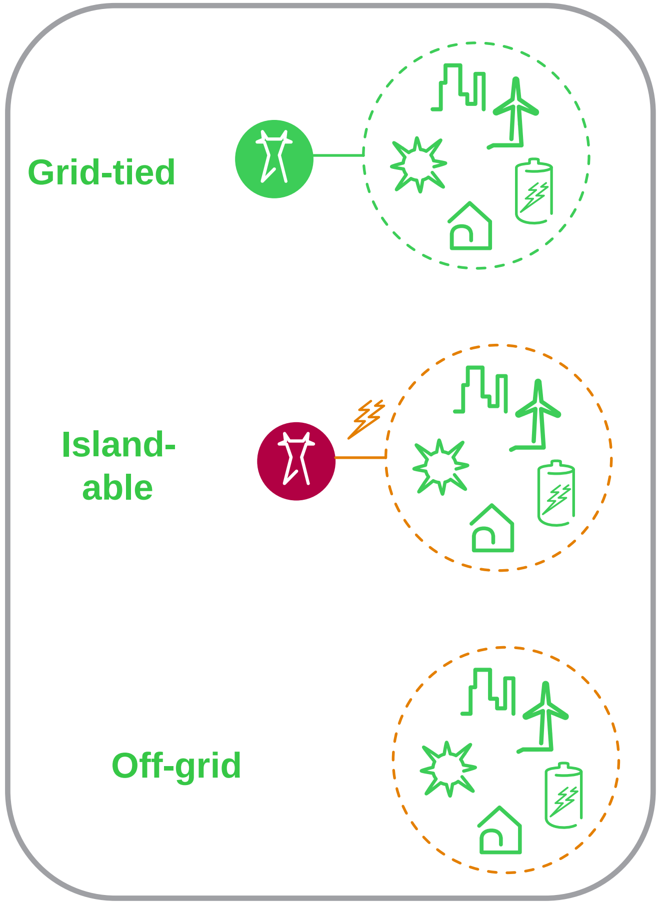

Distributed energy resources (generation and storage)
Energy storage
CHP or CCHP
Diesel generator(s) for emergency backup
Solar PV array
Automatic transfer switch
Energy Control Center
Distributed energy resources (non-critical controllable loads)
Wind turbine(s)
Microgrid control system
Power from main utility grid


Grid-tied
Island-able
Off-grid

Microgrid


GENERATOR
BATTERY ENERGY STORAGE SYSTEM/ PV INVERTERS
UTILITY TRANSFORMER
MV FEEDER
(SEPARATELY DERIVED)
SECONDARY WINDING
MAIN PARALLELING SWITCHBOARD
NEUTRAL BUS
GROUND BUS
SSBJ
TO TECH. GROUNDING RISER SYSTEM
T500
E901
MBRGB
TO ELEC GROUNDING
GEC


Schneider Electric
Energy Control Center


Grid-tied
Island-able
Off-grid

How?

Grid Interactive & Efficient Buildings

Function First Design Approach

Traditional Approach

Choose products

↓

Specify products

↓

Contractor bid/install

↓

Deliver multiple siloed systems

Outcome Oriented Approach

Specify *Use Case* that delivers <u>Value</u> to end user business

↓

Specify supporting applications

↓

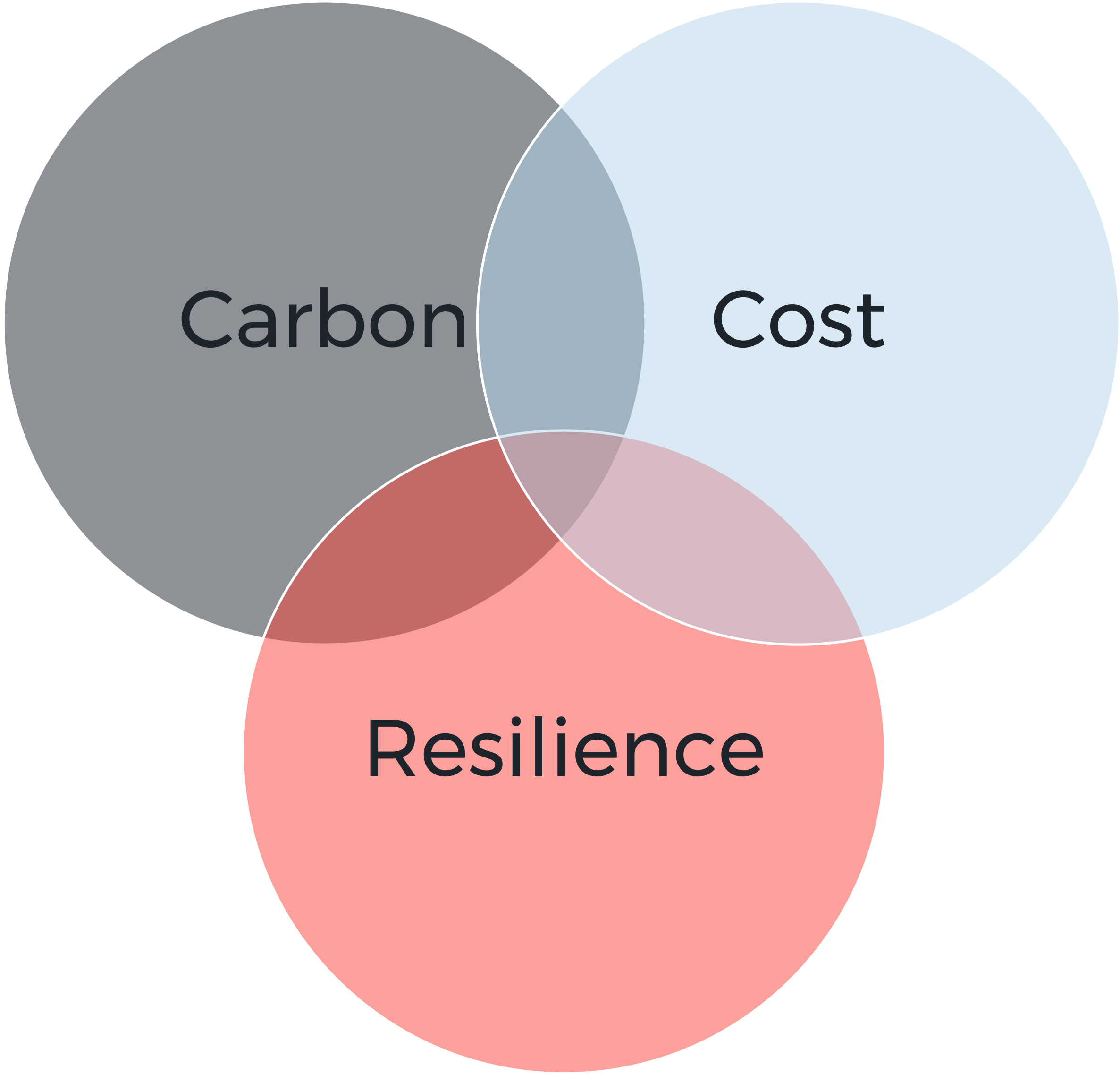
Select supporting products

↓

Deliver integrated system

Establish Goals & Objectives

What are you optimizing for?



Carbon

- Real-time grid emissions intensity
- Peak demand management – shifting or shaving
- Supports a net zero carbon goal

Cost

- Utility rate optimization
- Time of use rates, on-peak / off-peak demand charges
- New variable-rate or other innovative structures/markets

Resilience

- Off-grid functionality is essential
- Mission critical or unstable grid areas
- How much resiliency do I need to maintain while I optimize for cost or carbon?

Design Criteria & Approach

Use Cases
- Optimization (carbon, cost, etc)
- Failure scenarios
- Alternate modes

Generation
- Type (PV, fossil, next gen renewable etc)
- Size
- Intermittency

Storage
- Type (Li, flow, thermal)
- Runtime requirements
- Capacity

Controls
- Smarts (microgrid controller, sequences, etc)
- Levers (DR, flexible loads, setpoints, etc)

Design Criteria & Approach
GEB use cases

COST

Savings $

Monitoring & Forecasting

Demand Charge Reduction

Tariff Management

Self Consumption & “no wire”

Earnings $

Frequency containment Reserve / Fast Frequency regulation

Demand Response

CARBON

Renewable Integration

Export Management

Sharing strategy and fuel saving

RESILIENCE

Back-up power & safety

Off-grid preparedness

Grid connection management

Load shedding

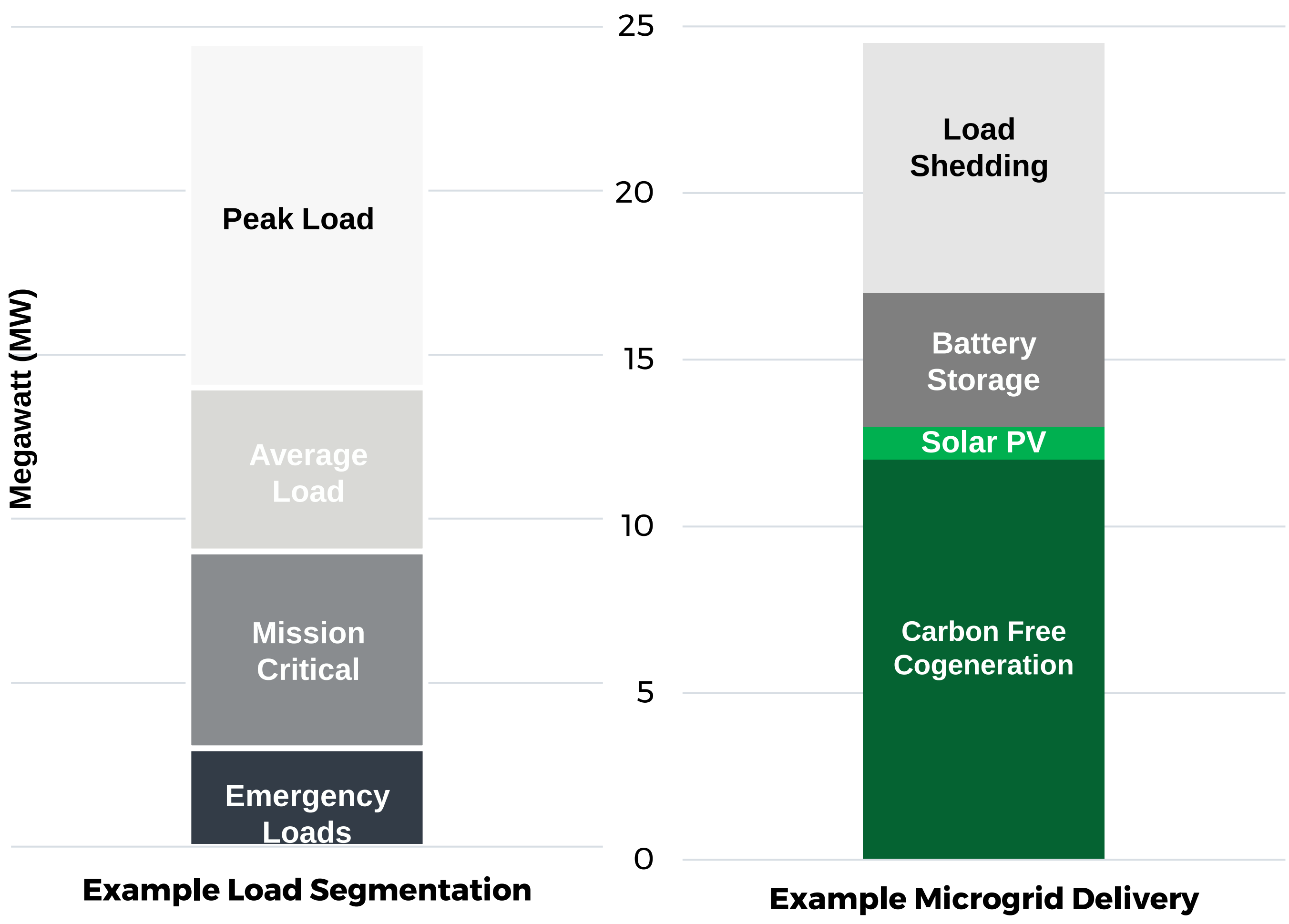
Protection setting management

Understanding Loads is Key for GREBs

Collaboration and Discovery Process:

- Understanding Mission Objectives
- Assess existing assets
- Load Segmentation & Prioritization
- Load Forecasting / Energy Efficiency
- The Impact/Cost of Power Outages to DAF
- Energy Resilience Metrics
- Energy Resilience Plans
- Transition Time / Seamless Islanding

DER's are sized based on emergency critical, average, and peak demands



Design Criteria & Approach

Critical Loads

- Design team workshop to identify and group critical loads into tiers or modes
- Ensure circuiting matches these tiers
- What does resiliency mode look like, DR mode, etc

6. **OPTIONAL STANDBY POWER:**

A. 50% OF THE FACILITY LOAD IS DEEMED CRITICAL AND WILL BE SERVED BY DEDICATED OPTIONAL STANDBY LOAD PANELS.

B. OPTIONAL STANDBY LOADS ARE GROUPED INTO THREE (3) PRIORITY CATEGORIES AND WILL BE SERVED BY DEDICATED BRANCH PANELS FOR METERING PER ASHRAE 90.1-2016 AND TO FACILITATE MANUAL LOAD SHEDDING AS REQUIRED DURING AN EVENT:

a. PRIORITY 1:
- SERVER EQUIPMENT

b. PRIORITY 2:
- PLUG LOADS
- LAN/ PHONE/ IT LOADS
- SECURITY
- IDF EQUIPMENT

c. PRIORITY 3:
- GENERAL HVAC
- IDF HVAC
- SERVER ROOM HVAC

Design Criteria & Approach
Modes of Operation

MICROGRID OPERATIONAL MODES:

1. **NORMAL** (UTILITY SUPPORTED) MODE
   - WITH PEAK DEMAND OFFSET
2. **OFFLINE** (ISLAND) MODE
   - UTILITY FAILURE
3. **TESTING** MODE
   - SYSTEM AND GENERATOR TESTING SCENARIOS
4. **RESILIENCY** MODE
   - MAXIMIZE GENERATOR RUNTIME FOR MULTI-HOUR UTILITY FAILURES
5. **TEMPORARY GENERATOR** MODE
   - PERMANENT PARALLELED GENERATOR IS OFFLINE AND TEMPORARY GENERATOR IS CONNECTED TO MANUAL TRANSFER SWITCH (MTS)
6. **DEMAND RESPONSE** MODE
   - 2-POSITION SWITCH TO ENABLE/ DISABLE ABILITY OF PGE TO USE BESS IN RESPONSE TO A PGE SIGNAL TO REDUCE POWER.
7. **FINANCIAL PAYBACK MODE OR ANTICIPATED RESILENCY** MODE
   - 2-POSITION SWITCH TO SELECT USING BESS TO ENHANCE FINANCIAL PAYBACK OR TO LEAVE BESS FULLY CHARGED READY FOR USE AS BACKUP POWER SOURCE.

Electrical Infrastructure

Components & Controls

- Interconnection sizing, net-metering
- BESS & renewable integration and circuiting
  - Be able to consume, & charge generated energy before selling back to the grid
- Controlling DERs
  - Microgrid controller (*or paralleling switchgear and controller*)*
  - Carefully mapping, and integration to BMS and/or PLC/Scada system
- Synchronizing energy sources
  - Careful attention to sequences when switching power sources

Electrical Infrastructure

Sub-Metering

SkySpark EVERYWHERE

CopperTree Analytics

ENERGY METERING SCHEDULE						
END USE CATEGORY	CT LOCATION	METERED LOAD	VOLTAGE	POLES	CT RATING	DEMAND LOAD (A)
HVAC	MPS-1	{CM} DP-H1	480 V	3	600 A	364 A
HVAC	MPS-1	{CM} DP-HC1	480 V	3	600 A	399 A
HVAC	LC1B-2	{DMU} EF-1-3	120 V	1	20 A	4 A
HVAC	LC1C-1	{DMU} EF-1-4	120 V	1	20 A	4 A
INTERIOR LIGHTING	DP-HC1	{DMU} EGRESS LIGHTING INVERTER	277 V	1	60 A	26 A
HVAC	LC1C-1	{DMU} ELEVATOR SUMP PUMP - ESP-1	120 V	1	25 A	14 A
EXTERIOR LIGHTING	INVERTER	{DMU} EXTERIOR - EGRESS LIGHTING	277 V	1	20 A	4 A
EXTERIOR LIGHTING	HC1	{DMU} EXTERIOR - LIGHTING	277 V	1	20 A	7 A
HVAC	LC1B-2	{DMU} FCU-01-06	208 V	2	20 A	1 A
HVAC	LC1B-2	{DMU} FCU-01-11,12,13, BC 1-03	208 V	2	20 A	5 A
HVAC	LC1B-2	{DMU} FCU-01-24,25,26	208 V	2	20 A	1 A
HVAC	LC1C-1	{DMU} FCU-01-27,30, BC 1-05	208 V	2	20 A	2 A
HVAC	LC1A-A	{DMU} FCU-01-28,29	208 V	2	20 A	4 A
HVAC	LC1A-B	{DMU} FCU-01-28R,29R	208 V	2	20 A	4 A
HVAC	LC2B-2	{DMU} FCU-02-05	208 V	2	20 A	1 A
HVAC	LC1C-1	{DMU} FCU-02-15,16	208 V	2	20 A	2 A
HVAC	LC1C-1	{DMU} FCU-02-17, BC 2-01,05,06	208 V	2	20 A	2 A
HVAC	LC1C-1	{DMU} FCU-02-18,19,20	208 V	2	20 A	3 A
HVAC	LC2B-2	{DMU} FCU-02-23	208 V	2	20 A	1 A
IDF	LC1B-2	{DMU} IDF 133 - 5-20R - RACK	120 V	1	20 A	3 A
IDF	LC1B-2	{DMU} IDF 133 - 5-20R - RACK	120 V	1	20 A	3 A
IDF	LC1B-2	{DMU} IDF 133 - 5-20R - RACK	120 V	1	20 A	3 A
IDF	LC1B-2	{DMU} IDF 133 - L6-30R - RACK	208 V	2	30 A	24 A
IDF	LC1B-2	{DMU} IDF 133 - L6-30R - RACK	208 V	2	30 A	24 A
IDF	LC1B-2	{DMU} IDF 133 - L6-30R - RACK	208 V	2	30 A	24 A
IDF	LC2B-1	{DMU} IDF 223 - 5-20R - RACK	120 V	1	20 A	2 A
	LC2B-1	{DMU} IDF 223 - L6-30R RACK	208 V	2	30 A	24 A
IDF	LC2B-1	{DMU} IDF 223 - L6-30R RACK	208 V	2	30 A	24 A
	LC2B-1	{DMU} IDF 223 - RACK RECEPT	120 V	1	20 A	2 A
IDF	LC2B-2	{DMU} IDF 243 - 5-20R - RACK	120 V	1	20 A	3 A
IDF	LC2B-2	{DMU} IDF 243 - 5-20R - RACK	120 V	1	20 A	3 A
IDF	LC2B-2	{DMU} IDF 243 - L6-30R - RACK	208 V	2	30 A	24 A
IDF	LC2B-2	{DMU} IDF 243 - L6-30R - RACK	208 V	2	30 A	24 A
INTERIOR LIGHTING	HC1	{DMU} LEVEL 1 - LIGHTING	277 V	1	20 A	8 A
INTERIOR LIGHTING	HC1	{DMU} LEVEL 1 - LIGHTING	277 V	1	20 A	7 A
INTERIOR LIGHTING	HC1	{DMU} LEVEL 1 - LIGHTING	277 V	1	20 A	8 A
INTERIOR LIGHTING	LC1B-1	{DMU} LEVEL 1 EAST - LIGHTING	120 V	1	20 A	4 A
INTERIOR LIGHTING	LC1C-2	{DMU} LEVEL 1 WEST - LIGHTING	120 V	1	20 A	6 A
INTERIOR LIGHTING	HC1	{DMU} LEVEL 2 - LIGHTING	277 V	1	20 A	10 A
INTERIOR LIGHTING	HC1	{DMU} LEVEL 2 - LIGHTING	277 V	1	20 A	9 A
INTERIOR LIGHTING	HC1	{DMU} LEVEL 2 - LIGHTING	277 V	1	20 A	11 A
HVAC	LC1C-2	{DMU} P-1	120 V	1	20 A	6 A
HVAC	LC1C-2	{DMU} P-2	120 V	1	20 A	6 A
HVAC	LC1C-2	{DMU} P-3	120 V	1	20 A	6 A
HVAC	LC1C-2	{DMU} P-4	120 V	1	20 A	6 A
SERVER ROOM	DP-HC1	{DMU} XFR-LC1A-A	480 V	3	125 A	35 A
SERVER ROOM	DP-HC1	{DMU} XFR-LC1A-B	480 V	3	75 A	3 A
PLUG LOAD	DP-HC1	{DMU} XFR-LC1B	480 V	3	175 A	164 A
PLUG LOAD	DP-HC1	{DMU} XFR-LC1C	480 V	3	125 A	71 A
PLUG LOAD	DP-H1	{DMU} XFR-LS	480 V	3	125 A	76 A

ENERGY METERING NOTES:

1. METERING SOFTWARE SHALL BE UTILIZED TO ADD AND/ OR SUBTRACT OTHER METERED DATA TO DERIVE ENERGY CONSUMPTION OF THE SPECIFED END USE CATEGORY.
   A. ALL METERS OF THE SAME END USE CATEGORY SHALL BE ADDED TOGETHER TO DERIVE A TOTAL BUILDING LOAD FOR EACH END USE CATEGORY LISTED.
   B. ALL BRANCH CIRCUIT METERS OF A DIFFERENT END USE CATEGORY THAN THE UPSTREAM PANEL AND/ OR TRANSFORMER SERVING THEM SHALL BE SUBTRACTED FROM THE METERED VALUE MEASURED BY THE UPSTREAM METER.
   C. METERED LOADS SHALL NOT BE DOUBLE COUNTED.
2. ALL METERING SYSTEMS SHALL INTEGRATE WITH BMS SYSTEM FOR REMOTE MONITORING OF ALL SOURCES AND END USE CATEGORIES.
3. PARALLELING MICROGRID CONTROLLER GATEWAY SHALL MONITOR ENERGY PRODUCTION FOR EACH SOURCE:
   A. PV
   B. BESS
   C. GENERATOR
   D. UTILITY

All Sub Meters included in CopperTree

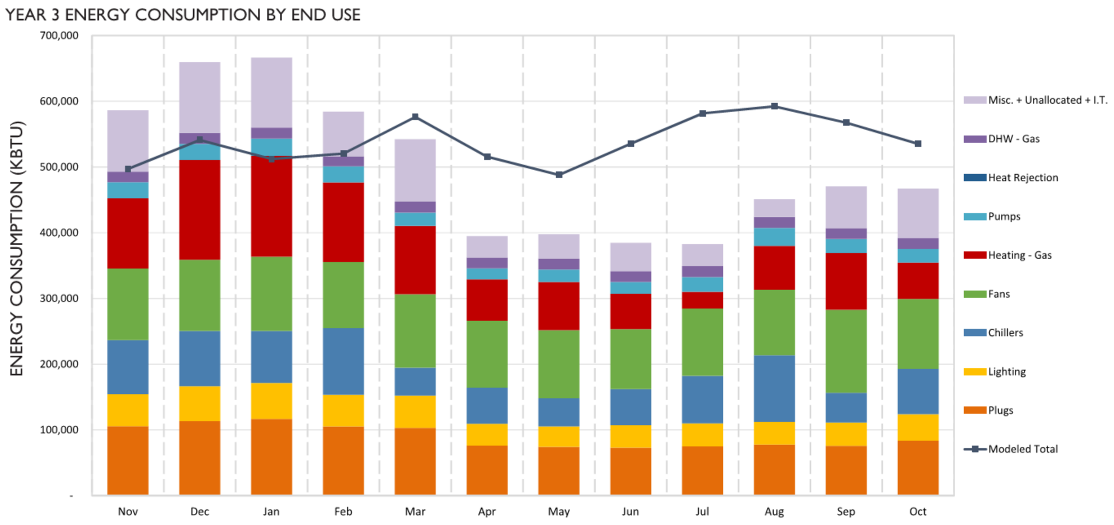
Microgrid components for energy production points / meters

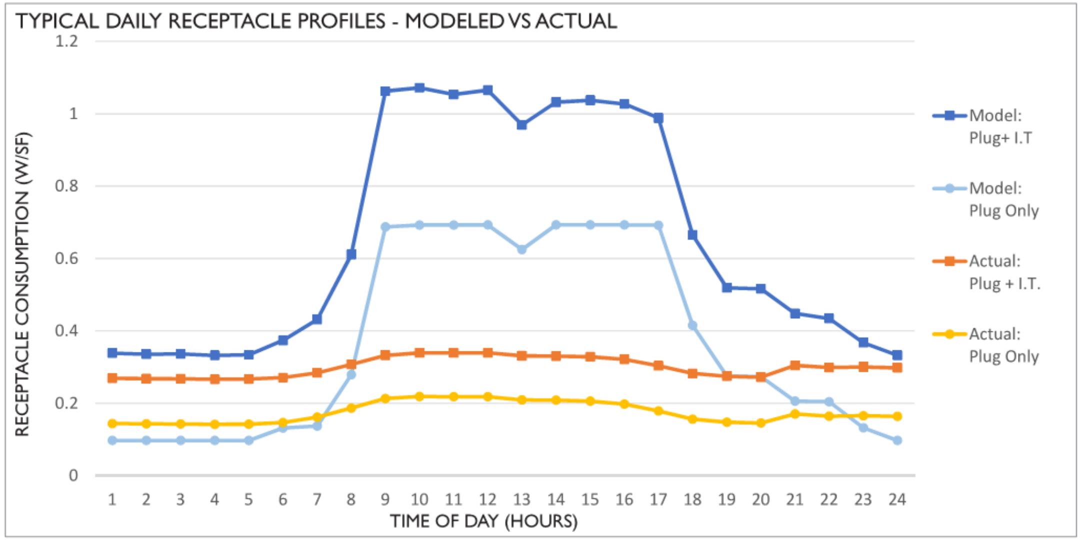
CopperTree to sum sub-meters and BMS calculation by end use. Totals for: Int Lighting, Ext Lighting, Plug, IDF/Server Room, HVAC Fans (zone HVAC), Heating/Cooling VRF, & DHW.

Additional items for CopperTree to map from BMS:

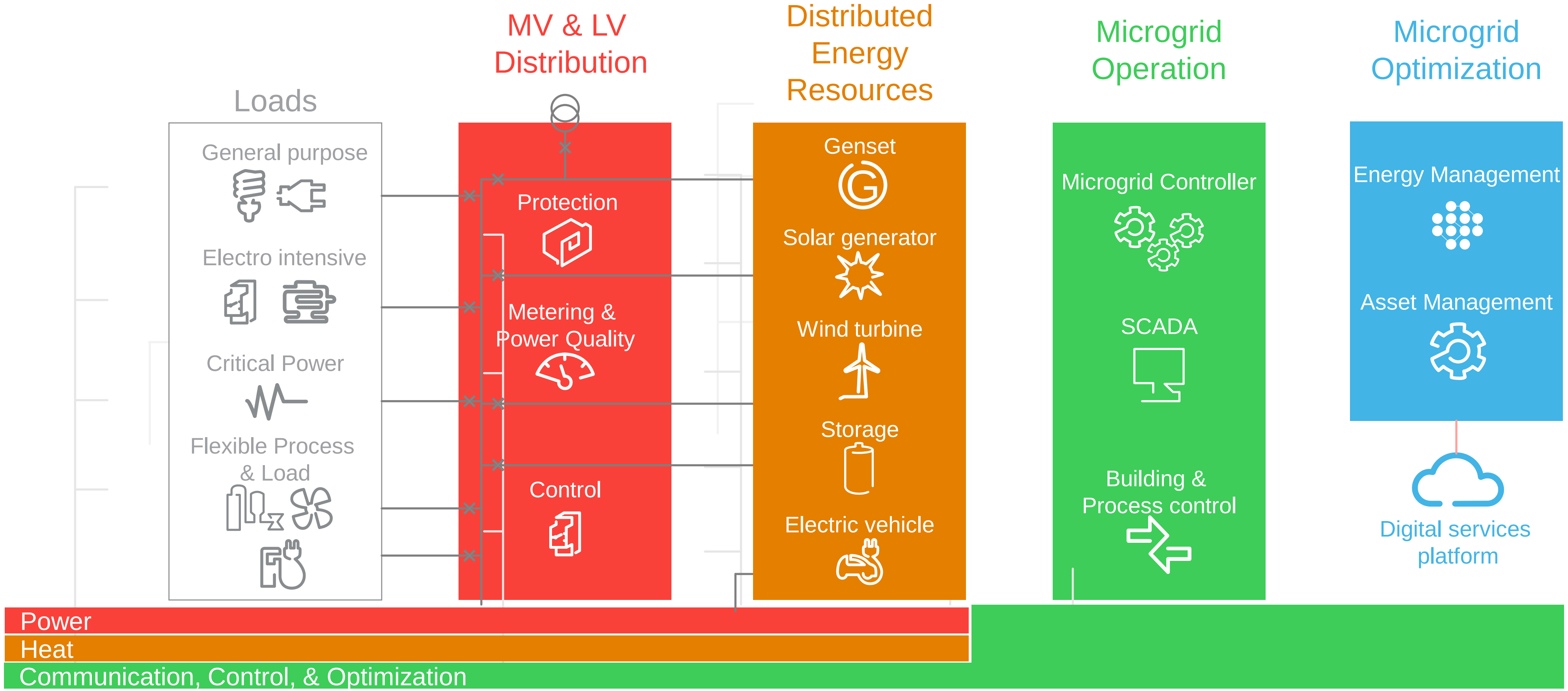
- Weather data (db, wb at minimum)
- DOAS data (CFM, power, SAT, RAT, HR efficiency if possible)
- VRF data (all data available from VRF system. if possible to isolate heating and cooling mode)
- PV Net Meter (production, site use, grid sell-back)
- DHW (power, EWT/LWT, GPM)
- HVAC (setpoints, thermostats, floor level fan power)
- Operable window (open/closed if available)

BMS Points Mapping:
A points mapping exercise will help coordinate this individual BMS points for CopperTree to incorporate from the controls contractor. Will need to determine what points are available from VRF system.

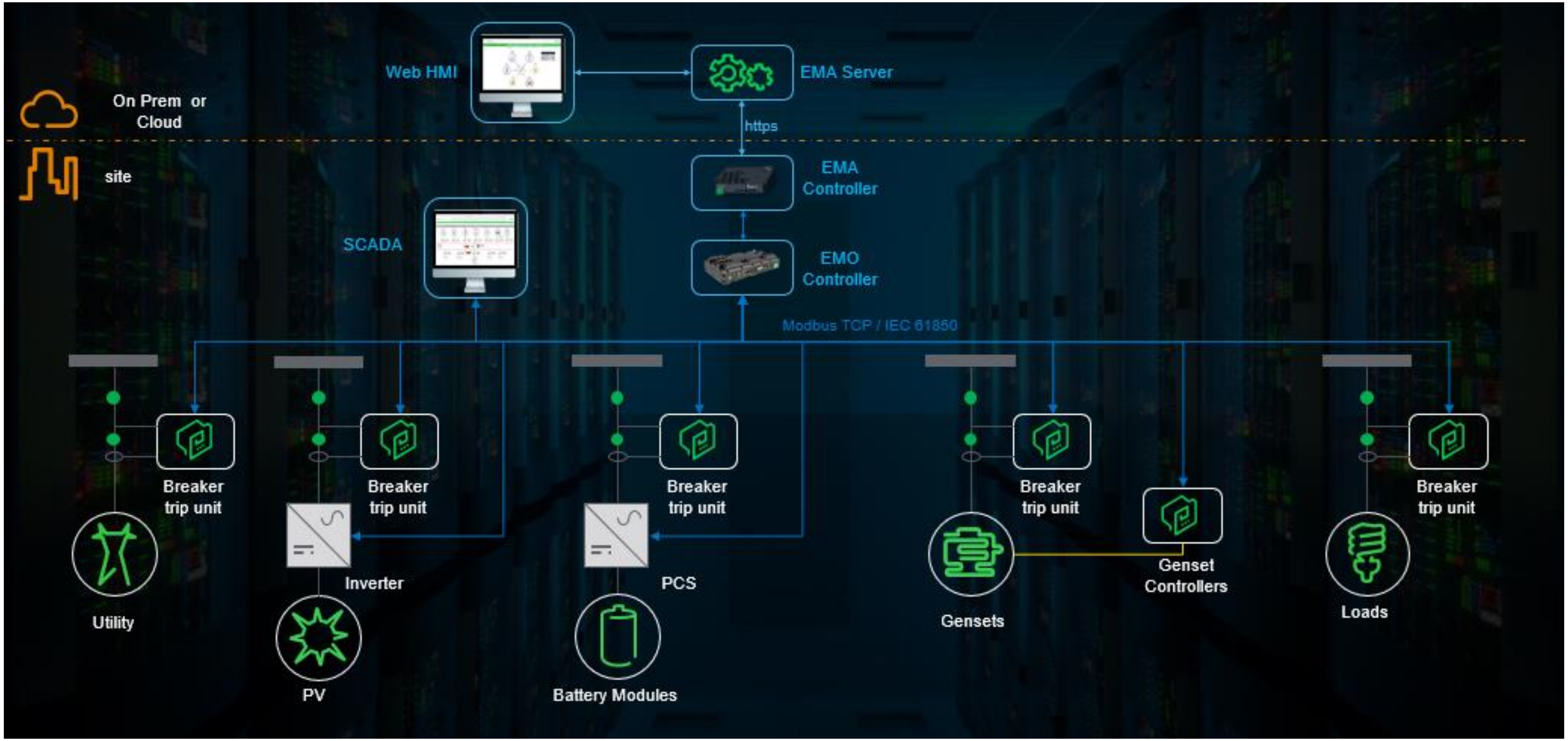




Microgrid Components

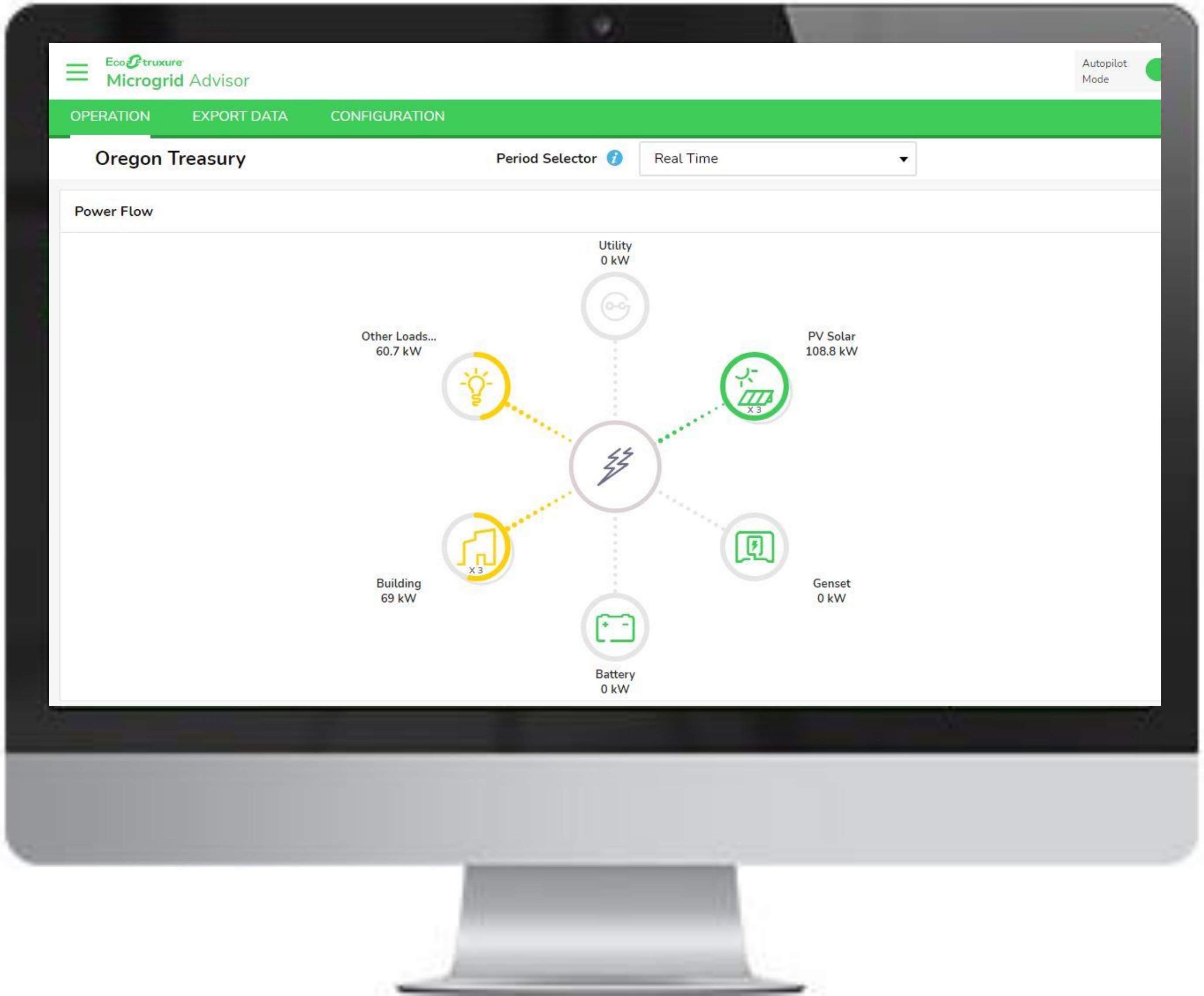


Command and Control Architecture



Grid-Interactive Efficient Buildings

Design Criteria & Approach
Microgrid Controller



Electrical Infrastructure
Control Sequences

- **RESILIENCY MODE**
  A. THIS MODE SHALL OPERATE SAME AS OFFLINE MODE EXCEPT FOR THE FOLLOWING CHANGES:
    - IF THE UTILITY FAILURE LASTS FOR MORE THAN 2-HOURS THAN THE PMC SHALL AUTOMATICALLY ENTER THIS MODE TO INCREASE GENERATOR RUNTIME.
    - GENERATOR MINIMUM LOADING THRESHOLD SHALL BE REDUCED TO 10%, IN LIEU OF 30%.
    - PMC SHALL CLOSE CONTACT MONITORED BY THE BUILDING'S BMS SYSTEM TO CHANGE HVAC SETPOINTS WIDER TO REDUCE HVAC LOADS.
    - PV SYSTEM SHALL BE PRIORITIZED AND CONTROLLED/ UTILIZED TO FULLY CHARGE BESS SYSTEM IN MOST EFFICIENT MANNER/ TIME AS PRACTICAL TO TAKE INTO ACCOUNT ANTICIPATED SOLAR INSOLATION LEVELS.
    - BESS TO BE OPERATED TO LOWER MINIMUM XX% (USER ADJUSTABLE) CAPACITY LEVEL.
    - PMC HMI AND REMOTE DISPLAYS SHALL SHOW GRAPHICALLY THAT THE SYSTEM IS IN RESILENCY MODE (INCREASED RUNTIME).
    - ALARM TEXTS AND EMAILS SHALL BE SENT STATING CURRENT BUILDING LOAD, CURRENT DURATION OF UTILITY FAILURE, DIESEL FUEL LEVEL AND A CALCULATED ESTIMATED SYSTEM RUNTIME REMAINING BASED ON TIME-OF-YEAR SOLAR INSOLATION, ANTICIPATED HOURLY BUILDING LOADS, CURRENT OPERATING MODE AND DIESEL FUEL LEVEL.
    - MICROGRID SWITCHBOARD VENDER SHALL RECOMMEND AND IMPLEMENT OTHER OWNER APPROVED PMC CHANGES TO HELP OPTIMIZE RUNTIME.

Integration

Microgrid 5 Stage Commissioning Process

To provide a clear understanding of what Schneider Electric means by Commissioning, please find five (5) levels of commissioning. This review is for discussion purposes. Please note not all levels may not be included or necessary in every proposal/project. Please review the proposal and reference these definitions to better understand the scope of work included for your specific microgrid project.		Responsible Party
Level 1 Factory Witness Testing	Level 1 commissioning normally takes place at the vendor's facility prior to shipment. Factory Witness testing includes the Customer/Representative traveling to the facility to witness tests conducted to ensure that the equipment is performing to requirements.	Technology Provider
Level 2 Site Acceptance Testing	Level 2 commissioning is executed upon receipt of the equipment at the destination site. The visual inspection is intended to confirm that the right equipment and quantities were received, and that the equipment was not damaged during shipment.	General Contractor
Level 3* Equipment Startup	Level 3 commissioning takes place individually after each piece of equipment has been installed. The equipment startup includes verification of correct installation, as well as energizing the piece of equipment to validate that as a standalone piece of equipment, it functions correctly. Scripts for testing are provided by the equipment supplier. If Level 1 Commissioning, the Factory Witness Test, is not included in the project SOW, the testing at Level 3 replaces it.	Technology Provider(s)
Level 4* Interconnection Test	Level 4 commissioning is performed to verify that the connections, either hardwired or communication based, are operational. Verification of the system interconnections is necessary prior to the start of the Level 5 commissioning.	General Contactor
Level 5* Integrated Systems Test	Level 5 commissioning is testing of the overall integrated system being supplied. The test is of the integrated system functionality of the equipment and controls associated with the project. Creation of the test scripts is performed by the Commissioning Agent at the completion of the engineering phase. Level 5 commissioning includes executing the test scripts that are approved by the customer and/or their Commissioning Agent.	DER / MG CONTROL and Cx Agent working together

**Support by the equipment vendor most likely will be necessary and is expected to be included as necessary in the scope of work of the technology provider or supplier of the equipment.*

Integration

Beyond Commissioning – Integrative System Testing

- Basic commissioning
- Monitor-based commissioning
- Integrative system testing
  - Detailed test of alternate modes, sequences, power switching
  - Data review with operators and stakeholders
  - Extended operator training

Schneider Electric

Grid-Interactive Efficient Buildings

Operator Intervention Planning

Following the successful commissioning and site acceptance testing of a microgrid system, most system owners expect their digitized, autonomous microgrids will provide the economic optimization for the peak costs they are looking to hedge against or keep the lights on during an event that causes community power outages.

Over years of supporting installed microgrids of varying sizes and complexities, we have gained valuable insights into their operation and learned microgrids are…

ACTIVE

…are dynamic systems rather than "set it and forget" pieces of individual equipment

SYSTEM APPROACH

…require a systematic approach to troubleshooting

DYNAMIC

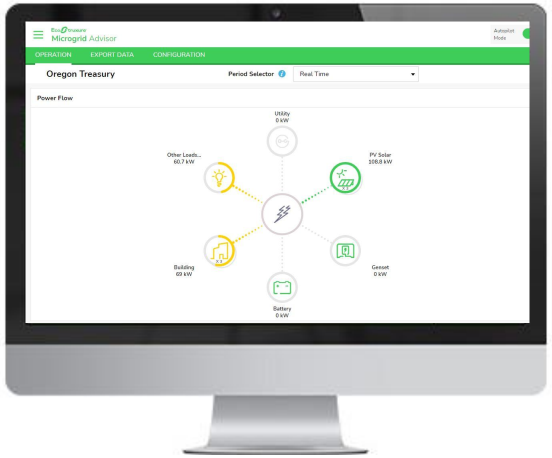
…are all about load and source optimization – both of which change seasonally and over time

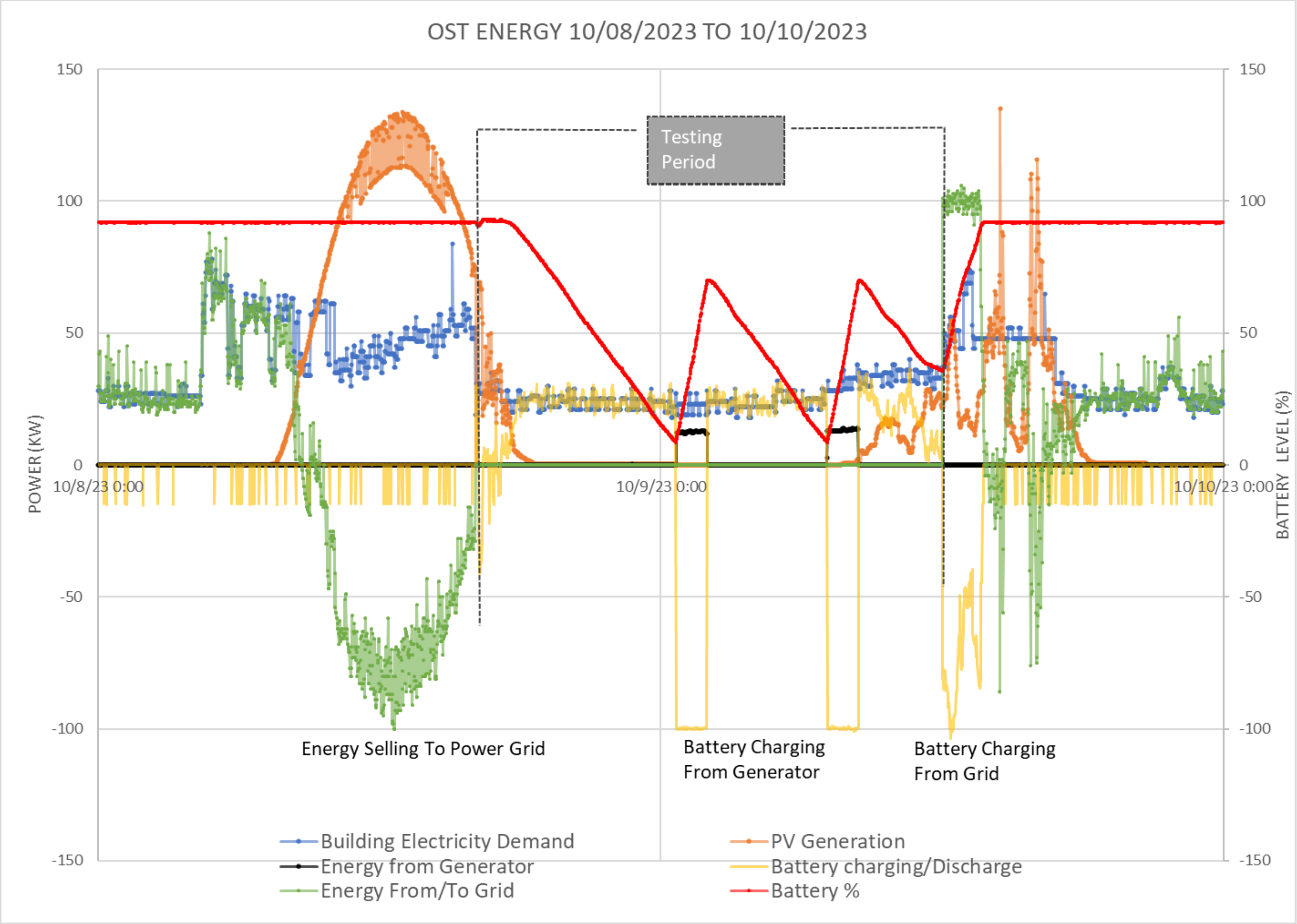
TESTING

…should regularly be tested in all operational modes

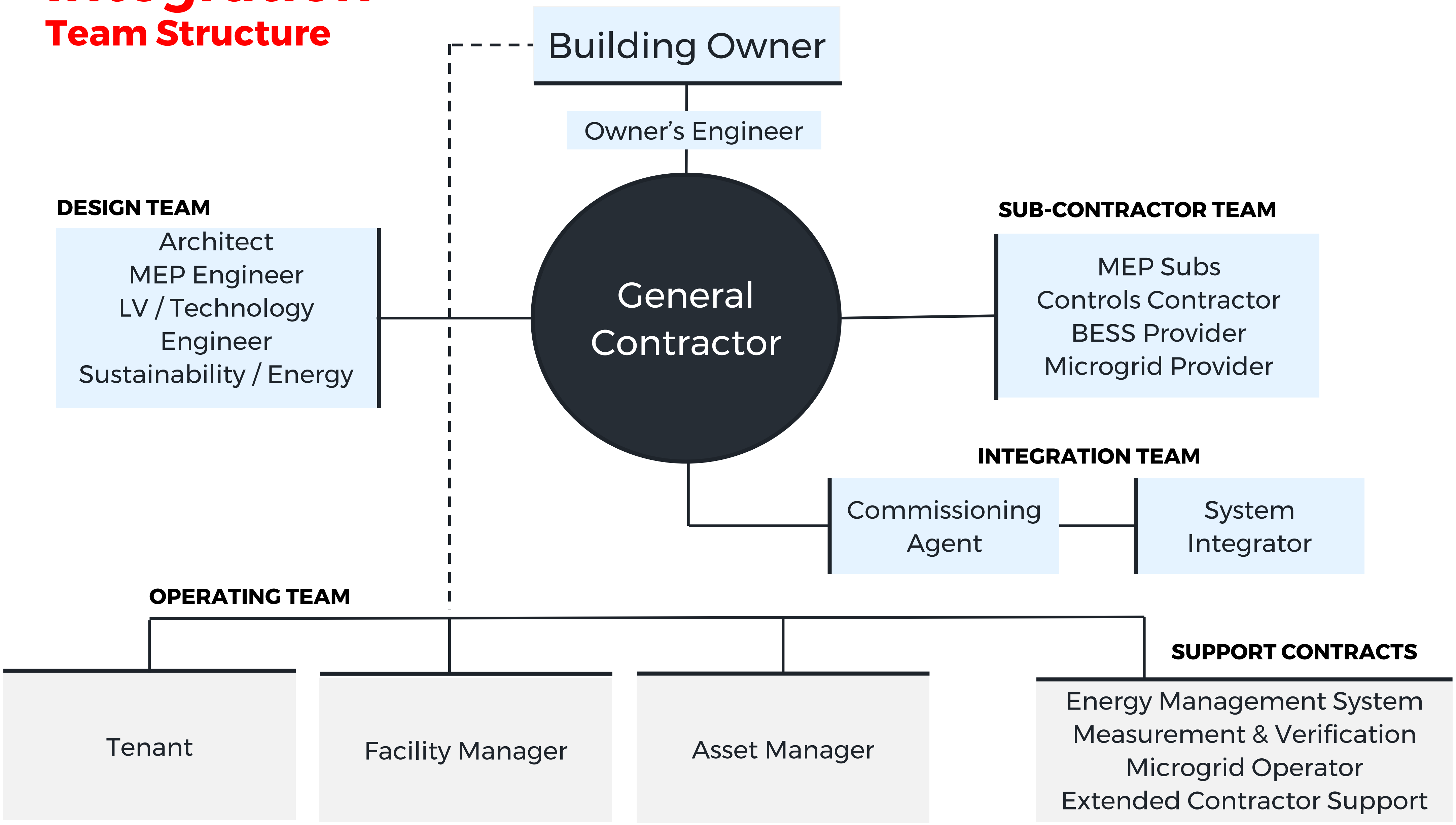
Integration

BESS Test





Integration
Team Structure



Integration

Microgrid 5 Stage Commissioning Process

EcoStruxture Service Plan Microgrids *(aka: Operator Intervention Plans)*

Features			Essential	Advanced	Plus Advanced
Support to Operations	**Troubleshooting and Diagnostics**	Direct Access to Microgrid Technical Experts (Business Hours) – Phone and Email	●	●	●
	Emergency Support	Break-fix on-site intervention: Services Level Agreement - max 8H*			
		Services Level Agreement - max 4H*			
		On-site intervention labor coverage		●	●
Parts	**Repair Parts**	Parts coverage for remedial repairs for Schneider Electric assets		●	●
	Spare Parts	Spare parts purchased and stored on-site available for immediate use			
Monitor**	**Electrical Equipment Monitoring & Alarming**	Continuous 24/7 electrical device monitoring including proactive technical assistance in case of alarms and automatically generated reports		●	●
On-site Maintenance	**Sequence of Operations Test**	System functional testing to confirm operation of software, controls, and assets			●
	Preventative Maintenance	Annual inspection and testing of electrical distribution equipment plus one cycle of de-energized preventative maintenance	●	●	●
Rest of System Support	**Coverage on additional assets**	Preventative maintenance, emergency response and repairs on 3rd party assets including Distributed Energy Resources and EV Chargers			●
	Owners On-site Rep	Schneider Electric Field Project Manager supervision for vendors onsite			
	Standard Operating Procedure Development	Develop and document Standard Operating Procedures and Emergency Operating Procedures for operations and maintenance			

- 1-, 3-, and 5-Year options available
- All plans are customizable
- Additional services can be added

** Prior validation of eligibility required based on system assets and location*

***Currently only for electrical distribution assets*

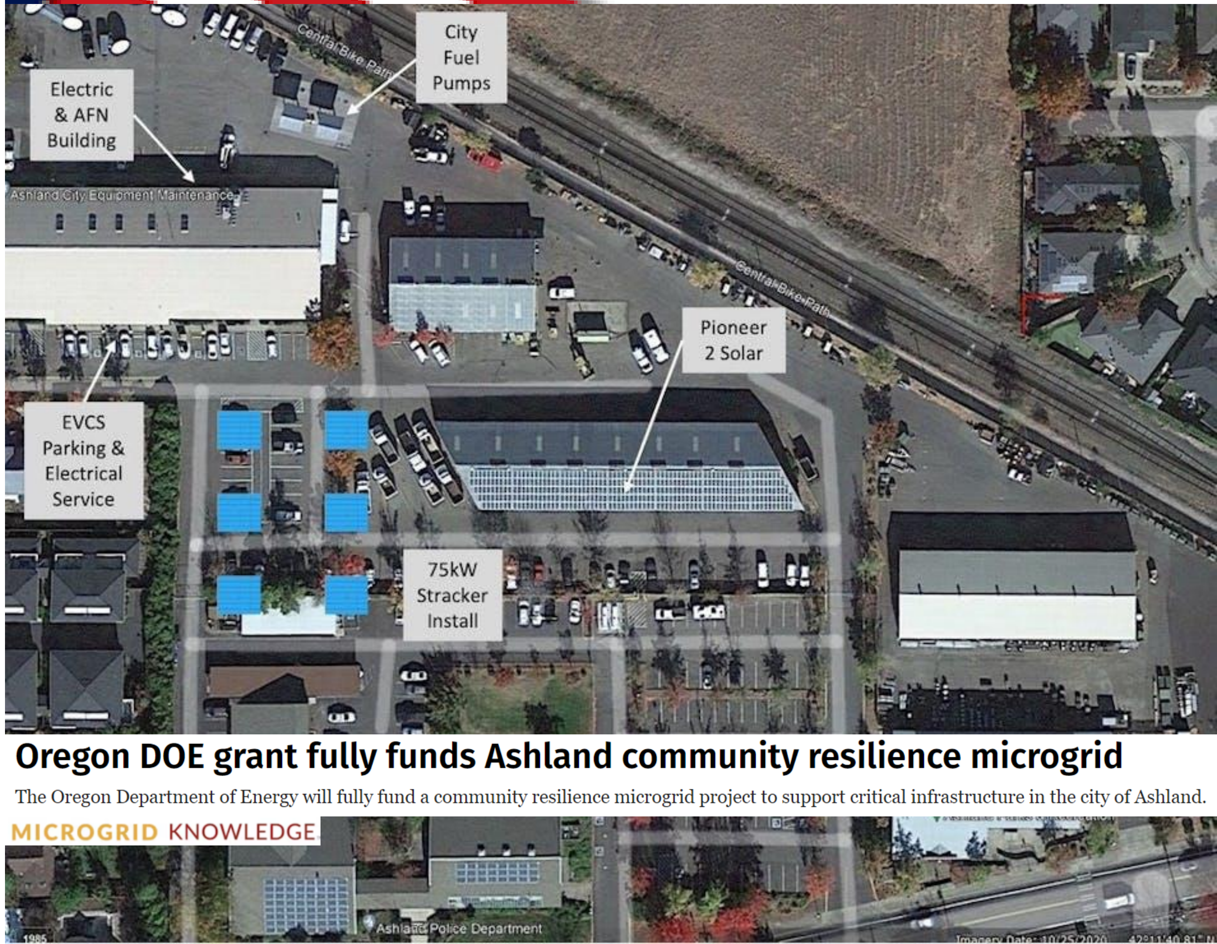
wsp

The Business Case

Revenue Streams

- ETO, DOE, and other local rebates/grants
- Inflation Reduction Act
  - Section 45X
    - Advanced Manufacturing
    - Production Credit
  - 30-40% ITC for solar PV, batteries, microgrid controllers, and other sustainable infrastructure

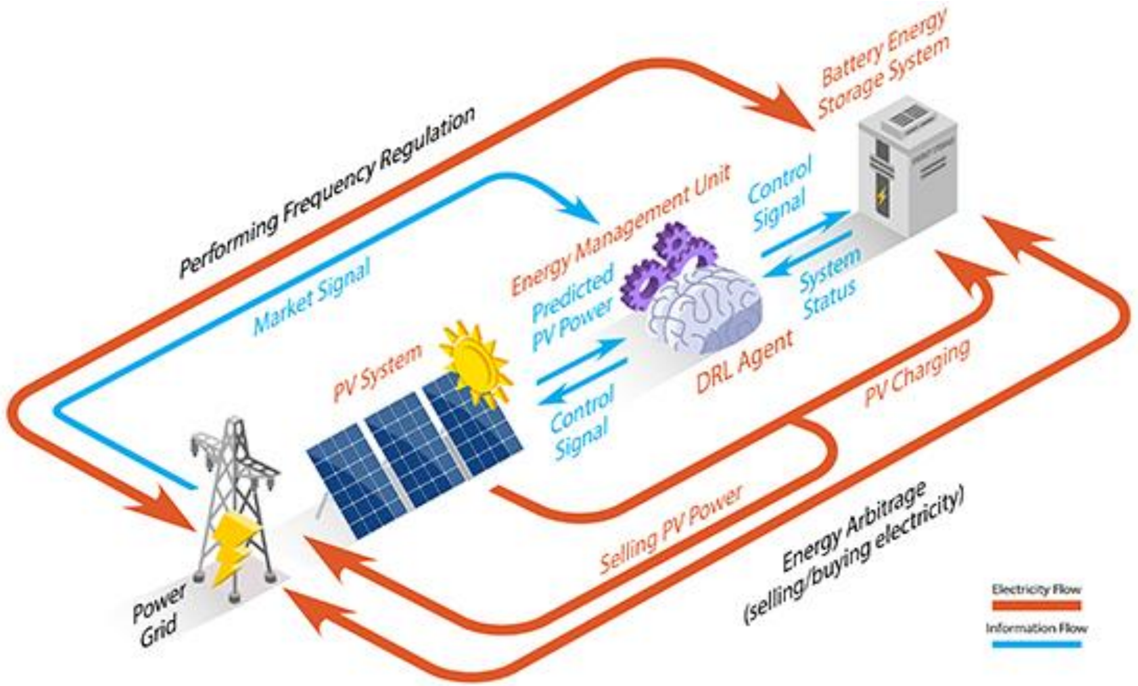
Energy Trust of Oregon

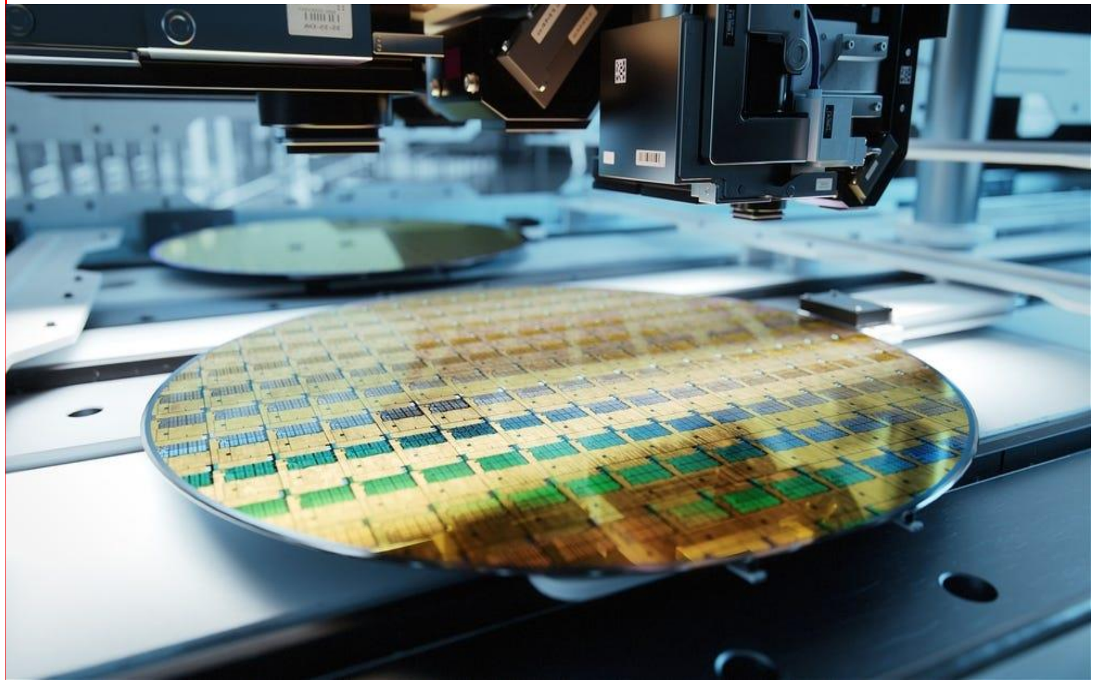


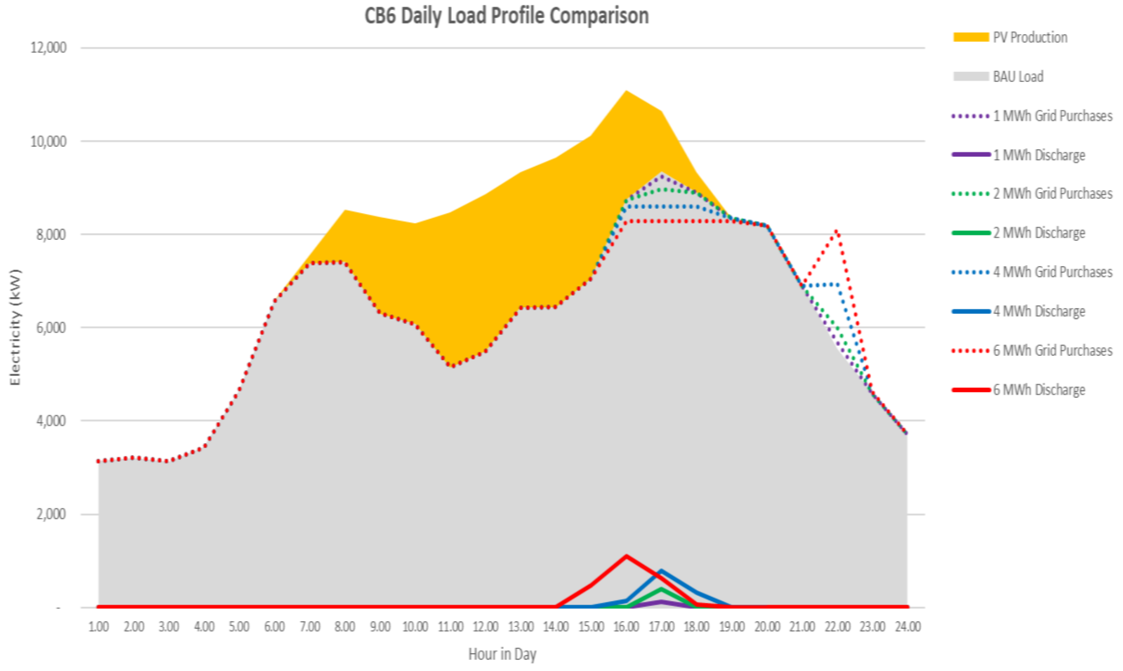
The Business Case

Revenue Streams

- Peak shaving (avoided demand charges)
- Energy arbitrage
- Business continuity and uptime (manufacturing, mission critical, etc)
- Energy efficiency (avoided consumption)
- Renewable energy production



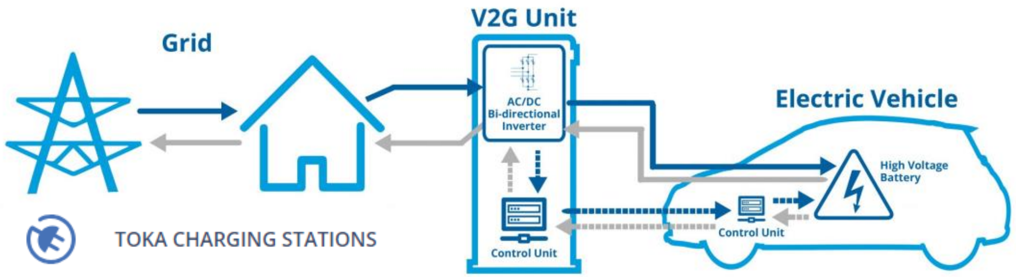




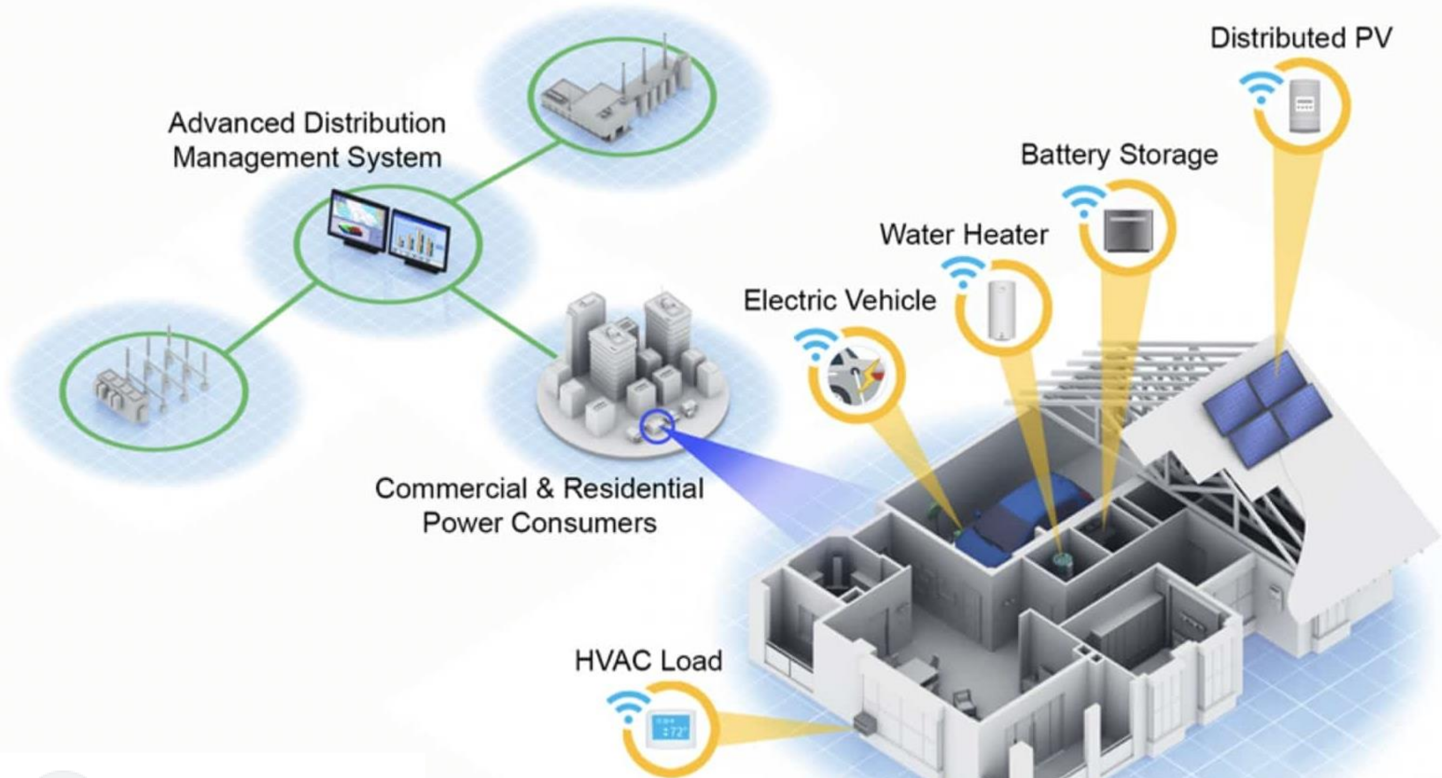
Grid-Interactive Efficient Buildings

What's Next?

Electrical Infrastructure



- AI
- V2G
- Other DER configurations & controls
- VPPs
- Others?



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THANK YOU!