IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-1: ***Please refer to the Company Response to JI 1-31.***

a. Please provide the avoided cost values which were provided by the ACES Power Marketing forward market price curves for MISO Zone 6, referenced in JI 1-31a.

b. Please indicate if the avoided cost values from the ACES Power Marketing forward market price curves are for energy or capacity.

c. Please clarify if the values provided in the Company response to JI 1-31.b.i are avoided energy costs or retail energy costs.

d. Please identify the cost effectiveness tests that used the avoided cost values provided in the Company response to JI 1-31.b.i.

RESPONSE:

a. Please see Big Rivers' response to Commission Staff's Request No. 2-7(a).

b. The avoided costs values from ACES are separated into energy and capacity values.

c. The ACES energy and capacity values represent avoided costs of power. Residential and non-residential retail energy values are also used to represent avoided energy costs for end-user participants. See Big Rivers' response to the Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 1-31.

d. The cost-effectiveness tests used in the potential study are the Total Resource Cost, Utility Cost, and Participant Cost.

Witness: Joshua Hoyt (Clearspring Energy Advisors, LLC)

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-2: ***Please provide copies of the "customized residential and non-residential sector-level potential assessment Excel models" referenced on page 75 of the Big Rivers 2023 IRP.***

RESPONSE: Big Rivers objects to this request as unduly burdensome, overly broad, and because it seeks information beyond that which would be relevant to the scope of this proceeding. The residential and non-residential sector-level potential assessment Excel models are proprietary models developed by Clearspring Energy Advisors, LLC for use in connection with its provision of services to its utility clients but not made available to Big Rivers or any other parties outside of Clearspring Energy Advisors, LLC. A detailed description of the methodology, including formulas used, is included in the Demand-Side Management Potential Study, Section 2.6, Demand-Side Potential Approach at pages 2-9, in Appendix B of the Big Rivers 2023 IRP.

Witness: Joshua Hoyt (Clearspring Energy Advisors, LLC)

For the Objections(s): Counsel

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-3: ***Please refer to page E-2 of the Demand-Side Management Potential Study, "Identification of Opportunities."***

a. Please provide the qualitative screening criteria used to evaluate measures.

b. For each measure that was eliminated from the study through this qualitative screening, please provide the reason for elimination. A response is not required for gas-only measures.

RESPONSE:

a. Please refer to the Demand-Side Management Potential Study, section 2.4.1 at pages 2-8, in Appendix B of Big Rivers' 2023 IRP.

b. Please see the attachment to this response.

Witness: Joshua Hoyt (Clearspring Energy Advisors, LLC)

Qualitative Screening Results - Residential
Big Rivers Electric Corporation

	Class	Category	Measure				Qualitative	Notes
1	Residential	Appliance	ENERGY STAR and CEE Tier 2 Refrigerator	IL	2021	E	Pass	
2	Residential	Appliance	ENERGY STAR Clothes Dryer	IL	2021	E	Pass	
3	Residential	Appliance	ENERGY STAR Clothes Washers	IL	2021	E&G	Pass	
4	Residential	Appliance	ENERGY STAR Dehumidifier	IL	2021	E	Pass	
5	Residential	Appliance	ENERGY STAR Dishwasher	IL	2021	E&G	Pass	
6	Residential	Appliance	ENERGY STAR Freezer	IL	2021	E	Pass	
7	Residential	Appliance	ENERGY STAR Water Coolers	IL	2021	E	Pass	
8	Residential	Appliance	Fuel Switching: Electric Clothes Dryer to Gas Clothes Dryer	PA	2021	E	Fail	Utility match
9	Residential	Appliance	Ozone Laundry	IL	2021	G	Fail	Utility match
10	Residential	Appliance	Refrigerator and Freezer Recycling	IL	2021	E	Pass	
11	Residential	HVAC	Advanced Thermostats	IL	2021	E&G	Pass	
12	Residential	HVAC	Air Handler Filter Whistles	PA	2021	E	Pass	
13	Residential	HVAC	Air Source Heat Pump	IL	2021	E&G	Pass	
14	Residential	HVAC	Boiler Pipe Insulation	IL	2021	G	Fail	Utility match
15	Residential	HVAC	Boiler Reset Controls	IL	2021	G	Fail	Utility match
16	Residential	HVAC	Central Air Conditioner Tune-Up	IA	2020	E	Pass	Combine with HVAC Tune-Up
17	Residential	HVAC	Central Air Conditioning	IL	2021	E	Pass	
18	Residential	HVAC	Central Air Source Heat Pump Tune-Up	IA	2020	E	Pass	Combine with HVAC Tune-Up
19	Residential	HVAC	Duct Insulation and Sealing	IL	2021	E&G	Pass	
20	Residential	HVAC	Ductless Heat Pumps	IL	2021	E&G	Pass	
21	Residential	Appliance	ENERGY STAR Air Purifier/Cleaner	IL	2021	E	Pass	
22	Residential	HVAC	ENERGY STAR and CEE Tier 2 Room Air Conditioner	IL	2021	E	Pass	
23	Residential	HVAC	ENERGY STAR Ceiling Fan	IL	2021	E	Pass	
24	Residential	HVAC	Furnace Blower Motor	IL	2021	E&G	Pass	
25	Residential	HVAC	Gas High Efficiency Boiler	IL	2021	G	Fail	Utility match
26	Residential	HVAC	Gas High Efficiency Combination Boiler	IL	2021	G	Fail	Utility match
27	Residential	HVAC	Gas High Efficiency Furnace	IL	2021	G	Fail	Utility match
28	Residential	HVAC	Geothermal Source Heat Pump Tune-Up	IA	2020	E	Pass	Combine with HVAC Tune-Up
29	Residential	HVAC	Ground Source Heat Pump	IL	2021	E&G	Pass	
30	Residential	HVAC	GSHP Desuperheaters	PA	2021	E	Pass	
31	Residential	HVAC	High Efficiency Bathroom Exhaust Fan	IL	2021	E	Pass	
32	Residential	HVAC	HVAC Tune-up	IL	2021	E	Pass	
33	Residential	HVAC	Programmable Thermostats	IL	2021	E&G	Fail	Better Measure
34	Residential	HVAC	Residential Energy Recovery Ventilator	IL	2021	E&G	Pass	
35	Residential	HVAC	Residential Furnace Tune-Up	IL	2021	E&G	Pass	Combine with HVAC Tune-Up
36	Residential	HVAC	Room Air Conditioner Recycling	IL	2021	E	Pass	
37	Residential	HVAC	Whole House Fan	IA	2020	E	Pass	
38	Residential	Lighting	Connected LED Lamps	IL	2021	E	Pass	
39	Residential	Lighting	Holiday String Lighting	IL	2021	E	Pass	
40	Residential	Lighting	LED Exit Signs	IL	2021	E	Fail	See Non-residential lights
41	Residential	Lighting	LED Fixtures	IL	2021	E	Pass	
42	Residential	Lighting	LED Nightlights	IL	2021	E	Pass	
43	Residential	Lighting	LED Screw Based Omnidirectional Bulbs	IL	2021	E	Pass	
44	Residential	Lighting	LED Specialty Lamps	IL	2021	E	Pass	
45	Residential	Load Mgmt	Air Conditioner Cycling - 100%			E	Pass	
46	Residential	Load Mgmt	Air Conditioner Cycling - 25%			E	Pass	
47	Residential	Load Mgmt	Air Conditioner Cycling - 50%			E	Pass	
48	Residential	Load Mgmt	Battery Storage			E	Pass	
49	Residential	Load Mgmt	Direct Load Control and Behavior-Based Demand Response Programs	PA	2021	E&G	Pass	
50	Residential	Load Mgmt	Level 2 Electric Vehicle Charger	IL	2021	E	Pass	
51	Residential	Load Mgmt	Peak Time Rebate Program			E	Pass	
52	Residential	Load Mgmt	Water Heater Cycling - 100%			E	Pass	
53	Residential	Load Mgmt	Water Heater Cycling - 25%			E	Pass	
54	Residential	Load Mgmt	Water Heater Cycling - 50%			E	Pass	
55	Residential	Other	Advanced Power Strip - Tier 1	IL	2021	E	Pass	
56	Residential	Other	Advanced Power Strips - Tier 2 Residential AV	IL	2021	E	Pass	
57	Residential	Other	ENERGY STAR Manufactured Homes	PA	2021	E&G	Fail	Can be delivered via individual programs
58	Residential	Other	ENERGY STAR Office Equipment	PA	2021	E	Fail	Market transformation
59	Residential	Other	Fuel Switching: Electric Heat to Gas/Propane/Oil/Heat	PA	2021	E	Fail	Utility match
60	Residential	Other	Gas Fireplace	IA	2020	G	Fail	Utility match
61	Residential	Other	High Efficiency Pool Pumps	IL	2021	E	Fail	Low market potential
62	Residential	Other	Home Energy Reports	PA	2021	E&G	Fail	Behavioral / Difficult to Monitor
63	Residential	Other	Pool Covers	IL	2021	E&G	Fail	Low market potential
64	Residential	Other	Residential New Construction	PA	2021	E&G	Pass	
65	Residential	Building Shell	Air Sealing	IL	2021	E&G	Pass	
66	Residential	Building Shell	Basement Sidewall Insulation	IL	2021	E&G	Pass	
67	Residential	Building Shell	Ceiling/Attic Insulation	IL	2021	E&G	Pass	
68	Residential	Building Shell	Floor and Rim Joist Insulation	PA	2021	E&G	Pass	
69	Residential	Building Shell	Floor Insulation Above Crawlspace	IL	2021	E&G	Pass	
70	Residential	Building Shell	Insulated Doors	IA	2020	E&G	Pass	

Qualitative Screening Results - Residential
Big Rivers Electric Corporation

	Class	Category	Measure				Qualitative	Notes
71	Residential	Building Shell	Low-E Storm Window	IL	2021	E&G	Pass	
72	Residential	Building Shell	Rim/Brand Joist Insulation	IL	2021	E&G	Pass	Combine with Floor and Rim
73	Residential	Building Shell	Triple Pane and Thin Triple Windows	IL	2021	E&G	Pass	
74	Residential	Building Shell	Wall Insulation	IL	2021	E&G	Pass	
75	Residential	Water Heating	Domestic Hot Water Pipe Insulation	IL	2021	E&G	Pass	
76	Residential	Water Heating	Drain Water Heat Recovery	IL	2021	E&G	Fail	Low market potential
77	Residential	Water Heating	Fuel Switching: Electric Resistence to Fossil Fuel Water Heater	PA	2021	E	Fail	Utility match
78	Residential	Water Heating	Gas Water Heater	IL	2021	G	Fail	Utility match
79	Residential	Water Heating	Heat Pump Water Heater	IL	2021	E	Pass	
80	Residential	Water Heating	Low Flow Faucet Aerators	IL	2021	E&G	Pass	
81	Residential	Water Heating	Low Flow Showerheads	IL	2021	E&G	Pass	
82	Residential	Water Heating	Shower Timer	IL	2021	E&G	Fail	Behavioral / Difficult to Monitor
83	Residential	Water Heating	Solar Water Heaters	PA	2021	E	Fail	Utility match
84	Residential	Water Heating	Thermostatic Restrictor Shower Valve	IL	2021	E&G	Pass	
85	Residential	Water Heating	Water Heater Temperature Setback	IL	2021	E&G	Pass	
86	Residential	Water Heating	Water Heater Wrap	IL	2021	E	Pass	

Qualitative Screening Results - Non-Residential

Big Rivers Electric Corporation

	Class	Category	Measure				Qualitative	Notes
1	Non-Residential	Building Shel	Commercial Weather Stripping	IL	2021	E&G	Pass	
2	Non-Residential	Building Shel	Efficient Windows	IA	2020	E&G	Pass	
3	Non-Residential	Building Shel	High Speed Rollup Doors	IL	2021	E	Fail	Program match-complicated measure calc
4	Non-Residential	Building Shel	Industrial Air Curtain	IL	2021	E&G	Fail	Program match-complicated measure calc
5	Non-Residential	Building Shel	Infrared Film for Greenhouse	IL	2021	G	Fail	Utility match
6	Non-Residential	Building Shel	Insulated Doors	IA	2020	E&G	Pass	
7	Non-Residential	Building Shel	Roof Insulation for C&I Facilities	IL	2021	E	Pass	
8	Non-Residential	Building Shel	Spring-Loaded Garage Door Hinge	IL	2021	G	Fail	Utility match
9	Non-Residential	Building Shel	Wall Insulation	IA	2020	E&G	Pass	
10	Non-Residential	Cooking	Combination Oven	IL	2021	E&G	Pass	
11	Non-Residential	Cooking	Commercial Steam Cooker	IL	2021	E&G	Pass	
12	Non-Residential	Cooking	Conveyor Oven	IL	2021	G	Fail	Utility match
13	Non-Residential	Cooking	Efficient Dipper Wells	IL	2021	E	Fail	Utility match
14	Non-Residential	Cooking	ENERGY STAR Convection Oven	IL	2021	G	Fail	Utility match
15	Non-Residential	Cooking	ENERGY STAR Electric Convection Oven	IL	2021	E	Pass	
16	Non-Residential	Cooking	ENERGY STAR Fryer	IL	2021	E&G	Pass	
17	Non-Residential	Cooking	ENERGY STAR Griddle	IL	2021	E&G	Fail	Market trans. ($0 cost)
18	Non-Residential	Cooking	ENERGY STAR Hot Food Holding Cabinets	IL	2021	E	Pass	
19	Non-Residential	Cooking	High Efficiency Pre-Rinse Spray Valve	IL	2021	E&G	Pass	
20	Non-Residential	Cooking	Infrared Chatbroiler	IL	2021	G	Fail	Utility match
21	Non-Residential	Cooking	Infrared Salamander Broiler	IL	2021	G	Fail	Utility match
22	Non-Residential	Cooking	Infrared Upright Broiler	IL	2021	G	Fail	Utility match
23	Non-Residential	Cooking	Pasta Cooker	IL	2021	G	Fail	Utility match
24	Non-Residential	Cooking	Rack Oven - Double Oven	IL	2021	G	Fail	Utility match
25	Non-Residential	Cooking	Rotisserie Oven	IL	2021	G	Fail	Utility match
26	Non-Residential	HVAC	Absorbent Air Cleaning	IL	2021	E&G	Pass	
27	Non-Residential	HVAC	Advanced Rooftop Controls	IL	2021	E&G	Pass	
28	Non-Residential	HVAC	Air and Water Source Heat Pump Systems	IL	2021	E	Pass	
29	Non-Residential	HVAC	Air Conditioner Tune-up	IL	2021	E	Pass	
30	Non-Residential	HVAC	Air Deflectors for Unit Ventilators	IL	2021	G	Fail	Utility match
31	Non-Residential	HVAC	Boiler Chemical Descaling	IL	2021	G	Fail	Utility match
32	Non-Residential	HVAC	Boiler Lockout/Reset Controls	IL	2021	G	Fail	Utility match
33	Non-Residential	HVAC	Commercial Gas Heat Pump	IL	2021	E&G	Fail	Utility match
34	Non-Residential	HVAC	Commercial Ground Source and Ground Water Source Heat Pump	IL	2021	E&G	Pass	
35	Non-Residential	HVAC	Condensing Unit Heaters	IL	2021	G	Fail	Utility match
36	Non-Residential	HVAC	Covers and Gap Sealers for Room Air Conditioners	IL	2021	E&G	Pass	
37	Non-Residential	HVAC	Demand Controlled Ventilation	IL	2021	E&G	Pass	
38	Non-Residential	HVAC	Destratification Fan	IL	2021	E&G	Pass	Combine with HVLS
39	Non-Residential	HVAC	Duct Insulation	IA	2020	E&G	Pass	
40	Non-Residential	HVAC	Duct Repair and Sealing	IA	2020	E&G	Pass	
41	Non-Residential	HVAC	Ductless Mini-Split Heat Pumps	PA	2021	E	Pass	
42	Non-Residential	HVAC	Economizer Repair and Optimization	IL	2021	E&G	Fail	Overly complex / requires detailed downstream work
43	Non-Residential	HVAC	Electric Chiller	IL	2021	E	Pass	
44	Non-Residential	HVAC	Electric Chillers with Integrated Variable Speed Drives	IL	2021	E	Pass	Combine
45	Non-Residential	HVAC	Energy Recovery Ventilator	IL	2021	E&G	Pass	
46	Non-Residential	HVAC	ENERGY STAR and CEE Tier 3 Room Air Conditioner	IL	2021	E	Pass	
47	Non-Residential	HVAC	Fan Thermostat Controller	IL	2021	E	Pass	
48	Non-Residential	HVAC	Fuel Switching: Small Commercial Electric Heat to Natural Gas/Propane/Oil	PA	2021	G	Fail	Utility match
49	Non-Residential	HVAC	Gas High Efficiency Single Package Vertical Air Conditioner	IL	2021	G	Fail	Utility match
50	Non-Residential	HVAC	Greenhouse Boiler Tune-Up	IL	2021	G	Fail	Utility match
51	Non-Residential	HVAC	Greenhouse Thermal Curtains	IL	2021	G	Fail	Utility match
52	Non-Residential	HVAC	Guest Room Energy Management	IL	2021	E	Pass	
53	Non-Residential	Water Heating	Heat Pump Water Heaters	PA	2021	E	Pass	
54	Non-Residential	HVAC	High Efficiency Boiler	IL	2021	G	Fail	Utility match
55	Non-Residential	HVAC	High Efficiency Furnace	IL	2021	G	Fail	Utility match
56	Non-Residential	HVAC	High Speed Fans	IL	2021	E	Pass	Combine
57	Non-Residential	HVAC	High Temperature Heating and Ventilation Direct Fired Heater	IL	2021	G	Fail	Utility match
58	Non-Residential	HVAC	High Turndown Burner for Space Heating Boilers	IL	2021	G	Fail	Utility match
59	Non-Residential	HVAC	High Volume Low Speed Fans	IL	2021	E	Pass	Combine
60	Non-Residential	HVAC	Hydronic Heater Radiator Replacement	IL	2021	G	Fail	Utility match
61	Non-Residential	HVAC	Infrared Heaters	IL	2021	G	Fail	Utility match
62	Non-Residential	HVAC	Kitchen Demand Ventilation Controls	IL	2021	E&G	Fail	Standards/Low Market
63	Non-Residential	HVAC	Linkageless Boiler Controls for Space Heating	IL	2021	G (E on)	Fail	Utility match
64	Non-Residential	HVAC	Multi-Family Space Heating Steam Boiler Averaging Controls	IL	2021	G	Fail	Utility match
65	Non-Residential	HVAC	Notched V Belts for HVAC Systems	IL	2021	E	Fail	Low savings potential
66	Non-Residential	HVAC	Oxygen Trim Controls for Space Heating Boilers	IL	2021	G	Fail	Utility match
67	Non-Residential	HVAC	Package Terminal Air Conditioner and Package Terminal Heat Pump	IL	2021	E	Pass	
68	Non-Residential	HVAC	Packaged RTU Sealing	IL	2021	E&G	Pass	
69	Non-Residential	HVAC	Process Boiler Tune-up	IL	2021	G	Fail	Utility match
70	Non-Residential	HVAC	Process Heating Boiler	IL	2021	G	Fail	Utility match
71	Non-Residential	HVAC	Room Air Conditioner Recycling	IA	2020	E	Pass	
72	Non-Residential	HVAC	Server Room Temperature Set Back	IL	2021	E	Pass	
73	Non-Residential	HVAC	Shut Off Damper for Space Heating Boilers or Furnaces	IL	2021	G	Fail	Utility match
74	Non-Residential	HVAC	Single-Package and Split System Unitary Air Conditioners	IL	2021	E	Pass	
75	Non-Residential	HVAC	Small Business Furnace Tune-Up	IL	2021	G	Fail	Utility match
76	Non-Residential	HVAC	Small Commercial Thermostats	IL	2021	E&G	Pass	
77	Non-Residential	HVAC	Space Heating Boiler Tune-up	IL	2021	G	Fail	Utility match
78	Non-Residential	HVAC	Stack Economizer for Boilers Serving HVAC Loads	IL	2021	G	Fail	Utility match
79	Non-Residential	HVAC	Stack Economizer for Boilers Serving Process Loads	IL	2021	G	Fail	Utility match

Qualitative Screening Results - Non-Residential

Big Rivers Electric Corporation

	Class	Category	Measure				Qualitative	Notes
80	Non-Residential	HVAC	Steam Trap Replacement or Repair	IL	2021	E&G	Fail	Utility match - primarily gas savings
81	Non-Residential	HVAC	Unitary HVAC Condensing Furnace	IL	2021	E&G	Fail	Utility match - primarily gas savings
82	Non-Residential	HVAC	Variable Speed Drive for Condenser Fans	IL	2021	E	Pass	Condense to VSD Fans
83	Non-Residential	HVAC	Variable Speed Drives for HVAC Pumps and Cooling Tower Fans	IL	2021	E	Pass	Condense to VSD Fans
84	Non-Residential	HVAC	Variable Speed Drives for HVAC Pumps and Return Fans	IL	2021	E	Pass	Condense to VSD Fans
85	Non-Residential	HVAC	Variable Speed Drives for Process Fans	IL	2021	E	Pass	
86	Non-Residential	Lighting	Commercial LED Exit Signs	IL	2021	E&G	Pass	Possibly condense
87	Non-Residential	Lighting	Commercial LED Grow Lights	IL	2021	E&G	Pass	Possibly condense
88	Non-Residential	Lighting	Exterior Photocell Repair	IL	2021	E	Pass	Possibly condense
89	Non-Residential	Lighting	Flourescent delamping	IL	2021	E&G	Pass	Possibly condense
90	Non-Residential	Lighting	High Performance and Reduced Wattage T8 Fixtures and Lamps	IL	2021	E&G	Pass	Possibly condense
91	Non-Residential	Lighting	LED Bulbs and Fixtures	IL	2021	E&G	Pass	Possibly condense
92	Non-Residential	Lighting	LED Open Sign	IL	2021	E&G	Pass	Possibly condense
93	Non-Residential	Lighting	LED Streetlighting	IL	2021	E	Pass	Possibly condense
94	Non-Residential	Lighting	LED Traffic and Pedestrian Signals	IL	2021	E	Pass	Possibly condense
95	Non-Residential	Lighting	Lighting Controls	IL	2021	E&G	Pass	Possibly condense
96	Non-Residential	Lighting	Lighting Power Density	IL	2021	E&G	Pass	Possibly condense
97	Non-Residential	Lighting	Miscellaneous Commercial/Industrial Lighting	IL	2021	E&G	Pass	Possibly condense
98	Non-Residential	Lighting	Multi-Level Lighting Switch	IL	2021	E&G	Pass	Possibly condense
99	Non-Residential	Lighting	Occupancy Controlled Bi-Level Lighting Fixtures	IL	2021	E&G	Pass	Possibly condense
100	Non-Residential	Lighting	Solar Light Tubes	IL	2021	E&G	Pass	Possibly condense
101	Non-Residential	Lighting	T5 Fixtures ad Lamps	IL	2021	E&G	Pass	Possibly condense
102	Non-Residential	Load Mgmt	Battery Storage			E	Pass	
103	Non-Residential	Load Mgmt	Electric Fleet Charging			E	Pass	
104	Non-Residential	Load Mgmt	Facility Load Control			E	Pass	
105	Non-Residential	Load Mgmt	Load Curtailment for Commercial and Industrial Programs	PA	2021	E	Pass	
106	Non-Residential	Load Mgmt	Peak Time Rebate Program			E	Pass	
107	Non-Residential	Other	Advanced Power Strip - Tier 1 Commercial	IL	2021	E	Pass	
108	Non-Residential	Other	Automatic Milker Takeoffs	PA	2021	E	Fail	Low market potential
109	Non-Residential	Other	Building Operator Certification	IL	2021	E&G	Pass	
110	Non-Residential	Other	Combined Heat and Power	IL	2021	G	Fail	Primarily gas boiler/process
111	Non-Residential	Other	Commercial Clothes Dryer Moisture Sensor	IL	2021	G	Fail	Works w Gas Dryers
112	Non-Residential	Other	Compressed Air Heat Recovery	IL	2021	G	Fail	Utility match
113	Non-Residential	Other	Compressed Air Low Pressure Drop Filters	IL	2021	E	Pass	
114	Non-Residential	Other	Compressed Air No-Loss Condensate Drains	IL	2021	E	Pass	
115	Non-Residential	Other	Compressed Air Storage Receiver Tank	IL	2021	E	Pass	
116	Non-Residential	Other	Computer Power Management Software	IL	2021	E	Pass	
117	Non-Residential	Other	Dairy Refrigeration Heat Recovery	IL	2021	E&G	Fail	Low market potential
118	Non-Residential	Other	Desiccant Dryer Dew Point Demand Controls	IL	2021	E	Pass	
119	Non-Residential	Other	Efficient Compressed Air Nozzles	IL	2021	E	Pass	
120	Non-Residential	Other	Efficient Desiccant Compressed Air Dryer	IL	2021	E	Pass	
121	Non-Residential	Other	Efficient Refrigerated Compressed Air Dryer	IL	2021	E	Pass	
122	Non-Residential	Other	Efficient Thermal Oxidizers	IL	2021	G	Fail	Utility match
123	Non-Residential	Other	Energy Efficient Gear Lubricants	IL	2021	E	Fail	Provisional/Low market potential
124	Non-Residential	Other	Energy Efficient Hydraulic Oils	IL	2021	E	Fail	Provisional/Low market potential
125	Non-Residential	Other	Energy Efficient Rectifier	IL	2021	E	Pass	
126	Non-Residential	Other	ENERGY STAR Computers	IL	2021	E	Fail	Market transformation
127	Non-Residential	Other	ENERGY STAR Dishwasher	IL	2021	E&G	Pass	
128	Non-Residential	Other	ENERGY STAR Office Equipment	PA	2021	E	Pass	
129	Non-Residential	Other	ENERGY STAR Servers	PA	2021	E	Pass	
130	Non-Residential	Other	ENERGY STAR Uninterruptible Power Supply	IL	2021	E	Pass	
131	Non-Residential	Other	Engine Block Timer for Agricultural Equipment	IL	2021	E	Pass	
132	Non-Residential	Other	High Efficiency Grain Dryer	IL	2021	E&G	Pass	
133	Non-Residential	Other	High Efficiency Pumps	PA	2021	E	Pass	
134	Non-Residential	Other	High Efficiency Transformer	IL	2021	E	Fail	Lacking sufficient data
135	Non-Residential	Other	High Frequency Battery Chargers	IL	2021	E	Pass	
136	Non-Residential	Other	High Speed Clothes Washer	IL	2021	E	Fail	Works w Gas Dryers
137	Non-Residential	Other	Irrigation Pump VFD	IL	2021	E	Pass	
138	Non-Residential	Other	Lithium Ion Forklift Batteries	IL	2021	E	Pass	Combine with HE Chargers?
139	Non-Residential	Other	Livestock Waterer	IL	2021	E	Pass	
140	Non-Residential	Other	Low Pressure Sprinkler Nozzles	IL	2021	E	Pass	
141	Non-Residential	Other	Modulating Commercial Gas Clothes Dryer	IL	2021	G	Fail	Utility match
142	Non-Residential	Other	Premium Efficiency Motors	PA	2021	E	Pass	Combine
143	Non-Residential	Other	Pump Optimization	IL	2021	E	Pass	
144	Non-Residential	Other	Reduce Compressed Air Setpoint	IL	2021	E	Pass	
145	Non-Residential	Other	Server Virtualization	PA	2021	E	Pass	
146	Non-Residential	Other	Smart Irrigation Controls	IL	2021	E	Pass	
147	Non-Residential	Other	Smart Sockets	IL	2021	E	Fail	Provisional/Low market potential
148	Non-Residential	Other	Swine Heat Pads	IL	2021	E	Pass	
149	Non-Residential	Other	Tunnel Washers	IL	2021	E&G	Pass	
150	Non-Residential	Other	VSD Air Compressor	IL	2021	E	Pass	
151	Non-Residential	Other	Warm-Mix Asphalt Chemical Additives	IL	2021	G	Fail	Utility match
152	Non-Residential	Refrigeration	Add Doors to Open Refrigerated Display Cases	IL	2021	E&G	Pass	
153	Non-Residential	Refrigeration	Automatic Door Closer for Walk-In Coolers and Freezers	IL	2021	E	Pass	
154	Non-Residential	Refrigeration	Beverage and Snack Machine Controls	IL	2021	E	Pass	
155	Non-Residential	Refrigeration	Commercial Solid and Glass Door Refrigerators & Freezers	IL	2021	E	Pass	
156	Non-Residential	Refrigeration	Door Heater Controls for Cooler or Freezer	IL	2021	E	Pass	
157	Non-Residential	Refrigeration	Efficient Motor Controls for Walk-In and Display Case Coolers/Freezers	IA	2020	E	Pass	
158	Non-Residential	Refrigeration	Efficient Motors for Walk-In and Display Case Coolers/Freezers	IA	2020	E	Pass	Combine

Qualitative Screening Results - Non-Residential

Big Rivers Electric Corporation

	Class	Category	Measure				Qualitative	Notes
159	Non-Residential	Refrigeration	Electronically Commutated Motors for Walk-in and Reach-in Freezers	IL	2021	E	Pass	Combine
160	Non-Residential	Refrigeration	ENERGY STAR Refrigerated Beverage Vending Machine	IL	2021	E	Pass	
161	Non-Residential	Refrigeration	ENERGY STAR Refrigeration/Freezer Cases	PA	2021	E	Pass	
162	Non-Residential	Refrigeration	Ice Maker	IL	2021	E	Pass	
163	Non-Residential	Refrigeration	LED Refrigerator Case Light Occupancy Sensor	IA	2020	E	Pass	
164	Non-Residential	Refrigeration	Milk Pre-Coolers	IL	2021	E	Fail	Low market potential
165	Non-Residential	Refrigeration	Night Covers for Open Refrigerated Display Cases	IL	2021	E	Pass	
166	Non-Residential	Refrigeration	Refrigerated Display Cases with Door Replacing Open Cases	PA	2021	E	Pass	
167	Non-Residential	Refrigeration	Refrigeration Economizers	IL	2021	E	Pass	
168	Non-Residential	Refrigeration	Scroll Compressor for Dairy Refrigeration	IL	2021	E	Fail	Low market potential
169	Non-Residential	Refrigeration	Scroll Refrigeration Compressor	IA	2020	E	Fail	Low market potential
170	Non-Residential	Refrigeration	Strip Curtain for Walk-in Coolers and Freezers	IL	2021	E	Pass	
171	Non-Residential	Refrigeration	VSD Milk Pump with Plate Cooler Heat Exchanger	IL	2021	E	Fail	Low market potential
172	Non-Residential	Water Heating	Commercial Pool Covers	IL	2021	E&G	Fail	Low market potential
173	Non-Residential	Water Heating	Controls for Central Domestic Hot Water	IL	2021	G	Fail	Utility match
174	Non-Residential	Water Heating	DHW Boiler Tune-up	IL	2021	G	Fail	Utility match
175	Non-Residential	Water Heating	ENERGY STAR Dairy Water Heater	IL	2021	E&G	Pass	
176	Non-Residential	Water Heating	Floating Head Pressure Control	IL	2021	E	Pass	
177	Non-Residential	Water Heating	Fuel Switching: Electric Resistance Water Heaters to Gas/Propane	PA	2021	G	Fail	Utility match
178	Non-Residential	Water Heating	Gas Hot Water Heater	IA	2020	G	Fail	Utility match
179	Non-Residential	Water Heating	Heat Recovery Grease Trap Filter	IL	2021	E&G	Pass	
180	Non-Residential	Water Heating	Low Flow Faucet Aerators	IL	2021	E&G	Pass	
181	Non-Residential	Water Heating	Low Flow Showerheads	IL	2021	E&G	Pass	
182	Non-Residential	Water Heating	Multifamily Central Domestic Hot Water Plants	IL	2021	G	Fail	Utility match
183	Non-Residential	Water Heating	Ozone Laundry	IL	2021	G	Fail	Utility match
184	Non-Residential	Water Heating	Pipe Insulation Dairy			E	Fail	Utility match
185	Non-Residential	Water Heating	Tank Insulation Dairy			E	Fail	Utility match
186	Non-Residential	Water Heating	Tankless Water Heater	IL	2021	G	Fail	Utility match
187	Non-Residential	Water Heating	Water Heater	IL	2021	E&G	Pass	Only <55 Gallon

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REQUEST NO. 2-4: ***Please provide a copy of the Demand-Side Management Potential Study Appendix C Multi-Perspective Model Results, in Excel format.***

RESPONSE: See the attachment to this response, an Excel spreadsheet titled "BREC_DSMQuantitative_JL2-4 Response.xlsx."

Witness: Joshua Hoyt (Clearspring Energy Advisors, LLC)

IN THE MATTER OF:
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REQUEST NO. 2-5: ***For each measure evaluated in the study Demand-Side Management Potential Study, please provide the following:***

a. The incremental annual energy savings.

b. The incremental measure cost.

c. The incentive amount used for the Program Potential scenario.

d. The measure life.

e. The TRC benefit-cost ratio.

RESPONSE: Please refer to Appendix C of the Demand-Side Management Potential Study, Appendix B of the Big Rivers 2023 IRP, for subparts a, b, d, and e.

c. Please see Big Rivers' response the Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-8, the estimated annual incentive amount for the Program Potential scenario.

Witness: Joshua Hoyt (Clearspring Energy Advisors, LLC)

IN THE MATTER OF:
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REQUEST NO. 2-6: ***Please provide the basis and rationale for a 2-year measure life for Non-Residential LED Bulbs / Fixtures, as indicated on page C-2 of the Demand-Side Management Potential Study.***

RESPONSE: The measure referred to represents traditional LED screw-in bulbs of different sizes in a commercial setting. The calculations are taken from the 2021 Illinois Statewide Technical Resource Manual. The deemed measure life allows for up to 15 years, however the issues related to market transformation put downward pressure on this type of lighting versus allocating a discrete spending budget to other end-uses/measures. In addition, on an individual basis, especially in a commercial setting where lights are on for extended periods of time, heat can degrade and shorten the life of LED bulbs. The non-residential lighting end-use category in the Potential calculations used a weighted measure life of 12 years for lighting. Changing the LED bulb measure to a 15-year life has no material impact on weighted lighting measure life or the weighted cost per kWh applied to that end-use.

Witness: Joshua Hoyt (Clearspring Energy Advisors, LLC)

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REQUEST NO. 2-7: ***Regarding the Demand-Side Management Potential Study Program Potential scenario (both Residential and Non-residential):***

a. Were levelized costs calculated? If so, please provide these calculations and results for each customer class.

b. Please provide the IRP modeling inputs used for the Program Potential scenarios (both Residential and Non-residential).

RESPONSE:

a. Levelized costs and benefits in the form of net present value calculations were calculated, and a direct input to the benefit-cost ratios was presented. For the $1 million annual spending scenario (UCT):

i. NPV Cost (Residential) = $4,354,558

ii. NPV Cost (Non-Residential) = $5,660,474

b. No IRP modeling inputs were used in the Program Potential scenarios. The Program Potential scenarios are an input to the IRP analysis.

Witness: Joshua Hoyt (Clearspring Energy Advisors, LLC)

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REQUEST NO. 2-8: ***For the Program Potential scenario of the Demand-Side Management Potential Study (both Residential and Non-residential), please provide:***

a. The incremental annual savings, by measure and customer class, for each year of the study. Please indicate if these savings are at the meter or generator.

b. The annual incentive cost, by measure and customer class, for each year of the study.

c. The annual administrative cost, by measure and customer class, for each year of the study.

d. The measure life, by measure and customer class, for each year of the study.

RESPONSE: Please refer to the below table for the responses to parts a-d.

a. As shown in the table below, Program Potential was estimated on an end-use basis for the Residential and Non-Residential sectors. Energy and demand savings have been adjusted for distribution and transmission losses, meaning the savings are at the generator.

b. The annual incentive cost by end-use and class sector is estimated based on the assumed administrative value from the measure models of a 15% adder to the incentive level (for advertising, outside consultants, etc.) plus a $150,000 program administration salary allocation, for a total of 28%, leaving 72% to the incentive value. This occurs in year one of each annual participation cohort. In contrast, a recent Progress Energy Florida multi-year evaluation put the incentive/administration split at 60/40.

c. As stated in response to part b., the annual administrative cost of each end-use is 28% of the program cost and is applied to the end-use costs.

d. The measure life assigned to each end-use category is presented below.

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Program Potential Statistics
Big River DSM Potential Study

Residential End-Use	Category	Annual MWh	Annual MW /1	Annual Incentive Cost $	Annual Admin Cost $	Measure Life Years
Space heating	HVAC	536	0.00	$100,139	$38,425	20
Air handlers (heat)	HVAC	25	0.00	$1,393	$535	6
Air conditioning	HVAC	397	0.16	$74,282	$28,503	20
Air handlers (cool)	HVAC	30	0.01	$1,701	$653	6
Ceiling fans	HVAC	0	0.00	$0	$0	10
Dehumidifiers	HVAC	62	0.04	$1,888	$725	12
Water heating	Water Heating	891	0.04	$90,843	$34,858	15
Clothes washers	Appliance	12	0.00	$3,064	$1,176	14
Clothes dryers	Appliance	0	0.00	$0	$0	16
Lighting	Lighting	51	0.01	$1,836	$704	7
Refrigerators	Appliance	37	0.01	$11,673	$4,479	17
Second refrig.	Appliance	200	0.04	$16,285	$6,249	8
Separate freezers	Appliance	21	0.00	$5,450	$2,091	22
Cooking	Appliance	0	0.00	$0	$0	8
Microwaves	Appliance	0	0.00	$0	$0	8
Dishwashers	Appliance	0	0.00	$0	$0	11
Most-used TVs	Appliance	0	0.00	$0	$0	6
Second TVs	Appliance	0	0.00	$0	$0	6
Pool pumps	Other	0	0.00	$0	$0	15
Hot tub pumps	Other	0	0.00	$0	$0	15
Hot tub heaters	Other	0	0.00	$0	$0	15
Other	Other	50	0.01	$6,146	$2,358	12

Non-Residential End-Use	Category	Annual MWh	Annual MW /1	Annual Incentive Cost $	Annual Admin Cost $	Measure Life Years
Space Heating	HVAC	225	0.00	$18,735	$7,189	14
Space Cooling	HVAC	310	0.15	$25,816	$9,906	14
Ventilation	HVAC	824	0.08	$68,623	$26,332	14
Water Heating	Water Heating	120	0.01	$2,654	$1,018	13
Lighting	Lighting	1,367	0.27	$55,754	$21,394	12
Cooking	Appliance	254	0.03	$10,373	$3,980	12
Refrigeration	Appliance	1,415	0.57	$132,300	$50,766	11
Office Equipment	Appliance	523	0.05	$32,020	$12,287	4
Other (incl. Process)	Other	1,113	0.11	$62,803	$24,098	9

/1 Summer Peak

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Witness: Joshua Hoyt (Clearspring Energy Advisors, LLC)

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REQUEST NO. 2-9: ***Were incentives and/or rebates available under the Inflation Reduction Act considered in the Demand-Side Management Potential?***

a. ***If so, please identify what incentives and/or rebates were considered and how they were considered.***

b. ***If not, please explain why not.***

RESPONSE: No specific incentives or rebates available under the Inflation reduction Act were included.

a. N/A

b. Please refer to Appendix B, Big Rivers 2023 IRP, Demand-Side Management Potential Study, section 2.6.4, page 2-12. This study is a Potential study and not a Design study. The purpose is to estimate how much energy and demand savings are available in the market. No specific programs were created as a result of this focus. In addition, the timing of the availability of the incentives in the Act and the window of time for the annual Program Potential do not align, making the Act's incentives difficult to incorporate even if specific programs were created for this study.

Witness: Joshua Hoyt (Clearspring Energy Advisors, LLC)

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REQUEST NO. 2-10: ***Please refer to your response to Staff 1-29(c).***

a. ***For each of the wind PPAs received in response to the All-Source Request for Proposals, identify the capacity, location, timing, and price of the wind included in the PPA.***

b. ***For each of the solar PPAs received in response to the All-Source Request for Proposals, identify the capacity, location, timing, and price of the solar included in the PPA.***

c. ***Identify and produce any analysis, workpapers, modeling input and output files, or other documents supporting the contention that the wind and solar PPAs received in response to the All-Source Request for Proposals "were not economical compared to the Natural Gas Combine[d] Cycle Plant." If no such documents exist, explain the basis for your contention.***

RESPONSE:

a. No offers for wind resources were received in response to the All-Source Request for Proposals.

b. Please see attached CONFIDENTIAL Excel workbook, provided subject to a motion for confidential treatment. The attachment details the short-listed solar and solar-plus-storage PPAs offered in the All-Source Request for Proposals for which Big Rivers sought reprising following passage of the IRA.

c. Please see Big Rivers' response to Commission Staff's Request No. 2-32, subpart b.

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Witness: Nathanial A. Berry

JI 2-10 ATTACHMENT

This attachment, in its entirety, has been submitted under seal with an accompanying request for confidential treatment.

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REQUEST NO. 2-11: ***Please refer to your response to Staff 1-32. For each of the years 2018 through 2023, identify the percent of hours for which Big Rivers bid or offered the Wilson plant into the MISO market with the following commitment status:***

a. Economic

b. Must-Run

c. Outage

d. Emergency

e. Not Participating

RESPONSE: The table below shows Big Rivers' Day Ahead Offers for Wilson by commitment status:

Commit Status	2018	2019	2020	2021	2022	2023
Economic	63.3%	18.9%	14.2%	2.5%	0.0%	0.0%
Must-Run	5.5%	73.1%	75.4%	89.6%	70.7%	89.6%
Outage	31.2%	8.0%	10.4%	7.9%	29.3%	10.4%
Emergency	0%	0%	0%	0%	0%	0%
Not Participating	0%	0%	0%	0%	0%	0%

Witness: Terry Wright, Jr.

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REQUEST NO. 2-12: ***Please refer to your response to JI 1.6.***

a. ***Please state whether Big Rivers has taken any steps since Winter Storm Elliott to avoid or minimize the chance of derates or outages at the Wilson plant during severe winter storms. If so, please explain those steps in detail. If not, please explain why not.***

b. ***Please state whether Big Rivers has taken any steps since Winter Storm Elliott to avoid or minimize the chances of starting failures at the Reid CT unit during severe winter storms. If so, please explain those steps in detail. If not, please explain why not.***

c. ***Please state whether Big Rivers has experienced any outages or derates at the Wilson, R.D. Green, or Reid CT unit in 2024 to date.***

d. ***If so, please identify for each such outage or derate the date, length, cause, and the size in MW if a derate.***

RESPONSE:

a. Big Rivers performed a thorough examination of Wilson's winter preparedness plan in compliance with NERC-011-2 & NERC-EOP-5. No deficiencies were found.

b. Big Rivers performed a thorough examination of the Reid CT's winter preparedness plan in compliance with NERC-011-2 & NERC-EOP-5. No deficiencies were found.

c. Big Rivers did experience outages/derates in 2024.

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

d. The following events are estimated and in draft form only, performance records for the month of January have not been closed at the time of this response.

Date	Unit	Size (MW)	Estimated Duration (Hours)	Type	Comments
1/18 – 1/22	Green 1	231	108.15	Outage	No gas availability*
1/18 – 1/22	Green 2	223	108.15	Outage	No gas availability*
1/17	Reid CT	65	13.25	Outage	Loss of control feedback signal
1/17 – 1/22	Reid CT	65	120.92	Outage	No gas availability*
1/15 – 1/16	Wilson	80	20.47	Derate	Lost communication with ball mill
1/25	Wilson	417	5.83	Outage	Mechanical - Loss of vital power

* Texas Gas Transmission issued a winter weather constraint suspending all PAL (Park and Loan) services due to pipeline operating constraints; point-to-point natural gas could not be procured prior to MISO Day Ahead Market close.

Witness: Nathanial A. Berry

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REQUEST NO. 2-13: ***Please refer to your response to JI 1.8.***

a. Please identify the specific "modeling results" in the 2023 IRP analysis that you contend support Wilson "running on coal throughout the entire study period," and explain in detail how such modeling results provide such support.

b. With regards to your response to JI 1.8 subpart b, please confirm that the 2023 IRP and supporting modeling does not provide a net present value (NPV) revenue requirement of other economic analysis of continuing to operate Wilson until 2045 versus retiring Wilson in any year before 2045. If not confirmed, identify the specific portion(s) of the IRP and supporting modeling that you claim provide such analysis.

RESPONSE:

a. Wilson was dispatched economically throughout the study period in all scenarios studied in the 2023 IRP. Due to the reliable nature of Wilson and its projected economic dispatch, the IRP modeling supports the position that Wilson is "running on coal throughout the entire study period."

b. Big Rivers' 2023 IRP did not analyze the retirement of Wilson in year 2045 or otherwise. See Big Rivers' response to the Commission Staff's Request Nos. 2-24 and 2-30; see also CONFIDENTIAL Attachments to Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 1-1. Table 2.3(c) on page 35 of Big Rivers' 2023 IRP identifies 2045 as the "Expected Retirement Date for Wilson," but Big Rivers

selected 2045 to comply with 807 KAR 5:058 Section 8(3)(b)(5) and to signify that Big Rivers expects Wilson to be operating throughout the Member-Owners' contract terms.

Witness: Nathanial A. Berry

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REQUEST NO. 2-14: ***Please refer to IRP pages 119–120 and Confidential Table 7.1.4(i) on IRP page 122. With regards to the forecasted renewables and storage costs identified in the table:***

a. Please explain how the costs identified in Table 7.1.4(i) were "forecasted using the cost curves" from the 2022 NREL Annual Technology Baseline and the EIA's public technology assessment.

b. Please explain why Table 7.1.4(i) shows overnight capital costs for solar PV increasing from 2023 through 2050, while the 2022 NREL Annual Technology Baseline forecasts a declining cost curve for solar PV over that same time period.

c. Please explain why Table 7.1.4(i) shows overnight capital costs for onshore wind that are higher than the range of capex costs for land-based wind identified in the 2022 NREL Annual Technology Baseline.

RESPONSE:

a. Please see Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-35 for a workbook showing the calculations for the values in Table 7.1.4(i). Capital costs from the 2022 AEO technology assessment developed by EIA were used as a starting point for 4-hour Li-Ion storage. See subparts b and c for solar and wind capital cost assumptions. The NREL forecast forward projections for capital costs and fixed O&M were used to develop cost curves on a year-over-year percentage change basis, subject to inflation. Big Rivers used the "conservative" curves for all technologies.

b. Because the IRP calculations were developed at a time when the NREL database reflected a period of market volatility related to post-COVID supply chain issues, solar capital cost curves were developed using market intelligence based on recent market offers known during the assumptions development period and implemented in conjunction with the approach described in subpart a.

c. Please refer to subpart b. of this response. Wind capital costs were developed in the same manner as described in subparts a and b.

Witness: John Christensen (1898 & Co.)

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REQUEST NO. 2-15: ***Please refer to your response to JI 1-33.***

a. Please identify and explain what factors make demand response a "highly technical subject" for a G&T market participant of MISO.

b. Please explain in detail the discussions regarding demand response that Big Rivers has "initiated" with its Member-Owners and/or other G&Ts.

c. Please produce any documentation of the discussions regarding demand response that Big Rivers has "initiated" with its Member-Owners and/or other G&Ts.

d. Please explain in detail Big Rivers' "observing" of or "lessons learned" from the demand response technology development and innovation occurring across the nation.

e. Please produce any documentation of Big Rivers' "observing" of or "lessons learned" from the demand response technology development and innovation occurring across the nation.

f. Please identify the anticipated timing of the demand response "future program offerings" referenced therein.

RESPONSE:

a. Based on MISO Business Practice Manuals ("BPM") Demand Response ("DR") requirements include:

- Metering in real time or five minute intervals
- Near real time communication infrastructure
- The ability to coordinate and offer DR on a daily basis
- The ability to respond to load control signals from the RTO
- Measurement and Verification capability

- Coordination between the G&T and Member-Owners
- Retail member participation

Big Rivers and its Member-Owners do not currently have DR programs or tariffs nor existing infrastructure to fully support it.

b. Big Rivers and Member-Owner staffs have met virtually on several occasions in the last year to discuss DSM related issues including Energy Storage, DSM study results and in April of this year to specifically discuss Distributed Energy Resource Management Systems ("DERMS").

c. See the attachment to this response.

d. Big Rivers staff is participating in G&T DER working groups that discuss existing DER/DERMS programs and DERMS technology currently being deployed in G&T's around the country.

e. See the attachment to this response.

f. There is presently no established timeline for program development at Big Rivers. Big Rivers will continue to evaluate opportunities and will submit proposed developed programs to the Commission for approval.

Witness: Russell L. Pogue

Subject: System Wide DSM Discussion
Location: Big Rivers HQ

Start: Wed 3/2/2022 10:00 AM
End: Wed 3/2/2022 12:30 PM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: Pogue, Russ
Required Attendees: Keith Ellis ([redacted]); Scott Adair; Todd Blackburn
Optional Attendees: Travis Spiceland; Ashley Turner; Ward Morgan; Greg Grissom

If you have additional items you would like on the agenda, please let me know. Feel free to pass the invite to others who might have interest.

Lunch will be served

Agenda

- Quick Review of 2020 DSM Potential Study
- Saturation Survey
  - Review of 2019 Survey
  - Planning for 2022 Survey
- DSM Issues
  - Energy Efficiency
  - Dynamic Pricing
  - Load Growth/Electric Vehicles
- Educational Opportunities
- Distributed Gen/Solar Development
  - Current development
  - Future development
- Infrastructure Investment and Jobs Act
  - Funding Sources
  - Member-Owner interest

Energy Related Formula Funding for Kentucky Under the Infrastructure Investment and Jobs Act		
Estimated for Kentucky*	**Program**	**Notes**
$8,109,821* (estimated for Kentucky)	State Energy Program	Estimated amount the Kentucky State Energy Office is expected to receive in SEP funds under the infrastructure bill. No state match required. A letter from the Governor on the status of the Kentucky Energy Emergency Plan is required as a condition of funding. NASEO estimate; exact allocation to be issued by DOE.
$1,621,964* (estimated for Kentucky)	Energy Efficiency Revolving Loan Fund Grant Program	The Kentucky State Energy Office is expected to receive of RLF funds. NASEO estimate; exact allocation to be issued by DOE. Additional funds will be available to the 15 states with the highest per-capita energy-related emissions or commercial/residential energy consumption as determined by DOE.
$2,092,247* (estimated for Kentucky)	Energy Efficiency and Conservation Block Grant Program	Amount the Kentucky State Energy Office is expected to receive via formula EECBG funds. Communities in Kentucky will be eligible for additional EECBG funding. NASEO estimate; exact allocation to be issued by DOE after bill passage.
$55,213,443* (estimated for Kentucky)	Weatherization Assistance Program	Amount Kentucky is expected to receive. NASEO estimate; exact allocation to be issued by DOE.
$69,000,000* (estimated for Kentucky)	National EV Formula Program	Formula funds to State DOTs over five years. Estimate provided by Biden Administration
*Pending**	Grid Resilience and Reliability.	The bill provides $2.5 billion to "states" via "a formula" determined by the U.S. Secretary of Energy. These funds are part of a set of grid resilience investments (billions) to be directed by DOE to investor- and consumer-owned utilities. States should consider what they would like to convey to DOE regarding a formula and state government receiving entity. NASEO recommends a unified message from states to maximize the value of the funds for states.
Energy-Related Competitive Program – Only State Energy Offices are Eligible		

***Important Note: The formula funding amounts indicated for your state are estimates based on past federal funding actions and federal program guidance. The actual amount a state receives or that the relevant federal agency will make available for competitive funding will be determined by those agencies following passage of the *Infrastructure Investment and Jobs Act*.**

$40 million (total for all states)	Energy Auditors Training Grant Program	Competitive program for State Energy Offices Only Maximum of $2 million per state
Other Competitive Programs – A Wide Range of Other Stakeholders are Eligible		
$300 million (total for all eligible entities)*	Carbon Capture and Utilization	Competitive program through U.S. DOE States and others eligible
$500 million (total for all eligible entities)*	Grants for energy efficiency and renewable energy improvements at public school facilities	Competitive program through U.S. DOE for EE, RE, and alt fuel vehicle upgrades School districts and schools are eligible. State Energy Offices may consider reaching out to schools
$225 million (total for all eligible entities)*	Building Energy Codes Technical Assistance and Training	Competitive program through U.S. DOE. States and others eligible
$2.5 billion (total for all eligible entities)*	Grants for Charging and Fueling Infrastructure	Competitive program through U.S. DOT. State Energy Offices potentially eligible (awaiting guidance from DOT)
$5 billion*	Energy Infrastructure Federal Financial Assistance Program	Competitive program through U.S. DOE. States eligible
$250 million*	Rural and Municipal Utility Advanced Cybersecurity Grant and Technical Assistance	Competitive grant program through U.S. DOE. States, municipal governments, rural utilities, and others eligible
$110 million*	Battery Recycling Grants	Two competitive grant programs through U.S. DOE. $60 million for battery recycling research, development, and demonstration programs (states eligible); $50 million for state and local programs

***Important Note: The formula funding amounts indicated for your state are estimates based on past federal funding actions and federal program guidance. The actual amount a state receives or that the relevant federal agency will make available for competitive funding will be determined by those agencies following passage of the *Infrastructure Investment and Jobs Act*.**

$50 million*	Smart Manufacturing Technology Implementation	Competitive grant program through U.S. DOE. States eligible

***Important Note: The formula funding amounts indicated for your state are estimates based on past federal funding actions and federal program guidance. The actual amount a state receives or that the relevant federal agency will make available for competitive funding will be determined by those agencies following passage of the *Infrastructure Investment and Jobs Act*.**

Scope of Work

Background

Significant federal funding opportunities now exist for the electric cooperatives of Kentucky resulting from the recently passed Infrastructure Investment and Jobs Act. The law provides several funding opportunities for Kentucky based businesses through block grant and revolving fund mechanisms provided through Kentucky state agencies as well as direct grant funding opportunities through federal agencies. Most of the funds are competitive and categorized with requirements; many requirements are still under development by the agency responsible for the funding, and may require a funding match.

The electric cooperatives of Kentucky seek assistance with evaluating the funding opportunities available and the actions needed to optimize the cooperative's utilization of funding in a way that is consistent with the strategic goals of our organizations.

The following is a complete list of Kentucky Electric Cooperatives:

Distribution Cooperatives:

Big Sandy RECC

Blue Grass Energy

Clark Energy

Cumberland Valley Electric

Farmers RECC

Fleming-Mason Energy

Gibson EMC

Grayson RECC

Inter-County Energy

Jackson Energy

Kenergy Corp

Licking Valley RECC

Meade County RECC

Nolin RECC

Owen Electric

Pennyrile Electric

Salt River Electric

Shelby Energy

South Kentucky RECC

Taylor County RECC

Tri-County Electric

Warren RECC

West Kentucky RECC

G&T Cooperatives

East Kentucky Power Cooperative

Big Rivers Electric Corporation

Deliverables

- Investigate funding information, bidding and participating requirements, etc. for each funding category/opportunity.
- Provide, via a slide deck, detailed information for each funding category including the federal and/or state agency responsible for the funds, their eligibility requirements, funding amounts possible, concepts/programs/infrastructure that electric cooperatives could fund, participation requirements (funding processes, matching fund requirements, reporting requirements, etc.).
- Coordinate and facilitate meetings (virtual and/or in-person) with the electric cooperatives to educate them on the funding opportunities and facilitate a high-level strategy development to optimize funding position of the cooperatives. Coordinate and lead at least two (2) education sessions and one (1) strategy discussion session. These high level strategy sessions should seek to encapsulate not only the operational and administrative aspects of the funding opportunities but also to discuss the strategic, economic and political inputs and outputs that are relevant to deciding whether to engage in a particular funding opportunity.
- Develop and deliver a report of high-level strategies suggested for the electric cooperatives of Kentucky.

How to Respond

Provide a proposal containing the qualifications detailing your company's knowledge and relevant experience supporting this scope of work. Provide your approach to the work identified in the Deliverables. Provide any working knowledge your organization has working with Kentucky's Electric Cooperatives. Identify the individuals along with their resumes who will be performing the work and their hourly rate(s). Provide a not-to-exceed quote for the Deliverables. Provide a timeline for Deliverables.

Additionally, please provide a statement in your response to this RFP that details how your company would assist any cooperative listed herein requesting individual strategy development and/or grant writing services beyond the Deliverables. Please provide a statement of how those services will be delivered and the proposed fee structure and hourly rates. Any individual strategy development or grant writing services will be subject to an agreement with the requesting cooperative.

Business Arrangements

East Kentucky Power Cooperative will contract for services on behalf of the electric cooperatives of Kentucky. Successful responding organization will be required to agree to EKPC's Service Agreement, attached for review. Please note any exceptions to the Service Agreement in your response.

Travel expenses, if any, will be reimbursed at cost.

National Association of State Energy Officials

Infrastructure Investment and Jobs Act

(As passed by the U.S. Senate August 10, 2021)

Provisions of Interest to NASEO Members

On August 20, 2021, the U.S. Senate passed the *Infrastructure Investment and Jobs Act* often referred to as the bipartisan infrastructure bill. As has been reported by NASEO, while the bill has not yet passed the U.S. House of Representatives, we anticipate that it will be passed before the end of September and would then be sent to the President for his signature.

Because of the historic size and scope of this bill, we strongly encourage State Energy Offices to become familiar with provisions of interest and to begin considering the implications and opportunities for your state. NASEO will hold regional, committee, and national calls to continue to inform states, and will hold "deep dive" discussions at the NASEO Annual Meeting in Portland, Maine this October. We are also engaging the U.S. Department of Energy to aid in navigating the implementation of these provisions.

Your input and questions are important to our elevating the needs of the states related to this bill, and your suggestions for how NASEO can best assist your offices are valuable. The bill is complex, and we have attempted to convey the provisions below accurately. However, we encourage you to also consult the text of the bill for more details and forward any questions to NASEO.

Summary of Key Energy Provisions

The following summary is organized by topical area, and not in the order the provisions appear in the bill. Each provision below includes Section numbers from the bill so that you are able to consult the bill directly for more details.

1. **U.S. State Energy Program Related Provisions**
   - U.S. State Energy Program (SEP) - $500 million for FY22-FY26 (Section 40109)
     - Via formula to State Energy Offices for any eligible SEP activity, to be spent over five years, with no match required.
     - Adds mandatory electric transmission and distribution planning to SEP and strengthens transportation and alternative fuel planning SEP options
   - State Energy Conservation Plans to include demand response (Section 40104)
   - State Energy Security Plans (Section 366, Section 40108)
     - Strengthens already required plans and adds governor letter
   - Energy Efficiency Revolving Loan Fund Capitalization Grant Program (INSULATE) - $250 million for FY22 to states (Section 40502)

- Would establish a revolving loan fund within SEP with capitalization grants to State Energy Offices for commercial and residential energy efficiency loan fund and audits
- 40% of funds distributed via SEP formula to states; 60% of the funds allocated to the 15 states with highest per-capita residential and commercial sector energy consumption or the highest annual per capita energy-related carbon emissions. See Page 1678, line 11 regarding what portion of the awards to states may be converted to grants vs loans

- Energy Auditors Training Grant Program – $40 million for FY22-FY26 (Section 40503)
  - Establishes an "SEP Competitive" for auditor training assistance
  - $40 million total, maximum of $2 million per state. FY22- FY26

2. Weatherization Assistance Program - $3.5 billion (Section 40551)

3. Low Income Home Energy Assistance Program - $500 million (Title VII)

4. Energy Efficiency and Conservation Block Grant Program (EECBG) - $550 million (Section 40552)

- 28% (approximately $150 million) to State Energy Offices (via EECBG formula)
- Modified the financing language in the underlying statute to make it easier to conduct financing programs, in an attempt to replicate the SEP financing language in 42 USC 6322(d)(5)

5. Energy Security

- Strengthens already required State Energy Security Plans (also known as energy assurance plans) and adds governor letter requirement (Section 40108) (also see SEP Section 40109)
- Enhancing grid security through public-private partnerships – Voluntary program for regional electric organization, utilities, and states to utilize maturity models and other tools to assess the physical and cyber security of the electric grid (Section 40121)
- Energy Cyber Sense program – Voluntary program to test the cybersecurity of technologies in the energy sector (Section 40122)
- Study of performance-based rate treatment for cybersecurity technologies involving interstate power (Section 40123)
- Rural and municipal utility advanced cybersecurity grant and technical assistance program – Creates a cybersecurity deployment, detection and response grant and technical assistance program with eligible entities including states, municipal governments, rural utilities and others ($250 million from FY'22-26) (Section 40124)
- Enhanced grid security – DOE shall consult with states, tribes, energy sector participants to develop an advanced cybersecurity technologies and pilot projects ($250 million from FY'22-26). Expand utility participation in the E-ISAC and provide technical assistance to small electric utilities ($50 million from Fy'22-26) (Section 40125)

6. Electric Grid Related Provisions

- Collaborative Transmission Siting – Mandatory State Energy Office requirement via SEP to conduct electric transmission and distribution planning (among the conditions for $500 million in funding), including feasibility studies and outreach to stakeholders (Section 40109)
- Siting of Interstate Electric Transmission Facilities (Section 40105)
  - States to issue reports on transmission capacity constraints and congestion. When designating National Interest Electric Transmission Corridors DOE is required to consider

lower cost. FERC can issue permit in certain circumstances even if state commission had denied siting application (state PUC authority is limited on transmission siting)

- Transmission Facilitation Program and Fund - $50 million FY22-FY26 (Section 40106)
  - $10 million for each fiscal year
  - Also creates $2.5 billion revolving loan fund that allows DOE to serve as an "anchor tenant" for a new transmission line or an upgrade of an existing line
- Deployment of Technologies for Grid Flexibility - $3 billion (Section 40107)
  - Amends Energy Independence and Security Act of 2007 to include Smart Grid investments
  - Authorizes $3 billion for the Smart Grid Investment Matching Grant Program
- Grid Infrastructure, Resilience, and Reliability - $5 billion for FY22-FY26 (Section 40101).
  - Directs DOE to establish a grant program to support activities to reduce the likelihood, consequences of, and impacts to the electric grid due to extreme weather, wildfire, and natural disaster.
  - Up to 50% of the total funding ($2.5 billion) going via formula determined by the Secretary (not via SEP) to states (not defined)
  - Requires matching funds 15%
  - States and tribes will have to submit a plan to describe the criteria and methods used to award grants to eligible entities and also the proposed funding distribution and recipients of the grants by the states and tribes. Grants are determined by formula determined by Secretary based on total population, total area, areas with low ratio of electricity customers to power lines, and probability of events, among other factors. Priority to projects which will have the greatest community benefits (rural and urban).
- Program Upgrading Our Electric Grid and Ensuring Reliability and Resiliency - $5 billion for FY22-FY26 (Section 40103)
  - Program for states, tribes, PUCs and local governments for transmission, storage, and distribution hardening and regional grid resilience. Requires match.
- Energy Improvement in Rural or Remote Areas, and Energy Infrastructure Resilience Framework - $1 billion for FY22-FY26 (Section 40103)
  - Funding for energy improvements for rural areas
  - Will create common analytical frameworks, tools, metrics, and data to assess the resilience, reliability, safety, and security of U.S. energy infrastructure
- Codes and Standards for Energy Storage (Section 40111)
  - Secretary to issue study no later than 18 months after enactment on barriers, foster collaboration and increase conformity across sectors; identify existing codes and standards; identify needed revisions or enhancements of codes and receive formal input from stakeholders on existing and new/revised codes
- Demonstration of EV Battery Second-Life Applications for Grid Services (Section 40112)
  - Directs Secretary to establish a demonstration project for second-life applications of EV batteries as aggregated energy storage installations to provide services to the electric grid

7. Buildings Related Provisions

- Building energy codes technical assistance and training - $225 million for FY22-FY26 (Section 40511)

- To be awarded by DOE to a variety of state (State Energy Offices and/or building code agencies), local, non-profit and other partners. Assistance can be used to address implementation needs in rural, suburban and urban areas. Includes related topics code updates, addition to or alteration of existing buildings, cost effective, high-performance and net zero energy buildings, improving resilience, health and safety, water savings and environmental impacts, and the economic impact of energy codes.

- Building, training and assessment centers – $10 million for FY22 (Sec. 40512)
  - DOE to provide grants to institutions of higher learning to establish building training and assessment centers to educate and train building technicians and engineers on implementing modern building technologies
  - Requires 50% cost share for career skills training
- Grants for energy efficiency improvements and renewable energy improvements at public school facilities - $500 million for FY22-FY26 (Section 40541)
  - Grants to be awarded by DOE for energy efficiency, renewable energy, and alternative fueled vehicle upgrades and improvements at public schools
- Energy efficiency materials pilot program - $50 million for FY22-FY26
  - Establishes pilot program to award grants to provide nonprofit buildings with energy efficient materials
- See also – Section 40107 Deployment of Technologies for Grid Flexibility

8. Transportation and Electric Vehicle Infrastructure Provisions

- Federal Joint Office of Energy and Transportation (Division J, Appropriations, Page 2653, line 10).
  - Will convene an Electric Vehicle Working Group to provide recommendations to the administration, to include a representative of the organization representing State Energy Offices
- Grants for Charging and Fueling Infrastructure - $2.5 billion FY22-FY26(Section 11401)
  - Grants to state, local, and public entities to install alternative fuel infrastructure along FHWA-designated Alternative Fuel Corridors
  - 50% of program funds will be dedicated to “Community Grants” for publicly-accessible alternative fuel charging/fueling projects outside of Alternative Fuel Corridors, with priority to rural, LMI and underserved communities, and multi-unit dwellings
- National EV Formula Program - $5 billion for FY22-FY26 (Division J, Appropriations, Page 2642, line 20)
  - Via formula to state Departments of Transportation to support EV chargers along federally-designated Alternative Fuel Corridors
- DOE Battery Recycling Grants to States (Section 40207)
  - 50% cost share requirement
  - $60 million for battery recycling research, development, and demonstration programs (states eligible)
  - $50 million for state and local programs
- Expands EIA data collection to include electric vehicle integration with electric grids (Section 40414)
- Requires states to consider measures to promote greater transportation electrification, including affordability/equity of charging options, improvement of customer experience, third-party investment in EV charging, and utility cost recovery models (Section 40431– applies to all state regulatory authorities and nonregulated utilities

- Replacement of Existing School Buses with Clean and Zero Emission School Buses – $5 billion (Division J, Appropriations, Page 2389, line 21)
- Electric or Low Emission Ferry Pilot Program - $250 million (Section 71102)
- Reduction of Truck Emissions at Port Facilities (Section 11402) - $250 million
- Carbon Reduction Program (Section 11403)
    - To include efforts to reduce impacts of freight movement and projects to deploy alternative fuel vehicles and reduce emissions at ports
- Fleet Transition Plan (Section 30018)
    - Requires grant applicants to submit zero emission transition plan addressing workforce transition, costs, and other indicators
- Study of impact of "cradle to grave" impacts of EVs (Section 40435)
- Study on impact of forced labor in China on the EV supply chain (Section 40436)
- Port Infrastructure Development Program - $2.25 billion (Division J, Appropriations, Page 2695, line 3)
    - Includes funding for projects that improve resilience of ports and port electrification, such as EV charging and hydrogen fueling infrastructure for drayage, trucks, and locomotives at ports, and related grid upgrades

9. Manufacturing Efficiency

- Sustainable Manufacturing Initiative (Section 376, Section 40522)
    - DOE EERE will provide onsite technical assessments for energy, water, and pollution prevention. Implementation of recommendations through AMO, BTO, FEMP, and NIST. Also includes R&D provision.
- Expansion of Industrial Assessment Centers (Section 457, Section 40521)
    - $150 million for establishing Industrial Assessment Centers
    - $400 million for training and support. 50% match. FY22- FY26. Includes funding for paid internships and apprenticeships and small business loans.
- Directs DOE and labs to increase access to smart manufacturing (supercomputing, industrial research and assessment centers) to small and medium size manufacturers (Secs. 40532 and 40533)
- Competitive funding for states to establish smart manufacturing technology implementation programs - $50 million FY22-FY26 (Sec. 40534).
    - Up to $2 million per award, 30% match.

10. Clean Energy Supply Chains

- Battery Processing and Manufacturing (Section 40207)
- Battery recycling RD&D - $60 million FY22-FY26 (Section 40207)
    - Includes state research agencies as well as universities, companies, industry, NGOs eligibility
- State and local programs for battery collection, recycling, reprocessing - $50 million FY22-FY26 (Section 40207)
    - 50% cost share
- Task force on producer responsibility—to include states and municipalities (Section 40207)

11. Solar

- Solar Energy Technologies on Mine Lands (Sec. 40341)

12. Hydrogen R&D

- Clean Hydrogen R&D Program in consultation with private sector (Section 40313)
- Regional Clean Hydrogen Hubs - $8 billion (Section 813)
    - To support commercialization and deployment
- Provisions for Clean Hydrogen Manufacturing Initiative (Section 815), Recycling Program (Section 815) - $500 million

13. Hydropower

- Hydroelectric production incentives - $125 million for FY22 (Section 40331)
- Hydroelectric efficiency improvement incentives - $75 million for FY22 (Section 40332)
- Pumped Storage Hydropower Wind and Solar Integration and System Reliability Initiative (Section 40334)
    - State Energy Offices are among eligible entities to receive financial assistance to carry out project design, transmission studies, power market assessments, and permitting for a pumped storage hydropower project to facilitate the long-duration storage of intermittent renewable electricity

14. Nuclear Energy Infrastructure

- Funding and technical assistance for siting micro-reactors, small modular, and advanced nuclear reactors (Section 40321)
- Discussion of zero-emission payment credits from states (Section 40323) in assessing economic viability of reactor

15. Carbon Capture and Utilization

- CCSUS Utilization Program – $300 million (Section 40301, Section 40302)
    - Provides grants over five years to eligible entities, including states and local governments.
    - Grants can be used to procure commercial or industrial products that use or are derived from anthropogenic CO2 and demonstrate significant net reductions in GHG emissions compared to incumbent technologies, processes and products.
- Carbon Capture Technology Program - $100 million for FY22-26 (Section 40303)
    - For design, engineering for CO2 transport infrastructure
- Carbon Dioxide Transportation Infrastructure Finance and Innovation (Section 40304)
    - Loan and loan guarantees program of $600 million each FY22, FY23; $300 million each FY24, FY25, FY26
- Secure Geologic Storage Permitting - $50 million for FY22-FY26 in State Grants through EPA (Section 40306)
- Carbon Removal - $3.5 billion for FY22-FY26 (Section 40308)- DOE to establish program to fund four regional direct air capture hubs (at least two in economically distressed communities with high levels of coal, oil, and natural gas resources)

16. Workforce

- Establishes a 21st Century Energy Workforce Advisory Board (Section 40211) and Jobs Council (Section 40553) with State Energy Office representation from STEAB
- Codifies annual U.S. Energy and Employment Report methodology and contents, including consultation with States as key stakeholders (Section 40553)

17. DOE Loan Program

- Discussion of eligibility of loan guarantees for projects receiving funds from State Energy Financing Institutions (Section 40401) (language developed with NASEO several years ago as a Murkowski/Cantwell proposal)

18. Buy American Sourcing Requirements (Section 70911, Section 70936)

Subject: DSM/EV Working Group Meeting
Location: HQ Conference Room 4A

Start: Thu 5/5/2022 9:30 AM
End: Thu 5/5/2022 12:30 PM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: Pogue, Russ
Required Attendees: 'Jeff Williams'; 'Travis Spiceland'; Jeremy. Goodman ([redacted]); Scott Heath; Todd Blackburn; Mike French ([redacted]); Bradley, Chris; Tapp, Tim; Scott Adair; 'Ward Morgan'; Jeremy Martin (Jeremy.Martin@bigrivers.com)
Resources: HQ Conference Room 4A

Draft Agenda:

- EV Charger technology:
  - Load Control Options
  - Home Charging
  - Public Charging
- Update on the EKPC Infrastructure funding
- Behind the meter charging cost
- Battery analysis presentation
- Dynamic Pricing discussion

10:00 Charge Point Presentation
11:00 Blink Presentation

ChargePoint Commercial Cloud Plan

Features and Ordering Information

The ChargePoint® Commercial cloud plan makes it simple to manage stations with a real-time graphical dashboard and detailed map. Charging session analytics and reports simplify operations and satisfy management requests for information. Additional features for fleet managers make it easy to electrify fueling, including controlling access to chargers and integration with other fleet systems.

Power management software allows site administrators to maximize the number of charging ports they can deploy while still ensuring EV drivers get an adequate charge. Power management features can also be used to reduce electricity costs.

When demand for charging exceeds supply EV drivers have to contend for charging spots. Waitlist lets drivers tap their card at stations to get in a queue and receive notifications when a station is available. Stations are held until the next driver in line arrives to plug in.

Setting fees for charging allows electricity costs to be recovered and motivates drivers to move their vehicles when they're done charging to make room for another car. Seven pricing models meet any requirement and a wizard simplifies configuration. Station owners who want to limit access to charging stations at their sites can take advantage of access controls that determine who can charge, and when.

Managing large charging networks can be challenging, especially when they're widely distributed. Features in the Commercial plan allow configuration of stations and reporting data to be securely delegated to third parties. Station managers also get access to support experts during business hours.

EV drivers who use connected stations get real-time availability of stations, simple navigation, the most convenient charging, tracking of their activity and reporting of helpful tips to assist other drivers. They also get 24-hour phone support so they're never stranded. Full-color, high-resolution instructional (or promotional) videos for drivers can be downloaded to stations with displays.

More advanced cloud plans, available with a simple upgrade, enable advanced analytics (with 15 minute reporting interval), integration with OpenADR and Building Management Systems through energy management APIs and many other useful capabilities to maximize station return on investment and the driver experience.

Commercial Cloud Plan Summary

Feature	Description
Flex Billing	Gives station managers the option to set prices that drivers pay to use their stations. Funds collected from drivers are electronically transferred to a designated bank account once a month. Different prices can be applied to different driver groups. Prices can be based on energy cost, duration, time of use or session. A pricing wizard is included with suggested pricing plans for different industries.
Waitlist	Lets drivers get in line to use ChargePoint stations.
Driver Access Controls	Empowers station managers to manage who can access their stations and when.
Administrative Controls (Rights Granting)	Allows secure delegation of configuration tasks and reports to third parties.
Videos	Allows branded video content to be delivered to supported stations.
Power Management	Manages available power at a circuit, panel or site level so more charging stations can be installed without upgrading existing electrical facilities; also reduces electricity costs by managing the load.
Scheduled Charging	Schedules the time when charging starts to reduce electrical costs.
24/7 Driver Support	Assists EV drivers with questions about charging.

Commercial Cloud Plan Summary continued

Feature	Description
Station Manager Support	Supports station managers over the phone (5 AM – 6 PM PT) or via email.
Charging Data and Analytics	Reports on key station metrics, including status, power and energy use, charging session details and more.
Fleet Vehicle Management	Allows fleet managers to activate RFID cards for fleet vehicles and track their station usage by vehicle.
Fleet Ecosystem Integration	Integrates fleet telematics, fuel card and asset management systems.
Fleet Access Controls	Limits charging to authorized fleet vehicles.
Valet Dashboard	Notifies station managers when cars are done charging so they can be moved.
Power Select	Permits stations to be provisioned on smaller circuits (< 40 amps) without exceeding the rated capacity.
Network Connection	Enables 24/7 remote monitoring and status of stations.
Automatic Station Software Updates	Downloads software upgrades over the air so the latest features and performance enhancements are always available.
Station Inventory	Displays real-time station availability and details in a simple online dashboard.

Ordering Information

One ChargePoint cloud plan is *required* per port to activate a charging station on the ChargePoint Network.

Description	Order Code
Commercial Cloud Plan for Level 2 (1, 2, 3, 4 or 5 years)	CPCLD-COMMERCIAL-*n*[1,2]
Commercial Cloud Plan for DC (1, 2, 3, 4 or 5 years)	CPCLD-COMMERCIAL-DC-*n*[1,3]
Commercial Cloud Plan for Express Plus (1, 2, 3, 4 or 5 years)	CPCLD-COMMERCIAL-EXPP-*n*[1]

[1] Substitute *n* for desired years of service (1, 2, 3, 4 or 5 years)
[2] Order Code CTSW-SAS-COMM-*n* has been deprecated: use CPCLD-COMMERCIAL-*n*
[3] Order Code CTSW-SAS-COMM-DC-*n* has been deprecated: use CPCLD-COMMERCIAL-DC-*n*

Contact Us

To order the Commercial Cloud Plan:

Visit chargepoint.com/sales

Call +1.408.705.1992

Email sales@chargepoint.com

ChargePoint, Inc.
254 East Hacienda Avenue, Campbell, CA
95008-6617 USA
+1.408.841.4500 or toll free +1.877.370.3802
chargepoint.com

Express 250

Smart DC Fast Charging

The ChargePoint® Express family is designed to meet the fast charging needs of today's and tomorrow's electric vehicles.

High Power in a Small Footprint

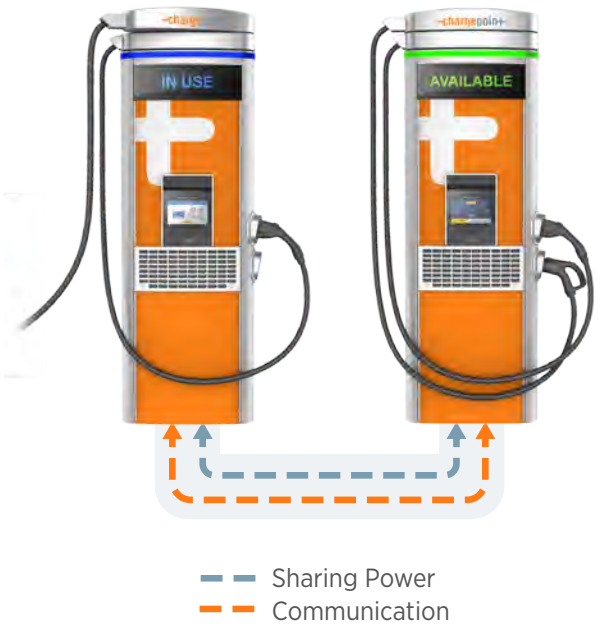
ChargePoint® Express 250 is based on industry-leading DC fast charging technology, engineered to fast charge current and next-generation electric cars, buses and trucks. At the heart of each Express 250 are 2 self-contained, easily swappable AC to DC Power Modules. This innovative design ensures that in the rare instance one module goes down, the station remains operational. It can be installed as a stand-alone station or in a paired configuration providing up to 25% more power than a 50kW station and 40% more with a paired configuration. When paired, smart power sharing and power allocation policies determine how much energy is allotted to each station in order to deliver flexible fast charging to two vehicles at a time.

Thoughtfully Designed

The Express 250's interactive LCD screen lets drivers easily interact with instructions, information or promotions. A wide-format LED display makes availability and status easy to see, even at a distance. Up to two connector types allow charging of any electric vehicle and an advanced cable management system provides extra reach, while keeping cables off the ground. Fault-tolerant design, remote monitoring and intelligent diagnostics provide proactive alerts to prevent station outages, eliminating driver frustration.

Smart & Fully Supported

Built-in cellular networking makes remote management of the Express 250 easy. ChargePoint Cloud Services lets station owners customize the stations to meet their specific requirements, including setting pricing policies for public charging or making stations available to certain driver groups such as employees only. Automatic software upgrades ensure the latest features are always available. The ChargePoint mobile app and in-dash systems tie everything together: drivers can locate stations, instantly begin charging, check their charging status, track their charging activity over time and, depending on the configuration, get in line to charge at busy stations.



Connectivity and more power in paired configuration

High Availability and Serviceability

The Express 250 has minimal moving parts, increasing reliability and minimizing ongoing maintenance. Modular components can be installed in the field without any specialized tools or expertise.

+ Instrumentation for remote monitoring, intelligent diagnostics and machine learning
+ Configurable levels of Power Module redundancy and duty cycle management

Universal Compatibility

The Express 250 supports battery packs from 200V to 1000V, ensuring both legacy and future electric vehicles can always be charged.

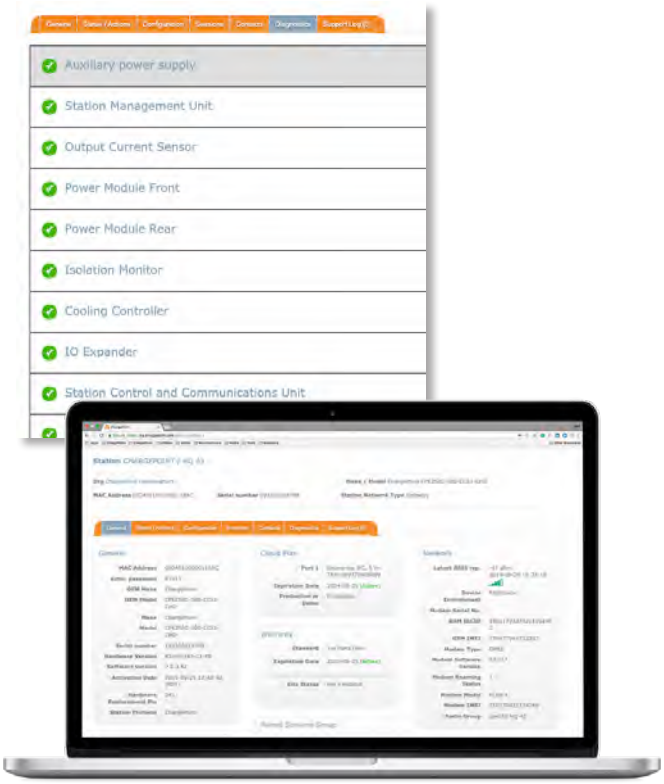
+ Compatible with international electrical grid standards and vehicles
+ Supports current and future global standards, including: CCS1, CCS2 and CHAdeMO

Connectors supported

Cloud-Based Station Management

The Express 250 lets station owners easily monitor the stations remotely, tailor pricing to different driver groups and configure power to manage electrical costs or meet site-specific power requirements. Automatic software updates instantly provide the latest features and enhancements to both drivers and station owners.

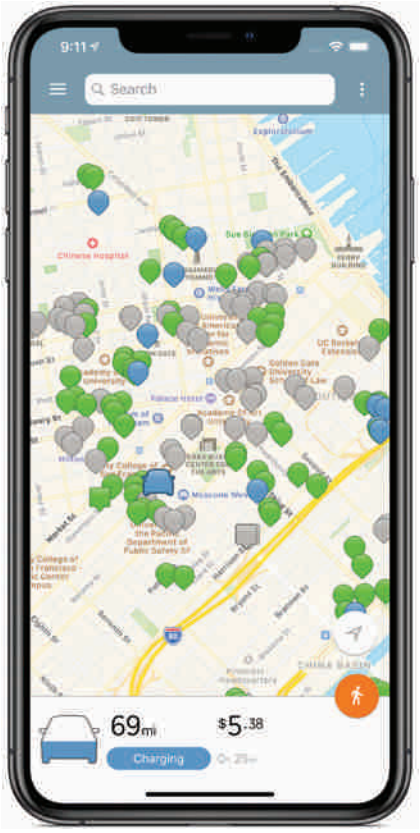
+ 24/7 station monitoring
+ Multiple authentication and/or payment methods



Cloud management and monitoring

Mobile App and In-Dash Integration

The Express 250 is integrated with the ChargePoint mobile app and vehicle in-dash systems to provide drivers with real-time availability of stations on the network, which also lets them "get in line" to use busy charging spots. To find out how ChargePoint benefits drivers, visit chargepoint.com/drivers



Mobile app view

When Charging is Mission Critical, Protect Your Investment with ChargePoint® Assure™

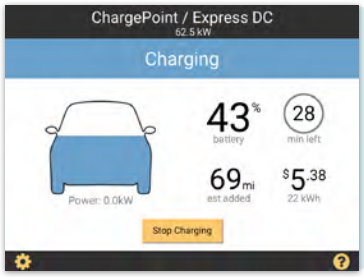
ChargePoint® Assure™ provides the most comprehensive EV station maintenance and management in the industry. The cost for parts and on-site labor to install is covered for all Assure eligible repairs, eliminating unexpected future expenses. Please visit chargepoint.com/products/service for more details.

Subscription Pricing Makes Ownership Easy

ChargePoint as a Service® gives you access to smart solutions with subscription pricing, allowing you to retain full control of your EV charging solutions while we manage everything else. To find out how to preserve your CapEx funds, visit chargepoint.com/products/cpaas

Express 250 Station Benefits

Cable management keeps cables off the ground and makes it easy to reach charging port in any location



Touch sensitive LCD display shows charging information and can be used in any season

LED ring and large LED display allows drivers to easily see availability of the station at a distance

Multiple different connectors ensure any car can be charged

Capacity to store two power modules (see Power Module Benefits below)

Power Module Benefits

Self-contained AC to DC power conversion system allows for smaller installation footprint

Sealed units are easily field installed in Express 250 stations

High-efficiency power conversion (> 95%) reduces electricity costs and wasted energy

Contact Us:

Visit chargepoint.com

Call +1.408.705.1992

Email sales@chargepoint.com

chargepoint

ChargePoint, Inc.
240 East Hacienda Avenue
Campbell, CA 95008-6617 USA

+1.408.841.4500 or
+1.877.370.3802 US and Canada toll-free

chargepoint.com

Express 250

DC Fast Charging Station

Site Preparation Guide

No accuracy guarantee

Commercially reasonable efforts were made to ensure that the specifications and other information in this manual are accurate and complete at the time of its publication. However, the specifications and other information in this manual are subject to change at any time without prior notice.

Warranty information and disclaimer

The Warranty you received with your Charging Station is subject to certain exceptions and exclusions. For example, your use of, or modification to, the ChargePoint® Charging Station in a manner in which the ChargePoint® Charging Station is not intended to be used or modified will void the limited warranty. You should review your warranty and become familiar with the terms thereof. Other than any such limited warranty, the ChargePoint products are provided "AS IS," and ChargePoint, Inc. and its distributors expressly disclaim all implied warranties, including any warranty of design, merchantability, fitness for a particular purposes and non-infringement, to the maximum extent permitted by law.

Limitation of liability

CHARGEPOINT IS NOT LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL, PUNITIVE OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION LOST PROFITS, LOST BUSINESS, LOST DATA, LOSS OF USE, OR COST OF COVER INCURRED BY YOU ARISING OUT OF OR RELATED TO YOUR PURCHASE OR USE OF, OR INABILITY TO USE, THE CHARGING STATION, UNDER ANY THEORY OF LIABILITY, WHETHER IN AN ACTION IN CONTRACT, STRICT LIABILITY, TORT (INCLUDING NEGLIGENCE) OR OTHER LEGAL OR EQUITABLE THEORY, EVEN IF CHARGEPOINT KNEW OR SHOULD HAVE KNOWN OF THE POSSIBILITY OF SUCH DAMAGES. IN ANY EVENT, THE CUMULATIVE LIABILITY OF CHARGEPOINT FOR ALL CLAIMS WHATSOEVER RELATED TO THE CHARGING STATION WILL NOT EXCEED THE PRICE YOU PAID FOR THE CHARGING STATION. THE LIMITATIONS SET FORTH HEREIN ARE INTENDED TO LIMIT THE LIABILITY OF CHARGEPOINT AND SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.

ChargePoint, Inc.
254 East Hacienda Avenue
Campbell, CA 95008 USA

US and Canada: +1.877.850.4562

support@chargepoint.com

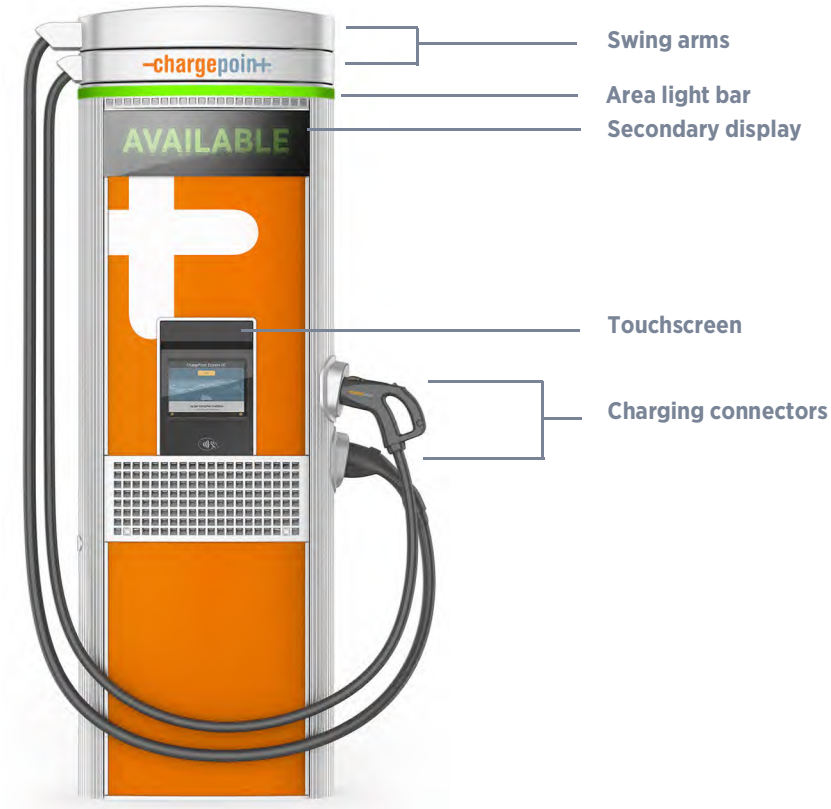
Contents

Introduction 1

This document describes how to prepare a project site for the ChargePoint Express 250 DC fast charging station. Read this section to familiarize yourself with the Express 250 and ensure that you have all the components, tools, and materials needed to prepare a concrete mounting pad for the Express 250.

Important: Always check local codes or consult an engineer to ensure that the site is prepared in compliance with all applicable codes.

Express 250 Overview



Before You Begin

- Ensure that the cellular coverage at the installation site is consistently strong. The Express 250 communicates with ChargePoint using the cellular network. A consistently strong cellular signal is needed before installers can activate the station. Use a cellular signal detection device (such as a Squid™) to ensure the signal is -70 dBm or better. If the signal is below -85 dBm, install repeaters to boost the strength of the cellular signals. Repeaters are often required when installing the Express 250 in an underground garage or enclosed parking structure.
- Check that the installation location is equipped with service wiring that supports the Express 250's power requirements. See Electrical Input on page 15.
- Ensure that a grounding conductor that complies with local codes is properly grounded to earth at the service equipment or, when supplied by a separate system, at the supply transformer.

Important: The Express 250 charging station is tested to IEC 61000-4-5, Level 5 (6 kV @ 3000A) standards. In geographic areas that experience frequent thunder storms, a supplemental surge protection breaker must be installed at the service panel.

- Install a disconnect switch installed per NEC Article 625 Electric Vehicle Charging and Supply Equipment Systems.

The Express 250 Concrete Mounting Template

Preparing the site requires running conduit and building a concrete mounting pad onto which to install the Express 250. To build the mounting pad, you will need the ChargePoint Express 250 Concrete Mounting Template (CPE250-CMT). The Concrete Mounting Template provides correctly-aligned mounting bolts and conduit openings to ensure the Express 250 can be easily positioned and mounted. The Concrete Mounting Template, available from ChargePoint, includes:

- 5/8-11 thread, 12 in long threaded mounting bolts with plastic caps on one end (x6)
- 5/8-11 nuts* (x24)
- 5/8-11 washers* (x24)
- Printed specification detailing how to position an assembled Concrete Mounting Template into the concrete.

*You will need only 12 of the 5/8-11 nuts and washers when assembling the Concrete Mounting Template. The remaining 12 are needed when securing the Express 250 to the mounting pad as described in the Express 250 Installation Guide.

Tools and Materials

In addition to the Express 250 Concrete Mounting Template (CPE250-CMT) described on the previous page, you will need:

- Digging tools (shovel, spade, etc.)
- Materials to prepare the form for pouring concrete
- Concrete
- Conduit (see page 5)
- 15/16” wrench (x2)
- Pliers to adjust the guide fingers on the conduit opening (if needed)
- Level

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Preparing the Mounting Pad 2

Follow the instructions in this section to prepare the mounting pad.

Overview of Steps

Run the Conduit and Cable

The Express 250 accommodates service wiring installed underground and run through conduit in compliance with local electrical codes. Consult local codes or a project engineer to determine the grade, quality, and size of the conduit. The CPE250-CMT accommodates service wiring through the flare, conduit, or locally appropriate wiring method.

Important: The terminal block on the Express 250 accepts 2 AWG wires only. If using a larger gauge wire to accommodate a long run, reduce the wire size at the disconnect.

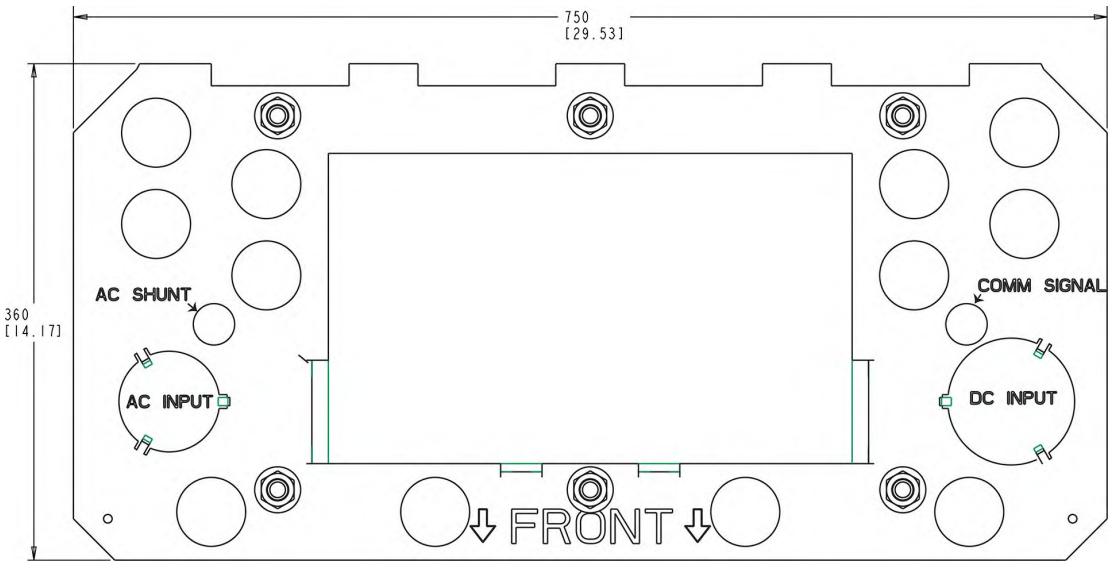
The outer diameter of conduit must not exceed the following:

- AC Conduit 2”
- DC Conduit 3”
- Shunt Trip Conduit 3/4”
- Data Conduit 3/4”

Mounting specifications are provided on page 9.

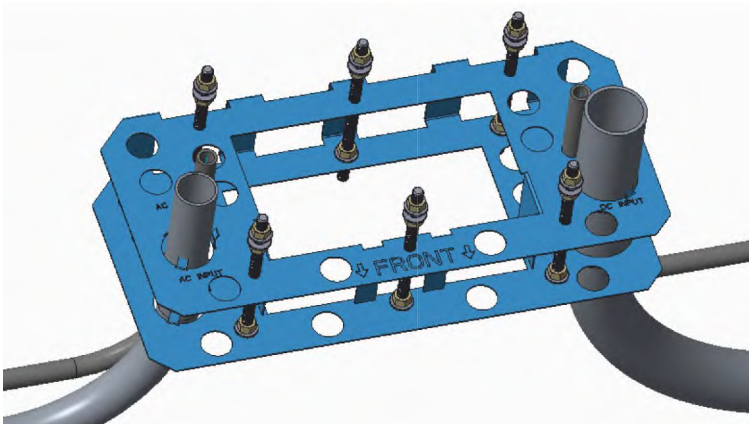
Assemble the Mounting Template

Before pouring concrete, you must assemble and position the mounting template. A top-down view, and an assembled template, is shown below.



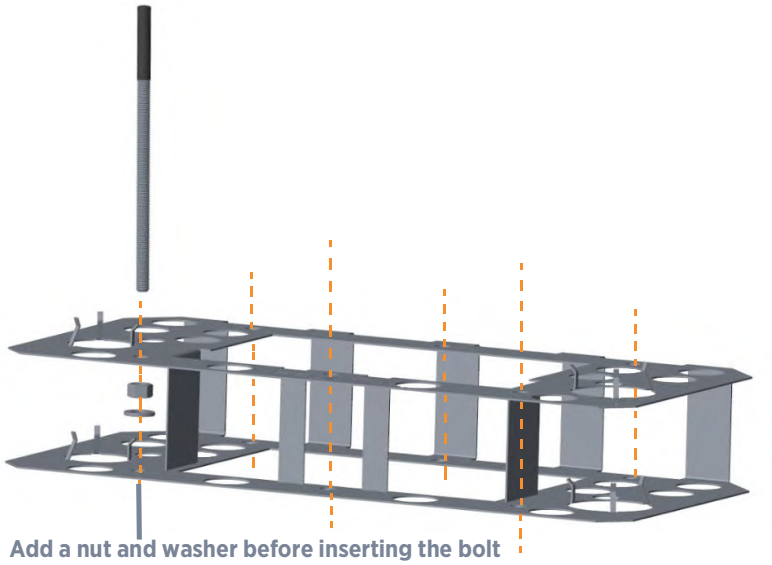
As shown, AC conduit enters the conduit opening on the left-hand side. The conduit on the right-hand side is used for DC conduit.

Follow the steps on the following pages to assemble the mounting template.



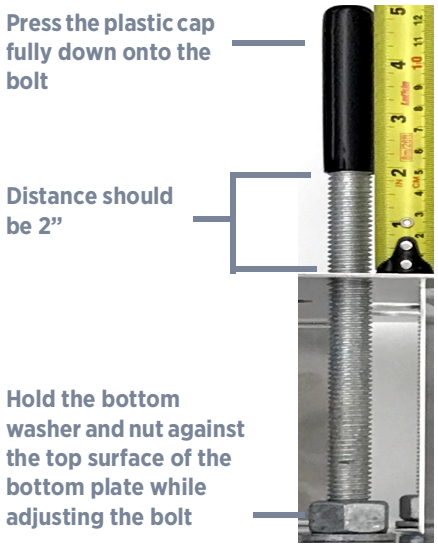
Step 1 Hold a mounting bolt by its plastic cap and insert the bare end into a bolt hole in the top plate of the template.

Step 2 Before inserting the bolt through the bottom plate of the template, thread a nut onto the bolt and add a washer (as shown).



Add a nut and washer before inserting the bolt through the bottom plate of thee template

Step 3 Ensure the plastic cap is pressed fully down on the bolt. Then, holding the bottom nut and washer flush against the top surface of the bottom plate, thread the bolt onto the nut until the distance between the bottom of the plastic cap and the surface of the top plate is 2”.



Step 4 Repeat Steps 1 to 3 for the remaining five bolts.

Step 5 Secure a second washer and nut onto the bottom of each bolt until flush with the bottom surface of the bottom plate. Tighten each nut to 50 in-lb.

Install the Mounting Template

Dig an opening to accommodate the wiring conduit and the concrete mounting pad. For details, see Mounting Specifications on page 9.

Step 1 Trench and excavate an opening for the foundation that meets local codes and requirements.

Step 2 Build the form for the foundation.

> **Important:** It is critical that the conduits are positioned properly and plumb. The tolerance where the conduits enter the station is 1/16 in (2 mm).

Step 3 On the template, locate the “FRONT” marking and the conduit guide fingers. The conduit guide fingers face up.

Step 4 Place the assembled mounting template so that the “FRONT” marking aligns with the location where the front of the station will be placed.

Step 5 Slide the mounting template over the conduits until the top surface of the template is positioned 2” (51 mm) below where the top surface of the concrete will be when poured. The surface of the concrete must align with the bottom of the plastic caps.

- Carefully press the mounting template down onto the conduit to avoid flexing it.
- Make sure that the conduits are plumb.
- Use a level to check that the mounting template is level from front to back and side to side.

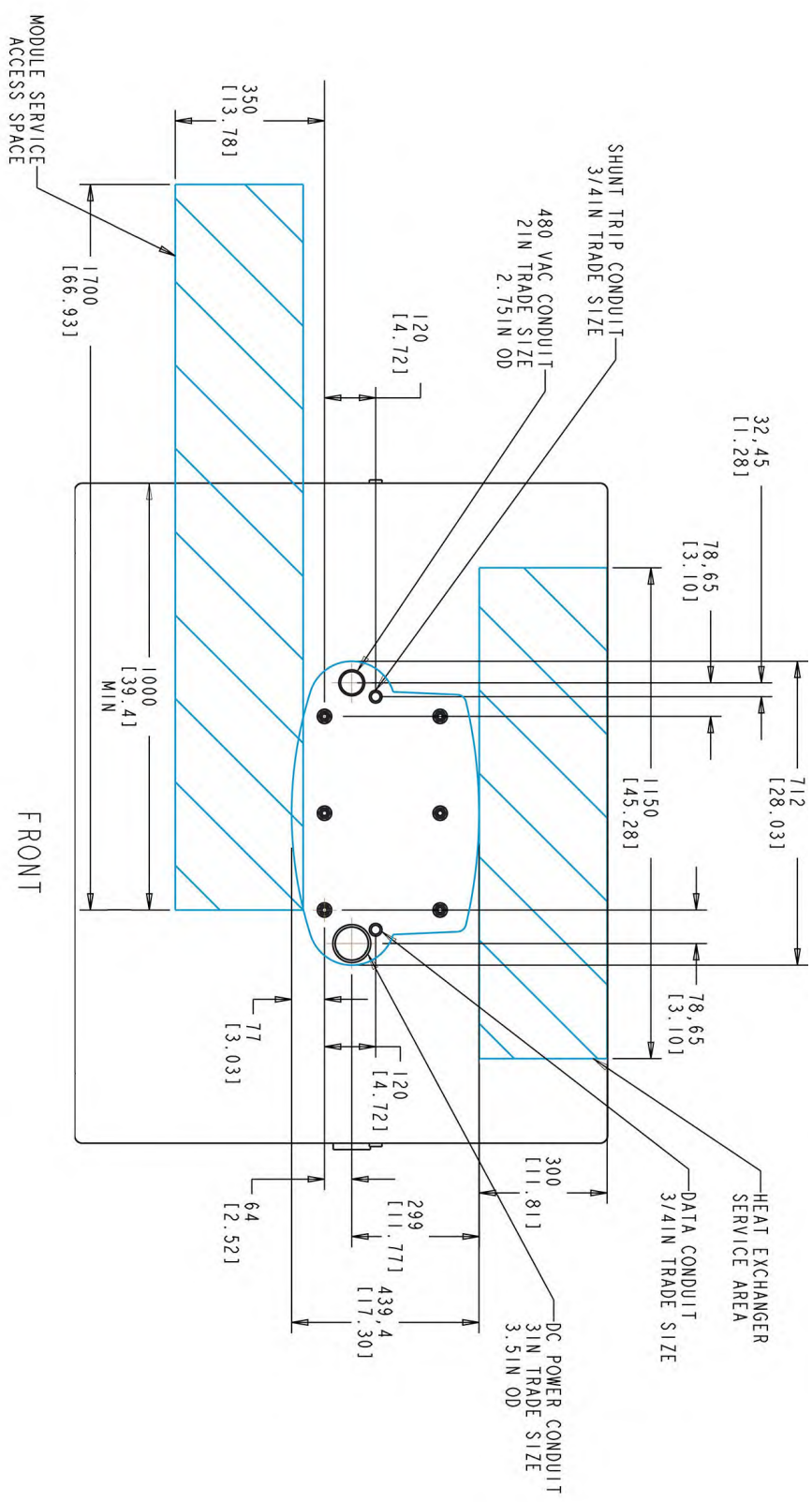
> **Important:** Before pouring concrete, the template and the conduit must be secured in place to prevent them from rising or floating out of position while the concrete is poured and curing.

Step 6 Pour the concrete.

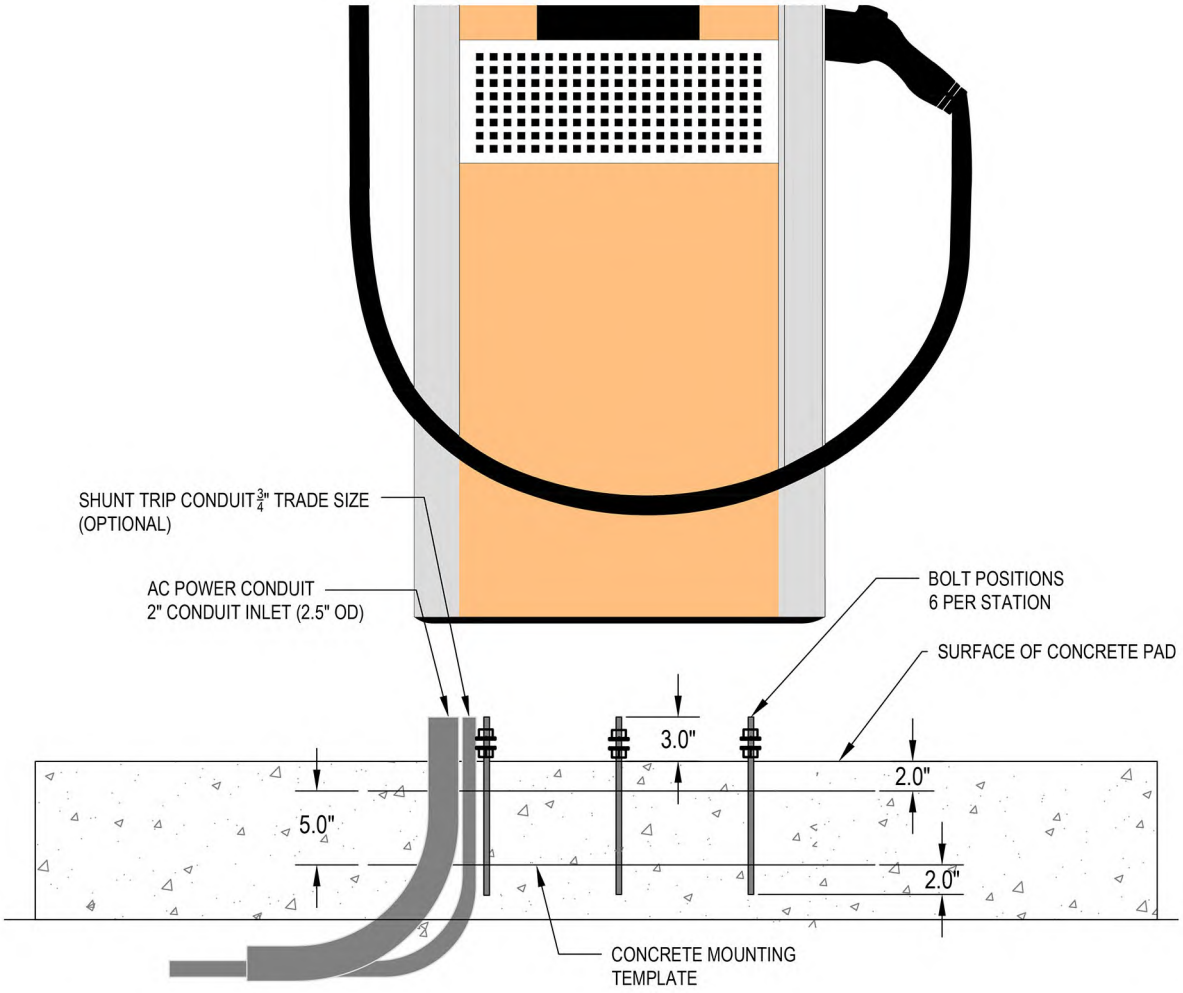
Note: Make sure the concrete surface between the conduits is completely level and free of any irregularities (such as chunks of concrete).

Mounting Specifications

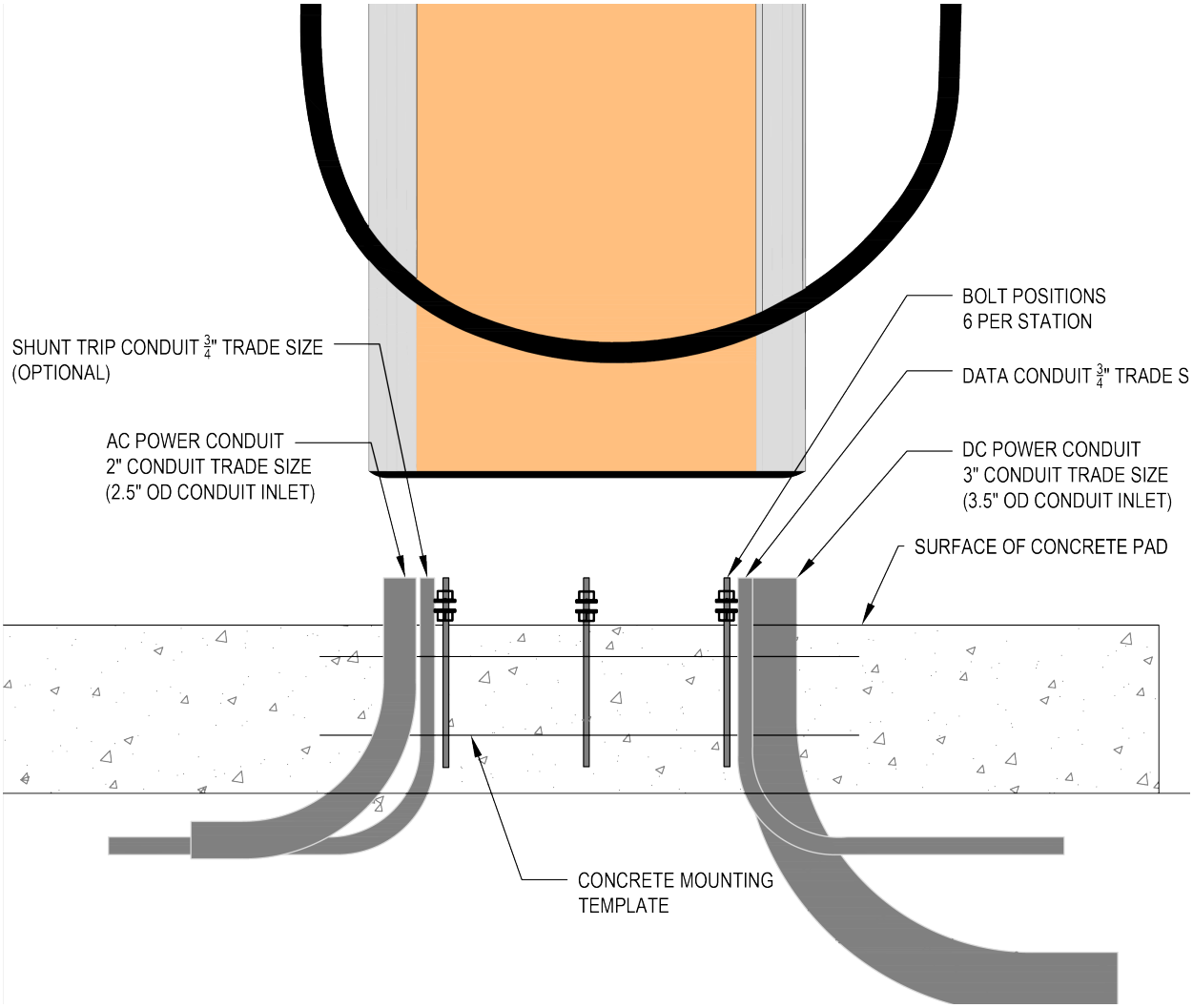
In the following specifications, measurements are provided in millimeters, with inches provided in brackets.



AC Conduit


SHUNT TRIP CONDUIT ¾" TRADE SIZE
(OPTIONAL)
AC POWER CONDUIT
2" CONDUIT INLET (2.5" OD)
BOLT POSITIONS
6 PER STATION
SURFACE OF CONCRETE PAD
3.0"
2.0"
5.0"
2.0"
CONCRETE MOUNTING
TEMPLATE

AC and DC Conduit



Example Photo - Site Preparation Complete

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Express 250 Specifications A

Power Module

Constant Max Power	31.25 kW
Max Output Current	78A
Dimensions	760 mm x 430 mm x 130 mm (2 ft 6 in x 1 ft 5 in x 5 in)
Weight	38 kg (84 lb)

Electrical Output

Max Output Power	62.5 kW
Output Voltage, Charging	200–1000 VDC
Max Output Current	156A
Max Modules	2

Electrical Input

Input Rating	480 (+-10%) VAC, 3-phase, 80A, 60 Hz
Wiring	4 conductors (L1, L2, L3, Ground). Although Neutral is not used in U.S., a terminal connector is provided.
Required Service Panel Breaker	100A (North America - 480V) 125A (EU - 400V)

Dimensions and Weight

Dimensions	2230 mm x 1120 mm x 420 mm (7 ft 4 in x 3 ft 8 in x 1 ft 4 in)
Weight	250 kg (551 lb) + 41 kg (90 lb) for each power module

Interfaces

Max Connector Types	Up to 3 different connector types
Supported Connector Types	• CCS1 (SAE J1772™ Combo) • CCS2 (IEC 61851-23) • CHAdeMO
Cord Length	3.8 m (12.5 ft)
Driver Interaction Display	Full-color 10-inch LCD display for driver interaction
Top Display	Full-color 20-inch LED display for notifications
Authentication	• RFID: ISO 15693, ISO 14443, NFC • Plug and Charge: IEC 15118-1 • Remote: Mobile and in vehicle (if supported by vehicle)

Safety and compliance

Safety Compliance	For U.S., complies with UL 2202, UL 2231-1, UL 2231-2 For Europe, complies with IEC 62196, IEC 61851, CE marking
EMC Compliance	U.S.: FCC part 15 Class A EU: EN55011, EN55022 and IEC61000-4

Environmental requirements

Operational Altitude	<3000 m (<9800 ft)
Operating Temperature	-30° C to 50° C (-22° F to 122° F)
Storage Temperature	-40° C to 50° C (-40° F to 122° F)
Operating Humidity	Up to 95% @ 50° C (122° F) non-condensing
Enclosure Rating	IP44 and NEMA Type 3R

Grounding requirements

The Express 250 must be connected to a grounded, metal, permanent wiring system. An equipment-grounding conductor must be run with circuit conductors and connected to an equipment-grounding terminal or lead on the Express 250.

A grounding conductor that complies to local codes must be grounded to earth at the service equipment or, when supplied by a separate system, at the supply transformer.

SAVE THESE IMPORTANT SAFETY INSTRUCTIONS

This manual contains important instructions that must be followed during installation of a ChargePoint® DC Fast Charging Station.

Grounding instructions

The ChargePoint® Charging Station must be connected to a grounded, metal, permanent wiring system; or an equipment-grounding conductor is to be run with circuit conductors and connected to the equipment grounding terminal or lead on the Electric Vehicle Supply Equipment (EVSE). Connections to the EVSE shall comply with all applicable codes and ordinances.

Safety and compliance

This document provides instructions to install the ChargePoint® Charging Station and should not be used for any other product. Before installing the ChargePoint® Charging Station, review this manual carefully and consult with a licensed contractor, licensed electrician and trained installation expert to ensure compliance with local building practices, climate conditions, safety standards, and all applicable codes and ordinances.

The ChargePoint® Charging Station should be installed only by a licensed contractor and a licensed electrician and in accordance with all local and national codes and standards. The ChargePoint® Charging Station should be inspected by a qualified installer prior to the initial use. Under no circumstances will compliance with the information in this manual relieve the user of his/her responsibility to comply with all applicable codes or safety standards. This document describes the most commonly-used installation and mounting scenarios. If situations arise in which it is not possible to perform an installation following the procedures provided in this document, contact ChargePoint, Inc. ChargePoint, Inc. is not responsible for any damages that may occur resulting from custom installations that are not described in this document.

254 East Hacienda Avenue
Campbell, CA 95008 USA
US toll free: +1.877.850.4562
www.chargepoint.com

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CT4000 Make-Ready Requirements Specification

Introduction

This document provides best practices and guidelines for preparing a site to install EV charging stations (Make-Ready). "Make-ready" means that all necessary electrical infrastructure to operate the charging stations, all conduit and wire is pulled to the station location(s), all concrete work is completed properly so the stations can be mounted and any cellular repeaters are installed if required.

ChargePoint recommends that you plan for 5%-10% of parking spaces and 10%-15% for high EV adoption areas like California for future planning. Consideration of electrical infrastructure that supports current and future needs for EV charging will help avoid costly upgrades later as demands for EV charging grows.

Regardless of the specific type of CT4000 charging station you will be installing, these high level Make Ready specification will be the same.

ChargePoint recommends using a certified electrician to evaluate available capacity of existing electrical panels and to identify any electrical panel upgrades that may be required to support EV charging for multiple make-ready parking spaces. An onsite evaluation is necessary to determine conduit and wiring requirements from panel to proposed "make-ready" parking spaces, as well as to measure cellular signal levels and identify suitable locations for placement of any necessary cellular signal booster equipment.

Station Location

To help minimize costs you will want to choose station locations that are somewhat close to the available electrical infrastructure. In selecting these types of locations it helps minimize long conduit and wire runs as well as any trenching work. You should also consider locations where it will be easy to add future stations.

You also need to ensure that station locations have strong 3G cellular connectivity to allow ChargePoint to communicate with the stations. If there is a weak signal at the station location a cellular signal booster (repeater) will need to be installed (See the Cellular Signal Levels section later in this document).

Finally, consider how easy the stations are to find for drivers needing to access them.

EV Make-Ready Construction

All construction must conform to all local codes that are designated by the state, local municipality or authorities of where you are performing the construction. Conduit and wire size will need to be determined based on the length of runs from electrical panel to the station location. The National Electrical Codes and local codes will help determine appropriate sizing.

Each Level 2 charging port requires a dedicated single-phase electrical circuit (32A @ 208/240V) with 40A circuit breaker at the electrical panel. A certified electrician must install all electrical circuits in accordance with local and National Electric Code requirements.

General guidelines for "make-ready" include:

1) Evaluation of existing electrical infrastructure to determine if there is sufficient existing utility service and electrical panel capacity and identify costs for any necessary upgrades and/or a new dedicated electrical panel.
2) For installation of dedicated EV electrical panel, choose panel location in close proximity to existing electrical supply.
3) Identify station locations for EV charging that are in close proximity to an electrical room with common area electrical panel; reduce distance for conduit runs and electrical wiring from electrical panel to all proposed EV parking spaces.
4) Determine the appropriate mounting location.
5) Ensure the wiring, circuit protection and metering is in place at the station installation location by reviewing the specification, wiring diagram and grounding requirements later in this document.
6) Ensure that you are using 6 or 8 gauge wire to station. If you will be feeding the station with larger wire like 4 gauge then you will need to splice the wire for 6 or 8 gauge.
7) If possible, avoid or minimize trenching requirements, especially more costly trenching to run conduit under asphalt surfaces.
8) Choose adjacent parking spaces in an area with adequate lighting and identify suitable locations with flat surface for wall mount stations or suitable floor surface for pedestal mount stations (no asphalt surfaces).
9) Use dual-port pedestal mount stations where possible in open areas for adjacent or tandem parking spaces.
10) Determine optimum conduit layout to minimize linear conduit costs to multiple EV parking spaces and size all conduit and electrical wiring in accordance with National Electric Code requirements.
11) Measure cellular signal levels for 3G Verizon and 3G AT&T carriers and identify optimum location for placement of ChargePoint gateway devices.
12) Ensure that adequate CDMA (Verizon, Sprint) or GSM (AT&T, Rogers) cellular coverage is available at the station installation location. To ensure adequate signal strength in underground or enclosed parking structures, cellular repeaters may be required. (See the Cellular Signal Levels section later in this document)
13) For below ground-level or enclosed parking garages, installation of a cellular signal booster often is required with indoor antenna located near gateway device and EV parking spaces and outdoor antenna typically located at the garage entrance ceiling or on the rooftop where cellular signal levels are optimum.
14) Determine cost budget options for make-ready electrical infrastructure to satisfy current needs and future needs. Prioritize locations for installation of charging stations based upon immediate and future needs, construction timelines, and costs.

For bollard mount charging stations, prepare the installation site by following the instructions in the Preparing Concrete Pad chapter. The mounting template for the bollard can be found at www.chargepoint.com/support-installation-guides.php. Ensure the PDF version is accurate by printing it

at 100% scale on 11" x 17" paper and then verify at least one dimension. (See also the Prepare the Installation Site for Bollard Mount later in this document)

Review the CT4000 Data Sheet (available at www.chargepoint.com/support-product-data-sheets.php).

It is recommended that only new 40A dual pole breakers are to be used. Used breakers can damage equipment and cause a fire risk.

Always check local codes to ensure compliance. You may need to adjust this specification to comply with codes that apply at your installation location.

If you have pre-existing infrastructure or are using your own preferred electrical contractor to prepare your site for charging, a Site Validation by a ChargePoint Operations and Maintenance (O&M) partner will be required to certify compliance with electrical specification requirements and to ensure that everything was prepared to ChargePoint specifications.

Cellular Signal Levels

ChargePoint charging stations communicate over the ChargePoint network via 3G cellular carriers to provide the following features to property managers and EV drivers:

- User authentication, access control, & billing
- Energy usage reporting
- Charging station utilization and charging session details for analytical reporting
- Real-time charging status to drivers using the ChargePoint mobile app or web portal
- Ability for drivers to start & stop charging sessions using the ChargePoint mobile app
- 24-hr driver support to remotely start charging sessions (ChargePoint cards also start & stop sessions)
- Text notifications to drivers when vehicle battery is full or stops charging
- Station fault alarms and remote diagnostic capability
- Over-the-air software upgrades for new station features or enhancements (future proof)

General guidelines when measuring cellular signal levels:

- Do not rely on cell phone apps to measure cellular signals when conducting site surveys
- Take 3G AT&T & 3G Verizon signal strength readings at exact proposed charging station locations
- Take cellular readings at location of where a cellular signal booster antennae will be installed to ensure there is enough signal to boost

Requirements for acceptable 3G AT&T and 3G Verizon cellular coverage are:

- Weakest acceptable signal levels at gateway device without using a signal booster are -85 dbm for 3G AT&T WCDMA & -90 dbm for 3G Verizon EVDO (ECLO > -10 using Squid Pro 3G);
- For a cellular signal booster solution inside parking garages, the weakest acceptable signal level at outside antenna location should be between -95 dbm and -100 dbm (the weaker the signal the less coverage area inside using a signal booster);

Below are a few suggested options for cellular signal boosters:

- WeBoost 4G-X for all carriers in North America, supports voice, 2G, 3G and 4G, max gain of 70 db for up to 10,000 square feet of coverage area;
- SureCall Fusion 5 for all carriers in North America, supports voice, 2G, 3G and 4G, average gain of 65 db & max 72 db for up to 6,000 square feet of coverage area;
- SureCall Force 5 for all carriers in North America to provide up to 20,000 square feet of coverage inside parking structure.

ChargePoint O&M partners will validate acceptable cellular signal strength at the site using a cellular signal strength reader. We recommend using a Squid Pro 3G M2M signal meter from Berkeley Varitronics Systems to distinguish 2G vs 3G cellular carrier frequencies. For details concerning acceptable cellular signal levels and signal booster solutions, please reference Make-Ready Specifications section at the end of this document.

Electrical Panel

Level 2 charging stations are considered continuous load devices (EVs draw maximum load for long durations); and therefore, electrical branch circuits to EV chargers must be sized at 125% of the load in accordance with National Electric Code requirements. This means that for a maximum 32A @208/240V output to an electric vehicle, 40A breakers are required and wiring conductor ampacity sized in accordance with NEC code for continuous load devices. Typically, 6 AWG or 8 AWG insulated electrical wiring is used depending upon distance between the electrical panel and the charging station.

When planning for multiple EV charging stations, it is best practice to segment non-continuous and continuous loads, with all branch circuits for EV charging on a dedicated electrical panel assembly with 40A circuit breakers. When sizing new electrical panels dedicated for EV charging, all branch circuits will support continuous load, and the panel rating sized for at least 125% of the total load on each leg of a 3-phase panel.

Specifications

AC Voltage	208/240VAC			208/240VAC		
	Current	Input Power Connection	Output Connector Type	Current	Input Power Connection	Output Connector Type
Standard	30A	One 40A branch circuit	40A dual pole (non-GFCI type)	30A x 2	Two independent 40A branch circuits	40A dual pole (non-GFCI type) x 2
Standard Power Share	n/a	n/a	n/a	32A	One 40A branch Circuit	40A dual pole (non-GFCI type)
Power Select 24A	24A	One 30A Branch circuit	30A dual pole (non-GFCI type)	24A x 2	Two independent 30A branch circuits	30A dual pole (non-GFCI type) x 2
Power Select 24A Power Share	n/a	n/a	n/a	24A	One 30A branch circuit	30A dual pole (non-GFCI type)
Power Select 16A	16A	One 20A Branch circuit	20A dual pole (non-GFCI type)	16A x 2	Two independent 20A branch circuits	20A dual pole (non-GFCI type) x 2
Power Select 16A Power Share	n/a	n/a	n/a	16A	One 20A branch circuit	20A dual pole (non-GFCI type)
Service Panel GFCI	Do not provide external GFCI as it may conflict with internal GFCI (CCID)					
Wiring – Standard	3-wire (L1, L2, Earth)			5-wire (L1, L1, L2, L2, Earth)		
Wiring – Power Share	n/a			3-wire (L1, L2, Earth)		
Station Power	8W typical (standby), 15W maximum (operation)					

Standard	7.2kW (240VAC@30A)	7.2kW (240VAC@30A) x 2
Standard Power Share	n/a	7.2kW (240VAC@30A) x 1 OR 3.8kW (240VAC@16A) x 2
Power Select 24A	5.8kW (240VAC@24A)	5.8kW (240VAC@24A) x 2
Power Select 24A Power Share	n/a	5.8kW (240VAC@ 24A) x 1 OR 2.9kW (240VAC@12A) x 2
Power Select 16A	3.8kW (240VAC@16A)	3.8kW (240VAC@16A) x 2
Power Select 16A Power Share	n/a	3.8kW (240VAC@16A) x 1 OR 1.9kW (240VAC@8A) x 2

Connector(s) Type	SAE J1772™	SAE J1772™ x 2
Charging Cable Length	18' (5.5 meters)	18' (5.5 meters) x 2
Overhead Cable Management System	Yes	
LCD Display	5.7" full color, 640x480, 30fps full motion video, active matrix, UV protected	
Card Reader	ISO 15693, 14443, NFC	
Locking Holster	Yes	Yes x 2

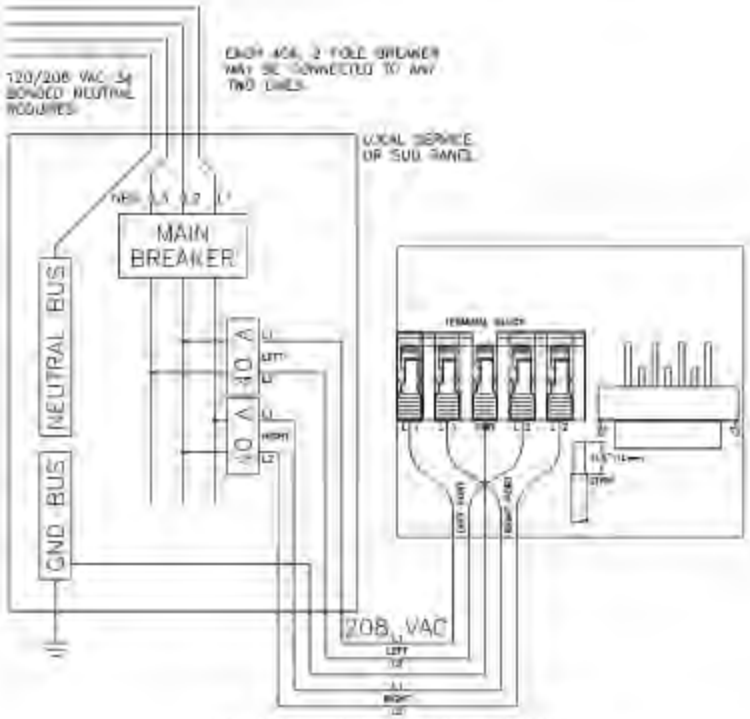
Ground Fault Detection	20mA CCID with auto retry
Open Safety Ground Detection	Continuously monitors presence of safety (green wire) ground connection
Plug-Out Detection	Power terminated per SAE J1772™ specifications
Power Measurement Accuracy	+/- 2% from 2% to full scale (30A)
Power Report/Store Interval	15 minute, aligned to hour
Local Area Network	2.4 GHz Wi-Fi (802.11 b/g/n)
Wide Area Network	3G GSM, 3G CDMA

Enclosure Rating	Type 3R per UL 50E
Safety Compliance	UL listed for USA and cUL certified for Canada; complies with UL 2594, UL 2231-1, UL 2231-2, and NEC Article 625
Surge Protection	6kV @ 3000A. In geographic areas subject to frequent thunder storms, supplemental surge protection at the service panel is recommended.
EMC Compliance	FCC Part 15 Class A
Operating Temperature	-22°F to 122°F (-30°C to +50°C)
Storage Temperature	-40°F to 122°F (-40°C to +50°C)
Operating Humidity	up to 95% @ +50°C (122°F) non-condensing
Non-Operating Humidity	up to 95% @ +50°C (122°F) non-condensing
Terminal Block Temperature Rating	221°F (105°C)
Maximum Stations per 802.11 Radio Group	10. Each station must be located within 150 feet "line of sight" of a gateway station.

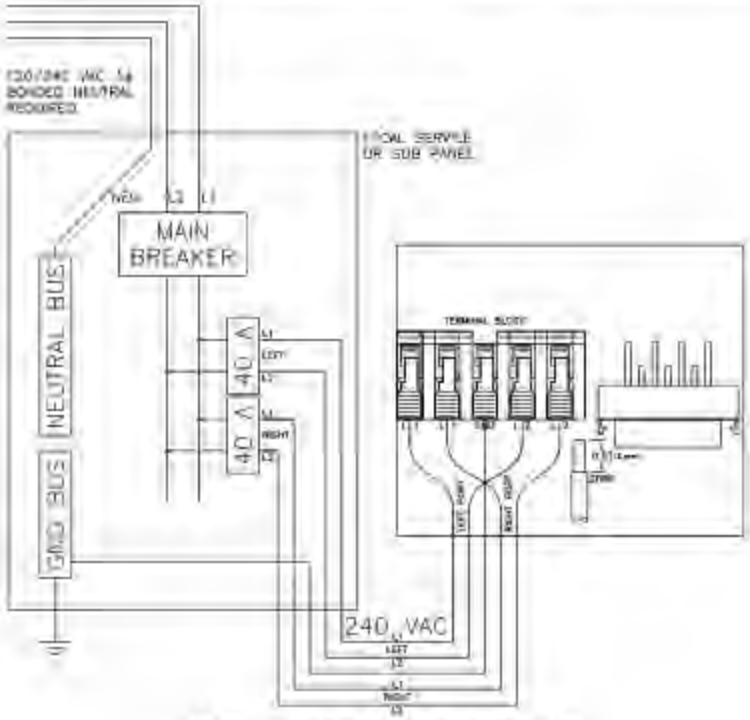
Dual Circuit Wiring Diagram

The following illustration describes the wiring for installing a CT4000 on a dual circuit. Wiring for a single circuit installation is described on the next page. Grounding requirements are described on page 1-6.

NOTE: Requires two dedicated circuits, each with its own two pole 40 A breaker. See Appendix B for lower power operation options.



208 VAC, THREE PHASE PANEL

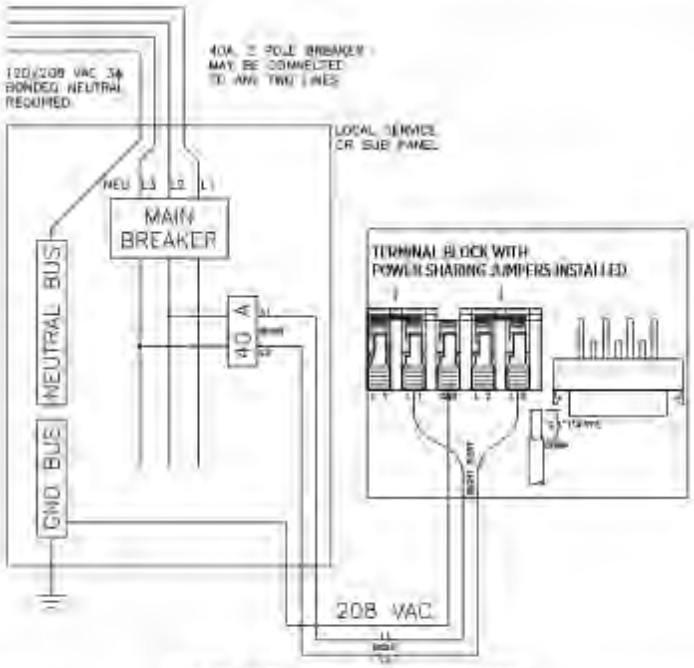


240 VAC, SINGLE PHASE PANEL

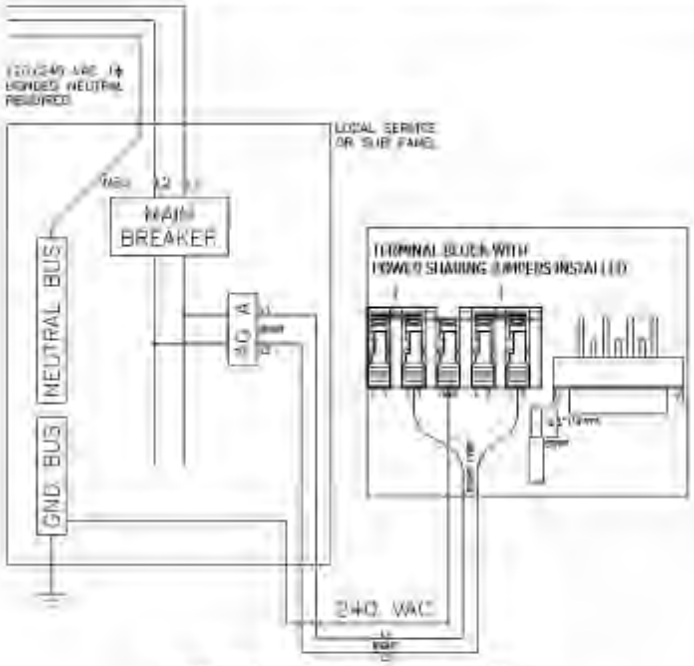
Single Port or Shared Power Wiring Diagram

The following illustration describes the wiring for installing a dual port CTA000 on a shared single circuit. For this installation, you will need the power sharing kit to allow both ports to share a two pole 40A circuit breaker. Wiring connections are provided in Appendix B. Grounding requirements are described on page 1-6. See Appendix B for lower power operation options.

Wiring for a dual circuit installation, see the previous page.



208 VAC, THREE PHASE PANEL



240 VAC, SINGLE PHASE PANEL

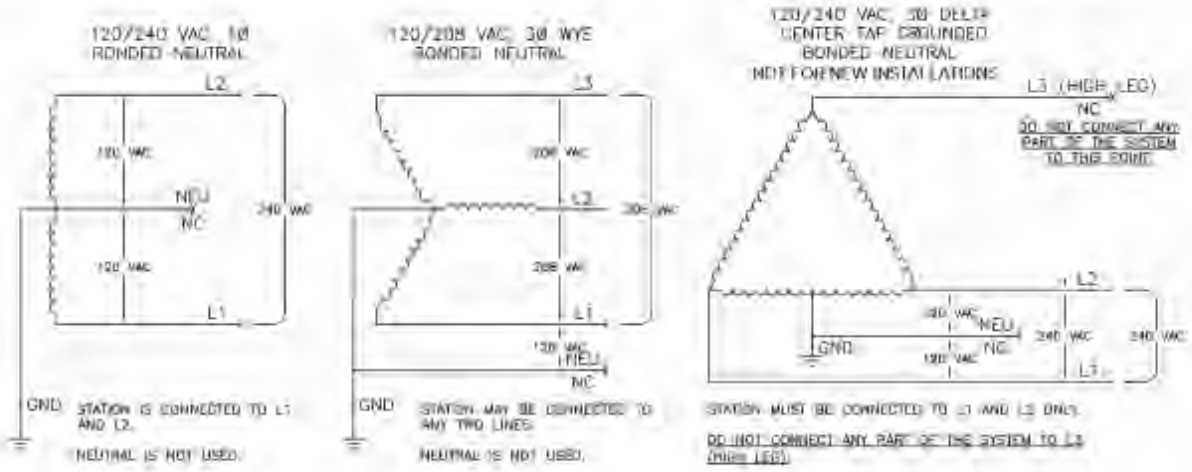
Grounding Requirements

The voltage of either line, relative to ground, must not fall below 80 volts or a Floating Line Connection error occurs (see page 5-3). Because the voltage of either line relative to ground must not be allowed to fluctuate, use only center-grounded systems. Neutral is not used to power the station but must be properly connected to ground, at the panel or transformer, to provide the necessary voltage reference relative to ground.

Connect to these systems

In a wye system, connect the station to ANY two lines, as shown below.

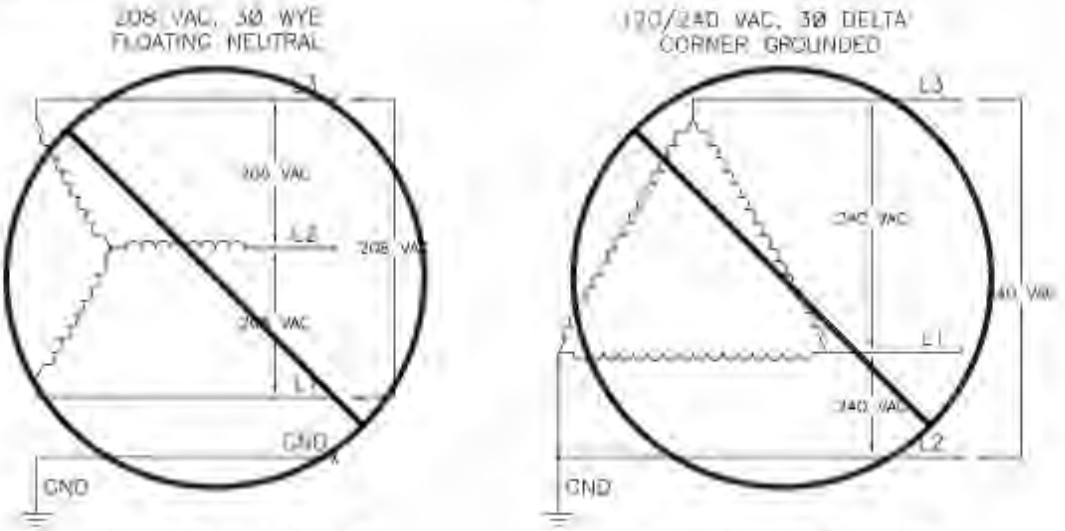
In a delta system, connect the station to a center-tapped secondary only, where the center tap is bonded and the station is connected to L1 and L3. This allows voltages to remain constant regardless of other loads that may be using the lines.



Do not connect to these systems

Do not connect ChargePoint stations to the following types of power sources:

- 120/208 VAC 3 phase wye, ungrounded
- 120/240 VAC 3 phase delta, corner-grounded
- Any system where the center point of the AC power source is not grounded



Preparing the Installation site for a Wall mount Station

When preparing the site for wall mounted stations, the conduit and wire must be brought to the location of the where the stations will be mounted. Below, are a couple images of sites showing how the conduit and wire was brought to the location where a wall mounted station will be installed. Flex conduit must be used to bring the wire to the station.

Preparing the Installation Site for a Bollard Mount

A

Before You Start

The ChargePoint® Charging Station's bollard mount can be installed either:

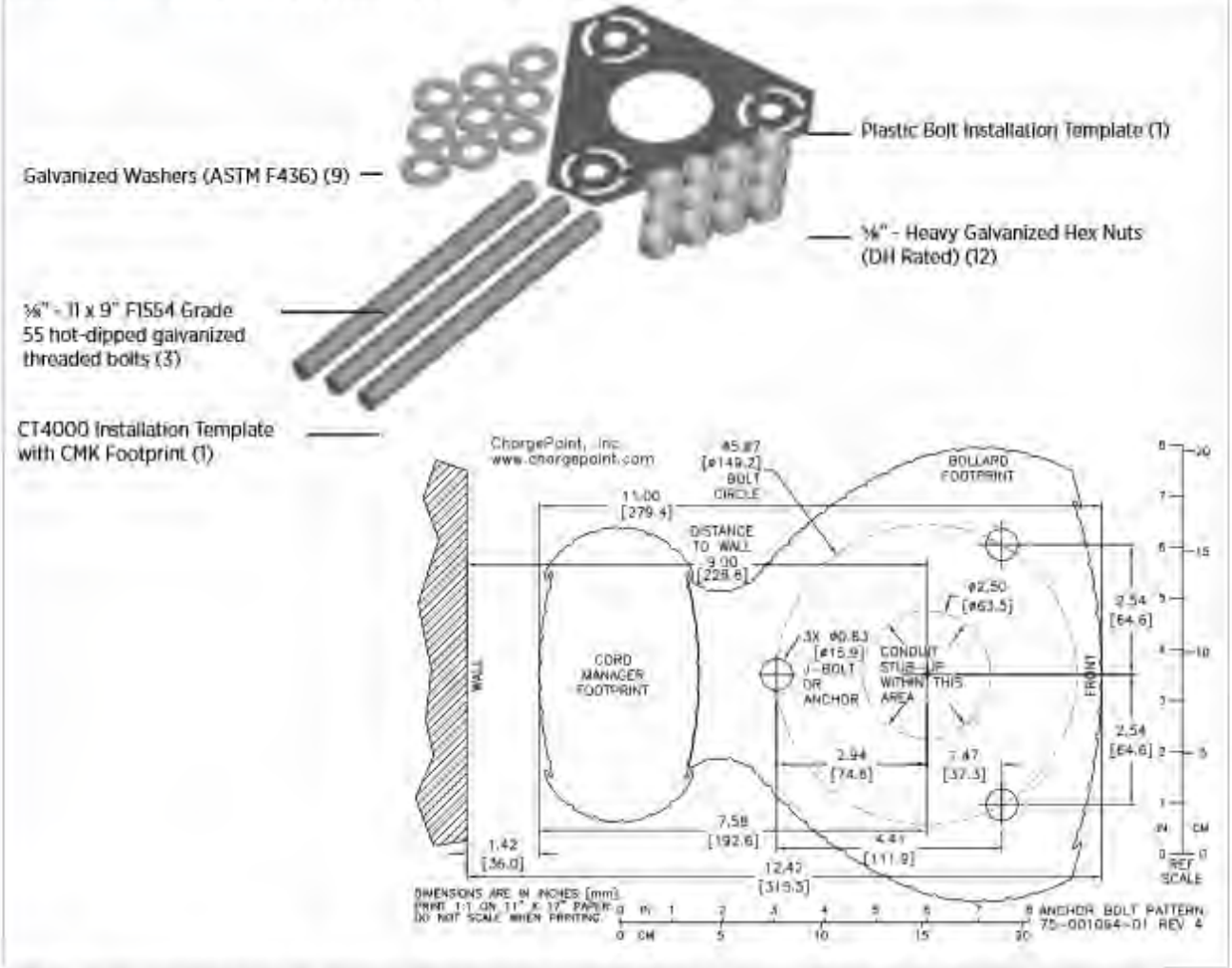
- into the ground
- onto an existing concrete surface (on an intermediate floor only)

The kit components you need to use, the tools required, and the installation steps vary depending on the type of installation. This appendix provides basic guidelines for both types of installations.

⚠ **IMPORTANT**: Always check local codes to ensure compliance. You may need to adjust the guidelines provided in this appendix to comply with codes that apply at your installation location.

Installation Overview

To install the CT4000 bollard mount into the ground, you will need the components shown below. These components can be purchased from ChargePoint by ordering a CT4000 Concrete Mount Kit.



*NOTE: When installing onto an existing concrete surface, you will need only 6 Galvanised Hex Nuts and 6 Galvanised Washers. But you will need several consumables as described on page A-3.

Casting Into New Concrete

Before casting into new concrete, review the site for suitability to install a CT4000. The CT4000's Clean Cord Technology requires space behind the power stub-up for the Cord Management Kit (CMK). To ensure adequate space, refer to the illustrations below and to the CT4000 Installation Template (75-001094-01) included in this installation kit.

IMPORTANT

- Always check local codes to ensure compliance. You may need to adjust these instructions to comply with codes that apply at your installation location.
- The concrete block must measure at least 24" on all sides.
- The bolt threads must extend 3" above the concrete.
- The conduit must be at least 1¼" in diameter and extend 12" to 24" above the concrete.
- Refer to the CT4000 Installation Guide for detailed installation instructions.

Kit Components Needed

You will need the entire contents of the CT4000 Concrete Mount Kit.

Follow These Steps

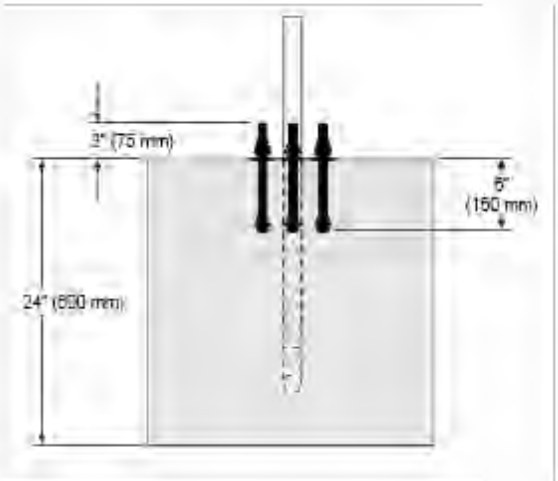
1. Install two nuts, with two washers captured between them, onto each of the three bolts, as illustrated. Lock them together so the lower end of the upper nut is located 6 – 6 ¼" from the bottom of the bolt. This sets the length of the exposed threads.
2. Insert the three bolts through the Plastic Bolt Installation Template. This ensures the relative position of the bolts and that the flange of the pole fits over the bolts.
3. On the bottom of each bolt, install a nut, a washer, and a nut. Lock the two nuts together so that the lower nut aligns to the bottom of the bolt.
4. Immediately after pouring the concrete, push the bolts into the concrete 6" deep, as illustrated. Ensure correct alignment and that the top 3" of the bolts remain exposed. Rotate the bolts as you insert them to draw concrete into the threads.

   NOTE:

   - It is important to rotate the bolts as you insert them. This allows the concrete to fully coat the threads of the bolts, reducing the amount of trapped air.
   - The Plastic Bolt Installation Template template can be left in place.
5. When the concrete is fully set, remove the upper nuts and one washer to install the bollard's mounting post.

You are now ready to install the CT4000's bollard mount. Refer to the CT4000 Installation Guide.

BOLT PREPARATION



Installing on Existing Concrete

If installing on existing concrete, perform the following tasks:

- Review the site for suitability to install a CT4000. The CT4000's Clean Cord Technology requires space behind the power stub-up for the Cord Management Kit (CMK). To ensure adequate space, reference the CT4000 Installation Template (75-001094-01) included in this installation kit.
- Review the dimensions of the existing concrete slab. To safely mount a CT4000 charging station, the concrete must be at least 6" thick. At this thickness, all of the CT4000's mounting bolts must be positioned at least 15" from the front edge, at least 12" from the side edges, and at least 6" from the rear edge of the concrete slab.
- If an existing charging station is already in place at the installation site, turn off all power to the station and disassemble according to the original manufacturer's instructions. Cut away any existing bolts or non-power conduit stub-up to ground level. You may need to plug cut-away conduits at the slab end, and disconnect wiring at the other end.

IMPORTANT: Always check local codes to ensure compliance. You may need to adjust these instructions to comply with codes that apply at your installation location.

Kit Components Needed

The CT4000 Concrete Mount Kit contains 12 Heavy Galvanized Hex Nuts and 8 Galvanized Washers. You will need only 6 of each.

Tools Required

Electric drill or Hammer drill (½" chuck may be required depending on drill bits used) (1)

Consumables Required

These consumables can be ordered online directly from McMaster (McMaster Product #s are included in the table below). Delete any items you already have, and change quantities to accommodate the number of stations you are installing.

NOTE: The consumption rate of these products will vary depending on conditions at the installation site.

Quantity	McMaster Product #	Description	Purpose
1*	7505A55	Epoxy Adhesive for Concrete, 9.3 Ounce Cartridge (Includes two mixing nozzles)	Filling drilled holes
1*	7505A56	Mixing Nozzles for 9.3 Ounce Epoxy Adhesive for Concrete	Filling drilled holes. NOTE: You may need extra mixing nozzles to accommodate delays of over three minutes when applying epoxy.
1	7622T23	Ratchet Rod Caulk Gun with Rod Barrel Frame for 10-13 Ounce Cartridge, 6:1 Thrust	Filling drilled holes. NOTE: Any standard caulk gun will work.
1	7437K35	Electrical Cleaning and Maintenance Aerosol, Any Angle Spray Duster, 8 Ounce Net Weight	Cleaning drilled holes
1	2960A22	Slow Spiral Round-Shank Masonry Drill Bit, ½" diameter, ½" Shank, 10" Drill Depth, 12" Length Overall	Drilling ½" holes in concrete. NOTE: The holes must be at least 6" deep.
1	2885A25	Drill Bit for Concrete Embedded Rebar, Round, ¾" Bit size, ½" Shank diameter, 12" Length Overall	Drilling ¾" hole through rebar
1	7227T13	Nylon Loop-Handle Brush, ¾" Brush Diameter, 3" Length Brush, 8 ½" Length Overall	Cleaning drilled holes.
1	9753K47	Push-on Round Cap, fits ¾" – 1¼" OD, ½" Inside Height, Packs of 100	Keeping the epoxy inside the drilled holes in situations where the slab is only 6" deep.

*Quantity based on installation of one charging station

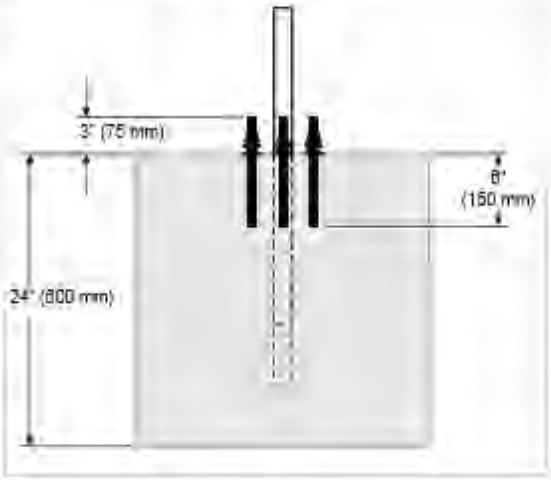
Follow These Steps

1. Install two nuts with two washers captured between them. Lock them together so the lower end of the nut is located 6" from the bottom of the bolt. This sets the length of the exposed threads.
2. Use the Plastic Concrete Bolt Installation Template to mark the hole locations.
3. Remove the template and drill three ¾" diameter holes 6" deep into the concrete. When locating the template, consider the charging station's total footprint. For reference, a template for the CT4000 charging station with CMK is included in this kit.

   NOTE:

   - It is important that the bolts are parallel after installation. Therefore, ensure the drill holes are plumb by using a bubble level to check the angle of the drill after drilling 1 to 1 ½".
   - If installing over existing buried conduit, position the center of the template around the conduit stub-up.
   - You may need two drill bits - one for the concrete (with the pilot) and another for the rebar (without the pilot). Always start the hole using the standard drill bit, then switch to the rebar drill bit only if drilling through rebar.

BOLT PREPARATION



4. Remove all dust from inside the drilled holes using compressed air, or a vacuum and/or a brush.
5. If the concrete slab is only 6" deep, insert a plug (McMaster Product #9753K56) in each hole to keep the epoxy in place until it hardens. Place the plug over the long end of a bolt and then use the bolt to push the plug to the bottom of the hole.
6. Fill each hole with epoxy to about 2 ½" to 3" below the top. Continue immediately to the next step because the epoxy sets within about eight minutes.

   NOTE: Inserting the threaded bolts displaces the epoxy, causing it to fill the holes to grade level. If the epoxy is below grade level, you can add more after the next step.

7. Place the Plastic Concrete Bolt Installation Template over the holes. This ensures the relative position of the bolts and that the flange of the pole fits over the bolts.
8. Insert the bolts through the template, into the holes. Rotate the bolts as you insert them to draw epoxy into the threads.

   IMPORTANT: The epoxy is very thick. Therefore, it is important to rotate the bolts as you insert them. This allows the epoxy to fully coat the threads of the bolts, reducing the amount of trapped air.

   NOTE: The installation template can be left in place.
9. If needed, top up the holes with epoxy to grade level.
10. Allow the epoxy to cure for at least 15 minutes* before removing the top nuts and washers.
11. Allow the epoxy to cure for 45 minutes* before applying torque to the nuts.

**Epoxy cure times assume you are using epoxy ordered from McMaster (Product # 7505A55). If using a different type of epoxy, you may need to adjust these times. Refer to the cure times provided with the epoxy.*

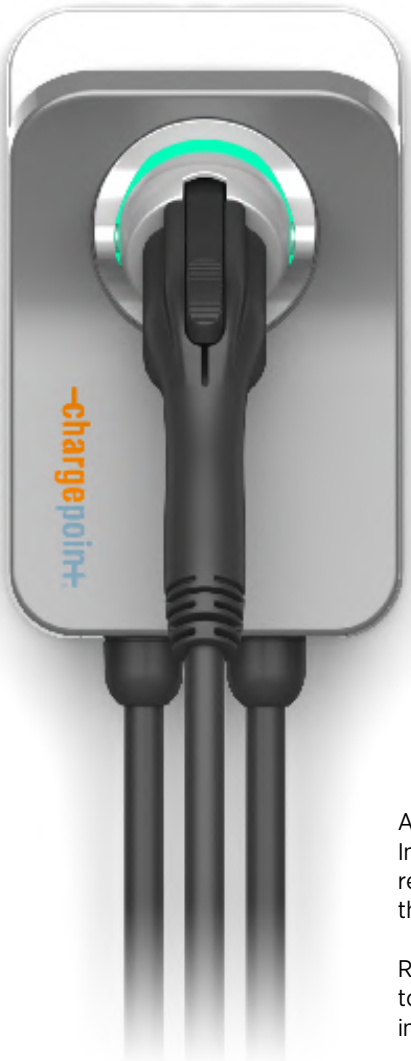
You are now ready to install the CT4000's bollard mount (see Chapter 2).

(Proper concrete pad with anchor bolts and conduit stub-up)

ChargePoint® Home Flex

16A-50A Flexible Amperage Charger

Installation Guide



ATTENTION:
Installers, please read this guide thoroughly.

Return the guide to the owner after installation.

Important Safety Instructions

SAVE THESE INSTRUCTIONS

WARNING: This manual contains important instructions for Home Flex. When using electric products, always follow basic precautions, including the following.

1. Read and follow all warnings and instructions before installing and operating the ChargePoint® charging station. Install and operate only as instructed. Failure to do so may lead to death, injury, or property damage, and will void the Limited Warranty.
2. Only use licensed professionals to install your ChargePoint® charging station and adhere to all national and local building codes and standards. Before installing the ChargePoint® charging station, consult with a licensed contractor, such as a licensed electrician, and use a trained installation expert to ensure compliance with local building and electrical codes and standards, climate conditions, safety standards, and all applicable codes and ordinances. Inspect the charging station for proper installation before use.
3. Always ground the ChargePoint® charging station. Failure to ground the charging station can lead to risk of electrocution or fire. The charging station must be connected to a grounded, metal, permanent wiring system, or an equipment grounding conductor shall be run with circuit conductors and connected to the equipment grounding terminal or lead on the Electric Vehicle Supply Equipment (EVSE). Connections to the EVSE shall comply with all applicable codes and ordinances.
4. Install the ChargePoint® charging station using a ChargePoint approved method. Failure to install on a surface that can support the weight of the charging station can result in death, personal injury, or property damage. Inspect the charging station for proper installation before use.
5. This charging station is not suitable for use in hazardous locations. Do not install Home Flex near flammable, explosive, or combustible materials.
6. This device should be supervised when used around children.
7. Do not put fingers into the electric vehicle connector.
8. Do not use this product if the flexible input power cable or EV charging cable is frayed, has broken insulation, or any other signs of damage. Call ChargePoint customer support immediately at 1.888.758.4389.
9. Do not use this product if the enclosure or the EV connector is broken, cracked, open, or shows any other indication of damage. Call ChargePoint customer support immediately at 1.888.758.4389.
10. Use 90°C wire copper conductors only.
11. Do not operate Home Flex in temperatures outside its operating range. For charging stations set to 16-48 A, the range is -40˚F to 122˚F (-40˚C to 50˚C). For charging stations set to 50 A, the range is -40˚ to 113˚F (-40 to 45˚C).

- Other than the charging cable, Home Flex contains no field serviceable parts. Do not attempt to repair or service any other part of the unit yourself. If the unit requires servicing, contact ChargePoint, Inc.
- Ensure that Home Flex charging cable is positioned so it is not stepped on, tripped over, or subjected to damage or stress. Do not close a garage door on the charging cable.

Important: Under no circumstances will compliance with the information in this manual relieve the user of his/her responsibility to comply with all applicable codes or safety standards. This document describes the most commonly used installation and mounting scenarios. If situations arise in which it is not possible to perform an installation following the procedures provided in this document, contact ChargePoint, Inc. **ChargePoint, Inc. is not responsible for any damages that may occur resulting from custom installations that are not described in this document or for any failure to adhere to installation recommendations.**

Product Disposal

ChargePoint Home Flex is electronic and therefore may not be disposed of as part of unsorted domestic waste. Inquire with local authorities regarding proper disposal. Product materials are recyclable as marked.

No Accuracy Guarantee

Commercially reasonable efforts were made to ensure that the specifications and other information in this manual are accurate and complete at the time of its publication. However, the specifications and other information in this manual are subject to change at any time without prior notice.

Copyright and Trademarks

CAN ICES-3 (A)/NMB-3 (A)

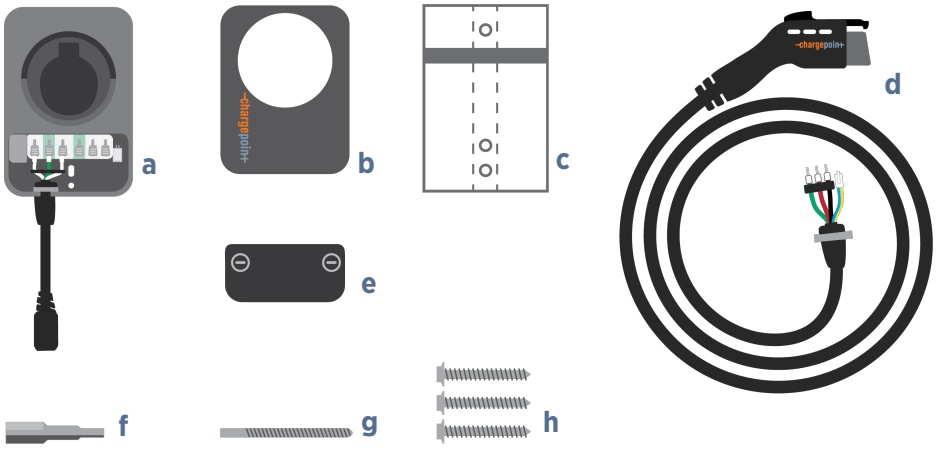
Table of Contents

Verify Contents

CAUTION: The ChargePoint Home Flex charging station must be installed by a licensed electrician. If you do not know where to find one, refer to the *ChargePoint Home Flex Quick Start Guide* or chargepoint.com/homeinstall for help.

Check the box to ensure you have the Quick Start guide, this installation guide, and these parts:

- **a.** Charging station (with attached input power cable)
- **b.** Faceplate (pre-installed on charging station)
- **c.** Installation template
- **d.** Charging cable with cable clip
- **e.** Wire cover (pre-installed on charging station)
- **f.** 10 mm (3/8 in) driver bit
- **g.** 4 mm (3/16 in) drill bit
- **h.** Three 6 mm (1/4 in) x 51 mm (2 in) lag screws



Note: If you are missing any of these parts, please call 1-888-758-4389.

Gather Tools

You also need:

a. One NEMA 6-50 outlet, NEMA 14-50 outlet, or supplies to install a hardwired circuit.

b. Tape

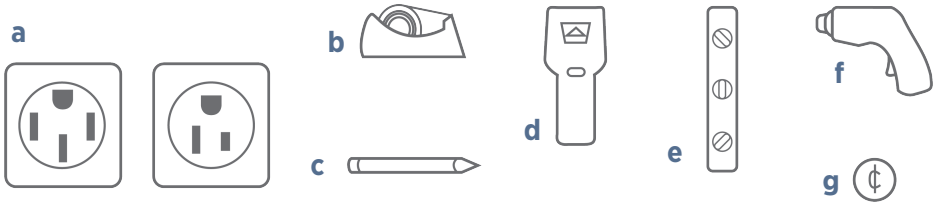
c. Pencil

d. Stud finder

e. Level

f. Drill

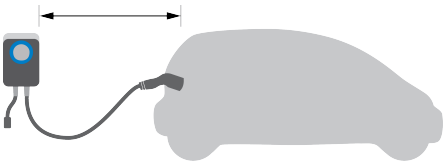
g. Coin



Plan the Location

Before beginning work, check the site for appropriate mounting location and electrical capacity.

1. Ensure the homeowner has chosen an installation location that allows the charging cable to reach the car's charging port while still providing slack. Ensure there is a stud available at the desired location for mounting the charging station. Ensure there is WiFi signal available.



Note: Outdoor installation is an option, but requires an outdoor-rated, weather-resistant electrical outlet or hardwired installation.

WARNING: In areas with frequent thunderstorms, add surge protection at the service panel for all circuits. Ensure all power and ground connections, especially those at the breaker and bus bar, are clean and tight. Remove all oxide from all conductors and terminals before connecting wiring.

2. Determine the desired charging amperage with the homeowner. Home Flex can be installed at a variety of amperages. Choose based on the availability of space or electrical capacity in the panel, the desired speed of charging, and whether the homeowner prefers a hardwired or plug-in installation.

CAUTION: Home Flex is a continuous load device. The circuit must be rated for 125% of the maximum load.

Circuit Rating	Max Load	Estimated Range per Hour	Plug-in	Hardwire
50 A	40 A	30 miles/48 km	yes	yes
40 A	32 A	25 miles/40 km	yes	yes
30 A	24 A	18 miles/29 km	no	yes
20 A	16 A	12 miles/19 km	no	yes

Important: In Canada, a plug-in installation is only allowed with a 50 amp circuit.

Home Flex can also be wired for higher amperages. Consult all applicable codes for breaker and wire sizing requirements. The field-

wiring terminal is rated to 105˚C and accepts a maximum of 16 mm^2 (6 AWG) wire.

Circuit Rating	Max Load	Estimated Range per Hour	Plug-in	Hardwire
80 A	50 A	37 miles/60 km	no	yes
70 A	50 A	37 miles/60 km	no	yes
60 A	48 A	36 miles/58 km	no	yes

3. Determine the plug type purchased by the homeowner. It is either a NEMA 6-50 or 14-50 type plug.

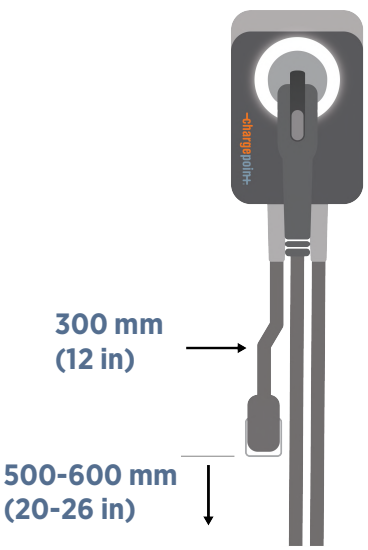
4. Determine if the desired circuit rating requires a hardwired circuit.

5. Ensure the electrical panel supports a 240 V dedicated circuit with a new, dedicated, non-GFCI two-pole circuit breaker, in accordance with local codes and ordinances.

   Note: If local codes require a GFCI breaker for plug-in installation, ChargePoint recommends a hardwire installation. We do not recommend using a GFCI breaker as the Home Flex has charging circuit interrupting device (CCID) protection. Using a GFCI breaker in the panel can cause nuisance tripping.

6. For plug-in installations, the NEMA outlet should be located 500-660 mm (20-26 in) from the ground adjacent to the stud where the charging station will be mounted.

   Note: The input power cable is 300 mm (12 in) long (as per the National Electric Code for EV chargers). Ensure the outlet is installed close enough to the stud for the input power cable to plug in.



7. Follow all applicable codes and ordinances and pull a permit for completing the electrical work as required.

Wire the Circuit

DANGER: RISK OF SHOCK. Turn off the circuit breaker to the 240 V outlet. Do not restore power to the outlet until installation is complete. Failure to follow these instructions could result in shock or electrocution.

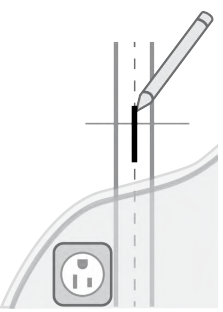
1. Install a plug-in or hardwired circuit:
   - For a 40 or 50 amp plug-in installation, wire the circuit with the appropriate 6-50 or 14-50 outlet. Install the outlet with the ground facing up.
   - For a hardwired installation, provide a listed conduit with wiring to the bottom or rear 19 mm (3/4 in) knockout for AC input. Seal the unused knockout with the plug provided. Return the original input power cable to the box.
2. Affix the label with the appropriate rating to the circuit in the panel.
3. Turn off power to the circuit at the panel before proceeding.

Mount the Charging Station

Note: For **Hardwired Installation**, proceed to page 13.

Plug-In Installation

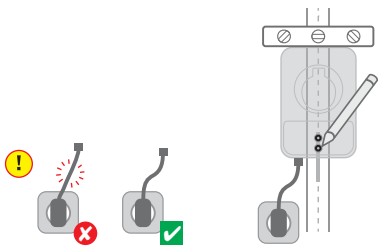
1. Remove the faceplate and the wire cover from the charging station. Set them aside.
2. Mark the center of the stud with a line approximately 1000-1100 mm (39-43 in) above the finished floor.



3. To find the charging station's ideal mounting height, plug the charging station's input power cable into the outlet.

DANGER: If the front status light turns on when the charging station is plugged in, the circuit is not off. STOP IMMEDIATELY. Unplug the charging station and turn off the power to the outlet at the circuit breaker until the installation is complete.

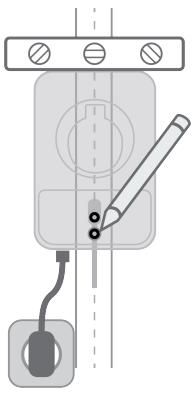
4. Place the charging station against the wall. Line up the charging station's two mounting holes with the marked stud line.



Note: Ensure the input power cable has a slight curve, and is not stretched.

5. Ensure the charging station is level. Mark the two lower mounting holes.

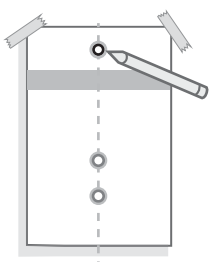
6. Unplug the charging station.



7. Line up the lower mounting holes on the installation template with the marks you made. Tape the template to the wall.

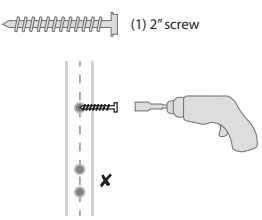
8. Mark the top mounting hole on the wall with the installation template.

9. Remove the template from the wall.



10. Drill the three mounting holes with the included drill bit.

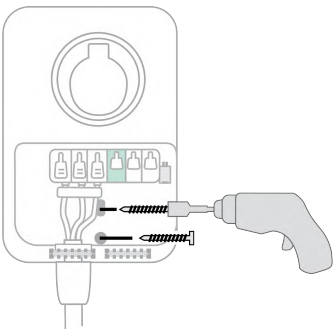
11. Use the driver bit to drive a lag screw into the top-most mounting hole, leaving a 3 mm (1/8 in) gap to hang the charging station on. Keep the remaining two screws for later use.



12. Hang the charging station on the protruding screw using the notch on the back of the charging station.

Note: Do not plug in the charging station yet.

13. Drive the remaining two lag screws into the bottom mounting holes to secure the charging station. Be careful not to damage the electrical wires.

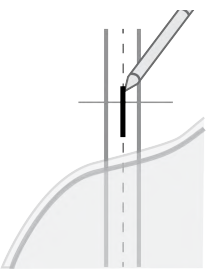


Note: Ensure the input wire does not make contact with the screw.

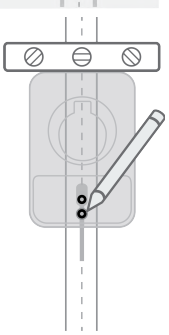
14. Proceed to the **Install the Charging Cable** section on page 15.

Hardwired Installation

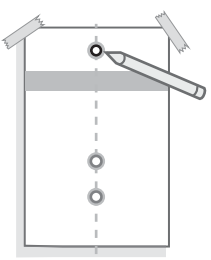
1. Remove the faceplate and the wire cover from the charging station. Set them aside.
2. Remove the cable clip and lift the white levers on the field-wiring terminal block to remove the input power cable.
3. Mark the center of the stud with a line between 1000-1100 mm (39-43 in) above the finished floor.



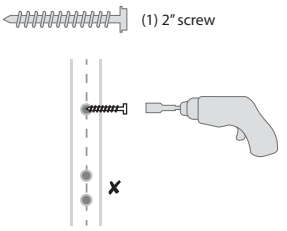
4. Hold the station against the wall stud, with the top of the station approximately 1270 mm (50 in) above ground level.
5. Ensure the charging station is level. Mark the two lower mounting holes.



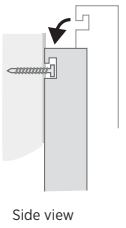
6. Line up the lower mounting holes on the installation template with the marks you made. Tape the template to the wall.
7. Mark the top mounting hole on the wall with the installation template.
8. Remove the template from the wall.
9. Drill the three mounting holes with the included drill bit.



10. Use the driver bit to drive a lag screw into the top-most mounting hole, leaving a 3 mm (1/8 in) gap to hang the charging station on. Keep the remaining two screws for later use.

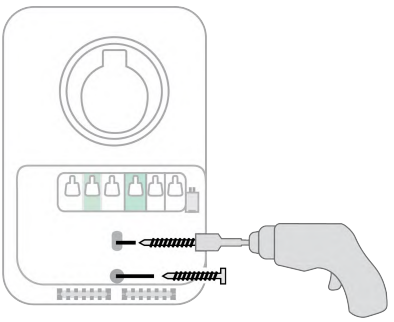


11. Hang the charging station on the protruding screw using the notch on the back of the charging station.


Side view

12. Drive the remaining two lag screws into the bottom mounting holes to secure the charging station.

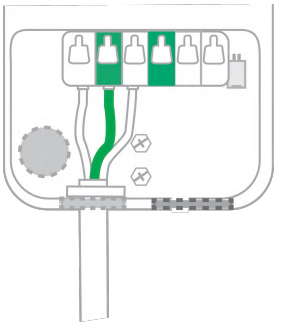
13. Insert the exposed wires from the hardwire circuit installation into the corresponding holes, pushing the cables up until the silver conductors are no longer visible.



Note: If mounting on an exterior wall and bringing power through the rear knockout, apply sealant around the rear knockout to prevent water ingress.

14. Bring power through the bottom or rear knockout.

15. Ensure the service wiring can easily reach the connectors on the charging station's input terminal block.



16. Strip each wire 12 mm (1/2 in).

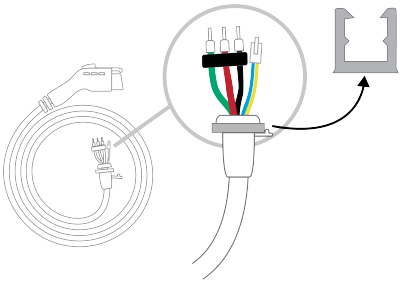
17. Ensure the white levers on the terminal block are open. Fully insert the wires into the connectors on the left side of the terminal block with the ground wire in the center.

18. Press the three levers down until they snap into place.

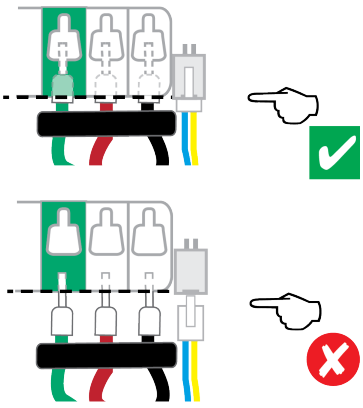
Note: The white levers are a pinch point. Be careful of fingers while handling them.

Install the Charging Cable

1. Remove the cable clip from the wire end of the cable, but do not discard it.
2. Fold the wire ends and insert them into the bottom hole of the charging station.



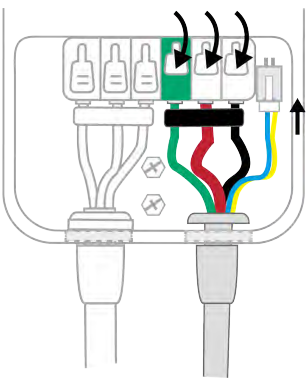
3. Match the green wire to the ground on the left terminal of the output block.
4. Insert the exposed wires into the corresponding holes, pushing the cables up until the silver conductors are no longer visible.



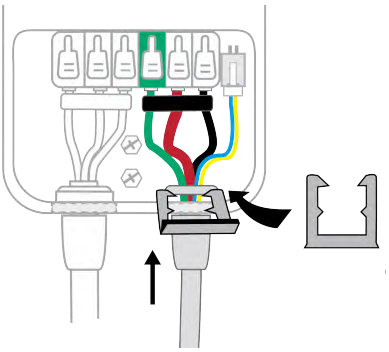
5. Snap the white levers all the way down on each wire.

   Note: The white levers are a pinch point. Be careful of fingers while handling them.

6. Insert the 4-pin plug into the connector to the right of the output supply wiring.

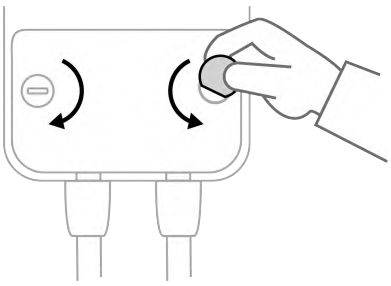


7. While pushing the cable up, slide the cable clip into the slot. This secures the cable and acts as strain relief.

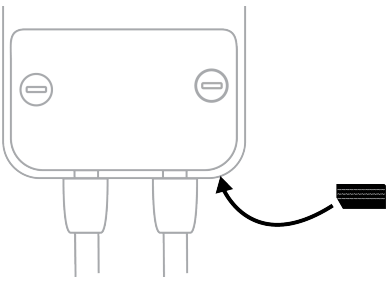


8. Place the wire cover over the exposed wiring. Use a coin to lock the wire cover in place.

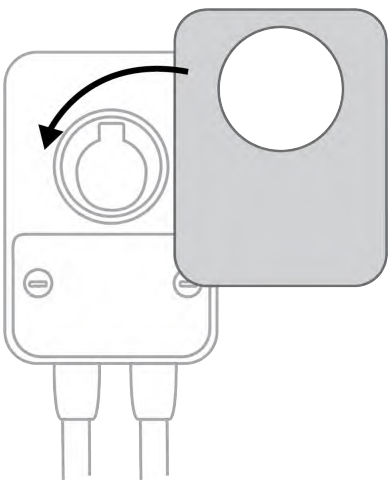
   Note: To avoid damage to the wire cover, do not use a screwdriver.



9. Apply the rating label to match the circuit feeding the charging station on the bottom of the station over the default rating displayed.

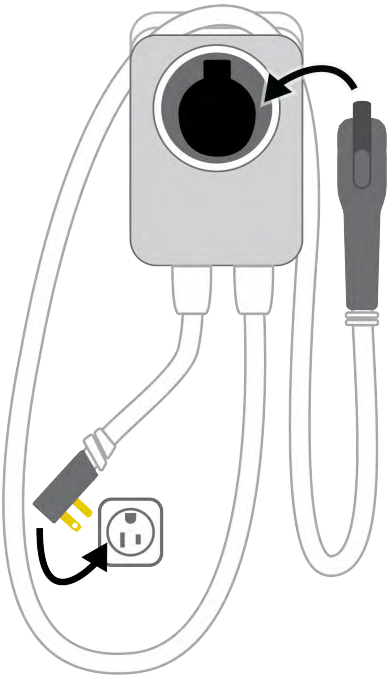


10. Snap the faceplate onto the charging station.



Complete the Installation

1. Extend the cable to its full length to remove any kinks or tension.
2. Drape the charging cable over the top of the charging station and dock the connector in its holster.
3. Ensure labels specifying circuit amperage are applied to the bottom of the charging station and to the circuit in the electrical panel.
4. Restore power to the circuit at the electrical panel.
5. Plug the charging station into the outlet (if applicable).
6. Watch to ensure that the front status light glows yellow, then blinks white.
7. Give the Quick Start Guide, the drill bit, the driver bit, and this Installation Guide to the homeowner.
8. Return all packaging materials to the box and give the box to the homeowner.



9. Advise the homeowner that the charging station is ready for activation via the mobile application.
10. Tell the homeowner the final amperage of the circuit and the expected charging rate available after activation. (Refer to the table in the Plan the Location section.)

Important: The Quick Start Guide contains information that the owner needs to activate their charging station. Without activation, the charging station charge current is limited to 16 amps.

Questions?

- chargepoint.com/homeinstall
- U.S. and Canada toll-free: +1-888-758-4389 (24 hours)

Limited Warranty

Limited Warranty for ChargePoint Home Electric Vehicle charging station

Our Promise

This Limited Warranty for ChargePoint Home Electric Vehicle charging station ("Warranty") applies to you, the original purchaser of a new CHARGEPOINT HOME charging station (the "charging station") from CHARGEPOINT solely for use by you at your residence. This warranty is not transferrable and is valid for purchasers located in the U.S.A. and Canada only.

LIMITED THREE-YEAR PARTS EXCHANGE WARRANTY: Subject to the exclusions from Warranty coverage set forth below, CHARGEPOINT warrants that, when used under normal operating conditions, your charging station will be free from any defects in materials or workmanship for a period (the "Warranty Period") of three (3) years from the date of original purchase. If, during the Warranty Period, your charging station becomes defective in breach of the Warranty, CHARGEPOINT will, upon written notice of the defect received during the Warranty Period, either repair or replace, at CHARGEPOINT's election, the charging station. The Warranty covers both parts and factory labor necessary to repair your charging station, but does not include any on-site labor costs related to un-installing or reinstalling the repaired or replacement charging station.

Follow These Easy Steps to Obtain Warranty Service

1. If at any time during the term of your Warranty you believe you have a defective charging station, contact Customer Service at 1.888.758.4389 or support@chargepoint.com and request a Return Material Authorization ("RMA") number from ChargePoint.
2. In connection with your RMA request, you will be asked for each of the following:
   - A detailed description of the problems you are experiencing with the charging station;
   - The model number and serial number of the charging station;
   - Proof of purchase; and
   - Shipping information.
3. If ChargePoint determines that the defect appears to be covered by your Warranty and your Warranty is still in effect you will be provided a Returned Material Authorization number (RMA number) to reference when returning the defective charging station for repair or replacement.
4. Ship the defective charging station to CHARGEPOINT and reference the RMA number in the shipping documentation. The charging station must be returned in its original shipping container or in another shipping container designed to prevent damage to the charging station.
5. If your charging station is covered by your Warranty, CHARGEPOINT will either repair or replace the defective charging station at no charge to you and ship the repaired or replaced charging station back to you at CHARGEPOINT's expense.

Important

1. You are responsible for the proper installation and maintenance of the charging station including the un-installing of any defective charging station and the installation of the repaired or replacement charging station returned to you.

2. Any service or repairs beyond the scope of the Warranty above will be performed upon customer approval at CHARGEPOINT's then prevailing labor rates and other applicable charges.
3. Any charging station that is found by CHARGEPOINT to be out-of-warranty or otherwise ineligible for warranty service will be returned, repaired or replaced upon your approval at CHARGEPOINT's standard charges at your expense.
4. Please read carefully through the detailed descriptions of the WARRANTY, the EXCLUSIONS FROM LIMITED PRODUCT WARRANTY, and the LIMITATIONS ON WARRANTY AND LIABILITY on the following pages to assure that your charging station is eligible for warranty service without additional cost to you.

Replacement Parts Or Charging Stations

You acknowledge that replacement parts or charging stations provided by CHARGEPOINT under the Warranty may be remanufactured or reconditioned parts or charging stations or, if the exact charging station is no longer manufactured by CHARGEPOINT, a charging station with substantially similar functionality ("Replacement Products"). All replaced parts, whether under warranty or not, become the property of CHARGEPOINT.

Any replacement parts or charging station so furnished will be warranted for the remainder of the original Warranty Period or ninety days from the date of delivery of such replacement parts or charging station, whichever is later. Should CHARGEPOINT be unable to repair or replace your charging station, CHARGEPOINT will refund the purchase price of the charging station to you.

Exclusions from Limited Product Warranty

IMPORTANT: The Warranty on your charging stations shall not apply to defects or service repairs resulting from the following:

- Improper site preparation or maintenance, improper installation, cosmetic damage such as scratches and dents, or normal aging.
- Abuse, vandalism, damage or other problems caused by accidents, misuse or negligence (including but not limited to physical damage from being struck by a vehicle), or use of the charging station in a way other than as specified in the applicable CHARGEPOINT documentation.
- Damage to the charging station caused by software, interfacing, parts, supplies or any other product not supplied by CHARGEPOINT.
- Installation, alteration, disassembly, modification, or relocation of the charging station that was not approved in writing or by ChargePoint or performed by ChargePoint or by a licensed electrician pursuant to this guide.
- Damage as a result of extreme power surge, extreme electromagnetic field or any acts of nature.
- Any other causes beyond the control of CHARGEPOINT.

IN ADDITION: The Warranty on your charging station shall not apply if the original identification markings (for example, serial numbers and trademarks) have been defaced, altered or removed or if the charging station is used or installed for any purpose other than for use at a single family residence.

CHARGEPOINT SPECIFICALLY DOES NOT WARRANT THAT ANY CHARGEPOINT SERVICES WILL BE ERROR FREE OR WILL OPERATE WITHOUT INTERRUPTION.

Limitations on Warranty and Liability

NO AGENT OF CHARGEPOINT IS AUTHORIZED TO ALTER OR EXCEED THE WARRANTY OBLIGATIONS OF CHARGEPOINT. THE REMEDIES IN THIS LIMITED PRODUCT WARRANTY ARE YOUR SOLE AND EXCLUSIVE REMEDIES. CHARGEPOINT MAKES NO OTHER EXPRESS OR IMPLIED WARRANTIES OTHER THAN THE WARRANTY SET FORTH ABOVE. ALL OTHER WARRANTIES, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF DESIGN, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (EVEN IF CHARGEPOINT HAS BEEN INFORMED OF SUCH PURPOSE) OR AGAINST INFRINGEMENT, ARE EXCLUDED TO THE EXTENT PERMITTED BY LAW. IF ANY IMPLIED WARRANTY CANNOT BE DISCLAIMED UNDER APPLICABLE LAW, SUCH IMPLIED WARRANTY SHALL BE LIMITED IN DURATION TO THE WARRANTY PERIOD DESCRIBED ABOVE. NO WARRANTIES APPLY AFTER EXPIRATION OF THE WARRANTY PERIOD.

Some states or jurisdictions do not allow the exclusion of express or implied warranties or limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

CHARGEPOINT IS NOT LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, PUNITIVE OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION LOST PROFITS, LOST BUSINESS, LOST DATA, LOSS OF USE, OR COST OF COVER INCURRED BY YOU ARISING OUT OF OR RELATED TO YOUR PURCHASE OR USE OF, OR INABILITY TO USE, THE CHARGING STATION, UNDER ANY THEORY OF LIABILITY, WHETHER IN AN ACTION IN CONTRACT, STRICT LIABILITY, TORT (INCLUDING NEGLIGENCE) OR OTHER LEGAL OR EQUITABLE THEORY, EVEN IF CHARGEPOINT KNEW OR SHOULD HAVE KNOWN OF THE POSSIBILITY OF SUCH DAMAGES. IN ANY EVENT, THE CUMULATIVE LIABILITY OF CHARGEPOINT FOR ALL CLAIMS WHATSOEVER RELATED TO THE CHARGING STATION WILL NOT EXCEED THE PRICE YOU PAID FOR THE CHARGING STATION. THE LIMITATIONS SET FORTH HEREIN ARE INTENDED TO LIMIT THE LIABILITY OF CHARGEPOINT AND SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.

Some states or jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Additional Information

This Warranty shall be governed by and construed in accordance with the laws of the State of California, U.S.A., exclusive of its conflict of laws principles. The U.N. Convention on Contracts for the International Sale of Goods shall not apply.

This Warranty is the entire and exclusive agreement between you and CHARGEPOINT with respect to its subject matter, and any modification or waiver of any provision of this statement is not effective unless expressly set forth in writing by an authorized representative of CHARGEPOINT.

Slim & Smart.

Blink HQ 200

50 Amp Residential Charger

A new generation of home charging, the Blink HQ 200 is designed to make charging from the comfort of your home even easier, faster, and better.

POWER • SPEED • INTELLIGENCE

Blink HQ 200 Benefits

- Basic plug-and-go, or intelligent Wi-Fi options
- Wi-Fi enabled home charger with remote operation and monitoring
- Variable output of 12A–50A
- Compatible with all electric vehicles with SAE 1772 connector*
- Quickly start a charge, schedule charging times, and set reminders on the Blink Mobile app
- Amazon Alexa, Google Home, and Apple Siri enabled
- Easy installation indoors or outdoors with included NEMA 14-50P plug
- 23ft cable provides flexible placement options in your garage or carport
- LED indicators provide current charging status
- Built-in wrap around cable management solution

Product Details

Amperage	50 amps max (selectable)
Voltage	180 VAC - 264 VAC, 50-60 Hz, Single Phase
Selectable Input/Output Power	2.9kW, 3.8kW, 7.7kW, 9.6kW, 11.5kW
Cable Length	23 ft.
Dimensions	13"H x 9.5"W x 3.7"D
Standards Compliance	UL Listed, NEW 625, SAE J1772, and NEMA 3R
Networked	Blink Network
Enclosure	NEMA Type 3R, Indoor/Outdoor
Installation Type	NEMA 14-50P

*Tesla adapter required

BlinkCharging.com • (888) 998.2546

PD02-20XL-01


blink®
LEVEL 2 AC EV
IQ 200
CHARGING STATIONS
SPECIFICATIONS
blink
blink
blink

Level 2 AC EV Charging Stations

The Blink IQ 200 Product Family is a collection of Level 2 AC Electric Vehicle (EV) charging stations. The products offer a modern and stylish appearance, the versatility of multiple charging current options, the ability to be installed in wall-mounted and pedestal-mounted configurations, and a peer-to-peer communications architecture which provides the ability to support a single primary charging station (or Kiosk) and multiple secondary charging stations.

FEATURES

Blink IQ 200 Unique Design

- Future-proof design supports charging currents from 12A to 80A
- Intuitive charge connector holster provides protection and storage
- Multi-colored high visibility illuminator indicates charging station's status
- Convenient cable management design supports a long reach and storage between uses
- Height design conforms with ADA requirements
- Fee options include time-based, kWh-based, or session-based billing functionality
- Payment methods: RFID, Apple Pay, Google Wallet, and all major credit cards
- Pedestal accessories include single, dual, and triple port options
- OCPP support
- Updated 25ft. cable with an ergonomic design
- Button locking mechanism prevents accidental disconnection

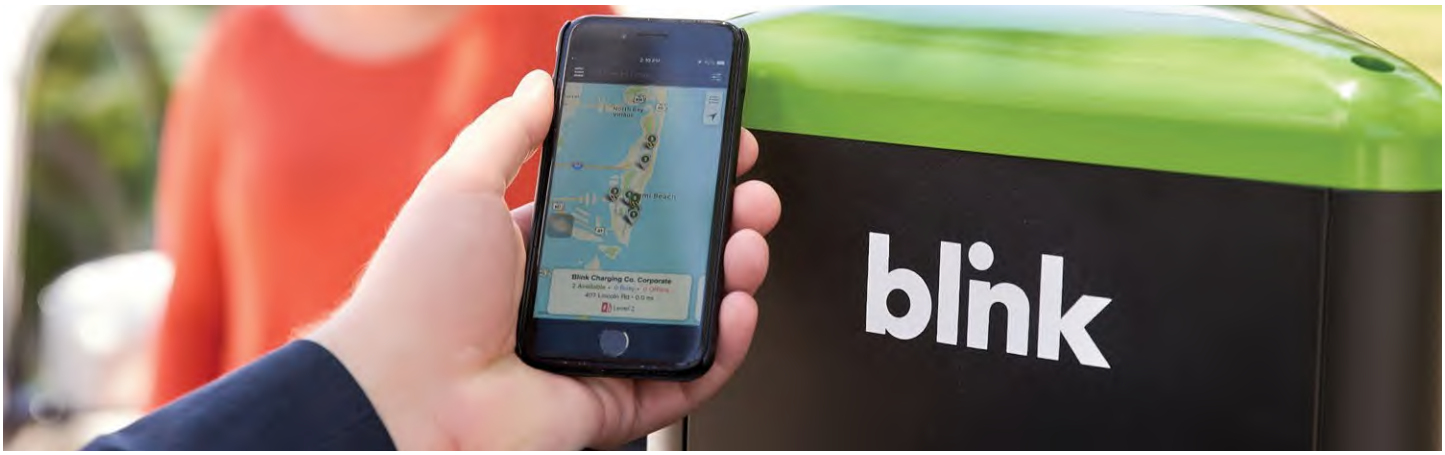
Touch Screen

- Daylight readable 7" color LCD with touch screen and 800 x 480 resolution
- Convenient, user-friendly user interface
- Displays charging station status and transaction details
- Pre-loaded with the Blink commercial user interface

Type 2 Charger Connector

- SAE J1772 Charge Connector (Standard in the United States)
- Grounded pole – first to make contact, last to break contact
- Designed for more than 10,000 cycles
- Can withstand being driven over by a vehicle
- Safe for use in wet or dry locations
- Compatible with integrated charge connector holster

Level 2 AC EV Charging Stations



Energy Management

- Internal meter to monitor energy and demand usage
- Supports real-time energy usage data evaluation
- Controllable output to support utility demand response requests
- Local load management capability for optimal energy outputs

Network, Product, and Customer Support

- Multiple modes of communication, including Wi-Fi and cellular
- Over-the-air firmware management enables remote updates
- Blink Customer Support Center with tracking system
- Blink Network Operations Center actively monitors/manages network
- Smart grid implementation and support for commercial use
- Smart-phone applications for status changes and notifications
- Role-based features to manage permissions and access levels
- Ability to manage multiple chargers with detailed data sets
- Secure, high-availability, enterprise-grade infrastructure
- Geographically separated secondary systems for disaster recovery and management

Safety and Compliance

- Ground monitoring circuit
- Charge circuit interrupting device (CCID) with automatic test
- Nuisance tripping avoidance and auto re-closure
- Cold load pickup (randomized auto-restart following a power outage)

Promotion and Advertising

In addition to promoting locations and Blink charging stations to EV drivers across the country via the Blink Mobile App and Blink Map, the Blink IQ 200 charging stations support the opportunity to promote and/or advertise businesses, properties, products, and services.

- Rich multimedia touch screen can be easily customized via Blink Ad Loop functionality
- Station panels can also be customized for branding and advertising and can be updated as necessary

Charging Stations Comparison

BLINK IQ 200 PRODUCT SPECIFICATIONS			
MODELS	SMART CHARGING STATION	ADVANCED CHARGING STATION	KIOSK
Model Number	QW2-80U-W1-N1-N-25	IQW2-80U-M1-R2-N-25	IQW2-00U-M1-R2-N-00
Part Number	01-0205	01-0207	01-0208
POWER SPECIFICATIONS			
Standby Power	<10W Standby		<10W Standby
Output Power (kW)	2.9kW 3.8kW 5.8kW 7.7kW 9.6kW 15.4kW 17.3kW 19.2kW		Not Applicable
Output Amperage (A)	12A 16A 24A 32A 40A 64A 72A 80A		Not Applicable
Circuit Breaker Options (A)	15A 20A 30A 40A 50A 80A 90A 100A		15A or 20A
Input/Output Nominal Voltage	208VAC/240VAC		120 Input
Input / Output Voltage Range	180VAC to 264VAC		90 to 132VAC Input; 180 to 264 VAC Input
Input / Output Frequency	60Hz		
Input Wiring Type	Hardwired		
Input Wiring Scheme	L1, L2, GND		L1, N, GND or L1, L2 GND
Cold-Load	Pickup Randomized delay between 120 and 720 seconds before charge resumes after a power failure.		Not Applicable
Power Measurement Accuracy	Embedded meter with a ±1% accuracy at the nominal input.		Not Applicable
Surge Protection	Up to 6kV at 3,000A		
FUNCTIONAL SPECIFICATIONS			
Charge Connector Type	SAE J1772		Not Applicable
Charge Cable Length	25 ft.		Not Applicable
Demand Response	Yes[2]		Not Applicable
Status Indicator	LED and Audio		
User Interface	None[1]	LCD, 7", Color, 800x480, w/Touch Panel	
Access Control	None[1]	Contactless Reader: RFID Cards: ISO/IEC 14443A/B, ISO/IEC 15693, MIFARE Plus, HID iCLASS, NEMA Smart Credit Cards2: Visa, Master Card, Discover, American Express NFC[2]: ISO 18092, Apple Pay, Google Wallet	
NETWORK SPECIFICATIONS			
Local Area Network (LAN)	2.4GHz Wi-Fi (802.11 b/g/n)		
Wide Area Network (WAN)	None	Cellular (3G GSM, 3G CDMA)	
Network Interface	Blink OCPP, OCPP 1.6J		
Mounting Type	Pedestal or Wall Mount		
SAFETY & COMPLIANCE SPECIFICATIONS			
Ground Fault Detection	CCID20, 20mA per UL 2231, Automatic Reset Feature and Manual Reset Feature		Not Applicable
Ground Monitor	Ground Monitor per UL 2231		Not Applicable
Safety Compliance	UL and cUL, NEC Article 625, RoHS, Norma Oficial Mexicana (NOM)		
Protection	Over-Voltage Protection (OVP), Under-Voltage Protection (UVP), Over-Current Protection (OCP), Over-Temp Protection (OTP), Short-Circuit Protection		
EMC Compliance	FCC Part 15 Class B, Industry Canada (IC), PTCRB		
ADA Compliance	Yes		
Energy Star Certified	Yes		Not Applicable
OPERATIONAL SPECIFICATIONS			
Enclosure Rating	NEMA Type 3R Indoor/Outdoor		
Operating Temperature	-30°C to +50°C (-22°F to +122°F)		
Storage Temperature	-40°C to +80°C (-40°F to +176°F)		
Operating Humidity	0 to 95% Relative Humidity, Non-Condensing		
Charger Dimensions	13.95"H × 10.65"W × 5.23"D		
Package Dimensions	19.57"L x 14.92"W x 16.61"D	19.57"L x 14.92"W x 16.61"D	19.57"L x 14.92"W x 10.63"D
Charger Weight (Unpackaged)	24.2lbs. (11kg)	25.3lbs. (11.5kg)	8.8lbs. (4kg)
Charger Weight (Packaged)	30lbs. (13.6kg)	31lbs. (14kg)	10lbs. (4.5kg)

Blink Charging Co. reserves the right to alter product offerings and specifications at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document.

[1]If applicable, an adjacent primary Advanced Charging Station or Kiosk can provide access control for up to 20 secondary Smart Charging Stations.

[2]May not be included in the initial product offering.

Pedestal Specifications

BLINK IQ 200 PEDESTAL SPECIFICATIONS				
MODELS	RECTANGLE, SINGLE	RECTANGLE, DUAL	TRIANGLE, DUAL	TRIANGLE, TRIPLE
Model Number	01-0210	01-0211	01-0212	01-0213
Number of Supported Charging Stations	1	2	2	3
User Interface Height	48″	48″	48″	48″
Pedestal Dimensions	56.04″ H × 13.58″ W × 4.28″ D	56.04″ H × 13.58″ W × 4.28″ D	59.00″ H × 12.50″ W × 11.19″ D	59.00″ H × 12.50″ W × 11.19″ D
Pedestal Weight (unpackaged)	TBD	TBD	TBD	TBD
Pedestal Weight (packaged)	TBD	TBD	TBD	TBD

Rectangle Pedestal
The rectangle pedestal slim installation is great for small spaces that may wish to expand in the future.

Triangle Pedestal
Maximizing space, the triangle pedestal can securely mount 1-3 independent charging stations.

Triangle Pedestal – Dual Port
Dual Port Using the triangle pedestal, the dual port unit features 1 advanced and 1 or 2 smart chargers.

IQ 200 Smart Units

The IQ 200 design allows for multiple deployment configurations including the innovative and cost-saving Smart/Kiosk units for high density, multiple unit, and fleet installations. Up to 20 Smart units can be connected to one Kiosk unit in which the charging session is initiated.

Wall Mount with Kiosk

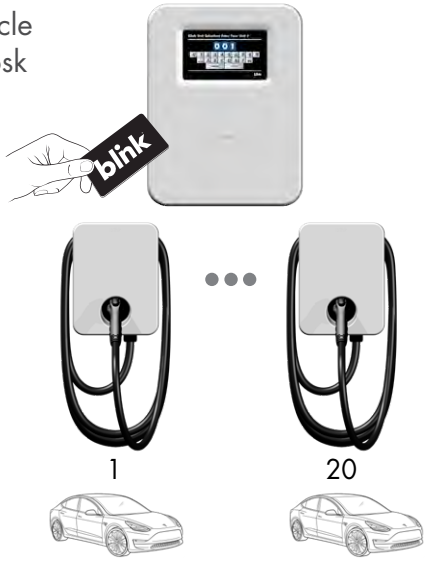
Pedestal with Kiosk

UI and Network Architecture Options

USER INTERFACE OPTIONS

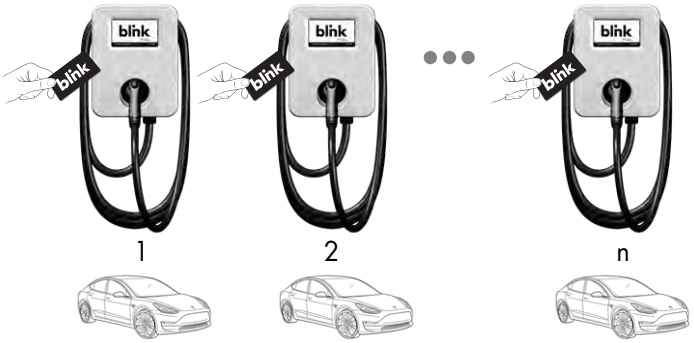
Kiosk

- Driver plugs in vehicle then proceed to Kiosk
- Kiosk controls all charging stations
- Up to 20 smart charging stations per Kiosk

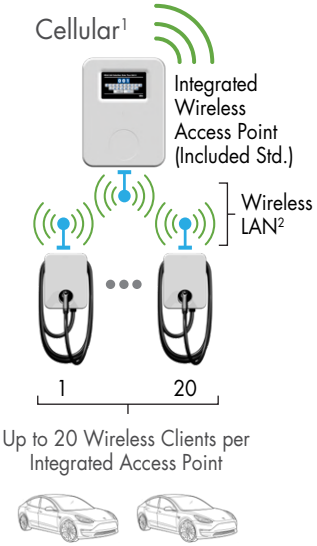


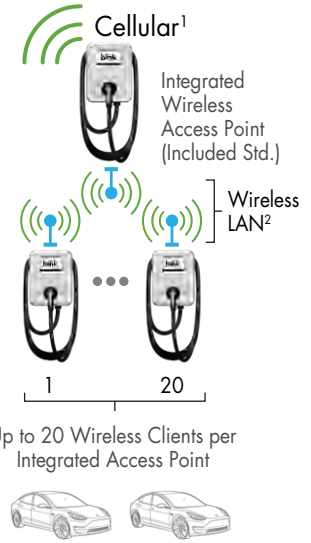
Standalone

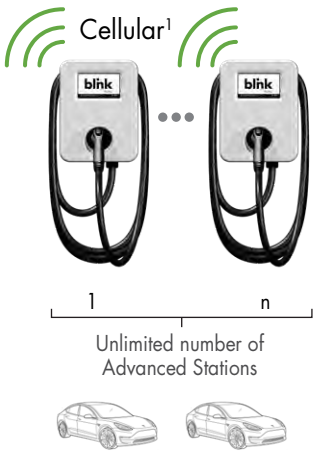
- Driver plugs in vehicle then utilizes the UI within the Blink Advanced Charging Station
- Each station operates independently

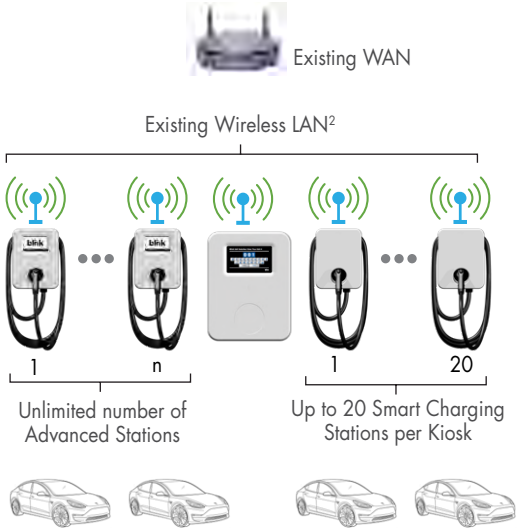


NETWORK ARCHITECTURE OPTIONS





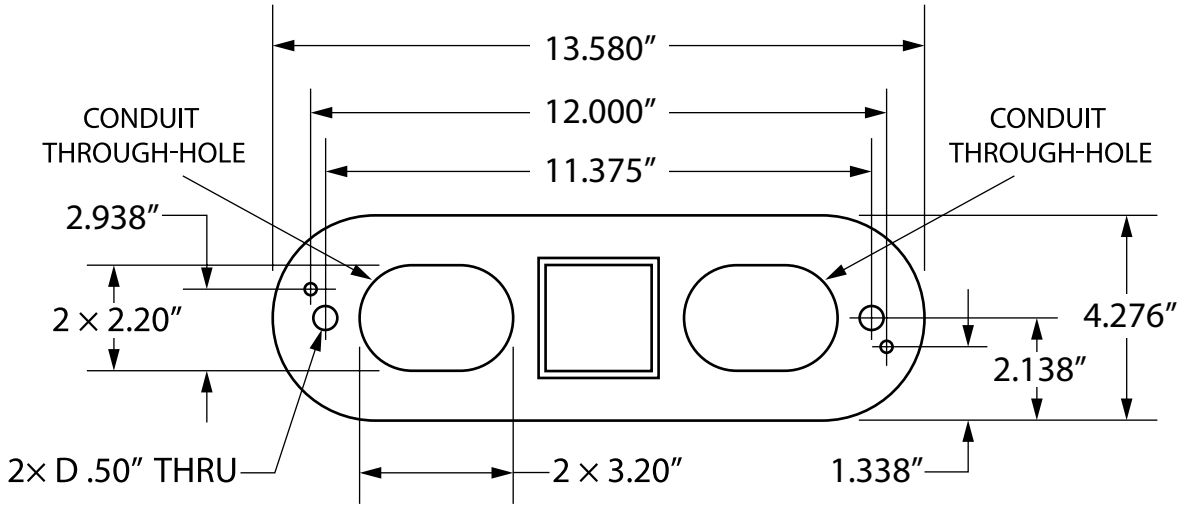




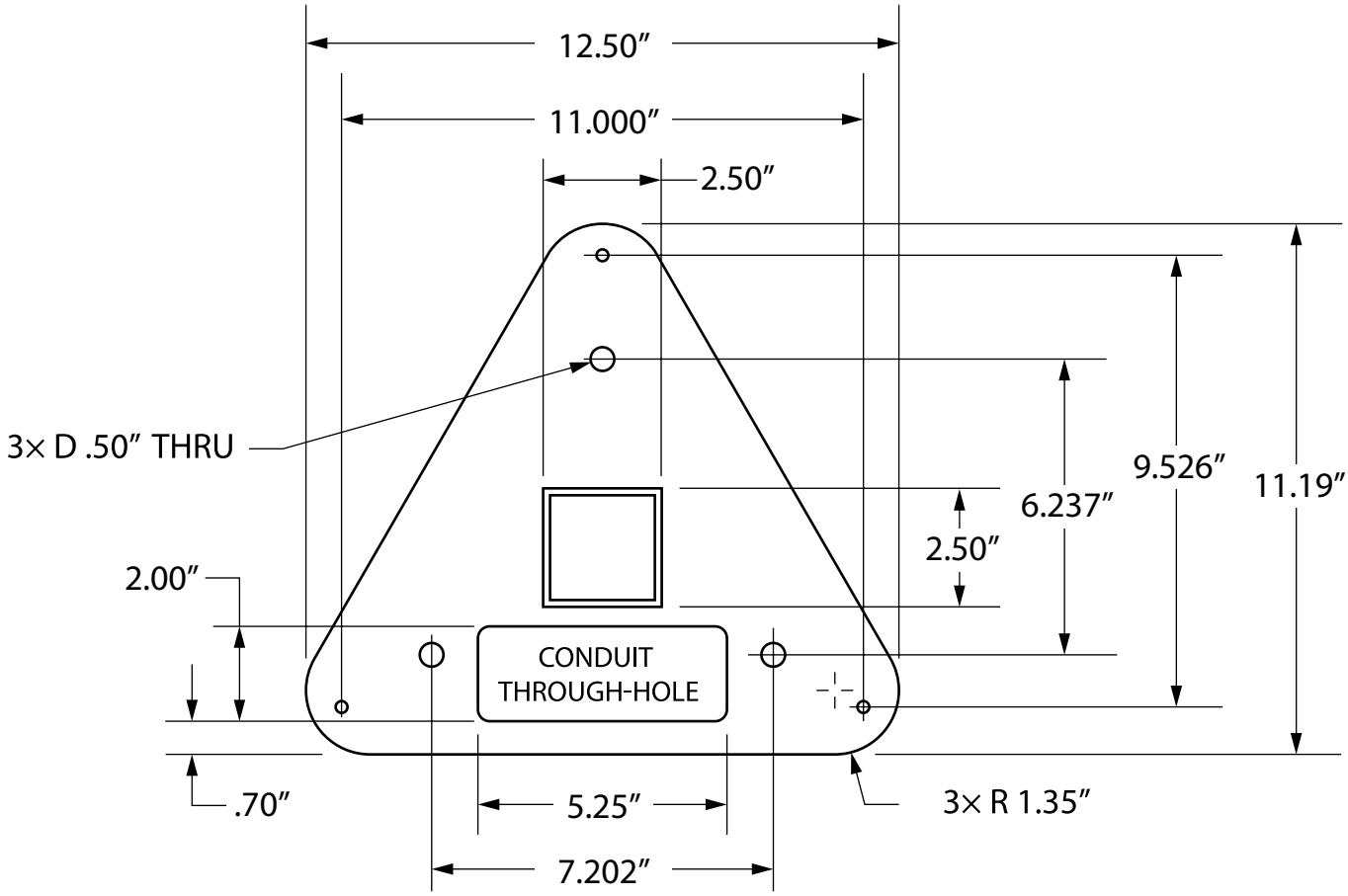
[1]Cellular 3G GSM / CDMA Capable
[2]Inegrated Wireless LAN is802.11 b/g/n capable

Pedestal Base Hole Pattern

RECTANGULAR PEDESTAL BASE HOLE PATTERN



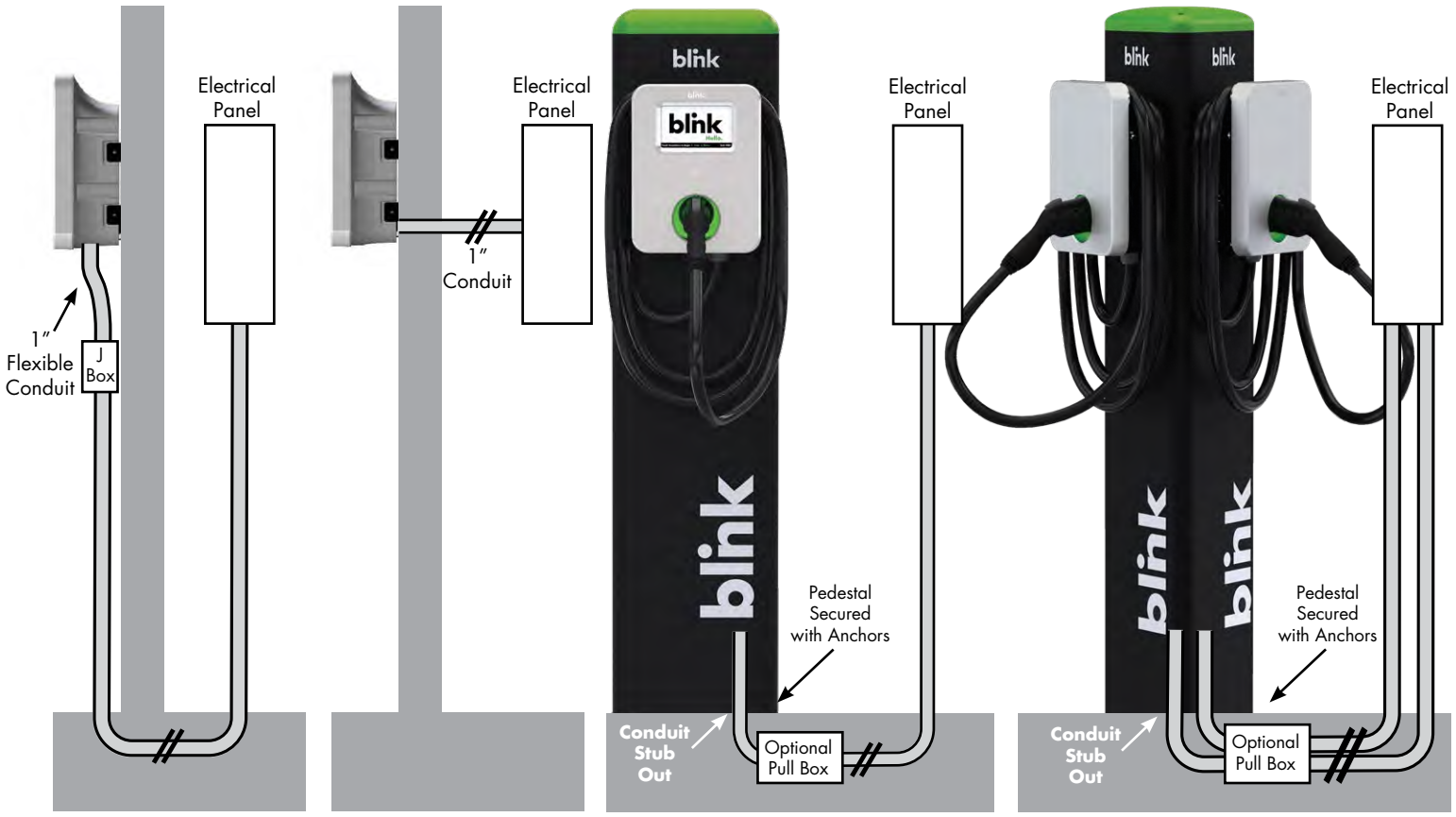
TRIANGULAR PEDESTAL BASE HOLE PATTERN



Pre-Installation Guide

ELECTRICAL WIRING SPECIFICATIONS					
Max. Continuous Current	Typical Circuit Breaker[3]	Typical Wire Specs[3]	Typical Conduit Size[3]	Blink IQ Conduit Size	Notes/Assumptions
12A	15A	Two #12AWG Wires (Line) One #12AW Wire (Ground)	1/2″	1″	≤ 150 ft. One-Way Distance ≤ 3% Voltage Drop
16A	20A	Two #10AWG Wires (Line) One #8AW Wire (Ground)	3/4″	1″	≤ 150 ft. One-Way Distance ≤ 3% Voltage Drop
24A	30A	Two #8AWG Wires (Line) One #10AW Wire (Ground)	3/4″	1″	≤ 150 ft. One-Way Distance ≤ 3% Voltage Drop
32A	40A	Two #8AWG Wires (Line) One #10AW Wire (Ground)	3/4″	1″	≤ 150 ft. One-Way Distance ≤ 3% Voltage Drop
40A	50A	Two #6AWG Wires (Line) One #8AW Wire (Ground)	3/4″	1″	≤ 150 ft. One-Way Distance ≤ 3% Voltage Drop
64A	80A	Two #4AWG Wires (Line) One #8AW Wire (Ground)	1″	1″	≤ 150 ft. One-Way Distance ≤ 3% Voltage Drop
72A	90A	Two #3AWG Wires (Line) One #8AW Wire (Ground)	1″	1″	≤ 150 ft. One-Way Distance ≤ 3% Voltage Drop
80A	100A	Two #2AWG Wires (Line) One #8AW Wire (Ground)	1″	1″	≤ 150 ft. One-Way Distance ≤ 3% Voltage Drop

[3]Consult with a licensed contractor, licensed electrician, or trained installation expert to ensure compliance with local building codes and safety standards.



Wall Mount Option 1

Wall Mount Option 2

Rectangular Pedestal Mount, Single

Triangular Pedestal Mount, Dual

blink

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(888) 998.2546

SCHEDULE III – MAKE READY REQUIREMENTS

The Host shall be responsible for the make-ready work as required to facilitate the final installation of the charger pedestal(s) and charger(s) included under the Agreement. Blink will be responsible for the installation of the pedestal(s) and charger(s) on top of the make-ready work to provide a complete and functional installation without any additional work or adjustment to the make-ready installation provided by the host.

The make-ready requirements include the following configurations:

- Dual-port Charger with Pedestal on Sidewalk
- Single-port Charger with Pedestal on Sidewalk
- Dual-port Charger with Pedestal on Concrete Pad
- Single-port Charger with Pedestal on Concrete Pad
- Dual-port Charger Wall Mount
- Single-port Charger Wall Mount

A dual-port charger is the assembly of an IQ-200 Advanced unit and IQ-200 Smart unit on a common triangular pedestal. The dual-port charger can be configured to share a single circuit or to have dedicated circuits for each port. The agreement will specify the applicable wiring configuration to be installed as part of the make-ready.

Please note that any variation to these requirements must be approved in writing by Blink

General Requirements – applicable to all configurations

- The following materials are required to be submitted to Blink within 30 days of Agreement execution.
    - A scaled Site Plan shall be provided that provides the following minimum information with respect to the installation:
        - Host name, site address
        - Parking lot layout including all travel lanes and ingress/egress
        - Location of source electric panel
        - Location of charger pedestal(s)
        - Conduit run from source panel to charger pedestal(s)
        - Location of disconnects, if any
        - Location of bollards, wheel stops, or other protective means to be installed
    - One-line electrical diagram for the circuits
    - Photos of source electric panel, typical grade conditions where trenching, and pedestal location(s)
- Make-ready work will not commence until Blink has reviewed and accepted the above materials and host has secured any required permits. Blink reserves the right to make edits on site plan prior to construction by host for ADA compliance and / or other make ready requirements
- All work shall be in conformance with the National Electric Code, latest edition, and all requirements of the local Authorities Having Jurisdiction (AHJ). All codes and requirements are considered minimum requirements and are superseded by these make-ready requirements where such make-ready requirements stricter. Host is responsible for obtaining any required permits and passing any required inspections.
- Conduit shall be **1-1/4"** minimum
- Underground conduit shall be schedule 40 PVC where permitted by code. No conduit should be visible on the site or exterior of the facility. Where PVC is not permitted, use IMC conduit and fittings suitable for the installation conditions as prescribed by code.
- Interior conduit in electric service rooms and other areas shall be EMT with compression style sealed couplings. Where EMT is not permitted, use other approved wiring method, with the exception of flexible conduit.
- A separate conduit or pair of conduits shall be run from the source electric panel to each of the pedestals included in the agreement. Where 2 circuits are required to feed the pedestal, each circuit should be run in a separate conduit.
- Conductors shall be copper, type THHN, **#6** AWG minimum, **#2** AWG preferred.
- Each circuit to be connected to a **2**-pole circuit breaker (single phase **208-240V** Supply) in the source electric panel. New breakers shall be provided, regardless of whether existing breakers are suitable. Breaker rating shall be **60A** minimum, **100A** preferred. Breaker rating shall match wire ampacity per code requirements. Panel directory to be updated to include added circuits.
- The host is responsible for determining the adequacy of the source electric panel to support the charging load. The host is responsible for any work required to provide a source panel suitable for the intended charger load.
- Provide a minimum of a **60"** wire whip at pedestal stub-up to facilitate charger connection without the need to extend wiring. Coil and attach wire to stub for protection.
- Upon completion of the installation, and approval of required AHJ inspections, the installation shall be commissioned. Commissioning for make ready includes the following:
    - Energize circuit(s) and test voltage at stub-up
    - Shut breakers and tag/lockout.
    - Photograph completed installation including circuit breaker panels, restoration of trenching, stub up with wire whip of intended pedestal / charger location, and intended parking spots
    - Update site plan and 1-line to represent as-built conditions.
    - Certify via certificate of completion
- Upon completion of commissioning, cover and protect stub-up and wiring, by placing a wood box over the stub and wiring and attach to slab with concrete screws within the pedestal footprint such that holes will not be visible upon final installation. Mark box with warning

and protect the public from any potential trip hazard with warning tape, cones, etc. as required. In the case of wall mount installation, the box shall be attached to wall.

- All conductors should be properly identified at both ends (panel and charger). Identification shall include panel id, location, and circuit number(s).
- For dual-port make-ready where 1 circuit is required, a junction box at grade, or junction box at location where conduit goes underground is required. Wire connection should be made with insulated Polaris multi-tap connectors for energized conductors and copper split bolt or weld for ground conductors. Tap conductors should be same size as circuit conductor. From junction box extend 2 conduits to pedestal and stub up as specified above.
- If source electrical panel is not visible from charger location, or as otherwise required by the AHJ, disconnect switches shall be provided for each circuit in accordance with code requirements.
- The host will be responsible for installation of wheel stops, bollards, or other protective means as determined or otherwise required by the AHJ and / or by Blink.
- Except for wall mounted installations, the host will install an 8' U-Chanel sign post, sunk 2' into the ground with 6' exposed, at the head of each parking stall serviced by a charger.
- Host is responsible for ensuring charger connectivity through wifi or cellular booster if cellular sim cards do not provide connectivity. Blink can provide assistance in helping host understand connectivity issues where the IQ 200 cellular sim card is not sufficient.

☐ **Configuration: Single/Dual-port Charger with Pedestal on Sidewalk**

- A minimum of 36" clear sidewalk must be maintained after installation pedestal.
- Curb of sidewalk must be no greater than 6" and no less than 4" above the adjacent parking surface to meet ADA requirements.
- For single-port, the center of conduit stub-up to be 3.5" off centered between parking stalls and set back 10" from the face of the curb (This will create 4" between the face of the charger and the face of the curb).
- For dual port, the center of conduit stub-up to be centered between parking stalls and set back 12" from the face of the curb (This will create 3.5" between the tip of the triangle and the face of the curb, which complies with ADA requirements).

☐ **Configuration: Single/Dual-port Charger with Pedestal on Concrete Pad**

- Concrete pad to be minimum 36"x 36". Pad shall be designed in accordance with local code requirements and AHJ. Host is responsible for any engineering, stamps, fees, etc. associated with the work.
- Concrete pad to be finished flush with adjacent parking surface or grade.
- Rebar shall be maintained with a minimum 3" clearance from forms and grade.
- Concrete pad(s) to be centered between parking spaces and align with the outside edge of the parking stall. No portion of the concrete pad should be located within the parking stall.
- Conduit stub-up to be centered between parking spaces and set back 12" outside the edge of the parking stall for dual-port.
- For single-port, the center of conduit stub-up to be 3.5" off centered between parking stalls and set back 10" from the face of the curb

☐ **Configuration: Single/Dual-port Charger - Wall Mounted**

- Conduit should be routed to a point 24" above the finished floor, below and centered on the intended charger location.
- Conduit should be routed parallel and perpendicular to the structure.
- Conduit should be routed up to the charger from below. If conduit is fed from above, it should drop down a minimum of 24" horizontally from the charger location to prevent physical interference.

Scalable.

Blink MQ 200

50 Amp Fleet & Multiunit EV Charging

Elevating EV charging solutions for large-scale charger deployments, the MQ 200 is designed for fleets and multiunit locations with a fast 50-amp output and effortless user experience, and paired with a robust new charger portal for maximum control.

POWERFUL • VERSATILE • COMPACT

Blink MQ 200 Benefits

- Smart Grid functionality for direct utility communications
- Local load management across two or more chargers
- Robust remote management tool via Blink Fleet portal and Blink Network
- Intuitive and powerful mobile management via Blink Mobile and Blink Fleet mobile apps
- Plug & Charge functionality (ISO 15118)
- Heavy duty 23ft cable
- Lockable SAE J1772 connector compatible with all EVs*
- Efficient and clear OLED Screen Interface
- Wall mount with optional pedestal and pole mounts
- Optional cable management accessories for pedestal, wall, ceiling, or pole mount
- Variable output of 12A-50A
- 4G LTE and Wi-Fi connectivity

Product Details

Max Output	50A
Input/Output Voltage Range	180VAC to 264VAC
Input/Output Amperage (Selectable)	12A, 16A, 24A, 32A, 40A, 48A, 50A
Cable Length	23 ft.
Dimensions	11.65"H × 8.91"W × 4.02"D
Standards Compliance	UL/ULC, CSA, NEC Article 625, RoHS
Networked	Blink OCPP, OCPP 1.6J, OCPP 2.0.1
Enclosure	NEMA Type 3R Indoor/Outdoor
Installation Type	Wall Mount and Pedestals with Cable Management Solutions

*Tesla Adapter Required
*The product image shown is for illustration purposes only and may not be an exact representation of the product.

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PD02-21X-02

30kW Wall Mounted DCFC

MAXIMUM POWER	30kW
OUTPUT VOLTAGE	200 – 950VDC
OUTPUT CURRENT@VOLTAGE	75A@400VDC | 40@750VDC | 30A@950VDC
INPUT VOLTAGE | FREQUENCY	480V +/- 5% (3P + N + PE) | 60 Hz
FLA | BREAKER RATING	40A | 50A
SETTABLE FLA	15A <> 40A
POWER FACTOR	>0.98
EFFICIENCY	>94% at nominal output power
DC CHARGE MODE	Mode 4,IEC-61851,ISO-15118, DIN SPEC 70121
CHARGING CONNECTOR STANDARD	Single Port: CCS1
CHARGING CABLE LENGTH	13 ft
WEIGHT	110 lbs
DIMENSIONS	27″w x 11″d x 19″h
INSULATION (INPUT – OUTPUT)	>2.5 kV
INGRESS PROTECTION	IP 54
OPERATING TEMPERATURE	-30 deg C to 55 deg C (-22 deg F to 131 deg F)
WORKING | STORAGE HUMIDITY	≤ 95% RH || ≤ 99% RH (Non-condensing)
DISPLAY	7″ LCD touch screen
COMMUNICATION PROTOCOL	OCPP 1.6J
ACCESS CONTROL	RFID: ISO/IEC 14443A/B
POWER ELECTRONICS COOLING	Air Cooled
REGULATORY COMPLIANCE	UL-2202 | EMC: EN 61000-6-1:2007,EN 61000-6-3:2007/A1:2011/AC:2012
COMMUNICATION	Ethernet - Standard, 3G/4G/Wi-Fi (Optional)
ELECTRICAL SAFETY: GFCI	RCD 20 mA Type A
ELECTRICAL SAFETY: SURGE PROTECTION	20 kA
ELECTRICAL SAFETY GENERAL	Over Voltage, Under Voltage, Over Current, Missing Ground
ELECTRICAL SAFETY: OUTPUT SHORT	Output power disabled when output is short circuited
ELECTRICAL SAFETY TEMPERATURE	Temperature Sensors @ Charge Coupler and Power Electronics
EMERGENCY STOP	Emergency Stop Button Disables Output Power

*The product image shown is for illustration purposes only and may not be an exact representation of the product.

60kW Standard Power DCFC

MAXIMUM POWER	58kW
OUTPUT VOLTAGE	150 – 500VDC
OUTPUT CURRENT	0 - 145A
INPUT VOLTAGE | FREQUENCY	480V +/- 5% (3P + N + PE) || 60 Hz
FLA | BREAKER RATING	80A || 100A
SETTABLE FLA	15A <> 40A
POWER FACTOR	>0.98
EFFICIENCY	>94% at nominal output power
DC CHARGE MODE	Mode 4,IEC-61851,ISO-15118, DIN SPEC 70121
CHARGING PROTOCOL	Dual Port CCS1 and CHAdeMO
PARALLEL CHARGE MODE (OPTIONAL)	29 KW per Port
WEIGHT	530 lbs (400 kg)
DIMENSIONS (LxDxH)	29"w x 19"d x 71"h
INSULATION (INPUT – OUTPUT)	>2.5 kV
INGRESS PROTECTION	IP 54
OPERATING TEMPERATURE	-30 deg C to 55 deg C (-22 deg F to 131 deg F)
WORKING | STORAGE HUMIDITY	≤ 95% RH || ≤ 99% RH (Non-condensing)
DISPLAY	7" LCD touch screen
COMMUNICATION PROTOCOL	OCPP 1.6J
ACCESS CONTROL	RFID: ISO/IEC 14443A/B || Credit Car Optional
POWER ELECTRONICS COOLING	Air Cooled
REGULATORY COMPLIANCE	UL-2202 || EMC: EN 61000-6-1:2007,EN 61000-6-3:2007/A1:2011/AC:2012
COMMUNICATION	Ethernet - Standard, 3G/4G/Wi-Fi (Optional)
ELECTRICAL SAFETY: GFCI	RCD 20 mA Type A
ELECTRICAL SAFETY: SURGE PROTECTION	20 kA
ELECTRICAL SAFETY GENERAL	Over Voltage, Under Voltage, Over Current, Missing Ground
ELECTRICAL SAFETY: OUTPUT SHORT	Output power disabled when output is short circuited
ELECTRICAL SAFETY TEMPERATURE	Temperature Sensors @ Charge Coupler and Power Electronics
EMERGENCY STOP	Emergency Stop Button Disables Output Power

*The product image shown is for illustration purposes only and may not be an exact representation of the product.

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PD02-21XII-01

120kW High Power DCFC

PRODUCT NUMBER	TP4-120-480	TP5-120-480
INPUT	480VAC (3P+N+PE)	
FREQUENCY	60Hz	
OUTPUT VOLTAGE	150-750VDC	150-1000VDC
OUTPUT CURRENT	0 to 200A	
FLA || BREAKER RATING	160A || 200A	
CONNECTORS	CCS1 CCS1 and CCS1 CCS1 & CHAdeMO	
CYCLIC CHARGE MODE	CCS1 - 200 A || CHAdeMO – 125 A	
PARALLEL CHARGE MODE (OPTIONAL)	60 kW per Port	
EFFICIENCY	≥94% at nominal output power	
POWER FACTOR	> 0.98	
OPERATING TEMPERATURE	-22°F to 131°F (-30°C to 55°C)	
ALTITUDE	< 6600' (2000m)	
WORKING || STORAGE HUMIDITY	≤ 95% RH || ≤ 99% RH (Non-condensing)	
WEIGHT	840 lbs (380kg)	
DISPLAY	7" LCD with touch screen	
ACCESS CONTROL	RFID: ISO/IEC 14443A/B || Credit Card Reader - Optional	
DIMENSIONS (L X D X H)	29" x 26.5" x 72"	
PROTECTIVE CLASS	NEMA 3S, IK10	
POWER ELECTRONICS COOLING	Air Cooling	
CHARING PROTOCOL STANDARDS	Mode 4 - IEC-61851, ISO-15118, DIN 70121 Mode 4 - CHAdeMO 0.9, 1.0	
LENGTH OF CHARGING CABLE	16ft (5m)	
INTERFACE PROTOCOL	OCPP 1.6J	
COMMUNICATION	Ethernet , 4G/Wi-Fi	
INSULATION (INPUT-OUTPUT)	>2.5 kV	
ELECTRICAL SAFETY: GFCI	RCD 20 mA Type A	
ELECTRICAL SAFETY: SURGE PROTECTION	20 kA	
ELECTRICAL SAFETY GENERAL	Over Voltage, Under Voltage, Over Current, Missing Ground	
ELECTRICAL SAFETY: OUTPUT SHORT	Output power disabled when output is short circuited	
ELECTRICAL SAFETY TEMPERATURE	Temperature Sensors @ Charge Coupler and Power Electronics	
EMERGENCY STOP	Emergency Stop Button Disables Output Power	
REGULATORY COMPLIANCE	UL-2202 || EMC: EN 61000-6-1:2007, EN 61000-6-3:2007/A1:2011/AC:2012	

*The product image shown is for illustration purposes only and may not be an exact representation of the product.

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PD02-21XII-01

150-180kW High Power DCFC

MAXIMUM POWER	150kW	180kW
OUTPUT VOLTAGE	200 – 950VDC	
OUTPUT CURRENT@VOLTAGE	300A @ < 500 VDC 160A @ 920 VDC	360A @ < 500 VDC 195A @ 920 VDC
INPUT VOLTAGE | FREQUENCY	480V +/- 5% (3P + N + PE) || 60 Hz	
INPUT CURRENT | BREAKER RATING	200A | 300A	240A ||300A
POWER FACTOR	>0.98	
EFFICIENCY	>94% at nominal output power	
DC CHARGE MODE	Mode 4,IEC-61851,ISO-15118, DIN SPEC 70121	
CONNECTOR CABLE LENGTH	16 ft (5 m)	13 ft (4 m)
WEIGHT	880 lbs (400 kg)	950 lbs (430 kg)
DIMENSIONS (L X D X H)	32"w x 30"d x 75"h (800 x 752 x 1900 mm)	
INSULATION (INPUT – OUTPUT)	>2.5 kV	
INGRESS PROTECTION	IP 54	
OPERATING TEMPERATURE	-30 deg C to 55 deg C (-22 deg F to 131 deg F)	
WORKING | STORAGE HUMIDITY	≤ 95% RH || ≤ 99% RH (Non-condensing)	
DISPLAY	7″ LCD touch screen	
COMMUNICATION PROTOCOL	OCPP 1.6J	
ACCESS CONTROL	RFID: ISO/IEC 14443A/B | Credit Card Optional	
POWER ELECTRONICS COOLING	Air Cooled	
REGULATORY COMPLIANCE	UL-2202 || EMC: EN 61000-6-1:2007,EN 61000-6-3:2007/A1:2011/AC:2012	
COMMUNICATION	Ethernet - Standard, 3G/4G/Wi-Fi (Optional)	
ELECTRICAL SAFETY: GFCI	RCD 20 mA Type A	
ELECTRICAL SAFETY: SURGE PROTECTION	20 kA	
ELECTRICAL SAFETY GENERAL	Over Voltage, Under Voltage, Over Current, Missing Ground	
ELECTRICAL SAFETY: OUTPUT SHORT	Output power disabled when output is short circuited	
ELECTRICAL SAFETY TEMPERATURE	Temperature Sensors @ Charge Coupler and Power Electronics	
EMERGENCY STOP	Disables output power with emergency stop button	

*The product image shown is for illustration purposes only and may not be an exact representation of the product.

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PD02-21XII-01

Subject: DSM Working Group
Location: https://bigrivers.zoom.us [redacted]

Start: Tue 7/18/2023 10:30 AM
End: Tue 7/18/2023 12:00 PM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: Pogue, Russ
Required Attendees: Marty Littrel; Todd Blackburn; Mike French ([redacted]); Tim Lindahl ([redacted]); Rob Stumph; Greg Grissom; Scott Adair; Travis Spiceland; Repsher, Ron
Resources: HQ Conference 321

DSM Potential Report Draft Agenda

- Historic DSM Reports
- Historic DSM/EE Programs
- 2023 Report Analytics
- Anticipated KPSC Response

I will update the agenda prior to the meeting. If you have additional items for the agenda, please let me know.

Russ Pogue
Manager of Power Marketing and Member Relations
Big Rivers Electric
Ph# 270 844 6159
Cell [redacted]

Join Zoom Meeting
https://[redacted]

Meeting ID: [redacted]
Passcode: [redacted]

One tap mobile
+16465588656,,84377302886#,,,,*180885# US (New York)
+16469313860,,84377302886#,,,,*180885# US

Dial by your location
• +1 646 558 8656 US (New York)
• +1 646 931 3860 US
• +1 301 715 8592 US (Washington DC)
• +1 305 224 1968 US
• +1 309 205 3325 US
• +1 312 626 6799 US (Chicago)
• +1 360 209 5623 US
• +1 386 347 5053 US
• +1 507 473 4847 US
• +1 564 217 2000 US
• +1 669 444 9171 US
• +1 689 278 1000 US
• +1 719 359 4580 US
• +1 720 707 2699 US (Denver)
• +1 253 205 0468 US
• +1 253 215 8782 US (Tacoma)
• +1 346 248 7799 US (Houston)

Meeting ID: 843 7730 2886
Passcode: 180885

Find your local number: https://bigrivers.zoom.[redacted]

Subject: DSM Working Group (DER & Storage)
Location: Zoom Meeting; https: [redacted]

Start: Tue 11/14/2023 11:00 AM
End: Tue 11/14/2023 12:30 PM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: Pogue, Russ
Required Attendees: Marty Littrel; Todd Blackburn; Mike French ([redacted]); Tim Lindahl ([redacted]); Rob Stumph; Greg Grissom; Scott Adair; Ashley Turner; Travis Spiceland; Scott Bradtmiller; Terry Wright (Terry.Wright@bigrivers.com)
Optional Attendees: Meredith Kendall
Resources: HQ Conference 321

If you would like to discuss additional subjects, please let me know. I will update the agenda as we get closer to the meeting date.

Scott Bradtmiller from NRCO will be joining us to discuss energy storage systems being deployed around the country and answer questions on renewables.

- Mine pump back storage
- Compressed Air/liquefied Air Storage
- Mechanical Energy Storage
- Battery Energy Storage
  - Flow Battery
  - Lithium Battery

- Energy Efficiency Program Support Discussion (presentation attached)

Join Zoom Meeting
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Meeting ID: [redacted]
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• +1 312 626 6799 US (Chicago)
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BIG RIVERS DEMAND SIDE PLANNING (DSM) PLANNING 2023

DSM Definition

- DSM includes both Energy Efficiency (EE) and Demand Response (DR)
- Energy Efficiency reduces the consumption of electricity by retail members
- Demand Response shifts load from high demand periods to lower demand periods

Statutory Requirement

- 807 KAR 5:058. Integrated resource planning by electric utilities:
  - Requires DSM Potential Study every three years as part of the IRP
- 278.285 Demand-side management plans:
  - Regulates the approval of DSM programs offered to retail members
- Determine approximate cost and effectiveness of DSM measures and programs

HISTORY

KPSC Influence

- 2008 – 2011 Commissioners strongly "encouraged" DSM program development
- Programs implemented 2012 & 2013
- KY Gov. changes D=>R 2015-2019
  - Support for DSM programs at KPSC changes
- Big Rivers withdrawals programs in late 2019
- Currently one minor program exists
- KY Gov. Changes R=>D
- CPCN will likely spur interest in DSM as alternative

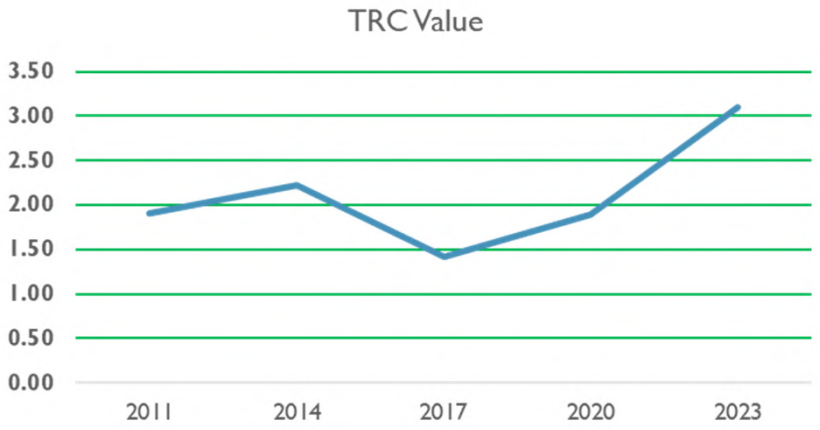
Programs Offered 2012 - 2020

- CFL/LED Distribution
- Energy Star Clothes Washer Incentive
- Energy Star Refrigerator and Recycling Incentive
- High Efficiency HVAC Incentive
- Residential Weatherization
- High Efficiency New Home Construction Incentive
- HVAC Service Incentive
- High Efficiency Lighting Incentive
- Non Lighting Commercial EE Incentive
- HVAC Service Incentive
- Commercial HVAC Incentives
- High Efficiency Outdoor Lighting

COST EFFECTIVENESS

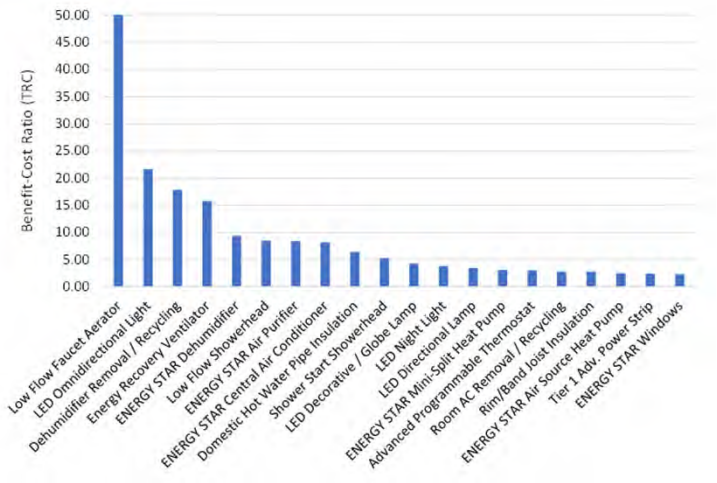
- Benefit to Cost ratios are used to determine cost effectiveness
  - Total Resource Cost (TRC)
  - Participant Cost (PCT)
  - Utility Cost (UCT)
  - Rate Impact Measure (RIM)
- 10 Year NPV Benefits/NPV Costs
- Commission historically uses TRC to evaluate overall cost effectiveness
- TRC considers all costs and benefits including retail member and utility

$1 Million Annual Program Budget per Study Year



2023 DSM POTENTIAL STUDY – RESIDENTIAL

Residential Measure TRC >1



Residential Program Impact

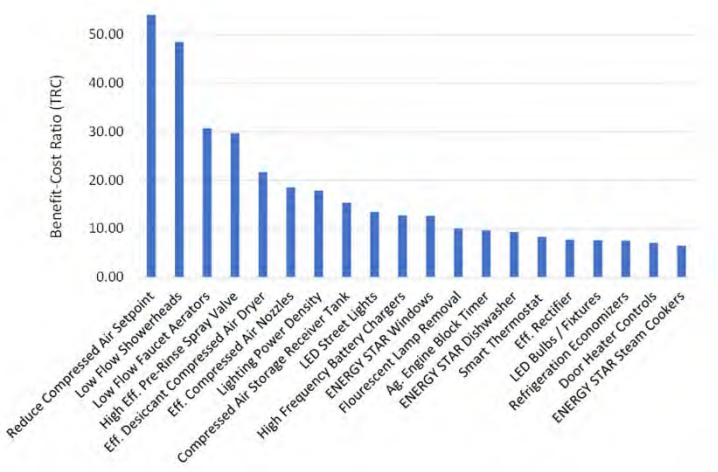
Energy (MWh) Category	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
HVAC	1,050	2,099	3,149	4,198	5,248	6,298	7,347	8,397	9,446	10,496
Water Heating	891	1,781	2,672	3,562	4,453	5,344	6,234	7,125	8,016	8,906
Appliance	269	539	808	1,077	1,347	1,616	1,886	2,155	2,424	2,694
Lighting	51	103	154	206	257	309	360	411	463	514
Other	50	100	150	200	250	300	350	400	450	500
Total	2,311	4,622	6,933	9,244	11,555	13,866	16,177	18,488	20,799	23,110

Demand (MW) Category	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
HVAC	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.9	2.1
Water Heating	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.4
Appliance	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5
Lighting	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Other	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Total	0.3	0.6	1.0	1.3	1.6	1.9	2.2	2.6	2.9	3.2

Note: MISO Summer Peak
Note: Cumulative Annual Impact

2023 DSM POTENTIAL STUDY – COMMERCIAL

Commercial Measure TRC >1



Commercial Program Impact

	Category	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Energy (MWh)	HVAC	1,359	2,717	4,076	5,435	6,793	8,152	9,510	10,869	12,228	13,586
	Water Heating	120	240	360	480	600	721	841	961	1,081	1,201
	Lighting	1,367	2,733	4,100	5,466	6,833	8,199	9,566	10,932	12,299	13,665
	Appliance	2,192	4,385	6,577	8,770	10,962	13,154	15,347	17,539	19,732	21,924
	Other	1,113	2,226	3,339	4,453	5,566	6,679	7,792	8,905	10,018	11,132
	Total	6,151	12,302	18,452	24,603	30,754	36,905	43,056	49,207	55,357	61,508

	Category	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Demand (MW)	HVAC	0.2	0.5	0.7	0.9	1.2	1.4	1.7	1.9	2.1	2.4
	Water Heating	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
	Lighting	0.3	0.5	0.8	1.1	1.4	1.6	1.9	2.2	2.5	2.7
	Appliance	0.6	1.3	1.9	2.6	3.2	3.9	4.5	5.1	5.8	6.4
	Other	0.1	0.2	0.3	0.4	0.6	0.7	0.8	0.9	1.0	1.1
	Total	1.3	2.6	3.8	5.1	6.4	7.7	8.9	10.2	11.5	12.8

Note: MISO Summer Peak
Note: Cumulative Annual Impact

10 YEAR DEMAND AND ENERGY REDUCTION

Big Rivers ELECTRIC CORPORATION

Program Potential Impact
$1 Million Annual Budget

Program Potential	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Annual Energy (MWh)	8,462	16,924	25,385	33,847	42,309	50,771	59,233	67,694	76,156	84,618
Demand (MW)	1.6	3.2	4.8	6.4	8.0	9.6	11.2	12.8	14.4	16.0

Assumption for Study - Not Reflective of Actual Program Design

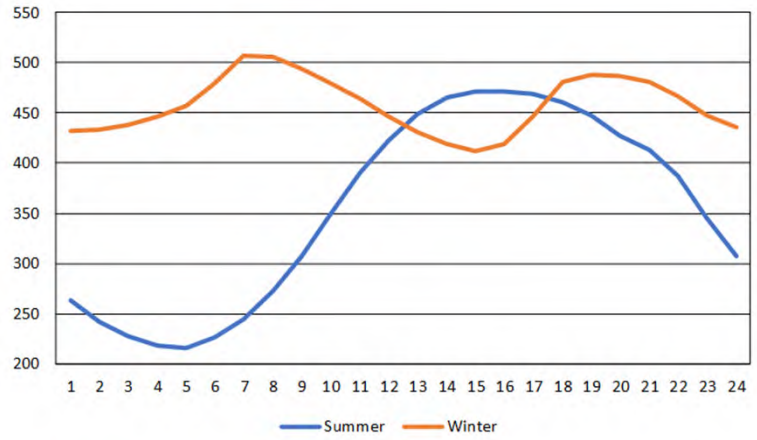
- 15% admin and promotion
- 85% incentives
- Incentives 30% of measure cost

DEMAND RESPONSE

MISO Demand Response Program

- Dynamic Pricing
- Load Modifying Resource (LMR)
  - Controllable Load
  - Emergency Conditions
  - Capacity Award
- Demand Response Resource (DRR)
  - Daily Offer
  - Market Response
  - Ancillary Markets

Big Rivers Average Peak Day Load Shape



DYNAMIC PRICING – TIME OF USE (TOU)

- Cost of electricity increases during times of high demand
- Incentive to change behavior
- Common types of dynamic pricing
  - Load Specific (i.e. EV Charging)
  - Whole House TOU
  - Critical Peak Pricing (CPP)
  - Peak Time Rebate
- Cost/Benefit based on Big Rivers avoided costs

AMI AND DISTRIBUTED ENERGY RESOURCES MANAGEMENT SYSTEM (DERMS)

Current AMI Deployment

- Kenergy 100%
- MCRECC 100% by end of 2023
- Jackson Purchase Current PLC System

DERMS Future Potential

- Centralized Load Control
  - EV Charging
  - A/C Load Control
  - Water Heater Load Control
- AMI Dependent
- Allows Participation in MISO DR Programs
- MISO Pays for Managed Loads

DEMAND RESPONSE CURRENT COST/BENEFIT

- System Wide Load Control may require:
  - DERMS
  - Locally installed devices (AC/Water Heater)
  - AMI
  - Measurement & Verification (M&V)
- TOU Rates
  - AMI
  - Secondary metering for load specific TOU

Demand Response TRC Values

Program	Sector	Type	Direct Control	TRC	UCT	PCT
Air Conditioner Cycling (25%)	Residential	Load Management	Yes	1.6	0.7	2.2
Air Conditioner Cycling (50%)	Residential	Load Management	Yes	3.3	1.5	2.2
Air Conditioner Control (100%)	Residential	Load Management	Yes	6.5	2.9	2.2
Water Heater Cycling (25%)	Residential	Load Management	Yes	0.3	0.1	2.2
Water Heater Cycling (50%)	Residential	Load Management	Yes	0.5	0.2	2.2
Water Heater Control (100%)	Residential	Load Management	Yes	0.9	0.4	2.2
Level 2 EV Charger	Residential	Load Management	Yes	1.2	1.1	1.3
Battery Storage	Residential	Load Management	Yes	0.4	1.0	2.8
Residential Load Control	Residential	Load Management	Yes	5.5	3.4	1.6
DLC (Customer Ownership)	Non-Residential	Load Management	Yes	2.1	1.2	1.2
DLC (Utility Ownership)	Non-Residential	Load Management	Yes	2.1	1.8	1.5
Battery Storage	Non-Residential	Load Management	Yes	0.9	2.4	5.9
Fleet Charging (Off-Peak)	Non-Residential	Load Management	Yes	2366.0	3.4	600.0
Peak Time Rebate	All	Load Management	No	49.5	2.3	121.9
Residential TOU	Residential	Dynamic Pricing	No	18.7	30.8	13.7
Residential CPP	Residential	Dynamic Pricing	No	41.1	67.9	68.6
Non-Residential TOU	Non-Residential	Dynamic Pricing	No	10.5	53.1	30.4
Non-Residential CPP	Non-Residential	Dynamic Pricing	No	37.8	191.7	199.3
Plug-In EV TOU	All	Dynamic Pricing	No	1.2	1.1	1.0

QUESTIONS AND GUIDANCE TO BIG RIVERS

- Are there specific programs/categories Members would like Big Rivers to evaluate further?
- Are there areas Members would want Big Rivers to avoid such as dynamic pricing or energy efficiency?

Subject: DSM Distributed Energy Resources Management System (DERMS)
Location: HQ Conference 321

Start: Tue 4/2/2024 10:00 AM
End: Tue 4/2/2024 11:30 AM

Recurrence: (none)

Meeting Status: Meeting organizer

Required Attendees: Marty Littrel; Todd Blackburn; Mike French ([redacted]); Tim Lindahl [redacted]; Rob Stumph; Greg Grissom; Scott Adair; Ashley Turner; Travis Spiceland; Terry Wright (Terry.Wright@bigrivers.com); Meredith Kendall; Scott Drake
Resources: HQ Conference 321

Please feel free to invite others that might have an interest. I will update with documents and presentations as available.

- What is a Distributed Energy Resource Management System (DERMS)?
- What is going on in the DERMS world? I have attached the NRECA DERMS survey and report published last September.
- How is East Kentucky approaching the development of a DERMS system?
    - Scott Drake from EKPC will provide a brief on how they are approaching DERMS

Microsoft Teams meeting

Join on your computer, mobile app or room device
[redacted]

Meeting ID: [redacted]
Passcode: [redacted]

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Business & Technology Surveillance

An Evolution into ADMS for a Changing Landscape

By Jim Weikert, Vice President of Utility Automation & Communications, Power System Engineering

AUGUST 2023

NRECA
America's Electric Cooperatives

An Evolution into ADMS for a Changing Landscape

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AUGUST 2023

SUBJECT MATTER EXPERT ON THIS TOPIC

David Pinney
Principal Analytical Tools & Software Products, NRECA Business and Technology Strategies,

This article is a product of the Analytics, Resiliency and Reliability Workgroup.

ARTICLE SNAPSHOT

WHAT HAS CHANGED?

The advanced distribution management system (ADMS) product category has become well-defined, and there are multiple offerings on the market that offer various benefits, such as restoration management, full system visibility, and Volt/VAR optimization.

WHAT IS THE IMPACT ON ELECTRIC COOPERATIVES?

ADMS enables new distribution management capabilities for mitigating outage impacts and enhancing the visibility into and control of distribution assets.

WHAT SHOULD CO-OPS KNOW/DO ABOUT IT?

It would be beneficial for cooperatives to become familiar with emerging ADMS capabilities, assess whether these are useful to your cooperative, and consider the steps that could be taken to acquire these capabilities (via distribution automation deployment, networking, system integration, and cybersecurity hardening).

A NOTE ON DERMS

ADMS and DERMS technology are both evolving platforms and can share many functionalities. NRECA is monitoring developments in both areas, and providing technical surveillance for our members as feasible. Please visit **cooperative.com** for updates.

Executive Summary

Recent federal funding for Smart Grid and increased plans for renewable energy on the distribution system have a lot more people talking about "ADMS" and wondering if its right for them. An advanced distribution management system (ADMS) brings the power of automation to distribution utilities that previously only transmission operators had. Informed by interviews with major ADMS vendors and a survey of cooperatives, this article describes ADMS technology available today, where cooperatives are at and what they are focusing on, and how to migrate to an ADMS.

Surveys of cooperatives ranging in size from less than 1,000 to more than 100,000 meters showed that technology is increasingly being used to control their distribution systems, with 80% of surveyed cooperatives having supervisory control and data acquisition systems (SCADA), 75% having SCADA coverage of a majority of their substations, and over 50% having SCADA communication to feeder devices.

ADMS is an evolution of distribution automation technology. At its foundation lies the SCADA system, which is used for monitoring and controlling substations and feeder equipment. ADMS typically adds outage management systems (OMS) for managing crews and communicating with customers during outages, and distribution management systems (DMS) for automating restoration, managing voltages, and using maps to visualize the system.

ADMS provides tools for utilities to better manage a dynamic distribution system, in light of increasing renewables and increased electrification. Co-ops surveyed indicated the value they primarily see includes:

- **Restoration**: Improving speed and efficiency of restoring service, especially in light of increased reliance on electricity as a source of energy for vehicles.
- **Visibility**: Seeing the locations of renewables and elective vehicles (EVs), and showing the impact of these to distribution operators.
- **Distributed Energy Resources Management Systems (DERMS)**: Having tools that can address traditional demand response, as well as provide visibility into and aggregate, optimize and dispatch broader DER across the system.
- **Volt/VAR Optimization**: Having tools that can manage voltage and VAR flow in a more dynamic environment.

By making small steps to build on where you are at today, cooperatives can incrementally realize the benefits of ADMS. Focus, simplicity and training are keys to keeping the transition to ADMS manageable.

- **Focus**: ADMS systems are a collection of modules with a broad range of functionality. Start with the component that brings you the most value and build on the lessons you learn from that.
- **Simplicity**: ADMS systems can operate on data models, such as GIS, and integrations that range from simplistic to elaborate. Start with simplistic models to build comfort within your cooperative and expand from there as you learn.
- **Training**: Vendors are very capable of guiding your team through the deployment. Using the deployment as an opportunity to train your staff well is essential for leveraging the ongoing benefit of an ADMS.

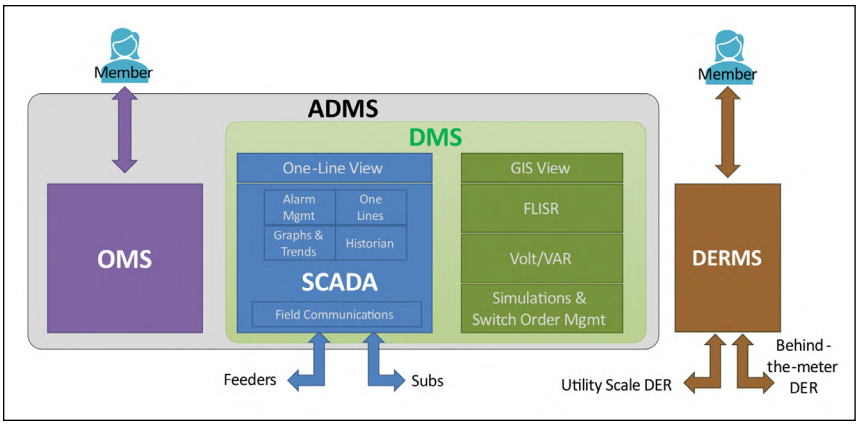

FIGURE 1: ADMS—An Evolutuion of Distribution Automatic Technology

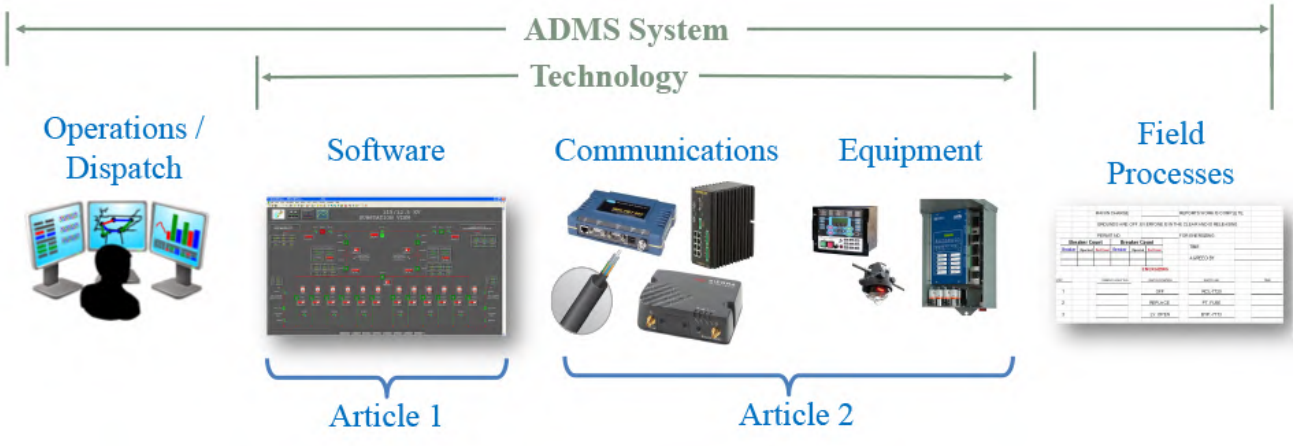

FIGURE 2: High-Level View of an ADMS

Getting Your Bearings

ADMS is often used as an umbrella term that includes the people, processes, software, equipment, and communications required. But, as shown in Figure 2, this article focuses on software.

As functionality extends from the substation to the field, the field equipment and communications become even more important, in addition to the processes dispatchers and field crews use to interact. A second article in this series will focus on those components.

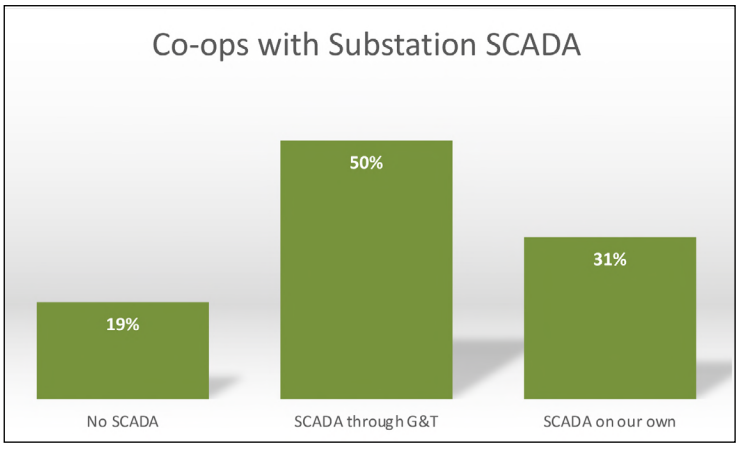

FIGURE 3: Breakdown of SCADA at Cooperatives

Cooperatives across the country were surveyed to provide a picture of peer perspectives toward ADMS. The co-ops were asked what they are doing today for SCADA and ADMS, as well as their vision for the future. This article includes snapshots from the 65 respondents, whose co-ops ranged in size from less than 1,000 to more than 126,000 meters.

SCADA for substations is a starting point for any utility looking to implement an ADMS. Figure 3 shows that 80% of co-ops responding to the survey have SCADA to their substations today.

Evolution of Functionality

The story of ADMS is one of evolution. For many years, utilities have used SCADA for insight into what is going on in their substations and for remotely controlling the devices inside of them. The **Figure 4** shows that 75% of co-ops responding to the survey have SCADA to a majority of their substations.

To help locate, analyze, and restore outages, most utilities rely on an OMS—and as they look to monitor and control equipment on their feeders more directly, they add a DMS.

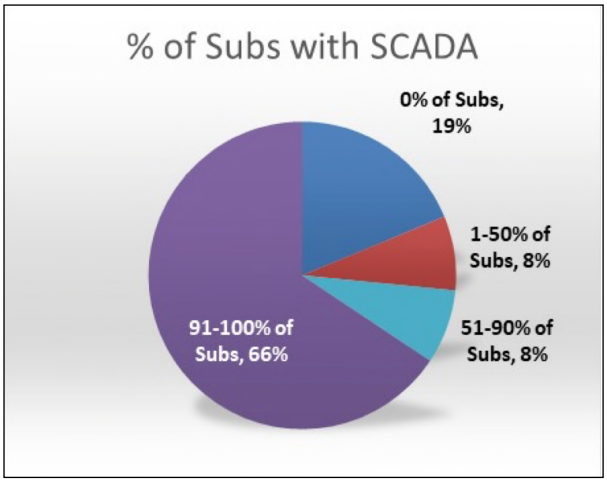

FIGURE 4: SCADA at Co-op Substations

> The evolution of these systems has culminated in ADMS, a term that is used broadly to encompass a range of software capabilities. While many in the utility industry provide their own definitions for ADMS, the diagram in Figure 5 defines what we consider to be included in ADMS.

For the purposes of this article, ADMS refers to a single software solution that incorporates the processes, data, and functions of SCADA, DMS, and OMS together. Additionally, the DMS component of ADMS covers a broad range of software technologies from fault location, isolation, and restoration (FLISR) for automating restoration to volt-VAR optimization (VVO) for managing voltage levels. Often included in the discussion are emerging technologies such as a distributed energy resource management system (DERMS) for managing renewable energy resources, both member-owned assets behind the meter and utility-owned assets in front of the meter.

To better understand the evolving role of ADMS in the electric utility industry, a representative sample of four leading ADMS vendors used by cooperatives were interviewed—Minsait Advanced Control Systems (ACS), Open Systems International, Inc. (OSI), Survalent, and Schneider Electric—and their insights incorporated throughout this article.

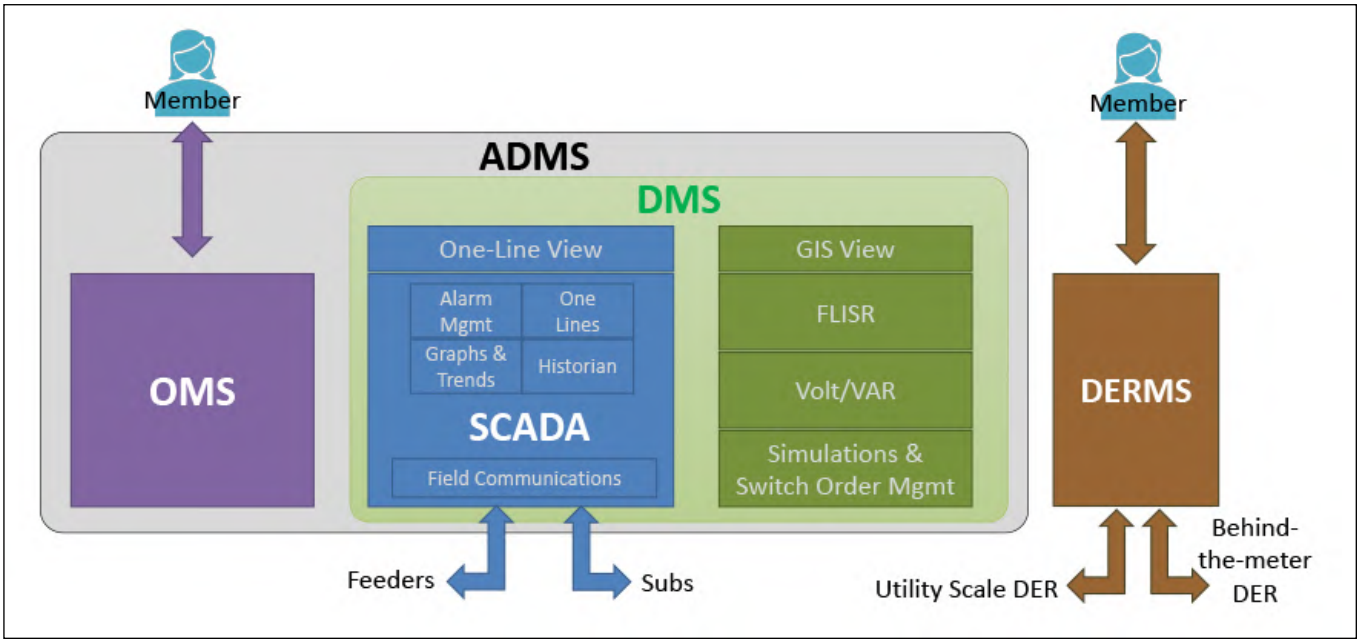

FIGURE 5: Major Components of an ADMS

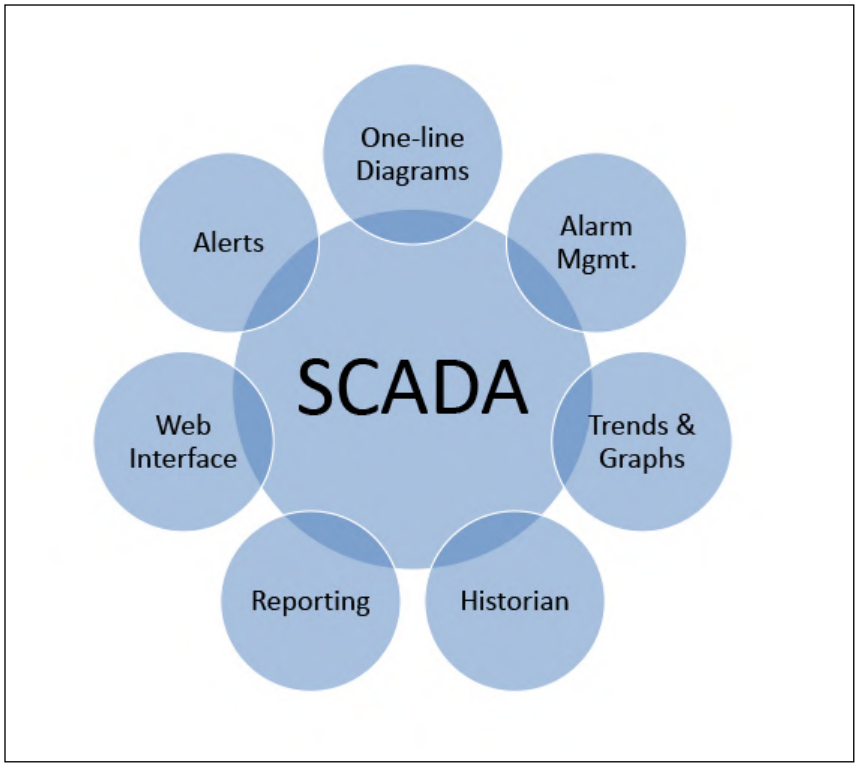

FIGURE 6: SCADA Software Components

SCADA—The Core of ADMS

The heart of ADMS software is SCADA software, which traditionally has been used to monitor and control substations.

Technology has evolved well beyond the simplistic SCADA software from the 1980s and 1990s. However, all the foundational SCADA functionality remains: the systems provide one-line diagrams of substations and whole electric systems, process alarms from the field, allow operators to control equipment, and keep historical records of events and user actions. See Figure 6.

Modern SCADA software has seen additional improvements in alarm management, the ability for some historians to store data as it is received, the ability to view real-time and historic data at the same time, visibility beyond the control room with web interfaces that look just like control room screens, and notifications via email and texts to personnel.

OMS and DMS—Essential Additions

Two major components are added to SCADA to make it into an ADMS: DMS and OMS.

- **Distribution management system (DMS)**: Software functionality designed specifically for visibility and control of the distribution system from the substation to the customer meter.
- **Outage management system (OMS)**: A software system primarily used to identify the location of outages, notify members of the status of those outages, and coordinate crew activities to get the outages restored.

Many utilities today have separate software systems for OMS and SCADA. Additionally, though much less common, some utilities that have implemented DMS functionality have done so with software that is separate from their SCADA. This is most frequently true when the DMS functionality, such as automating restoration, is done through the coordination of relays and/or recloser controls themselves.

DMS and OMS systems both look to manage distribution feeders. They each require a model of the feeders, and both provide an interface for operators in the control room to manage the feeders. Because changes to the distribution system impact both DMS and OMS, there is value in having both in a single ADMS platform.

DERMS—An Increasingly Important Complement

An additional component, a distributed energy resource management system (DERMS), is increasingly included in the discussion with ADMS, though not necessarily an essential component of one.

For many years, a demand response management system (DRMS) was used to do simplistic on/off control of in-home devices, such as water heaters and A/C units, disabling them to reduce demand at peak times. With rapid expansion of in-home technology to include distributed energy resources (DER), like solar and battery storage as well as electric vehicles (EVs), the software has evolved to DERMS, which is used to manage a complex interaction of behind-the-meter resources, as a portfolio of energy resources.

While the behind-the-meter equipment controlled by a DERMS is connected to the distribution system through the meter, ADMS today focuses on control of the distribution feeders more directly. While most ADMS vendors provide some DERMS functionality, capabilities vary significantly. Many vendors who provide a standalone DERMS system provide much broader capabilities than ADMS vendors with DERMS modules. Carefully considering the role that behind-the-meter resources will play in managing your distribution system is important when deciding on an approach for ADMS and DERMS.

In speaking about their approach to DERMS, Brandon Horne, Business Development Manager at Schneider Electric, shared: "We think of DERMS as a holistic approach from the grid to the prosumer. DERMS is a utility-wide transformation. When considering DERMS technologies, it is important to ensure those solutions encompass the needs of all the different areas within a utility, from managing impacts on the grid to engaging with your members."

Why Migrate to ADMS?

While technology has evolved to include a new range of new systems and functionality, not every new capability will be a good fit for your cooperative. Implementing any new technology requires the dedication of capital, human resources, and process change. Understanding whether ADMS makes sense for your cooperative, which components are the most valuable to implement and when, are critical questions to consider.

Substation SCADA and OMS have been adequate for many years, and some cooperatives have yet to deploy SCADA. So, why would cooperatives be considering ADMS? The biggest driver is a desire to prepare for changes in the industry and the associated expectations of members, particularly to meet the evolving needs of renewables and electric vehicles.

- **Distributed Generation**: Residential, commercial, and utility-scale solar, storage, and fossil backup units are increasing on cooperatives' systems as a result of legislation and customer desire. This adds variability that had not existed before in power flow and hidden sources of generation. These resources also present new opportunities for cost-saving demand management.
- **Electrification and Electric Vehicles**: Members are increasingly expecting electric system reliability to meet the needs of electric vehicles, and those EVs are causing rapid changes to load profiles.

The DMS functionality of ADMS allows cooperatives to respond to much more dynamic loads and generation. In much the same way that transmission system operators (TSO) manage a dynamic grid, future distribution cooperatives may play a role of distribution system operators (DSO), managing a dynamic distribution system. Figure 7 depicts the evolution of capabilities with ADMS.

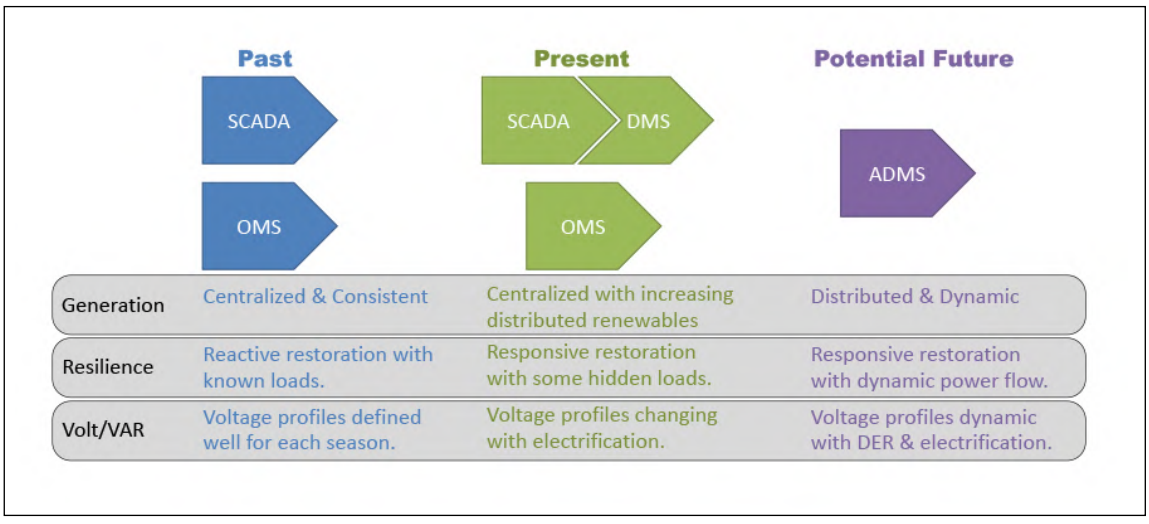

FIGURE 7: The Evolution of Capabilities Available Through Various Systems

< PREVIOUS VIEW >

Young Ngo, Chief Technology Officer of Survalent, underscored the value, saying, "ADMS and the components of ADMS allow cooperatives to leverage an increasing number of intelligent devices, including batteries, storage, and EVs, and ultimately provide greater satisfaction to their members. ADMS allows cooperatives to provide a new business model for whoever wants to participate in the grid and to modernize their grid."

In addition to its benefits, DMS also adds complexity for operators who now have independent OMS and DMS systems modeling feeder behavior in parallel. While the two systems can be integrated so that operations do not have to be duplicated, utilities looking for a single user interface for feeder management are considering ADMS.

DMS Capabilities

The DMS components included in ADMS are modular, so each cooperative should carefully consider which functions are important to meet their objectives. Figure 8 shows the primary objectives of DMS interest from survey respondents.

To structure the conversation, it is valuable to categorize the functionality that can be achieved from DMS modules. The following sections group the discussion into functionality related to 1) restoration, and 2) voltage and VAR optimization.

1. RESTORATION RELATED COMPONENTS

- **Fault Detection, Isolation and Restoration (FDIR) or Fault Location, Isolation and Service Restoration (FLISR)**: FLISR modules communicate with feeder equipment to detect when faults occur, determining which devices the fault is between, by identifying which have and have not seen the fault. Once the segment is identified, FLISR can isolate the faulted line segment, restoring service to members by transferring them to adjacent circuits.
- **Fault Location**: Separately, by reading fault currents from an electronic relay, the software module can perform power flow calculations on the electrical model of the feeder to determine which span of wire was damaged to create the fault (i.e., where a tree or animal touched the wire) to direct crews to the location more quickly. While many relays offer fault distance information, that distance is based on a simplified estimate of the feeder impedance and cannot account for multiple wire sizes and taps.

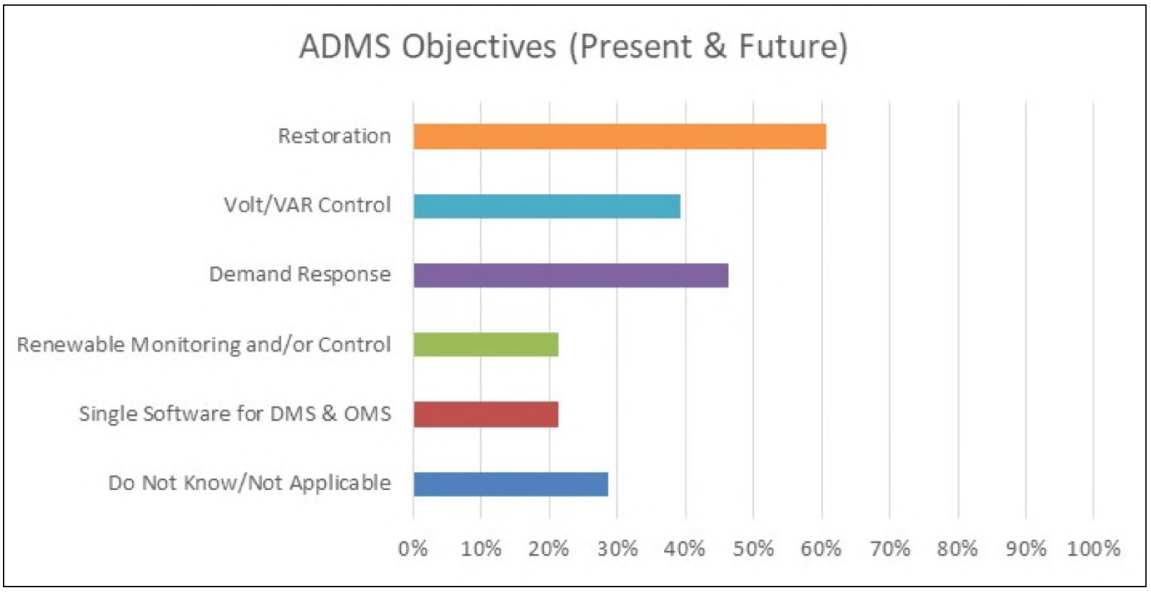

FIGURE 8: Primary Objective of DMS Interest Among Cooperatives

- **Rotational Load Shedding**: Load shedding modules use prioritized lists of circuits to select the least detrimental way to reduce demand during emergency events. They cycle through circuits, balancing the time that any one circuit is out of power, while staying below allowable demand values.
- **Switch Order Management (SOM)**: SOM modules assist operators in building and tracking execution of switching orders. They track regardless of whether the devices are communicating with SCADA. Some vendors offer mobile tools for crews to update progress of executing the switch order directly from the field.
- **Simulation**: Simulation allows operators to test what-if switching scenarios. Simplistic simulation verifies that all circuits remain energized and that no portion of the system is overloaded. Advanced simulation performs full power flow modeling to determine voltage profiles on the feeder. Ten percent of survey respondents indicated that they use their software for testing switching orders.
- **Solar Estimation**: As penetration of solar and battery storage increases on feeders, the measured load at the substation is only a fraction of the actual load, with behind-the-meter generation accounting for the difference. Given the practical limits of communicating continuously with a large number of inverters, many vendors support continuous estimation of solar generation on a feeder. Based on interconnect locations, these systems use meteorological data to estimate irradiance and, therefore, generation.

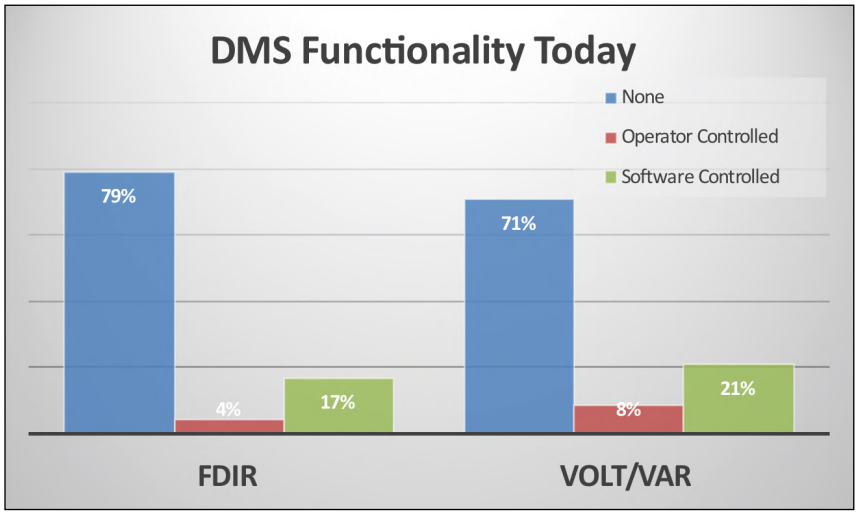

FIGURE 9: Status of Co-ops Implementing FDIR and Volt/VAR Optimization

2. VOLTAGE & VAR OPTIMIZATION COMPONENTS

- **Volt/VAR Optimization (VVO) or Integrated Volt/VAR Control (IVVC)**: Maintains acceptable voltage levels throughout the feeder, in addition to other objectives, such as power factor correction, loss minimization, energy efficiency, and peak demand shaving. VVO minimizes voltage regulator and capacitor bank operations to limit wear and tear, especially in the event of voltage fluctuations caused by high penetrations of solar photovoltaic (PV). Future deployments can increasingly incorporate the capabilities of inverters to manage reactive power on feeders as well.
- **Conservation Voltage Reduction (CVR)**: CVR uses regulation devices to continuously optimize voltage. It can produce energy savings by minimizing voltage within acceptable limits. CVR often works with VVO/IVVC to control capacitors to maintain acceptable voltage profiles.
- **Demand Based Voltage Reduction (DVR)**: DVR is a subset of CVR that is enabled only during peak demand intervals to temporarily reduce voltage to reduce demand.

Many cooperatives are now in the process of implementing many of the features described from the objectives above. Figure 9 illustrates where co-ops are today in implementing two major features: FDIR and Volt/VAR Optimization.

As can be seen in this chart, most co-ops have not yet implemented this functionality. A few are performing this functionality by enabling their operators to perform it from the control room. Approximately 20% of respondents have implemented DMS software modules to perform FDIR and Volt/VAR optimization.

How Do I Get to an ADMS?

Transitioning to an ADMS involves careful planning. There are several critical steps that can make that transition more effective:

1. Building Good Data
2. Designing Integrations for Data Quality, Maintainability and Cybersecurity
3. Deploying Field Equipment with Communications
4. Developing Operational Procedures

This article will discuss the first two steps in this list, allowing the second article in this series to cover the preparation of field equipment and communications and operational procedures.

Building Good Data (Models)

Any utility with SCADA can have a DMS. Basic DMS functionality starts very simplistically and can build from that foundation to a highly refined machine. As the graph in Figure 10 shows, over 50% of survey respondents have SCADA communications with feeder equipment today, effectively positioning them with a foundational DMS system.

The most critical step in getting to DMS is how a utility approaches the model that tells the DMS software how the feeders are connected and how they work electrically. The data in the model must be accurate, relevant, validated, and consistent, especially data migrated from legacy systems. Key data from SCADA, GIS, and load models should be kept up to date in real-time or as close to real-time as possible. Additionally, tuning of the models both at time of deployment as well as on-going is critical to be effective. If not, features of an ADMS cannot be fully leveraged and incorrect conclusions could be drawn.

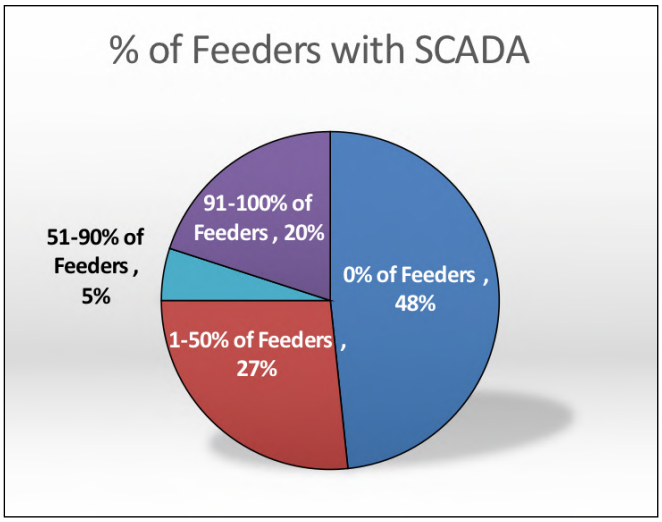

FIGURE 10: Survey Response about SCADA with Feeder Equipment

Cooperatives need to consider the tradeoff between the desired functionality and the complexity of the model required to support that functionality. Several examples that illustrate DMS feeder model complexity and the corresponding level of DMS capability, stepping up from operator-only to a power flow model, are offered in **Figure 11** and the accompanying explanation.

- **Operator Only (without Model)**: The operator is aware of how feeder devices are connected to substations and each other, either through experience, by looking at one-line displays build on the SCADA system, or by looking at external maps. In this scenario, SCADA talks to feeder equipment, giving the operator the ability to read information as well as control devices. No additional software modules are necessary beyond SCADA.
- **Logical Model**: Some vendors offer solutions that do not require cooperatives to import a model. Instead, the DMS module is configured to indicate which feeder devices are connected to each other and on the same feeder. The configuration includes basic parameters about the devices to define their limits.
- **Visual Model**: GIS is imported into DMS strictly as a visual layer to allow operators to see the location of field equipment on a map. Equipment points on the map can display telemetered data and be controlled by the operator. Thirty percent of survey respondents with SCADA indicated that they had brought GIS into the system for visualization.
- **Connectivity Model**: GIS is imported into DMS to provide connectivity between all elements in the system. The model can determine which elements are energized and which are de-energized, and can use this information to isolate faults and back feed. DMS is aware of the location of the DER devices.

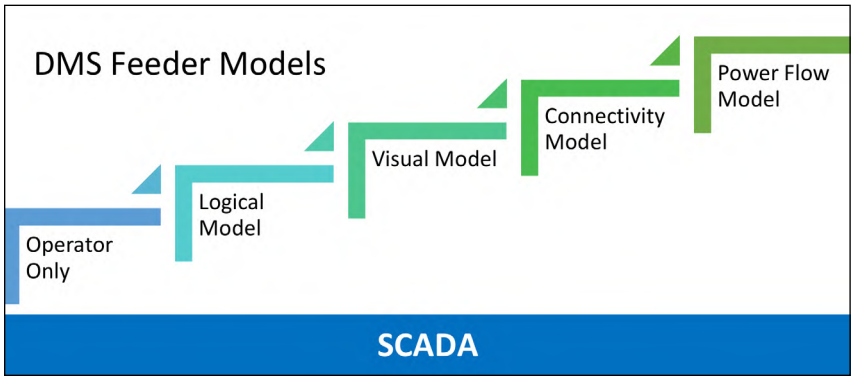

FIGURE 11: DMS Model Complexity and Corresponding Capabilities

- **Power Flow Model**: GIS and a database of electrical parameters of all components (equipment database) are imported into DMS along with load allocation profiles for each meter (or service transformer) location. The DMS can perform power flow calculations including the impact of distributed generation voltage and power profiles and fault location from fault currents.

Giovanni Polizzi, Vice President, Sales & Marketing with ACS, described one of their solutions to stepping into ADMS: "You don't necessarily need to implement a full DMS and have a GIS-based source model. We have a FLISR solution that is template-based and allows the utility to use simple tools to adapt the topology to their system. By knowing just the basic electrical parameters, it can do the necessary load flow calculations to make switching decisions in response to faults. So, they don't have to do a GIS import immediately."

Integration and Cybersecurity

Integration between software systems is key to any deployment of ADMS. The diagram in Figure 12 illustrates integrations between some of the major systems typically included in an ADMS implementation. The systems being integrated span from customer-focused systems which reside on the cooperative's corporate network, to operations-focused systems which reside on the control network. The diagram is colorized to distinguish between systems used primarily for operations and those used primarily for customer and billing.

The diagram, even though it lists 12 different systems that are in common use, is intentionally simplified for illustrative purposes, leaving off many other software systems which interact across a utility.

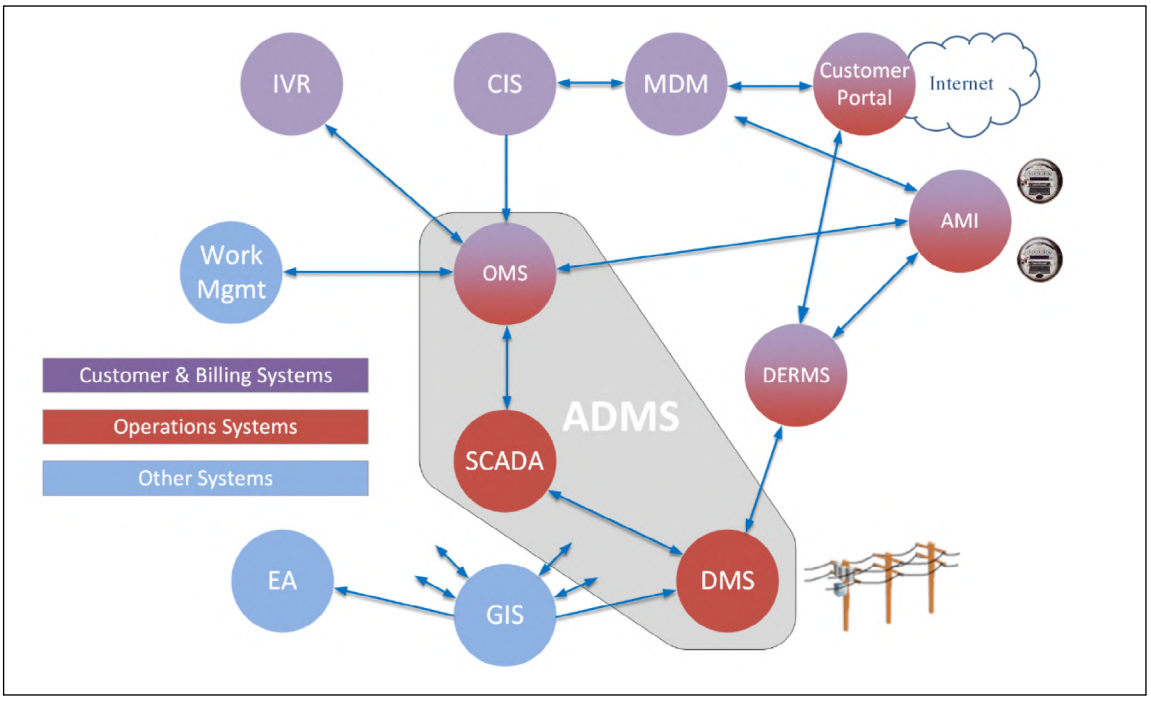

FIGURE 12: Integration of Systems with ADMS

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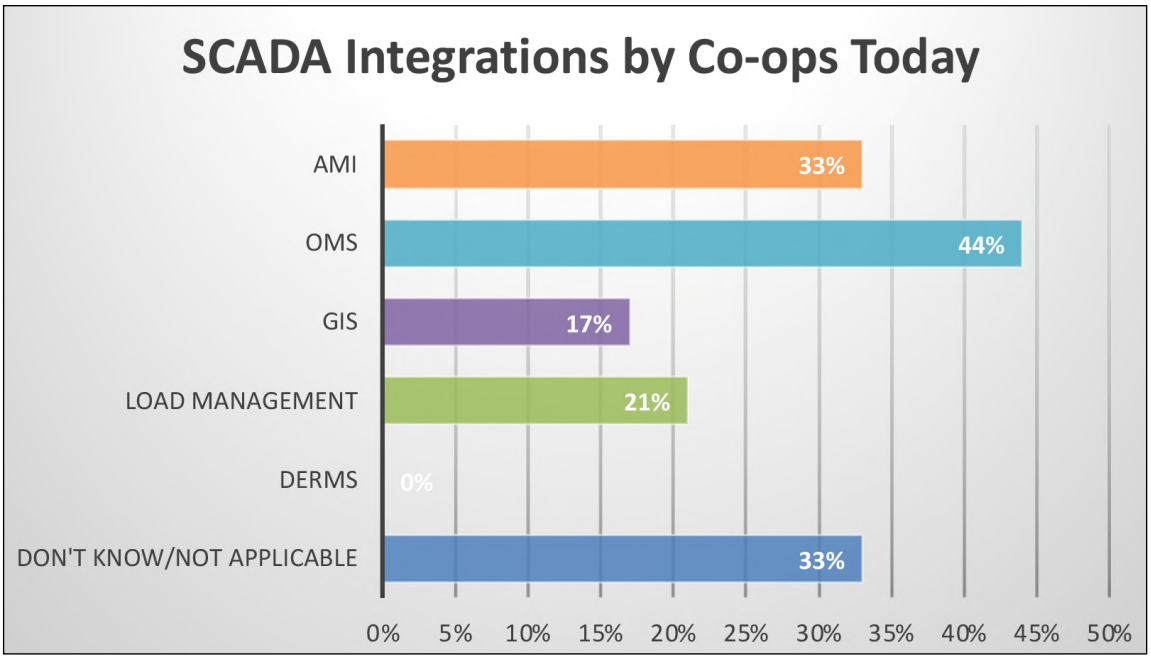

FIGURE 13: Survey Responses Regarding Integrating SCADA with Other Systems

Cooperatives are at very different places in integrating their SCADA systems with other systems. As shown in Figure 13, integrations to OMS and AMI are fairly common. None of the survey respondents indicated that have integrated with DERMS at this time.

When designing your system, it is essential that integrations are both secure and sustainable. Keep the following principles in mind:

- **Segmentation**: Segmenting your operational systems and corporate systems is foundational to a secure ADMS. Fortunately, major ADMS vendors have architected their systems with this mind. The North American Electric Reliability Corporation Critical Infrastructure Protection (NERC CIP) principles identify the need for firewalls for isolation, ensuring that all data connections are initiated from the control network, and use of proxies when exchanging data to avoid data sent externally into the control network.
- **Standards-based**: Avoid custom adapters, which add significant time and cost to ongoing maintenance. Fortunately, **MultiSpeak®** has become the standard for most ADMS integrations. GIS integration is the one interface in which file transfers are still common, though Esri's Utility Network use of web services and a common data model offers a good opportunity to standardize data exchange with GIS.
- **Patching and Maintenance**: Patches are inevitable to respond to changing cybersecurity threats, and it is important to have clearly defined processes in place for upgrading and patching the operating system and ADMS software. Performing these efficiently without affecting the functionality of the DMS is essential. Many utilities are incorporating a platform separate from production for testing patches.
- **Cybersecurity Monitoring and Response Plan**: Monitoring firewalls and endpoint protection on workstations and servers is important for detecting cybersecurity threats quickly. Utilities should plan for systems and staff to monitor and respond to issues, and develop plans for responding to various scenarios.

While integrations and the design of a secure network architecture require detailed attention, most ADMS designers are well-acquainted with how to do so effectively.

In an interview, Hormoz Kazemzadeh, Vice President of Distribution and Smart Grid at OSI, described their attention to security and integration. "We have over 100 utilities that are actively under NERC CIP. We ensure that our ADMS is delivered with the same level of

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cybersecurity as our transmission systems. To meet NERC CIP requirements, we designed our architecture from the ground up with domains and security zones, and with standards-based integrations and secure interfaces using proxies that "pull" external data into the system rather than allow data to be directly sent/pushed into the system."

Where Should I Go from Here?

ADMS adoption takes time. As the surveys showed, cooperatives' use of technology to control their distribution system is increasing, with 80% having SCADA, 75% having coverage of a majority of their substations, and over 50% having SCADA communication to feeder devices.

The following are some tangible steps for moving toward ADMS:

STEP 1—IDENTIFY WHAT'S MOST IMPORTANT

As you would when responding to any industry change, identify your goals. See Figure 14.

Consider the anticipated growth of renewables and storage on your system. The growth of renewables and increases in electrification, especially from EVs, is likely to ramp up in the coming years, especially given the large investments from both government and private spending.

Considering your system, and especially focusing on areas of the system where you would be more likely to see these increases first, what changes do you want to be prepared for? What capabilities would help you prepare for those changes?

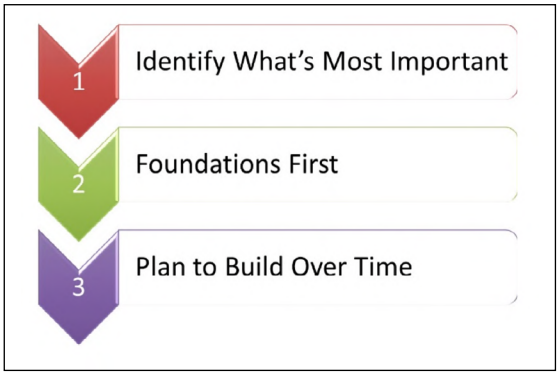

FIGURE 14: Steps Toward ADMS

According to our survey, many cooperatives have a desire for the following capabilities:

- **Restoration**: Improving speed and efficiency of restoring service, especially in light of increased reliance on electricity as a source of energy for vehicles.
- **Visibility**: Seeing the locations of renewables and EVs, and having tools that show the impact of these to distribution operators.
- **DERMS**: Having tools that can address traditional demand response, as well as provide visibility into broader DER across the system.
- **Volt/VAR**: Having tools that can manage voltage and VAR flow in a more dynamic environment.

STEP 2—FOUNDATIONS FIRST

Start where you are at today and build a strong foundation of SCADA communication to intelligent feeder equipment.

Regardless of whether you are working on deploying SCADA or building on an existing foundation you have, this foundation is an essential step in leveraging the powerful tools of ADMS. As an upcoming article on distribution automation will discuss, identifying locations on your feeders where upgrading field equipment is beneficial and then providing communications to that equipment is an important place to start. As you do that, integrate this equipment into SCADA.

STEP 3—BUILD OVER TIME

Start with simple approaches and build on these as your team becomes more comfortable and as the quality of your data model improves.

The ability for operators to monitor and control feeder equipment is a critical first step in building an ADMS future. It gets your team comfortable with the technology and allows you to identify processes to change.

As you are doing this, also improve the quality of your data model, refining the GIS and electrical models of your system.

When adding ADMS software, first add just the modules that achieve the most important

goals identified in Step 1, and select modules that aligns with the quality of the models you have. You can start with visualization, logical or connectivity-based models first, and consider building into full power flow models in time as you see value.

ADMS offers many benefits that can help co-ops adapt to increasing demands from renewables and electrification. Using a step-by-step approach can help the transition to ADMS be successful. ■

ABOUT THE AUTHOR

Jim Weikert earned a BS degree in Electrical Engineering from the Milwaukee School of Engineering at Milwaukee, Wisconsin and an MBA from Edgewood College at Madison, Wisconsin. He has almost 30 years of engineering experience in utility and industrial automation and communications. He regularly assists utilities in creating long-term strategies for smart-grid technologies, communications, and data analytics. He and his team then help these utilities in deploying and integrating operations and business systems and the communications that support them. He has a strong background in wireless communications, SCADA, GIS, software and analytics, outage management and work management systems.

QUESTIONS OR COMMENTS

- David Pinney, Principal Analytical Tools & Software Products, NRECA Business and Technology Strategies, **David.Pinney@nreca.coop**
- To find more resources on business and technology issues for cooperatives, visit our **website**.

ANALYTICS, RESILIENCY AND RELIABILITY WORKGROUP

The Analytics, Resiliency and Reliability (ARR) Work Group, part of NRECA's Business and Technology Strategies department, is focused on on current and future data and research required to provide prompt technical and economic support to the NRECA membership. Specifically focused toward the electric co-op community, ARR products and services include: development and maintenance of a portfolio of energy analytics products and services; collection and analysis of data; and provision of additional products and services in the areas of the data collection, IT architecture, sensors, and energy markets. For more information, please visit **www.cooperative.com**, and for the current work by the Business and Technology Strategies department of NRECA, please see our **Portfolio**.

LEGAL NOTICE

< PREVIOUS VIEW

Subject: G&T DER Roundtable
Location: https://zoom.us/[redacted]

Start: Tue 8/31/2021 10:00 AM
End: Tue 8/31/2021 1:00 PM

Recurrence: (none)

Meeting Status: Accepted

Organizer: King, Kim

All – for those who have not yet "accepted" this invitation, please join us! The agenda is below:

2021 Roundtable Agenda

11:00 DER Subcommittee Update

- Working Group Updates - Scott Hammond, CEPCI; Jeff Haase, GRE; Jeff Pratt, Oglethorpe)
- Introduction of DO Working Group - Jim Musilek, NCEMC)

11:45 FERC 2222 – the Big 2x4 – Mary Ann Ralls, NRECA

12:15 EV Session –

- Cooperative EV Space Discussion (data collection and Federal facilities activity) – Brian Sloboda, BTS-NRECA
- "EV Incentives - Is it worth it?" – Scott Drake, EKPC

BREAK

- National Brand for Charging - TBD
- EV Education Opportunities - Catherine Powers, ODEC

1:30 "Are there Headwinds to Solar and Batteries (EVs and utility batteries)?" –Michael Loenen, NRCO

1:50 Wrap-Up and Announcement about 2022 DER Roundtable

Topic: G&T DER Roundtable

Time: Aug 31, 2021 11:00 AM Eastern Time (US and Canada)

Join Zoom Meeting

https://zoom.us/j/[redacted]

Meeting ID: [redacted]

Passcode: [redacted]

Dial in:

[redacted] Toll-free

[redacted] US Toll-free

2023 DER Roundtable
DRAFT AGENDA

Tuesday, May 9, 2023 (continued)

1:00 p.m. - 2:30 p.m.	Electric Vehicle Trends - Part I	Cory Ellis, PowerSouth	Vienna East, West
	Insights about telematics-based programs, commercially available light duty and fleet EVs, electric school buses with centralized and bus driver home-based charging, Ford F150 with vehicle to grid (V2G) capabilities, public charging trends and state National Electric Vehicle Infrastructure (NEVI) roll-outs.		
2:30 p.m. - 2:45 p.m.	Break and Networking		South Foyer
2:45 p.m. - 4:00 p.m.	Electric Vehicle Trends - Part II		
4:00 p.m. - 4:30 p.m.	Day 1 Debrief	Erin Puryear, ODEC	
4:30 p.m.	Adjourn		
5:30 p.m.	Chef JJ's Cooking Competition		Lobby
	Meet in lobby to walk to Chef JJ's Cooking Competition		
6:00 p.m. - 8:00 p.m.	Dinner Event at Chef JJ's		Chef JJ's 42 W. South St. Indianapolis, IN

Wednesday, May 10, 2023

8:00 a.m. - 8:30 a.m.	Breakfast and Networking		South Foyer
8:30 a.m. - 8:45 a.m.	Welcome	Jeff Conrad, WVPA	Vienna East, West
8:45 a.m. - 10:00 a.m.	Definition of a Distribution Operator	Jim Musilek, NCEMC	Vienna East, West
	The Distribution Operator model and transmission cost mitigation opportunities. What is it and why is it important? Benefits and opportunities. Reliability focus. Visibility to device level. Pricing signals. Business case ideas and more.		
10:00 a.m. - 10:15 a.m.	Break and Networking		South Foyer
10:15 a.m. - 12:00 p.m.	Energy Storage	Jeff Haase, Great River	Vienna East, West
	Business cases and technologies for utility scale and retail energy storage applications such as future technologies, grid impacts and opportunities and commercial and industrial applications.		
12:00 p.m. - 1:00 p.m.	Lunch and Networking		South Foyer

Subject: DER Aggregation Working Group Meeting
Location: [redacted]

Start: Thu 8/3/2023 1:00 PM
End: Thu 8/3/2023 2:00 PM

Recurrence: (none)

Meeting Status: Accepted

Organizer: Blake Kleaving
Resources: @webex

DER Subcommittee – DER Working Group Meeting #2
Agenda to Follow

-~-

- Do not delete or change any of the following text. -

Join my Webex Personal Room meeting.

[redacted]

Meeting link: [redacted]
Meeting number (access code): [redacted]

Join by phone
Tap to call in from a mobile device (attendees only)
[redacted] United States Toll Free
[redacted]1 US Toll
[redacted]

Join from a video conferencing system or application
Dial [redacted]
You can also dial [redacted] and enter your meeting number.

Subject: DER: Operational Alignment

Start: Thu 8/17/2023 1:00 PM
End: Thu 8/17/2023 2:00 PM

Recurrence: (none)

Meeting Status: Accepted

Organizer: Tom Castle

Microsoft Teams meeting

Join on your computer, mobile app or room device Click here to join the meeting<https://teams.microsoft.com/l/meetup-[redacted]
Meeting ID: [redacted]
Passcode: [redacted]
Download Teams<https://www.microsoft.com/en-us/microsoft-teams/download-app> | Join on the web<https://www.microsoft.com/microsoft-teams/join-a-meeting>
Or call in (audio only)
[redacted]#> United States, Louisville
Phone Conference ID: [redacted]#
Find a local number<https://dialin.teams.microsoft.com/[redacted]

Learn More<https://aka.ms/JoinTeamsMeeting> | Meeting options<https://teams.microsoft.com/[redacted]

Subject: DER Operational Alignment

Start: Tue 11/28/2023 2:00 PM
End: Tue 11/28/2023 3:00 PM

Recurrence: (none)

Meeting Status: Accepted

Organizer: Tom Castle

Microsoft Teams meeting

Join on your computer, mobile app or room device
[redacted]

Meeting ID: [redacted]
Passcode: [redacted]
Download Teams | Join on the web

Or call in (audio only)
[redacted] United States, Louisville
Phone Conference ID: [redacted]
Find a local number | Reset PIN

Learn More | Meeting options

Subject: DER Systems Working Group
Location: Microsoft Teams Meeting

Start: Tue 12/5/2023 10:00 AM
End: Tue 12/5/2023 11:00 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: Cory Ellis

Microsoft Teams meeting

Join on your computer, mobile app or room device
[redacted]

Meeting ID: [redacted]
Passcode: [redacted]

Or call in (audio only)
[redacted] United States, Chicago
Phone Conference ID: [redacted]
Find a local number | Reset PIN

Learn More | Meeting options

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-16: ***Please refer to your response to JI 1-34.***

a. Please identify all efforts that Big Rivers has undertaken since 2019 to "maintain[] contact with staff from the Kentucky Housing Corp ("KHC") to encourage the use of the funding to allow applicable projects to be completed."

b. Please produce any documentation in the Company's possession concerning any efforts identified in response to subpart (a).

c. The annual progress reports referenced in the response do not indicate that Big Rivers has spent any money since 2019 to promote or encourage participation in the Low-Income Weatherization Program Pilot. Please confirm whether this is the case. If it is not the case, please specify the amount of money spent each year since 2019 to promote and/or encourage participation in the program and identify what those funds were spent on.

RESPONSE:

a. Communication was primarily over the phone to both the KHC and individual Community Action Agencies ("CAA") to discuss potential projects and discuss eligibility of deferred housing. There were, at times, email communications and virtual meetings to discuss the program and identify potential projects.

b. See the attachment to this response.

c. The program was specifically aimed at removing homes from the deferral list at each CAA. Local weatherization managers at the CAAs identified eligible projects and made the decision to participate in the program. Promoting participation in the program involved contacting the CAAs to discuss if projects are available.

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

Witness: Russell L. Pogue

From: Deanna McCord <[redacted]>
Sent: Wednesday, January 27, 2021 3:48 PM
To: Pogue, Russ
Subject: RE: Weatherization Program

Hi Russ,

Unfortunately, I'm not optimistic about further activity for the program this year. I've made numerous contacts with our partners but they just don't seem to be identifying eligible BREC clients. Please let me know when you anticipate the program ending if it's not renewed and we'll contact you should we identify any eligible homes before then.

I'm disappointed we weren't able to take full advantage of the program. We appreciate your efforts to support the Weatherization Assistance Program and hope we'll have the opportunity to partner again in the future.

Regards,
Deanna

From: Pogue, Russ [mailto:Russ.Pogue@bigrivers.com]
Sent: Tuesday, January 26, 2021 10:51 AM
To: Deanna McCord <[redacted]>
Subject: Weatherization Program

Deanna,

Happy 2021! Hope everything is going well for you. I am preparing the first annual report to the KPSC for the 2020 program results. Do you think we will have additional activity this year? I need to make a decision whether to continue the program. Currently we have the program registered as a pilot. If you don't think there are project out there that will participate, I think we may discontinue. What are your thoughts?

Thanks,

Russ

Russ Pogue
Manager of Power Marketing and Member Relations
Big Rivers Electric
Ph# 270 844 6159
Cell [redacted]

Subject: Big Rivers DSM Program Review
Location: [redacted]

Start: Wed 2/23/2022 1:00 PM
End: Wed 2/23/2022 2:00 PM

Recurrence: (none)

Meeting Status: Accepted

Organizer: Keli Reynolds

This meeting is to discuss the DSM program that Big Rivers has and the obstacles that you may face using it. Please try to have at least one representative from your agency in the meeting.

Microsoft Teams meeting

Join on your computer or mobile app
[redacted]

Or call in (audio only)
[redacted] United States, Houston
Phone Conference ID: [redacted]
Find a local number | Reset PIN

Learn More | Meeting options

From: Deanna McCord <[redacted]>
Sent: Tuesday, August 17, 2021 1:34 PM
To: Pogue, Russ
Subject: RE: I spoke too soon

Hi Russ,

I know Kent Dodd had hoped to have several more projects but I think possibly COVID has put a damper on that. Unfortunately, I don't anticipate that the other three agencies will take advantage of the program. Would you like for me to follow-up with Kent to see what his projections are?

Regards,
Deanna

From: Pogue, Russ <Russell.Pogue@bigrivers.com>
Sent: Tuesday, August 17, 2021 1:42 PM
To: Deanna McCord <dmccord@kyhousing.org>
Subject: RE: I spoke too soon

EXTERNAL EMAIL: Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hey Deanna,

I am preparing to make a recommendation to our Energy Services department head about the continuation of the Low Income Weatherization Program and wanted to get a feel if you think there will be additional demand for funding. I've had a total of two projects in the last two years and with covid impacts, I thought possibly the demand might pick up in the future. Any thoughts?

Thanks,

Russ

From: Pogue, Russ
Sent: Monday, July 12, 2021 1:15 PM
To: 'Deanna McCord' <[redacted]>
Subject: RE: I spoke too soon

Deanna,

Do you foresee additional low income weatherization projects that might qualify for our program at Big Rivers?

Thanks,

Russ

From: Deanna McCord <[redacted]>
Sent: Thursday, January 28, 2021 8:56 AM
To: Pogue, Russ <Russ.Pogue@bigrivers.com>
Subject: I spoke too soon

Russ,

I had emailed all the partners to do one last check in but hadn't heard back from Kent Dodd and took that as a negative answer. Looks like I was wrong. Please see Kent's email below that he thinks he may have 6 more qualified applicants. Let me know if you want to discuss.

Regards,
Deanna

From: Kent Dodd [redacted]
Sent: Thursday, January 28, 2021 9:32 AM
To: Deanna McCord <[redacted]>
Subject: Re: Big Rivers Electric DSM

Deanna,

Looking at my waiting list I do see that we have 6 homes that should qualify.
We are currently auditing one of them and I am certainly considering using the funding source.
I do not remember all of the restrictions for the program so I will need to look into that.

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Regards,

Deanna

From: Pogue, Russ [mailto:Russ.Pogue@bigrivers.com]
Sent: Tuesday, January 26, 2021 10:51 AM
To: Deanna McCord <[redacted]>
Subject: Weatherization Program

Deanna,

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Thanks,

Russ

Russ Pogue

Manager of Power Marketing and Member Relations

Big Rivers Electric

Ph# 270 844 6159

Cell [redacted]

--

Kent Dodd
Weatherization Program Director
Energy Auditor
Quality Control Inspector
Email: [redacted]

West Kentucky Allied Services
400 North 7th Street
Mayfield, KY 42066
Phone (270) 247-4046
Fax (270)247-2158
[redacted]

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Sent: Tuesday, August 17, 2021 12:42 PM
To: Deanna McCord
Subject: RE: I spoke too soon

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Sent: Monday, July 12, 2021 1:15 PM
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Subject: RE: I spoke too soon

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Russ

From: Deanna McCord <[redacted]>
Sent: Thursday, January 28, 2021 8:56 AM
To: Pogue, Russ <Russ.Pogue@bigrivers.com>
Subject: I spoke too soon

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Sent: Thursday, January 28, 2021 9:32 AM

To: Deanna McCord <[redacted]>
Subject: Re: Big Rivers Electric DSM

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> **Subject:** Weatherization Program
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Ph# 270 844 6159

Cell [redacted]

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Email: [redacted]

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From: Pogue, Russ
Sent: Wednesday, January 5, 2022 9:09 AM
To: Deanna McCord; Kent Dodd ([redacted]); PACS Wx; David Gilkey; David Lindsey; John Maske; Johnny Luckenbill
Subject: RE: DSM funds available in your area

Thanks Deanna!

The homes must received service from JPEC, Kenergy or MCRECC. We can provide up to $1,500 for heath and safety and up to $1,500 for HVAC upgrade. Please give me a call if you have questions.

Thanks,

Russ

Russ Pogue
Manager of Power Marketing and Member Relations
Big Rivers Electric
Ph# 270 844 6159
Cell [redacted]

From: Deanna McCord <[redacted]>
Sent: Wednesday, January 5, 2022 9:04 AM
To: Kent Dodd [redacted]>; PACS Wx [redacted]; David Gilkey <[redacted]>; David Lindsey <[redacted]>; John Maske <[redacted]>; Johnny Luckenbill <[redacted]>
Cc: Pogue, Russ <Russ.Pogue@bigrivers.com>
Subject: DSM funds available in your area

Good morning all,

Jackson Purchase Electric, Kenergy, and Meade County RECC all have significant funding available for Low Income Weatherization services for their customers. The funds are earmarked for homes that need H&S work to prevent a deferral. If the home qualifies because of the deferral prevention, they can also help pay for heat system replacement.

For more information please contact Russ Pogue (copied on this email).

Kindest regards,

Residential Energy Efficiency

www.learnree.com

Deanna McCord
Manager, Training Initiatives
Residential Energy Efficiency
Kentucky Housing Corporation
[redacted]
Toll Free in KY: 800-633-8896
TTY: 711

KHC is celebrating 45 years of financing the American dream.

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From: Pogue, Russ
Sent: Wednesday, January 5, 2022 7:52 AM
To: 'Deanna McCord'
Subject: RE: I spoke too soon

Deanna,

Those funds are available to any qualifying projects. They are not specific to tornado damage, but must be deferred projects. $1,500 for H&S and $1,500 for HVAC.

Thanks,

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Subject: Weatherization Program

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From: Pogue, Russ
Sent: Monday, February 7, 2022 2:14 PM
To: Deanna McCord
Subject: Accepted: Call with Russ at Big Rivers Electric

From: Deanna McCord <[redacted]
Sent: Monday, February 7, 2022 3:01 PM
To: Pogue, Russ
Subject: RE: Big Rivers electric DSM funds

How about next Thursday, Feb. 17, 2:30 Central?

Regards,
Deanna

From: Pogue, Russ <Russ.Pogue@bigrivers.com>
Sent: Monday, February 7, 2022 3:51 PM
To: Deanna McCord <[redacted]>
Subject: RE: Big Rivers electric DSM funds

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Tuesday morning would work for me. Any other day would be afternoon.

From: Deanna McCord <[redacted]>
Sent: Monday, February 7, 2022 2:28 PM
To: Pogue, Russ <Russ.Pogue@bigrivers.com>
Subject: RE: Big Rivers electric DSM funds

Russ,

My apologies, Keli is out of the office Thursday but forgot to update her calendar. She'll be back next Tuesday. Would you have any time available next week or the week after?

Regards,
Deanna

From: Pogue, Russ <Russ.Pogue@bigrivers.com>
Sent: Monday, February 7, 2022 3:08 PM
To: Deanna McCord <[redacted]>
Subject: RE: Big Rivers electric DSM funds

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Deanna,

Any time afternoon on Thursday would work for me.

Thanks,

Russ

From: Deanna McCord <[redacted]>
Sent: Monday, February 7, 2022 2:04 PM
To: Pogue, Russ <Russ.Pogue@bigrivers.com>
Subject: RE: Big Rivers electric DSM funds

Hi Russ,

We understand there would be a long approval process and would still like to discuss it with you. Would you have any time Thursday of this week or sometime next week to have a call or virtual meeting with Keli and myself to discuss the specifics?

We also have another project we'd like to talk to you about. We just have a basic concept and would like your input on if it's doable and how to structure it. If you can send me a few options for meeting times I'll get it set up.

Regards,
Deanna

From: Pogue, Russ <Russ.Pogue@bigrivers.com>
Sent: Monday, February 7, 2022 10:06 AM
To: Deanna McCord <[redacted]>
Subject: RE: Big Rivers electric DSM funds

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Hey Deanna,

I would need more information on the basic outline. Keep in mind that even a pilot project would require a year or more the put it through the regulatory process at KPSC. I have a meeting with my distribution coops coming up in early March. If you can provide me some details, I would be happy to put that in front of them.

Thanks,

Russ

From: Deanna McCord <[redacted]>
Sent: Friday, February 4, 2022 12:52 PM
To: Pogue, Russ <Russ.Pogue@bigrivers.com>
Subject: FW: Big Rivers electric DSM funds

Hi Russ,

Please see the exchange below. KHC has been in planning for a cooling program for the better part of a year. Is this something Big Rivers would be interested in piloting for the Kentucky Weatherization program? I think Keli's intention is to prove out the concept then approach the Cabinet again in order to take it statewide. Let me know if you'd be open to a discussion.

Regards,
Deanna

From: Keli Reynolds <[redacted]>
Sent: Friday, February 4, 2022 1:31 PM
To: Deanna McCord <[redacted]>
Subject: RE: Big Rivers electric DSM funds

We have some details, but I'm having some issues with CHFS wanting to put a cooling program in the LIHEAP plan. I'm still working on it, but I am wondering if Big Rivers would be open to the idea. We could even have them participate in our committee where we are deciding on what it looks like. Would you be willing to setup a meeting with them for us to discuss the possibility? He would basically be helping us test our ideas.

Keli H. Reynolds
Manager, Single Family & HCA Support
Kentucky Housing Corporation
1231 Louisville Road
Frankfort, KY 40601
[redacted]
800-633-8896 (in Kentucky only)
www.kyhousing.org

For all your technical assistance needs regarding any Housing Contract Administration program, please visit our Help Desk.

Subscribe to free email updates about KHC news and announcements. Sign up for eGrams today!

Follow us in social media: Twitter: twitter.com/KYHousing / Facebook: www.facebook.com/kyhousing

From: Deanna McCord <[redacted]>
Sent: Friday, February 4, 2022 12:59 PM
To: Keli Reynolds <[redacted]>
Subject: RE: Big Rivers electric DSM funds

Possibly. I can speak with Russ. Can you send me some basics on what the program would involve, like the qualifications and what equipment/measures would be provided?

Regards,
Deanna

From: Keli Reynolds <[redacted]g>
Sent: Friday, February 4, 2022 11:49 AM
To: Deanna McCord <[redacted]>
Subject: RE: Big Rivers electric DSM funds

You think that Big Rivers would have a taste to run a pilot cooling program with Weatherization-eligible clients?

Keli H. Reynolds
Manager, Single Family & HCA Support
Kentucky Housing Corporation
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From: Deanna McCord <[redacted]>
Sent: Tuesday, January 4, 2022 3:09 PM
To: Keli Reynolds <[redacted]>
Subject: Big Rivers electric DSM funds

Keli,

Russ Pogue is with Big Rivers Electric Corporation in western Kentucky. Their service territory includes the Mayfield area.

Russ says they have significant funding available for Low Income Weatherization if it's needed. They already have a DSM program in place for H&S issues to prevent deferral and for heat system replacement.

Regards,
Deanna

From: Pogue, Russ <Russ.Pogue@bigrivers.com>
Sent: Tuesday, January 4, 2022 11:29 AM
To: Deanna McCord <[redacted]>
Subject: RE: I spoke too soon

Happy New Year Deanna,

We have significant funding available for LIW support if there are projects that qualify. Let me know if there are opportunities.

Thanks,

Russ

From: Deanna McCord <[redacted]>
Sent: Wednesday, February 16, 2022 3:28 PM
To: Keli Reynolds
Cc: Pogue, Russ
Subject: Big Rivers service counties by agency

Here are the counties served by each of Big Rivers member Co-ops.

Jackson Purchase
Ballard WKAS
Graves WKAS
Marshall WKAS
Carlisle WKAS
Livingston PACS
McCracken WKAS

Kenergy
Breckenridge Central
Henderson Audubon
Muhlenberg PACS
Caldwell PACS
Hopkins PACS
Ohio Audubon
Crittenden PACS
Livingston PACS
Union Audubon
Daviess Audubon
Lyon PACS
Webster Audubon
Hancock Audubon
McLean Audubon

Meade County RECC
Breckenridge Central
Hancock Audubon
Meade Central
Grayson Central
Hardin Central
Ohio Audubon

Residential Energy Efficiency
www.learnree.com

Deanna McCord
Manager, Training Initiatives
Residential Energy Efficiency
Kentucky Housing Corporation
[redacted]
Toll Free in KY: 800-633-8896
TTY: 711

KHC is celebrating 45 years of financing the American dream.

From: Deanna McCord <[redacted]
Sent: Thursday, February 17, 2022 8:08 AM
To: Pogue, Russ; Keli Reynolds
Subject: RE: Big Rivers service counties by agency

Thanks, Russ.

Keli, are you going to schedule this? My calendar is up to date.

Regards,
Deanna

From: Pogue, Russ <Russ.Pogue@bigrivers.com>
Sent: Thursday, February 17, 2022 8:59 AM
To: Deanna McCord <[redacted]; Keli Reynolds <[redacted]>
Subject: RE: Big Rivers service counties by agency

EXTERNAL EMAIL: Do not click links or open attachments unless you recognize the sender and know the content is safe.

Deanna,

The dates/times for next week and the week after I'm available are listed below.

Feb 23 After 10 am central
Feb 24 Afternoon
Feb 25 Anytime

March 1 After 10 am

Thanks,

Russ

From: Deanna McCord <[redacted]>
Sent: Wednesday, February 16, 2022 3:28 PM
To: Keli Reynolds <[redacted]>
Cc: Pogue, Russ <Russ.Pogue@bigrivers.com>
Subject: Big Rivers service counties by agency

Here are the counties served by each of Big Rivers member Co-ops.

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Deanna McCord
Manager, Training Initiatives
Residential Energy Efficiency
Kentucky Housing Corporation
[redacted]
Toll Free in KY: 800-633-8896
TTY: 711

KHC is celebrating 45 years of financing the American dream.

From: Pogue, Russ
Sent: Monday, February 7, 2022 9:06 AM
To: Deanna McCord
Subject: RE: Big Rivers electric DSM funds

Hey Deanna,

I would need more information on the basic outline. Keep in mind that even a pilot project would require a year or more the put it through the regulatory process at KPSC. I have a meeting with my distribution coops coming up in early March. If you can provide me some details, I would be happy to put that in front of them.

Thanks,

Russ

From: Deanna McCord <[redacted]
Sent: Friday, February 4, 2022 12:52 PM
To: Pogue, Russ <Russ.Pogue@bigrivers.com>
Subject: FW: Big Rivers electric DSM funds

Hi Russ,

Please see the exchange below. KHC has been in planning for a cooling program for the better part of a year. Is this something Big Rivers would be interested in piloting for the Kentucky Weatherization program? I think Keli's intention is to prove out the concept then approach the Cabinet again in order to take it statewide. Let me know if you'd be open to a discussion.

Regards,
Deanna

From: Keli Reynolds <[redacted]>
Sent: Friday, February 4, 2022 1:31 PM
To: Deanna McCord <[redacted]>
Subject: RE: Big Rivers electric DSM funds

We have some details, but I'm having some issues with CHFS wanting to put a cooling program in the LIHEAP plan. I'm still working on it, but I am wondering if Big Rivers would be open to the idea. We could even have them participate in our committee where we are deciding on what it looks like. Would you be willing to setup a meeting with them for us to discuss the possibility? He would basically be helping us test our ideas.

Keli H. Reynolds
Manager, Single Family & HCA Support
Kentucky Housing Corporation
1231 Louisville Road
Frankfort, KY 40601
[redacted]
[redacted]

800-633-8896 (in Kentucky only)
www.kyhousing.org

For all your technical assistance needs regarding any Housing Contract Administration program, please visit our Help Desk.

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Follow us in social media: Twitter: twitter.com/KYHousing / Facebook: www.facebook.com/kyhousing

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From: Deanna McCord <[redacted]>
Sent: Friday, February 4, 2022 12:59 PM
To: Keli Reynolds <[redacted]>
Subject: RE: Big Rivers electric DSM funds

Possibly. I can speak with Russ. Can you send me some basics on what the program would involve, like the qualifications and what equipment/measures would be provided?

Regards,
Deanna

From: Keli Reynolds <[redacted]>
Sent: Friday, February 4, 2022 11:49 AM
To: Deanna McCord <[redacted]>
Subject: RE: Big Rivers electric DSM funds

You think that Big Rivers would have a taste to run a pilot cooling program with Weatherization-eligible clients?

Keli H. Reynolds
Manager, Single Family & HCA Support
Kentucky Housing Corporation
1231 Louisville Road
Frankfort, KY 40601
[redacted]
[redacted]
800-633-8896 (in Kentucky only)
www.kyhousing.org

For all your technical assistance needs regarding any Housing Contract Administration program, please visit our Help Desk.

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---

From: Deanna McCord <[redacted]>
Sent: Tuesday, January 4, 2022 3:09 PM
To: Keli Reynolds <[redacted]>
Subject: Big Rivers electric DSM funds

Keli,

Russ Pogue is with Big Rivers Electric Corporation in western Kentucky. Their service territory includes the Mayfield area.

Russ says they have significant funding available for Low Income Weatherization if it's needed. They already have a DSM program in place for H&S issues to prevent deferral and for heat system replacement.

Regards,
Deanna

From: Pogue, Russ <Russ.Pogue@bigrivers.com>
Sent: Tuesday, January 4, 2022 11:29 AM
To: Deanna McCord <[redacted]>
Subject: RE: I spoke too soon

Happy New Year Deanna,

We have significant funding available for LIW support if there are projects that qualify. Let me know if there are opportunities.

Thanks,

Russ

From: Deanna McCord <[redacted]>
Sent: Tuesday, February 8, 2022 3:10 PM
To: Pogue, Russ
Subject: RE: FW: call with Big Rivers Electric

How about 3:00 central on Wednesday?

Regards,
Deanna

-----Original Appointment-----
From: Pogue, Russ <Russ.Pogue@bigrivers.com>
Sent: Tuesday, February 8, 2022 3:43 PM
To: Deanna McCord
Subject: Declined: FW: call with Big Rivers Electric
When: Thursday, February 17, 2022 3:30 PM-4:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: https:/[redacted]

Deanna,

I have had an unavoidable conflict develop on my end. Could we do this call on the 16th or 18th at the same time?

Thanks,

Russ

Subject: call with Big Rivers Electric
Location: [redacted]

Start: Wed 2/16/2022 3:00 PM
End: Wed 2/16/2022 4:00 PM

Recurrence: (none)

Meeting Status: Accepted

Organizer: Deanna McCord

Deanna McCord is inviting you to a meeting.

[redacted]

To join by phone instead, tap here: **+**[redacted]

Looking for a different dial-in number?
See our [redacted]

If also connecting through a room phone, join without audio

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-17: ***Please refer to your response to Staff 1-14(c). With regards to the contention that "[i]t is unlikely that the model would have chosen to retire the Wilson unit and replace it with an alternative if the model had been given the option":***

a. Please explain in detail the basis for that contention.

b. Please produce any workpapers, modeling files, or documents supporting that contention.

RESPONSE: See Big Rivers' response to Commission Staff's Request Nos. 2-24 and 2-30.

Witness: Nathanial A. Berry

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-18: ***Please refer to your response to Staff 1-14(c). With regards to the reference to the "large unrecovered balance on Big Rivers' financial statement":***

a. Please explain what role the large unrecovered balance plays in your decision to assume the continued operation of the Wilson plant until 2045.

b. Please identify the unrecovered balance for the Wilson plant for each of the years 2018 through 2023.

c. Please identify the forecasted unrecovered balance for the Wilson plant for each of the years 2024 through 2045.

d. Please state whether Big Rivers has evaluated seeking funding under the federal Inflation Reduction Act to pay off some or all of the unrecovered balance on the Wilson plant.

i. If so, please explain the results, and produce any documentation, of such evaluation.

ii. If not, please explain why not.

RESPONSE:

a. While the potential stranded assets are a consideration, the unrecovered balance on Big Rivers' financial statement is only one consideration among several supporting Big Rivers' decision to continue operation of the Wilson plant throughout the study period (through 2050), including but not limited to the reliable nature of Wilson.

b. The unrecovered balance for the Wilson plant for each of the years 2018 through 2023 is provided in the attachment to this response.

c. The forecasted unrecovered balance for the Wilson plant for each of the years 2024 through 2045 is provided in the attachment to this response.

d. Big Rivers has not evaluated seeking funding under the federal Inflation Reduction Act to pay off some or all of the unrecovered balance on the Wilson plant.

i. N/A

ii. Big Rivers has no intention of closing the Wilson plant due to its demonstrated ability to produce economic and reliable energy and capacity. See Big Rivers' response to Commission Staff's Request Nos. 2-24.

Witnesses: Nathanial A. Berry (for subpart a)

Christopher A. Warren (for subparts b-d)

Big Rivers Electric Corporation
Case No. 2023-00310
Attachment for Response to KFTC KRC 2-18 (b.-c.)
Wilson Unrecovered Costs by Year

$ in Millions

Year End:	Actual **2018**	Actual **2019**	Actual **2020**	Actual **2021**	Actual **2022**	Actual **2023**	Forecast **2024**	Forecast **2025**	Forecast **2026**	Forecast **2027**	Forecast **2028**
Wilson Plant - Total Unrecovered Costs[(1)]	$ 490.3	$ 498.0	$ 535.0	$ 476.3	$ 582.0	$ 544.8	$ 533.2	$ 514.3	$ 513.1	$ 494.8	$ 477.9

Notes:

(1) Total Unrecovered Costs include Gross Plant-In-Service less Accumulated Depreciation, Construction Work in Progress (CWIP), and deferred expenses recorded to Regulatory Asset Accounts.
Amounts do not include any estimates for future decommissioning costs.

Big Rivers Electric Corporation
Case No. 2023-00310
Attachment for Response to KFTC KRC 2-18 (b.-c.)
Wilson Unrecovered Costs by Year

$ in Millions

Year End:	Forecast **2029**	Forecast **2030**	Forecast **2031**	Forecast **2032**	Forecast **2033**	Forecast **2034**	Forecast **2035**	Forecast **2036**	Forecast **2037**	Forecast **2038**	Forecast **2039**
Wilson Plant - Total Unrecovered Costs[(1)]	$ 459.0	$ 444.0	$ 426.8	$ 411.6	$ 397.9	$ 403.0	$ 386.1	$ 371.1	$ 354.1	$ 339.6	$ 325.0

Big Rivers Electric Corporation
Case No. 2023-00310
Attachment for Response to KFTC KRC 2-18 (b.-c.)
Wilson Unrecovered Costs by Year

$ in Millions

Year End:	Forecast **2040**	Forecast **2041**	Forecast **2042**	Forecast **2043**	Forecast **2044**	Forecast **2045**
Wilson Plant - Total Unrecovered Costs[(1)]	$ 310.8	$ 296.6	$ 282.8	$ 266.8	$ 250.8	$ 232.4

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-19: ***Please refer to your response to JI 1-46(b) and to Table 7.2.1(a) on page 135 of the IRP. With regards to the annual project capacity limits for 4-hour storage, solar PV, and wind set forth in the referenced table:***

a. Please explain in detail the basis for your belief that the annual build limits for wind, solar, and storage are based on how much Big Rivers "could develop annually given the financial and personnel requirements to do so." Please identify any experience and produce any analysis or other documents supporting that belief.

b. Please state whether the annual build limits applied to PPAs as well as self-build projects. If so, please explain why given that the Big Rivers financial and personnel requirements would be less for a PPA than for a self-build. If not, please identify what annual limits were placed in the IRP modeling on solar, wind, and storage PPAs.

RESPONSE:

a. The annual build limits were applied in light of various factors, including the size of Big Rivers' load profile, transmission considerations, supply chain issues, and interconnection queue delays. When these and related matters are considered, the annual build limits are actually quite high and thus unlikely to remove feasible projects from evaluation. Big Rivers is right-sized for its current workload—adding resources to facilitate any significant construction of additional generation would require more labor, more overhead, and significant carrying costs.

b. The EnCompass model does not include any PPAs for storage, solar PV, or wind. Projects involving these resources, whether self-build or involving a PPA, will face many of the same challenges and risks associated with transmission, supply chain, and interconnection queue. *See In the Matter of: Electronic Application of Big Rivers Electric Corporation for Approval of Amendment to Power Purchase Agreement*. Case No. 2022-00296 (Sep. 22, 2022).

Witness: Nathanial A. Berry

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-20: ***Please refer to your response to JI 1-46(c). Please explain in detail why the model was set to "select a roughly equal amount of capacity from storage as the other generic resource types" as opposed to some other amount of storage. Please produce any analysis or other documents supporting that approach.***

RESPONSE: Big Rivers objects that the phrase "as opposed to some other amount of storage" is unduly vague and ambiguous in the context of this request. Without waiving this objection, Big Rivers states as follows. The model set the storage limits from 50 MW to 600 MW (including all MW levels between). Because the transmission system must be able to support the resulting storage as both a load and as a resource, amounts near or above the 600 MW limit have the potential to significantly impact the transmission system. Properly assessing those impacts would require detailed local and regional studies.

Witness: Nathanial A. Berry

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-21: ***Please refer to your response to JI 1-51(b). Please identify and produce the "current published research" regarding carbon capture estimates referenced therein.***

RESPONSE: As provided in Big Rivers' response to Commission Staff's Request No. 1-44, published research related to carbon capture costs, including the "IPM Model-Updates to Cost and Performance for APC Technologies CO2 Reduction Retrofit Cost Development Methodology" prepared by Sargent & Lundy, can be found on the Environmental Protection Agency's website at:

https://www.epa.gov/system/files/documents/2023-03/Attachment%206-1%20CO2%20Reduction%20Retrofit%20Cost%20Development%20Methodology%20in%20EPA%20Platform%20v6%20Post-IRA%202022%20Reference%20Case.pdf

See also Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request Nos. 2-56 and 2-58 for published research related to carbon capture costs.

Witness: Nathanial A. Berry

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-22: ***Please refer to your response to Staff 1-36. Please explain in detail why the model was offered a natural gas combined cycle plant with a capacity of 635 MW rather than 454 MW or some other capacity closer in size to the Green units that would be replaced.***

RESPONSE: The IRP model did not assume the natural combined cycle would replace the Green units, but instead studied other alternatives while considering factors beyond capacity size. For example, Big Rivers' 2023 IRP at Page 116 explains, "Four other thermal alternatives were modeled with the intent to provide further alternatives in place of a new combined cycle power plant. These options would include a 237 MW simple cycle gas turbine power plant, an alternative combined cycle gas turbine power plant available later in the study period, 21 MW block of Wartsila reciprocating engines, and a 105 MW Aeroderivative." Also, page 156 of the 2023 IRP, presented the alternative of "two 237 MW combustion turbines in place of the new NGCC." Ultimately the units would not provide base load energy, as they would operate at a lower capacity factor. Additionally, smaller capacity generators suffer from higher heat rates, impacting cost competitiveness.

Witness: Nathanial A. Berry

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-23: ***Please refer to your response to Staff 1-38(c). With regards to the "system fit" of demand response programs that Big Rivers is "still evaluating":***

a. Please explain in detail what is meant by the "system fit" of demand response programs and what considerations and factors go into evaluating such system fit.

b. Please state when Big Rivers began evaluating the "system fit" of demand response programs.

c. Please produce any analysis or other document regarding Big Rivers evaluation of the system fit of demand response programs.

d. Please describe the "extensive downstream work" needed before implementation of demand response programs and explain why such work is needed.

e. Please identify the "downstream work" regarding implementation of demand response programs that Big Rivers has carried out to date.

RESPONSE:

a. Demand-response programs often involve considerable up-front investment cost prior to implementation. As a result, it is important to consider factors related to how the proposed program fits with the current profile or portfolio of the utility. These factors could include considerations such as:

i. Does the target customer class (or classes) exist in sufficient scale to meet the targeted amount of demand reduction?

ii. If the program is a specific commercial process, does that process fit with the industry? For example, a commercial irrigation demand response program might be a poor fit if a large portion of the industry is rice farming which has irrigation practices that might not be supported.

iii. Is there AMI deployment across the member distribution cooperatives? Are there technical issues with communications across different metering platforms?

b. See Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-15.

c. See Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-15.

d. As stated above in part a., demand-response programs typically require up-front capital investments that can be expensive. Before full deployment of any demand-response program and its associated capital investment, a number of studies must be developed. Typically, evaluation of any proposed demand response program requires:

i. Technological evaluation of metering adequacy and communication protocols.

ii. Development and planning of measurement and verification processes.

iii. Commissioning a pilot study to test out measurement and verification processes in a real-time environment with actual customers.

iv. Incorporating lessons learned from the pilot project into a revised program plan prior to full deployment.

e. See Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-15.

Witnesses: Russell L. Pogue (subparts b, c, and e)

Joshua Hoyt (Clearspring Energy Advisors, LLC) (subparts a and d)

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-24: ***Please refer to the Company's response to JI 1-18(d). Please supplement the table provided to include (as requested in the original request), for each of the years 2018 to 2023, the total number of DG customers and the total capacity (KW) of DG, broken out for each class and distribution Member-Owner. If you are unable to provide this information, please explain in detail why not.***

RESPONSE: Please see the attachment to this response. Big Rivers collects data on the distributed generation at the request of the KY Energy and Environment Cabinet (EEC). The data in the attached tables contains all the information we request from the Member-Owners and includes County, Net Meter or Non-Net Meter status and type of resource (currently only Solar).

Witness: Russell L. Pogue

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-25: ***Please refer to the Company's response to JI 1-18(g). Please explain why Big Rivers has not prepared or reviewed any analysis of the potential grid resilience and reliability benefits of distributed solar generation in its territory.***

RESPONSE: Big Rivers continues to monitor FERC Order No. 2222 and other developments related to distributed solar generation and other distributed energy resources. While no specific projects have been identified or evaluated, Big Rivers will continue to work with its Member-Owners to address needs and consider opportunities as appropriate.

Witness: Christopher Bradley

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-26: ***Please refer to the Company response and attachment to JI 1-23 providing Gross Margin analyses for the Non-Member Energy customer contracts for years 2018 through 2023 and the forecast Gross Margin analyses for the Non-Member Energy customer contracts for years 2024 through 2037.***

a. Please identify and produce any analyses or calculations providing net margin data for the Non-Member Energy customer contracts for years 2018 through 2023.

b. Please identify and produce any projections or forecasts providing net margin data for the Non-Member Energy customer contracts for years 2024 through 2037.

RESPONSE:

a. Big Rivers does not conduct net margin analysis for Non-Member customer contracts.

b. Big Rivers does not conduct net margin analysis for Non-Member customer contracts.

Witness: Christopher A. Warren

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-27: ***Please refer to the confidential attachment to JI 1-23. Please explain why*** [redacted]

RESPONSE: [redacted]

Witness: Chris A. Warren

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-28: ***Please refer to the Company response to JI 1-24(d) and the confidential attachment to JI 1-23, and to Staff 1-8. Please explain why [redacted], despite the fact that [redacted] and Big Rivers' response that the Company "is in discussions with OMU about contract renewal" and "[n]o terms have been agreed to."***

RESPONSE: The Gross margin analysis of Non-Member Energy customer contracts provided as Big Rivers' response to Kentuckians for the Commonwealth and Kentucky Resource Council's Request No. 1-23(b) was an output of Big Rivers' annual budgeting processes. The budgeting process is ongoing and can be amended as circumstances are clarified such as terms of future Non-Member sales. See Big Rivers' response to Kentuckians for the Commonwealth and Kentucky Resource Council's Request No. 2-27. The modeled Non-Member sales referred to in Big Rivers' response to Commission Staff's Request No. 1-8(c) reflect the current termination dates of the existing Non-Member sales agreements. Extensions of existing Non-member sales agreements were not modeled in the IRP because, at the time of the IRP's preparation, the likelihood of such extensions (as well as their provisions) were not known with sufficient clarity to warrant inclusion.

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

Witness: Terry Wright, Jr.

CONFIDENTIAL
Filed with Motion for
Confidential Treatment

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-29: ***On December 20, 2023, there was a widely reported "leak" of fly ash from the D.B. Wilson plant. See, e.g., Adam Kight, Major ash leak reported at power plant in Ohio County, several people injured, 44News (Dec. 20, 2023), https://www.wevv.com/news/kentucky/major-ash-leak-reported-at-power-plant-in-ohio-county-several-people-injured/article_64de44de-9f4b-11ee-83e7-6fc5b775714e.html.***

a. ***Please explain in detail the cause of the "leak" that resulted in this incident.***

b. ***Please confirm that a "stuck valve" (as described in the video accompanying the above article) was a contributing factor to the incident. If you are unable to confirm, please explain why not.***

c. ***Please explain the purpose of the valve that was involved in the incident. How frequently and for what reasons is the valve opened?***

d. ***Does the Company have any permits that authorize fly ash to be released to the environment through the valve? If yes, please identify and produce copies of any such permits. If not, please explain why not.***

e. ***Does the Company have written policies or procedures for conducting maintenance on the valve? If yes, please produce a copy of any such policies or procedures. If not, please explain why not.***

f. ***Were the workers involved in this incident wearing any safety equipment? If yes, please identify any such equipment that they were wearing. If not, please explain why not.***

g. ***Please provide the Company's best estimate of how much fly ash was released to the environment during this incident. Please produce any documents in the Company's possession that reflect this calculation.***

h. ***Please identify what steps (if any) the Company took after the incident to ascertain how much fly ash might have been deposited on properties off- site from***

the Wilson plant, to locate that fly ash, and/or to clean it up. Please produce any documentation of these steps that is in the Company's possession.

i. Please produce any documents reflecting the Company's communications with the Division of Waste Management or other government agencies concerning cleanup of fly ash released in this incident.

RESPONSE: Big Rivers objects to this request as overly broad, unduly burdensome and not reasonably tailored to lead to relevant or admissible evidence. The IRP is a planning proceeding focused on better implementing a long term resource planning process through the examination of energy providers' current business assumptions and projections. Inquiry into a particular event that occurred after the submission of the IRP which has no bearing on this proceeding is not appropriate.

For the Objection(s): Counsel

IN THE MATTER OF:
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REQUEST NO. 2-30: ***Please refer to the Company's response to Joint Intervenors' Request No. 1-57. Does the Wilson plant discharge treated wastewater from its FGD system pursuant to its KPDES permit?***

a. If yes, please identify where in the KPDES permit for the Wilson plant such discharges are authorized, and please explain why the Wilson plant's wastewater treatment system is in full compliance with the 2020 ELG Rule.

b. If not, please explain why not.

RESPONSE: No, Big Rivers does not discharge treated wastewater from its FGD system at this time.

a. N/A

b. To date, the FGD system is not producing wastewater at levels significant enough to require discharge. The FGD system is designed to be a zero discharge system.

Witness: Michael S. Mizell

IN THE MATTER OF:
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REQUEST NO. 2-31: ***Please refer to the Company's 2022 Annual Groundwater Monitoring and Corrective Action Report for the Federal Coal Combustion Residuals Rule – Wilson Phase II Landfill (Jan. 19, 2023), which is available at http://www.bigrivers.com/wp-content/uploads/2023/01/2022-CCR-GWMCAR_FINAL_20230119-RS.pdf.***

a. ***Please confirm that assessment monitoring for the Wilson Phase II Landfill has identified Statistically Significant Increases of lithium and cobalt in downgradient groundwater monitoring wells. If your response is anything other than an unqualified confirmation, please explain in detail.***

b. ***Please confirm that the Company completed an Assessment of Corrective Measures in 2019 for the Wilson Phase II Landfill and is in the process of selecting a remedy. If your response is anything other than an unqualified confirmation, please explain in detail.***

c. ***Please identify what, if anything, the Company did in its modeling or analysis for the 2023 IRP to account for the need for a corrective action remedy for groundwater at the Wilson Phase II Landfill. If the Company did not account for the need for a corrective action remedy at Wilson as part of its IRP modeling or analysis, please explain in detail why not.***

RESPONSE:

a. Confirmed.

b. Confirmed.

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

c. As noted in Big Rivers' 2nd Half 2023 Remedy Selection Progress Report, and in accordance with 40 CFR § 257.97,[1] Big Rivers is continuing to collect monitoring data from all of the monitoring wells at Wilson Station so that it can effectively evaluate and develop a comprehensive remedy for the Phase II landfill. While study continues and until such time as a remedy has been identified, it would be premature to model any financial or performance impacts in an IRP.

Witness: Michael S. Mizell

[1] *See* Big Rivers' CCR Rule Compliance and Data Information webpage: https://www.bigrivers.com/ccr-rule-compliance-wilson-station/

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REQUEST NO. 2-32: ***Please refer to the Company's response to Joint Intervenors' Request No. 1-29.***

a. ***Do any of Big Rivers' Member-Owner distribution cooperatives currently serve data centers as customers? If yes, please identify all such data centers, including by name, location, capacity need (in MW), percentage of capacity need that is firm capacity, anticipated load factor, and which consumer class they belong to. If the answer is no or you are unable to answer, please explain why not.***

b. ***Do any of Big Rivers' Member-Owner distribution cooperatives anticipate that any proposed data centers will begin operating in their territories in the next three years? If yes, please identify all such data centers, including by name, location, capacity need (in MW), percentage of capacity need that is firm capacity, anticipated load factor, and which consumer class they belong to. If the answer is no or you are unable to answer, please explain why not.***

c. ***For each currently operating or proposed data center identified in response to subparts (a) and (b) above, please explain in detail whether or how the facility has been incorporated into the load forecast for this IRP.***

RESPONSE:

a. Big Rivers and its Member-Owners are separate organizations. Big Rivers does not have access to individual customer data with the exception of special contracts between a large customer, the applicable Member-Owner, and Big Rivers. Please see Big Rivers' response to Kentuckians for the Commonwealth and Kentucky Resource Council Request Nos. 1-28 and 1-29. As previously stated, Blockware Mining, Inc. is the only known cryptocurrency facility or

data center that Big Rivers supplies through its Member-Owners, and it is in the Large Industrial Customer class.

b. As previously stated, Big Rivers is unaware of any proposed data centers. Big Rivers cannot answer on behalf of its Member-Owners.

c. See the response to subpart a.

Witness: Terry Wright, Jr.

IN THE MATTER OF:
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REQUEST NO. 2-33: ***Please refer to the Section 4.8 of the 2023 IRP.***

a. Please explain how the load forecast incorporates naturally occurring energy efficiency.

b. Please provide any quantitative projections of naturally occurring energy efficiency that the Company relied on for this IRP, and identify the sources or bases for those projections.

RESPONSE:

a. The residential use per consumer models incorporate Energy Information Agency ("EIA") historical and forecasted efficiency estimates into the variable construction. EIA historical and forecasted efficiencies for residential stocks of electric heating and central air conditioning are incorporated and enable the residential use per consumer model to incorporate the historical changes of naturally occurring energy efficiency, as well as forecasted efficiency changes, into the residential use per consumer forecasts.

b. The appliance efficiency data source is from EIA's Annual Energy Outlook ("AEO"). Clearspring processed historical AEO publications to populate the historical efficiencies of electric heating and central air conditioning. The 2022 AEO was used to set the forecasted efficiency values during the years of the load

forecast. The 2022 AEO data can be found here:

https://www.eia.gov/outlooks/aeo/data/browser/#/?id=30-AEO2022&sid=ref2023-d020623a.16-30-AEO2023&sourcekey=0

Witnesses: Matt Sekeres and Steve Fenrick (Clearspring Energy Advisors, LLC)

IN THE MATTER OF:
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REQUEST NO. 2-34: ***Please refer to Table 7.1.4 (g) at page 121 of the 2023 IRP.***

a. Please provide the locations that were used to develop the capacity factor of 21% for new solar resources.

b. Please provide the source that was used to develop the capacity factor for new solar resources.

RESPONSE:

a. Hourly production profiles are from a proprietary subscription database to which 1898 & Co. has access for the geographical area around MISO LRZ 6. The profile location corresponds to the "MISO-IN-KY: SolarShape:1-Axis" from Horizons Energy.

b. The capacity factor profile came from the Horizons Energy National Database EnCompass model.

Witness: John Christensen (1898 & Co.)

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REQUEST NO. 2-35: ***Please refer to Table 7.1.4(i) labeled "Renewable and Storage Project Cost" at page 122 of the IRP.***

a. Please provide the supporting workbooks, with all formulas and links intact, used to develop the cost for each technology provided in Table 7.1.4(i).

b. Please explain if the capital costs provided for solar and four-hour battery storage are reported before the impact of the ITC or after the impact of the ITC.

RESPONSE:

a. Please see the CONFIDENTIAL Excel workbook attached to this response.

b. The capital costs provided are the capital cost estimates for the projects before applying any potential credit or bonus incentives.

Witness: John Christensen (1898 & Co.)

JI 2-35 ATTACHMENT

This attachment, in its entirety, has been submitted under seal with an accompanying request for confidential treatment.

IN THE MATTER OF:
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REQUEST NO. 2-36: ***Please refer to Table 7.1.4(j) labeled "Thermal Generation Project Cost" at page 124 of the IRP. Please provide the supporting workbooks, with all formulas and links intact, used to develop the cost for each technology provided in Table 7.1.4(j).***

RESPONSE: Please see the CONFIDENTIAL Excel workbook attached to this response, which is being produced subject to a motion for confidential treatment.

Witness: John Christensen (1898 & Co.)

JI 2-36 ATTACHMENT

This attachment, in its entirety, has been submitted under seal with an accompanying request for confidential treatment.

IN THE MATTER OF:
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REQUEST NO. 2-37: ***Please refer to the planning reserve margins referenced on page 133 of the IRP.***

a. Please explain if a coincidence factor was applied to the planning reserve margins modeled in EnCompass.

i. If a coincidence factor was applied, please identify the factor and provide the supporting workbooks, with all formulas and links intact, used to develop the coincidence factor and the planning reserve margins modeled in EnCompass.

ii. If a coincidence factor was not applied, please explain why it was not.

RESPONSE:

a. The Planning Reserve Margin Requirements used in the EnCompass model were published by MISO for Local Resource Zone 6.[1]

i. A coincidence factor was not applied to the Planning Reserve Margin Requirement values supplied by MISO.

ii. The Seasonal Planning Reserve Margin Requirements were modeled in accordance with MISO's 2023-2024 LOLE Study Report.

Witness: John Christensen (1898 & Co.)

[1] *See Planning Year 2023-2024 Loss of Load Expectation Study Report*, MISO, https://cdn.misoenergy.org/PY%202023-2024%20LOLE%20Study%20Report626798.pdf.

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REQUEST NO. 2-38: ***Please refer to the table labeled as "Annual Maximum Project Capacity for EnCompass Model" on page 135 of the IRP.***

a. Please explain why wind was allowed to be selected in 2028 before four-hour storage was allowed to be selected in 2029.

b. Please provide support for the assumption that 4-hour battery storage resources could not be brought online before 2028.

RESPONSE:

a. There is currently only a very limited amount of storage operating in MISO, so Big Rivers did not believe it was prudent to be overly aggressive when developing its four-hour storage timelines. In the case of wind, there is a significant wind presence in MISO, so MISO is very familiar with these types of resources.

b. MISO's interconnection queue is one of the most significant timeline factors for developing new projects. Progressing from an initial application in the queue to a finished generator interconnection application is likely take up to two (2) years.

The MISO queue notwithstanding, and for reasons described in response to subpart a., above, Big Rivers prefers to acquire experience with intermittent generation on its system before expanding the scope and potential impact of such resources beyond that currently contemplated.

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Witness: Terry Wright, Jr.

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REQUEST NO. 2-39: ***For each of the new supply side resources modeled in EnCompass, please provide the operating life that was modeled for each technology type.***

RESPONSE: Please see the table below for the operating life that was modeled in EnCompass.

Resource Options for EnCompass Model	
Name	**Operating Life (years)**
Solar PV	30
Onshore Wind	30
4-Hour Li-Ion BESS	20
Simple Cycle Gas Turbine	40
Combined Cycle Gas Turbine (BREC CC)	40
Reciprocating Engine	40
Aeroderivative	40

Witness: John Christensen (1898 & Co.)

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REQUEST NO. 2-40: ***Please explain if transmission interconnection costs were included for each of the new supply side resource alternatives modeled in EnCompass.***

a. ***If transmission interconnection costs were modeled, please provide the costs modeled in addition to the supporting documents, analysis, and workbooks, with all formulas and links intact, used to develop those costs.***

b. ***On page 116 of the IRP, Big Rivers Energy stated that "The new natural gas combined cycle power plant (635 MW), both with and without 90% CCS, was modeled assuming Big Rivers would own and operate the facility near the existing Green Station Facility." Given the capacity size difference between the Green Station Facility and the proposed new NGCC, please explain if Big Rivers anticipates the new NGCC requiring transmission system upgrades if it is located near the Green Station facility.***

c. ***Please identify the location of the proposed new NGCC that Big Rivers has submitted to the MISO interconnection queue.***

RESPONSE: Transmission interconnection costs were not modeled in EnCompass for supply-side resources.

a. N/A.

b. At this time, no transmission system upgrades have been identified. However, MISO and the neighboring systems have not yet performed the detailed studies necessary to determine the impact the proposed facility will have on the transmission network.

c. The proposed NGCC is expected to be located on Big Rivers' property adjacent to the existing Green Generating Station in Henderson County.

Witnesses: **John Christensen, 1898 & Co. (for subpart a)**

Christopher Bradley (for subparts b & c)

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REQUEST NO. 2-41: ***Please refer to the workbook named "Master Assumptions Workbook", worksheet named "Base NG Fuel Forecasts", column labeled as "FT Demand Fee". Please explain why there are no values reported in this column.***

RESPONSE: The costs for Firm Transportation (FT) of natural gas for the BREC CC are covered by the fixed costs modeled as part of the BREC CC and the "FT Commodity Fee" in Column T of the Master Assumption Workbook on sheet "Base NG Fuel Forecasts." There is no FT Demand Fee on the commodity for the BREC CC.

Witness: Nathanial A. Berry

IN THE MATTER OF:
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REQUEST NO. 2-42: ***Please explain if Big Rivers currently has firm transportation for its existing natural gas resources.***

a. ***If yes, please provide the cost of the firm transportation for each of the existing natural gas resources.***

b. ***If not, please explain why not.***

RESPONSE: Big Rivers does not currently have firm transportation for its existing natural gas resources.

a. N/A.

b. There are separate, large monthly fees to maintain both firm gas and firm transportation. Those fees must be paid monthly regardless of whether Big Rivers utilizes its natural gas units. Big Rivers' gas units simply are not called upon by MISO often enough to justify paying these large monthly fees.

Witness: Nathanial A. Berry

IN THE MATTER OF:
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REQUEST NO. 2-43: ***Please identify and explain the cost and other assumptions Big Rivers made around the firm gas transportation for the new natural gas combined cycle power plant modeled in EnCompass.***

a. ***If Big Rivers did not include the costs for firm gas transportation, please explain why not.***

RESPONSE: Big Rivers included costs for firm gas transportation within the new natural gas combined cycle power plant modeled in EnCompass. There are both variable and fixed costs associated with firm gas transportation. [redacted]

CONFIDENTIAL
Filed with a Motion for Confidential Treatment

IN THE MATTER OF:
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[redacted]

[redacted].

Witness: Nathanial A. Berry

CONFIDENTIAL
Filed with a Motion for
Confidential Treatment

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REQUEST NO. 2-44: ***Please refer to the workbook named "Master Assumptions Workbook", worksheet named "FOM", column labeled as "Firm Gas Cost" in columns AI and AQ.***

a. Please explain why there is a firm gas cost reported for the Green units starting in 2029 but not for 2023 through 2028.

b. Please state whether the Fixed O&M costs for the BREC CC unit identified in columns AZ and BA include a Firm Gas Cost. If so, please identify what that cost is for each of the years 2029 through 2050. If not, please explain why not.

c. Please state whether the Fixed O&M costs for the Generic CT identified in columns BC and BD include a Firm Gas Cost. If so, please identify what that cost is for each of the 2029 through 2050. If not, please explain why not.

RESPONSE:

a. The estimates for the completion of infrastructure upgrades required by Texas Gas Transmission, LLC to provide the Green units with firm gas transmission is late in 2028. Big Rivers conservatively used an in-service date of early 2029 to account for any construction delays.

b. The Fixed O&M costs for the BREC CC unit identified in columns AZ and BA include a Firm Gas Cost estimate of $7.835 Million per year.

c. The Fixed O&M costs for the Generic CT identified in columns BC and BD do not include Fixed Firm Gas Costs. As discussed in response to Big Rivers' Response to Kentuckians

for the Commonwealth/Kentucky Resource Council's Request No. 2-53, the Generic CT was modeled such that it incurred the $/MMBtu delivery fees.

Witness: Nathanial A. Berry

IN THE MATTER OF:
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REQUEST NO. 2-45: ***Please refer to the workbook named "Master Assumptions Workbook", worksheet named "VOM". Please explain why there is a difference in the VOM reported for the "BREC CC" and the "Generic CC".***

RESPONSE: As noted in Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-52, the BREC CC costs are based on the detailed cost estimate developed by Big Rivers for the construction of a combined cycle on the Green site. The Generic CC was not modeled as a resource alternative in the EnCompass model, but the costs were based on publicly available data**.**

Witness: John Christensen (1898 & Co.)

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REQUEST NO. 2-46: ***Please refer to the workbook named "Master Assumptions Workbook", worksheet named "SAC". Please provide the supporting workbooks, with all formulas and links intact, used to develop the seasonal SAC values reported for each of the resources contained in the worksheet.***

RESPONSE: Please see the responsive CONFIDENTIAL Excel workbooks (Attachments 2, 3, 4, and 5) attached to this response, submitted subject to a motion for confidential treatment. These attachments contain all the data used to calculate SAC for each resource, but as downloads from the MISO Module E Capacity Tracking Tool, they do not contain formulas.

Similar data is provided for the prospective resources, see CONFIDENTIAL Attachment 1. There are some differences between the Master Assumptions workbook SAC Tab and the values in Attachment 1 to this Response. While gathering information for Big Rivers' Responses to Requests for Information, 1898 & Co. discovered issues with capacity values that were included in the IRP workbooks. The values reported in Attachment 1 represent the values that were used for modeling purposes. Please also see Big Rivers' supplemental response to Kentuckians for the Commonwealth and Kentucky Resource Council's Request No. 1-1, which updated files reflect the correct capacity values.

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WITNESSES: **Terry Wright, Jr.**

John Christensen (1898 & Co.)

JI 2-46 ATTACHMENT

This attachment, in its entirety, has been submitted under seal with an accompanying request for confidential treatment.

IN THE MATTER OF:
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REQUEST NO. 2-47: ***Please provide the MISO Market import and export assumptions modeled in EnCompass, including any additional constraints that were modeled, such as an annual or monthly import/export limit.***

RESPONSE: The EnCompass model was developed to mimic the actual interactions between MISO and Big Rivers. The model was configured to allow for all of Big Rivers' load energy to be purchased from the MISO market, and all of its generation or potential generation energy to be sold to the MISO market.

Capacity imports were unconstrained in the model through 2028. Starting in 2029 and beyond, the model was configured to prevent the purchase of market capacity. The model was not configured to sell surplus capacity at any time during the study period.

Witness: John Christensen (1898 & Co.)

IN THE MATTER OF:
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REQUEST NO. 2-48: ***Please provide Big Rivers' MISO market energy purchases and sales for each month between January 2018 through December 2023.***

RESPONSE: Please see the attachment to this response.

Witness: Terry Wright, Jr.

BIG RIVERS ELECTRIC CORPORATION
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MISO Energy Market
Sales and Purchases

Sales	
Month	Volume (MWH)
Jan-18	279,275.904
Feb-18	182,604.424
Mar-18	279,807.928
Apr-18	344,622.721
May-18	339,496.586
Jun-18	328,687.557
Jul-18	250,467.178
Aug-18	327,636.279
Sep-18	285,347.394
Oct-18	140,172.360
Nov-18	100,648.315
Dec-18	126,347.177
Jan-19	229,868.520
Feb-19	309,820.873
Mar-19	264,432.019
Apr-19	197,874.937
May-19	250,326.822
Jun-19	250,965.524
Jul-19	217,681.958
Aug-19	147,862.821
Sep-19	150,971.144
Oct-19	109,491.741
Nov-19	183,295.979
Dec-19	89,849.940
Jan-20	66,856.204
Feb-20	92,192.147
Mar-20	21,970.057
Apr-20	46,445.316
May-20	86,361.744
Jun-20	105,065.670
Jul-20	117,389.650
Aug-20	149,097.746
Sep-20	49,865.291
Oct-20	140,677.617

Purchases	
Month	Volume (MWH)
Jan-18	59,683.603
Feb-18	85,297.324
Mar-18	91,896.709
Apr-18	50,629.680
May-18	43,523.556
Jun-18	86,300.883
Jul-18	64,929.655
Aug-18	47,037.731
Sep-18	52,187.307
Oct-18	43,221.592
Nov-18	66,926.261
Dec-18	48,715.733
Jan-19	61,272.719
Feb-19	58,222.981
Mar-19	64,410.328
Apr-19	78,669.518
May-19	56,591.685
Jun-19	43,107.960
Jul-19	48,992.700
Aug-19	64,905.170
Sep-19	59,629.030
Oct-19	132,189.058
Nov-19	113,815.676
Dec-19	164,756.454
Jan-20	134,067.749
Feb-20	71,451.229
Mar-20	164,812.278
Apr-20	129,288.489
May-20	85,418.478
Jun-20	78,915.059
Jul-20	114,231.224
Aug-20	76,305.290
Sep-20	80,526.964
Oct-20	88,005.127

BIG RIVERS ELECTRIC CORPORATION
Case No. 2023-00310
MISO Energy Market
Sales and Purchases

Sales	
Month	Volume (MWH)
Nov-20	81,959.857
Dec-20	91,626.211
Jan-21	39,959.800
Feb-21	105,224.450
Mar-21	29,222.119
Apr-21	246,195.155
May-21	256,025.077
Jun-21	190,598.326
Jul-21	194,987.906
Aug-21	161,445.614
Sep-21	183,991.469
Oct-21	200,879.674
Nov-21	226,567.625
Dec-21	114,267.011
Jan-22	109,101.057
Feb-22	44,284.680
Mar-22	103,304.226
Apr-22	24,895.268
May-22	26,249.392
Jun-22	37,474.657
Jul-22	13,294.031
Aug-22	38,158.050
Sep-22	25,136.000
Oct-22	1,358.842
Nov-22	50,399.476
Dec-22	44,117.688
Jan-23	17,021.340
Feb-23	22,793.267
Mar-23	51,463.767
Apr-23	48,179.680
May-23	42,183.042
Jun-23	17,104.192
Jul-23	20,201.048
Aug-23	32,230.719

Purchases	
Month	Volume (MWH)
Nov-20	138,180.490
Dec-20	83,793.495
Jan-21	79,923.606
Feb-21	91,286.968
Mar-21	143,328.908
Apr-21	72,308.305
May-21	48,393.761
Jun-21	71,423.920
Jul-21	77,247.506
Aug-21	49,849.417
Sep-21	60,113.611
Oct-21	55,744.060
Nov-21	55,825.285
Dec-21	94,189.640
Jan-22	85,354.262
Feb-22	135,994.874
Mar-22	56,723.096
Apr-22	102,844.259
May-22	141,322.538
Jun-22	147,253.169
Jul-22	215,594.258
Aug-22	206,469.055
Sep-22	184,428.277
Oct-22	362,128.615
Nov-22	340,481.380
Dec-22	192,752.551
Jan-23	199,564.238
Feb-23	75,532.751
Mar-23	155,387.156
Apr-23	117,760.878
May-23	132,479.111
Jun-23	223,125.386
Jul-23	150,280.294
Aug-23	161,063.134

BIG RIVERS ELECTRIC CORPORATION
Case No. 2023-00310
MISO Energy Market
Sales and Purchases

Sales	
Month	**Volume (MWH)**
Sep-23	26,936.052
Oct-23	16,235.200
Nov-23	15,120.670
Dec-23	9,306.049

Purchases	
Month	**Volume (MWH)**
Sep-23	223,436.127
Oct-23	91,958.535
Nov-23	170,771.461
Dec-23	181,673.851

NOTE:

The amounts listed are comprised of hourly generation sales and Big River load purchases in the MISO Energy Market. It doesn't include any forward purchase or sales hedging activity.

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-49: ***Please refer to the workbook named "Master Assumptions Workbook", worksheet named "EE Firm Capacity".***

a. Please confirm that the firm capacity modeled in EnCompass for the energy efficiency resources is found in column G labeled as "Monthly Firm Cap – PRMR".

i. If yes, please explain why the calculation in column G takes the value reported in column F and divides by one plus the reserve margin.

ii. If yes, please confirm if the calculation used to develop the values reported in column G is intending to gross up for the planning reserve margin. If not, please explain what the calculation in column G is intending to achieve.

iii. If not confirmed, please provide the firm capacity modeled in EnCompass for the energy efficiency resource.

b. Please provide the supporting calculation used to develop the firm capacity values reported in column F.

c. Please confirm if a coincidence factor has been applied to the values reported in column F

RESPONSE:

a. The firm capacity modeled in EnCompass is listed column G labeled "Monthly Firm Cap-PRMR".

i. The calculation performed subtracts the planning reserve margin from the "Monthly Firm Capacity" values that are based on the summer peak.

ii. The calculation in column G is intended to net the planning reserve margin out of the firm capacity value.

iii. The firm capacity modeled in EnCompass for Energy Efficiency is reported in Column G.

b. The values in column F are calculated by dividing the monthly peak reduction by the annual maximum peak reduction.

c. A coincidence factor was not applied to the values shown in column F.

Witness: John Christensen (1898 & Co.)

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
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BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-50: ***Please reconcile the capital cost of the carbon capture and sequestration modeled for the D.B. Wilson Generating Station as reported in the EnCompass input assumption workbook "Master Assumptions Workbook", worksheet name "Wilson with 90% CC" in cell E6 and the $2.5 billion project cost referenced in response to Joint Intervenors' Request No. 1-13(b).***

RESPONSE: The costs presented in the Master Assumptions Workbook for CCS technology on Wilson are based on the data provided by the EPA and referenced in Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-51. The capital costs were escalated to the year of installation as shown in the Master Assumptions Workbook.

The $2.5 billion project cost referenced in Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 1-13(b) was based on the upper end of cost projections outlined in the Letter of Intent for the New ERA Project for Wilson submitted to the RUS dated September 15, 2023.

Witness: Nathanial A. Berry

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
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BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-51: ***Please refer to the workbook named "Master Assumptions Workbook", worksheet named "EPA Coal Data". Please provide the source of the capital cost reported in cell U14.***

RESPONSE: As provided in Big Rivers' response to Commission Staff's Request No. 1-44, published research related to carbon capture costs can be found on the Environmental Protection Agency's website. Please see the link provided in Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-21.

Witness: Nathanial A. Berry

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
BIG RIVERS ELECTRIC CORPORATION
CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-52: ***Please refer to the Confidential Table 7.1.4(j) labeled as "Thermal Generation Project Cost" and the workbook named "Master Assumptions Workbook", worksheet named "Alt_Capital&FixedOM".***

a. Please reconcile the difference in the Overnight Capital Cost reported in Table 7.1.4(j) and the workbook for the Combined Cycle Gas Turbine.

b. Please confirm which capital cost was modeled in EnCompass for the new Combined Cycle Gas Turbine that is referenced in the IRP as the "BREC CC".

RESPONSE:

a. The generic combined cycle gas turbine was not modeled as a resource alternative in the Encompass model due to the detailed estimate developed for the "BREC CC". The capital cost estimate in the master assumptions workbook for the generic combined cycle was developed using the approach outlined in Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-14.

b. The capital costs on the "Alt Capital&FixedOM" sheet in the Master Assumptions workbook are for a generic combined cycle which was not modeled in our analysis. The values in both the "IRP Input Tables" tab of the "Master Assumptions Workbook" and Table 7.1.4(j) were the inputs used for the "BREC CC" and were based on Big Rivers' detailed estimate of the cost to construct the combined cycle project on the Green site.

IN THE MATTER OF:
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BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

Witness: John Christensen (1898 & Co.)

IN THE MATTER OF:
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BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-53: ***Please refer to Table E-1 in "Appendix E – Technical Appendix" to the IRP. Please explain why the natural gas fuel cost input modeled in EnCompass is lower for the Big Rivers NGCC compared to Green Station.***

RESPONSE: Delivery cost adders for Big Rivers NGCC are estimated to be lower than for the Green Station. Green Station fuel delivery is subject to five (5) delivery fee adders -- the Daily PAL charge, ACA Fee, IT Fee (which converts to FT Fee in 6/1/2029), HOT Fee, and a 6% sales tax. The Big Rivers NGCC is subject to four (4) delivery fee adders -- the ACA Fee, FT Commodity fee, HOT fee and the 6% Sales Tax.

Witness: Nathanial A. Berry

IN THE MATTER OF:
ELECTRONIC 2023 INTEGRATED RESOURCE PLAN OF
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BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-54: ***Please refer to the 2022 All Source RFP that was provided in response to Joint Intervenors Request No. 1-9. In Section 4.1.5 of the 2022 All Source RFP it states that "BREC will also consider any Proposal for a facility to be developed on an existing BREC-owned site."***

a. Please state if Big Rivers received any bids for solar or storage resources that could be sited at an existing BREC-owned site. If so, identify for each such bid the resource, capacity, timing, and price in the bid.

b. Please explain if Big Rivers has evaluated the potential to self-build solar or storage resources at an existing BREC-owned site. If so, please explain the results of such evaluation and produce any documentation. If not, please explain why not.

RESPONSE:

a. None of the RFP bids proposed constructing solar or storage resources on Big Rivers' owned sites, and Big Rivers did not analyze whether any bids could be sited on an existing BREC-owned site.

b. Big Rivers has not formally evaluated self-build solar or storage on existing Big Rivers' owned sites. Big Rivers' PACE project is not proposed for construction on a Big Rivers' owned-site. Big Rivers believes it would be imprudent to build at the Coleman site until the CCR Rule related to Legacy Ponds is finalized.

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Witness: Nathanial A. Berry

IN THE MATTER OF:
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BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-55: ***Please provide the EnCompass input database used to develop each of the modeling runs presented in the IRP.***

RESPONSE: The EnCompass database was provided as CONFIDENTIAL attachments to Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 1-1.

Witness: John Christensen (1898 & Co.)

IN THE MATTER OF:
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CASE NO. 2023-00310

BIG RIVERS ELECTRIC CORPORATION'S RESPONSES TO KENTUCKIANS FOR THE COMMONWEALTH AND KENTUCKY RESOURCE COUNCIL'S SUPPLEMENTAL REQUESTS FOR INFORMATION

REQUEST NO. 2-56: ***Please refer to the 2023 New ERA Program LOI included as Attachment 1 to your response to JI 1-13, and the Rural Utilities Service Notice of Funding Opportunity ("NOFO") referenced therein. With regards to the financial assistance request set forth at pages 3–4 of the LOI of a $630 million grant and a $1.89 billion zero-interest loan to cover the $2.5 billion total estimated capital cost of installing CCS on the Wilson plant:***

a. ***Please state whether Big Rivers believes that the financial assistance request included in the LOI fits within the $970 million cap on the total amount that any one applicant can receive under the NewERA Program, as noted in the NOFO at 88 Fed. Reg. at 31,221.***

i. ***If so, please explain how, including an explanation of how Big Rivers believes the $1.89 billion zero-interest loan would count towards the $970 million cap.***

ii. ***If not, please explain why Big Rivers submitted an LOI for financial under the NewERA Program that exceeds the per-applicant cap on total funding that can be obtained under that program.***

b. ***Please state whether Big Rivers based its NewERA Program financial assistance request on the capital cost for CCS assumed in the IRP modeling, as discussed on pages 145–46 of the IRP. If so, please explain how. If not, please explain why not.***

c. ***Please explain why Big Rivers did not seek funding under the NewERA Program for renewable energy projects, distributed energy strategies, energy storage systems, transmission improvements, or projects that would significantly reduce energy demand, each of which are identified in the NOFO as eligible projects (see 88 Fed. Reg. at 31,223).***

RESPONSE:

a. While Big Rivers' LOI for the New ERA program included a project with an estimated capital cost of $2.5 billion, if Big Rivers is invited to apply, the application will fall below the $970 million maximum limit for a single borrower set by the RUS NOFO.

b. Big Rivers' LOI for the New ERA program estimated the capital and operating cost in part from data contained in "Carbon capture economics: Why $200 / tCO2 is the crucial figure" published on the "ey.com" website managed by the CRU Group. Please see the article attached to this response. The IRP modeling used projections from EIA's public technology assessment developed by Sargent & Lundy along with EPA estimates for carbon capture technologies. Please see Big Rivers' response to Kentuckians for the Commonwealth/ Kentucky Resource Council's Request No. 2-50. If Big Rivers receives an invitation to apply for New ERA, cost estimates will be reevaluated and adjusted accordingly to move forward with the project.

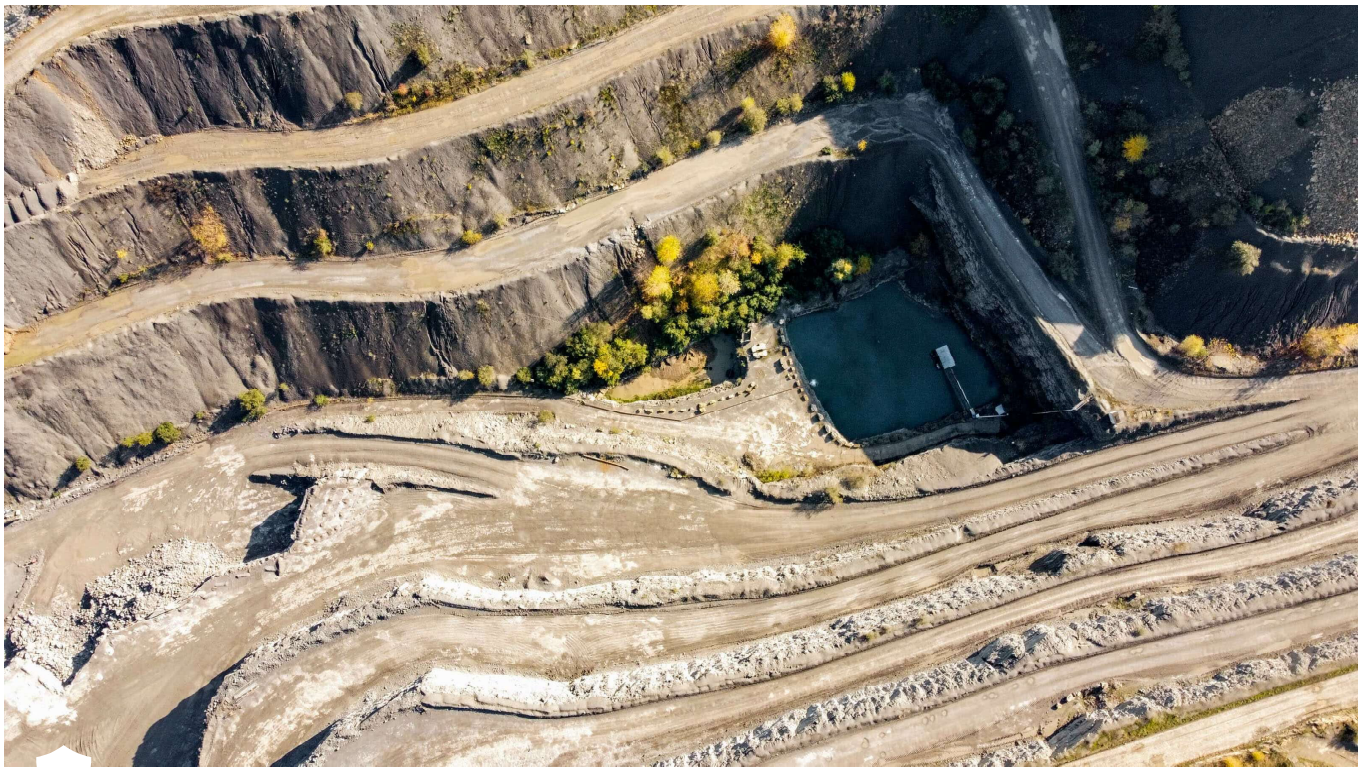
c. Big Rivers believes the project for which it has sought funding represents an excellent opportunity to strengthen its system, and it aligns with Big Rivers' desire to match funding opportunities with projects that are part of its strategic goals.

Witness: Talina R. Mathews

Carbon capture economics: Why $200 /tCO2 is the crucial figure

Posted 20 March 2023

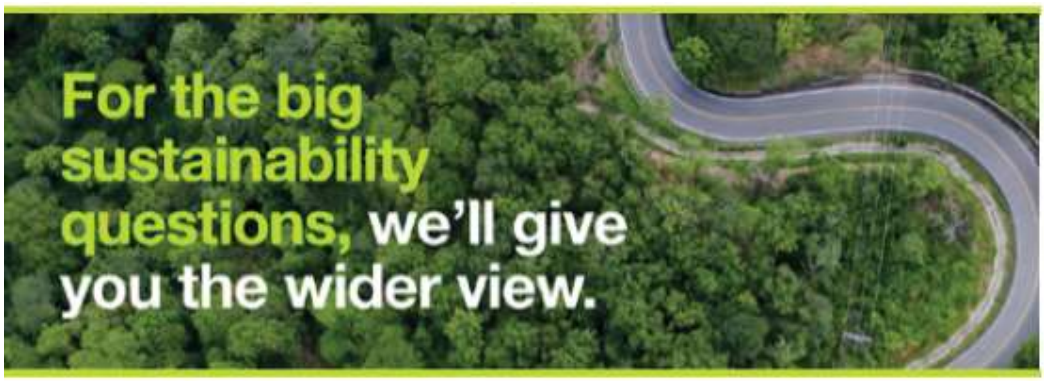
All new Knowledge and Insights for Sustainability can now be found here



Carbon capture and storage (CCS) costs are typically mis-quoted, failing to include full costs. In many cases, only 'other' operating costs are quoted, but these account for only ~10–15% of total costs from capture to injection. Full costs of CCS must cover the initial investment, financing, energy use (n.b. which leads to a significant loss of output at the power plant that is typically ignored), 'other' operating costs and distribution as well as injection costs.

CRU's CCS database covers historical and proposed projects — including capacity, end-use, technology and costs — and shows a carbon price of ~$200 /$tCO_2$ is needed for currently proposed CCS coal power projects to be competitive. Thus, neither the current carbon price in Europe (i.e. ~$100 /$tCO_2$) nor the 45Q tax credits for CCS under the US IRA (i.e. $85 /$tCO_2$) are sufficient to incentivise investment in CCS without other support. This conclusion has implications not just for coal power, but for all hard-to-abate sectors for which CCS is considered a decarbonisation solution.

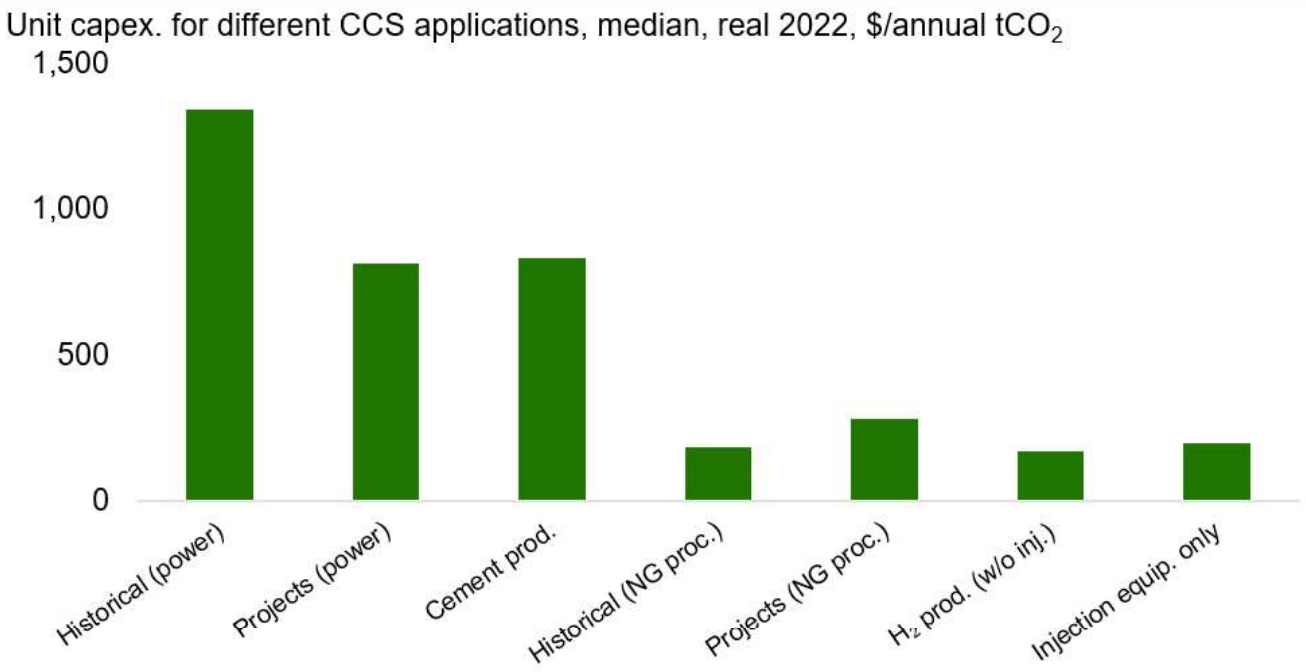
CRU provides credible and independent views of costs and technology development, vital for the energy transition. This Insight is one of many highlighting this work.



Coal power is the highest cost application of CCS

CRU has built a database of over 300 carbon capture and storage (CCS) projects globally dating from 1972 to present day, as well as proposed future developments. These projects cover different CCS applications including power generation, natural gas processing, hydrogen production (i.e. blue hydrogen), cement production and others. For many of these projects we have been able to collect capex. and capture data. The chart below presents a high level view of capex. costs for CCS in different end-uses.

Figure 1: Unit capex. depends on the characteristics of the gas stream subject to capture



DATA: **CRU Sustainability CCS database**; Note: median costs are shown but some values are based on limited data; confidence is higher for power generation and hydrogen production; NG proc[essing] relates to the removal of CO_2 from natural gas following extraction to improve its heating value.

The chart shows that the unit capex. of a carbon capture facility can vary significantly, which is largely driven by different characteristics of the off-gas or tail gas from which the CO_2 is captured. Off-gases with high a CO_2 concentration and/or high partial pressure typically require a less costly CCS process than off-gases with low CO_2 concentration and low partial pressure. For example, power plants with a low pressure off-gas stream that contains 10–15% CO_2 will have a higher unit capex. cost than a steam reforming hydrogen production unit that has an off-gas with both higher CO_2 concentration and pressure. These different conditions will dictate the size and complexity — and therefore investment cost — of the installed equipment.

Further, the data for power generation suggests that costs of CCS installations have fallen. Proposed projects exhibit a median unit capex. of ~$800 /annual tCO_2 collected (real 2022), whereas historical projects are >$1,300 /annual tCO_2 (real 2022). However, this cost reduction probably does not reflect the true cost reduction seen over time, which is expected to be smaller than suggested, as the sample of historical installations includes a high proportion of smaller-scale demonstration projects that, by default, will be higher cost than full scale commercial operations. The sample of future projects includes a majority of commercial-scale operations and we believe the median value given is more representative of a large-scale plant in the near-to-medium term.

Carbon capture requires significant sacrifice in power plant output

Quoted operating costs of a CCS plant, where these are available, can vary widely but we believe this is less due to specific differences in operating costs themselves and more due to the boundary conditions within which quoted operating costs are measured.

For example, a CCS plant associated with a power station will consume significant quantities of steam and power that are usually taken directly from the power station steam and power circuits. However, necessarily, this means the saleable output of power is reduced significantly. Thus, depending on whether the stated operating costs include the opportunity cost of lost power sales, or uplift in cost associated with the lower output, will affect the value given. Also, stated costs may or may not — and often do not — include the cost of distributing and injecting the captured CO_2.

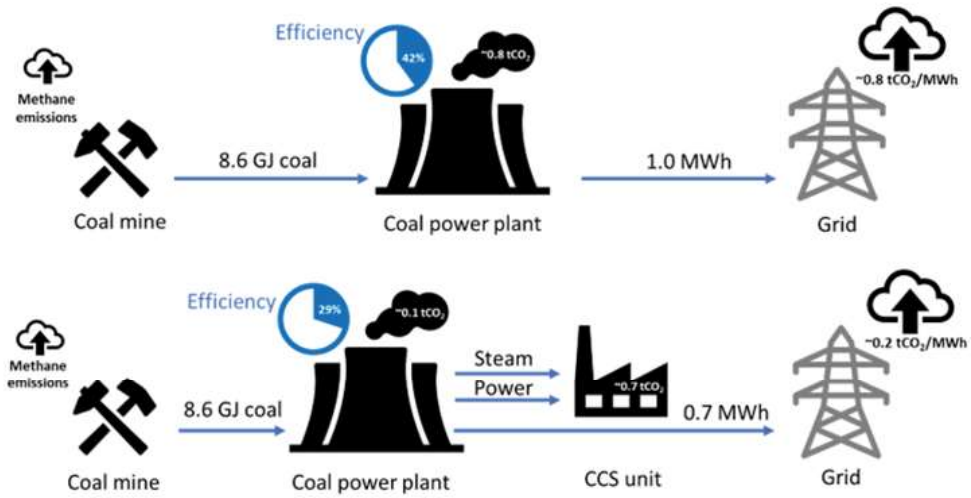
Table 1: Stated operating costs of CCS plant don't always include full costs

Operating costs	$/tCO$_2$	Comment
Energy	~20	Steam and power use can reduce power plant output by 30% or more
O&M	10–20	Solvent replacement, spares & parts, labour etc.
Injection	10–20	Costs to compress, distribute (by pipe) and inject
Total	**40–60**	**Total operating costs for capture through to injection**

SOURCE: **CRU Sustainability CCS database** and added research; NOTE: CCS reduces the output of the power plant; the full cost of replacing that lost output with new capacity has not been assessed; here, only the opportunity cost of the lost power sales for a coal plant have been assessed.

A typical MEA (i.e. monoethanolamine)-based CCS facility consumes ~2.5 GJ/tCO_2 of steam to strip the collected CO_2 from the solvent, and between 90–125 kWh/tCO_2 of power for compression, pumping liquid solvent, cooling and other duties. Thus, for a coal-fired power plant operating at 42% efficiency, a CCS unit capturing 80–90% of carbon emissions will reduce net output of the plant by ~30%. At typical, historical wholesale power prices, this use of internal energy would amount to ~$20 /t$CO_2$ of lost sales or more (i.e. a loss of 0.3 MWh at $50 /MWh wholesale price to collect 0.7 tCO_2; see Figure 2). For a lower efficiency plant — that is, emitting more CO_2 per unit of output — the loss of output might lift towards 35%, as more energy is consumed.

Figure 2: Unit capex. depends on the characteristics of the gas stream subject to capture



SOURCE: CRU

The equivalent value for a gas-fired power plant operating at 55% efficiency would be a reduction of ~15–20% of output depending on the capture rate.

Increasingly, it is suggested that CCS facilities can capture up to 99% of the CO_2 in a gas stream. While this is probably correct in theory — if unproven under full-scale commercial operation — there will be an energy penalty for doing so that is typically ignored. In practice, most operating CCS plants have captured up to 85% of the CO_2 in the gas stream, which is likely an economic compromise between cost and capture rate, and this is used as a base case here. The assumption of a higher capture rate introduces significant risk that, in practice, emissions reductions will not be as high as some expect. Further, CCS at a coal-fired power plant will do nothing to abate the methane fugitive emissions at coal mines.

Other operating costs associated with the solvent make-up, labour, spares & parts as well as sustaining capital amount to ~$10–20 /$tCO_2$. Distribution and injection costs will add a further ~$10–20 /$tCO_2$, although this will depend very much on the proximity of the storage deposit. Thus, full operating costs of a CCS facility on a coal-fired power station could vary between ~$40–60 /$tCO_2$ at typical, historical wholesale power prices.

Where we could find information, quoted operating costs for CCS facilities associated with fossil-based hydrogen production (i.e. steam methane and/or autothermal reforming; SMR and ATR) are of the order ~$20–35 /$tCO_2$, which specifically does not include distribution and injection costs. This would put total costs of CO_2 capture, distribution and injection at

~$30–45 /$tCO_2$. This fits with the expectation that operating costs for CCS on SMR/ATR units are lower overall than on a power station due to higher tail gas CO_2 concentrations and pressures.

CCS needs CO_2 at ~$200 /t to compete with unabated coal

Using proposed project costs and assumptions such as a 7% WACC, 25% tax, 30-year project lifespan and 12% working capital requirement, the CCS plant's Levelised Cost of Captured CO_2 (LCOCC) would be ~$131 /$tCO_2$.

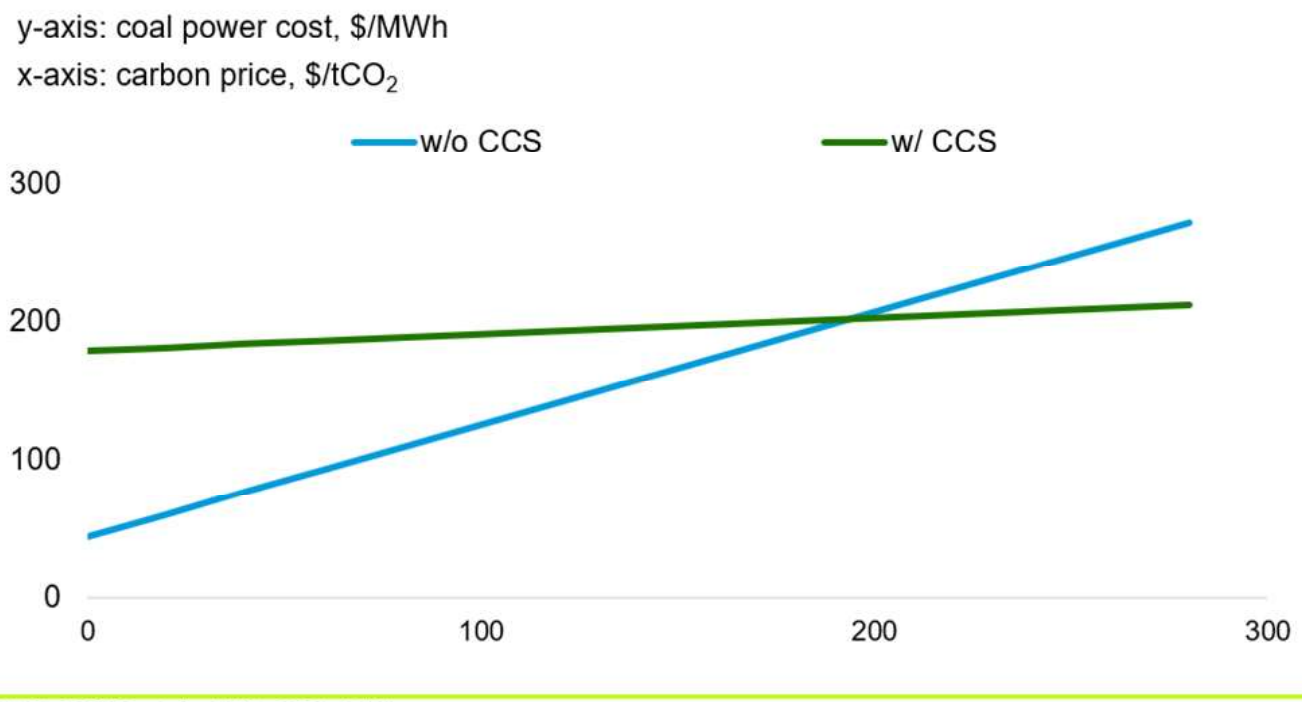
From the perspective of power costs, not just capture costs, a CCS plant capturing 85% of emissions from a coal-fired plant would lift the Levelised Cost of Electricity (LCOE) from an unabated ~$125 /MWh to ~$190 /MWh based on the following assumptions:

- typical coal plant asset base and non-fuel operating costs
- a coal price of $3.6 /GJ (i.e. pre-energy crisis, steady-state coal price)
- an efficiency of 42%
- unabated carbon emissions of ~0.82 tCO_2/MWh
- current carbon price of ~$100 /$tCO_2$

But, while CCS is not competitive today, as carbon prices rise — where they are applied — coal-fired CCS will become increasingly competitive with unabated peers, but parity is only achieved at a carbon price of ~$200 /$tCO_2$ under the assumptions described. That figure would be higher for coal plants operating at lower efficiencies, such as in the USA. For context, this required carbon price can be compared with that in Europe today of ~$100 /$tCO_2$ (i.e. ~€90 /tCO_2) and the 45Q carbon capture tax credit under US Inflation Reduction Act of $85 /$tCO_2$. Neither is sufficient on their own to incentivise carbon capture on a coal-fired power plant. The equivalent breakeven CO_2 price for a natural gas-fired power plant would be ~$180 /$tCO_2$.

The use of captured CO_2 for enhanced oil recovery (EOR) could provide additional revenue to support the building of CCS plants. However, given each tonne of CO_2 used for EOR ultimately leads to an additional CO_2 emission of ~0.7–2.9 tCO_2 from the added oil produced, it seems unlikely this approach could form part of a sustainable future.

Figure 3: CCS coal power needs carbon at ~$200 /$tCO_2$ to be competitive with unabated coal



DATA: **CRU Sustainability CCS database**

Of course, all of the above assumes that suitable geological deposits can be found for storage of the captured CO_2 and that these are in relatively close proximity to the power station. The proximity of geological deposits could have a significant influence on the costs shown and, therefore, on the carbon price needed to incentivise the installation of CCS.

CCS costs can fall but dispatchable power costs will stay high

It is generally assumed that CCS costs will fall, leading to lower LCOEs of coal-fired power with CCS, but this can only happen if commercial scale facilities are installed in the near term, at current high costs, such that the technology can move up the experience curve. The current cost disadvantage makes this difficult to achieve without support. That aside, assuming a 30% reduction in unit capex. (n.b. which has been suggested by some equipment providers), lower energy use and, therefore, only a 25% loss of power plant output as well as a reduction in other operating costs to $20 /$tCO_2$, all by 2050, gives an LCOE of ~$145 /$tCO_2$. This would lower the carbon price needed to put CCS-derived coal power on a par with unabated technology at ~$125 /$tCO_2$. However, this isn't the full story.

Many commentators propose coal-fired CCS power would, by necessity, be dispatchable, providing intermittent power to balance shortfalls in output from variable renewables. This means that boiler, steam turbine and CCS equipment, as well as associated distribution

and injection equipment, would have to be sized for the maximum output of the power plant, but would operate at low load factors for much of the time, when renewable output is high. Using CCS in this way brings several disadvantages:

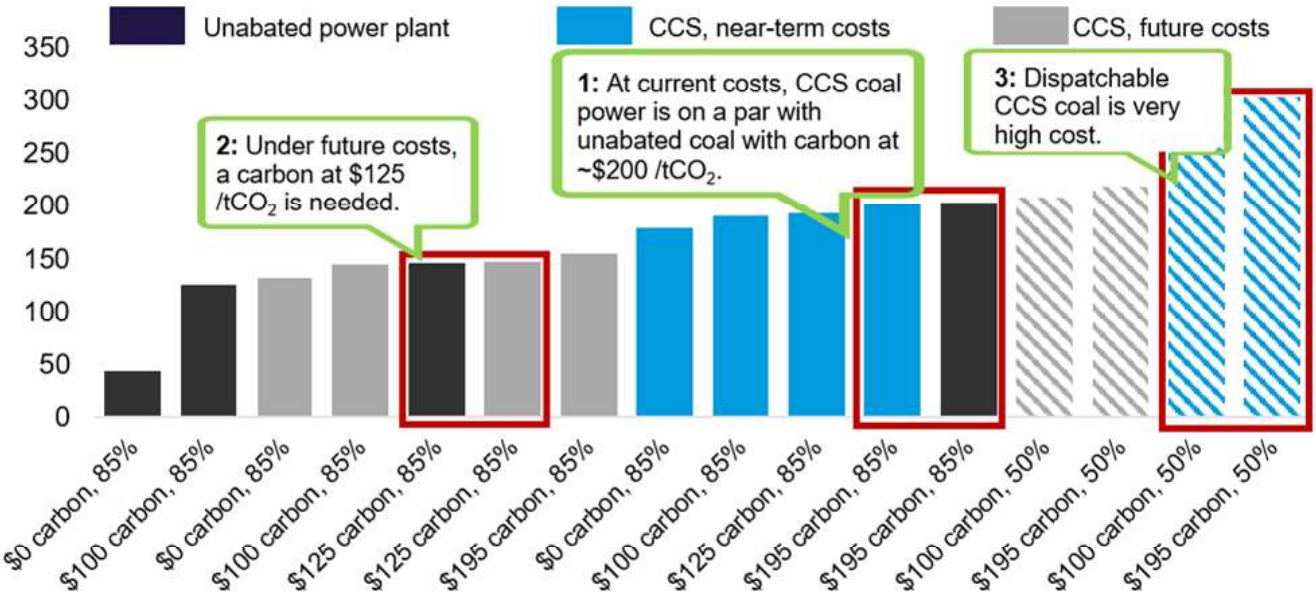
- Firstly, CCS is a high capex. decarbonisation solution and low load factors will raise the unit annual capital charge substantially, lifting the LCOCC.
- Secondly, the thermal cycling associated with stops and starts will lead to lower capture and energy efficiencies as well as equipment availability issues.
- Thirdly, a frequent start/stop regime would require added investment on equipment, added maintenance and would lower efficiencies at both the coal and CCS plant.

Our modelling suggests that the LCOE of coal-fired power plant with CCS, operating at an average load factor of 50%, would rise to ~$290 /MWh at steady-state fuel costs and a carbon price of $100 /$tCO_2$. We believe this is a conservative estimate of costs under dispatchable conditions.

The costs of the various configurations modelled and discussed above are set out below.

Figure 4: Operating a coal-fired CCS power plant flexibly will be very high cost

Coal power cost under different scenarios, $/MWh (y-axis), $/$tCO_2$ and % load factor (x-axis)



DATA: **CRU Sustainability CCS database** and modelling; NOTE: percentages denote load factor: 85% is considered base load; 50% dispatchable.

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This analysis suggests that base load, CCS-based coal power could be competitive with unabated coal power at carbon prices that are envisaged in the future (i.e. ~$200 /$tCO_2$ falling to ~$125 /$tCO_2$; see CRU's Long Term Carbon price forecast), but investment is needed now to allow CCS technology to move up the experience curve and make this a reality.

Thus, CCS-based coal power could be an economically viable part of the power mix, but only if suitable storage sites can be found, public perceptions of CCS improve and residual emissions as well as structurally higher power prices are acceptable. However, given the capex. intensity of CCS and operational challenges of flexible operation, dispatchable CCS-based coal power to balance increasing renewables on the grid (n.b. which many suggest would be the major role for CCS-based power) is highly unlikely to be a viable solution in our view. This is even before considering the significant variability constraints on distribution and injection of CO_2. Operation of such capital and energy intensive equipment at low load factors is unlikely to be a viable proposition and costs will rise rapidly.

If you want to know more about our analysis of carbon capture or want to get a more transparent, realistic and independent view of costs under the energy transition and decarbonisation, get in touch and we'd be happy to talk about our work.

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IN THE MATTER OF:
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REQUEST NO. 2-57: ***Please refer to page 4 of the 2023 New ERA Program LOI. With regards to the claim therein that with the requested NewERA financial assistance, an estimated $1.98 billion in 45Q tax credits, and "strong cost and project management," the CCS project on Wilson "could be cost neutral or slightly cost positive":***

a. Please state whether that claim factors in each of the following costs related to CCS:

i. CO2 transportation costs.

ii. CO2 storage costs.

iii. The heat rate penalty that the Wilson plant would incur.

iv. The capacity penalty that the Wilson plant would incur.

v. The annual fixed O&M costs for the CCS technology.

vi. The variable O&M costs for operating the CCS technology.

b. For each cost in subsection a that was factored into the claim that the project "could be cost neutral or slightly cost positive," please explain how it was factored in. For each cost in subsection a that was not factored into the claim, please explain why not and how the claim would be impacted if the cost had been factored in.

RESPONSE:

a.-b. Big Rivers' estimated capital and operating cost included in the New ERA LOI were derived using information from "Carbon capture economics: Why $200/tCO$_2$ is the crucial figure"

article attached to Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Council's Request No. 2-56. This article addresses the full costs of CCS including the initial investment, financing, energy use, other operating costs and distribution as well as injection costs. Big Rivers' estimate of costs was derived from the proposed project median unit capex of $800 per ton CO_2 (low case) and historical projects median unit capex of $1300 per ton CO_2 (high case). The CO_2 tonnage used in the calculation was 1,940,000 per the Achievable Reductions Tool (ART).

Witness: Talina R. Mathews

IN THE MATTER OF:
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REQUEST NO. 2-58: ***Please refer to pages 4–5 of the 2023 New ERA Program LOI. With regards to the annual and lifetime GHG reduction estimates for the Wilson CCS project set forth therein:***

a. Please explain the distinction between the GHG "reduction" and GHG "avoided" figures.

b. Please state whether the GHG reduction and/or GHG avoided figures factor in GHG emissions that may be created in generating the electricity needed to power the CCS technology.

c. Please explain how the 47.9% annual GHG reduction and 52.6% decrease in carbon intensity figures were calculated, including whether those percents are measured based on total GHG emissions from the Wilson plant without CCS, or the total GHG emissions from the Big Rivers generating fleet as a whole.

i. If the 47.9% and 52.6% figures are measured based on total GHG emissions from the Wilson plant without CCS, please explain how they are consistent with the 90% CCS assumption utilized in the IRP modeling(see IRP page 145).

RESPONSE:

a. As stated in its New ERA Letter Of Interest ("LOI"), Big Rivers' estimated GHG reductions were calculated using the Achievable Reductions Tool (ART) provided by the USDA Rural Utilities Service (RUS) . A copy of the ART in Excel spreadsheet format is attached to this response. See the CONFIDENTIAL attachment to this response, subject to a motion for confidential treatment for calculations and factors. The GHG "avoided" figure refers to the tons

avoided by increasing zero emission supply, whether new generation or purchases, to meet system growth. The GHG "reductions" figure refers to the emissions reduced from existing fossil generation because of CCS.

b. The GHG reduction and GHG avoided figures do not factor in GHG emissions that may be created in generating the electricity needed to power the CCS technology.

c. The GHG reductions in tons and the decrease in carbon intensity were based on the total GHG emissions from the Big Rivers total system generation supply (all owned generation and purchases in the baseline year (2022)).

i. N/A.

Witness: Talina R. Mathews

JI 2-58 ATTACHMENT

This attachment, in its entirety, has been submitted under seal with an accompanying request for confidential treatment.

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REQUEST NO. 2-59: ***Please refer to Confidential Attachment 1 to your response to JI 1-10. For each of the years 2018 through 2022, please state whether Big Rivers received any revenues for the Wilson plant beyond the energy, capacity, and ancillary services revenues identified in Attachment 1. If yes, please identify the amount and source(s) of such revenues for each of the years 2018 through 2022.***

RESPONSE: In addition to energy, capacity, and ancillary services revenues identified in the attachment to Big Rivers' response to Kentuckians for the Commonwealth/Kentucky Resource Counsel's Request No. 1-10, the Wilson plant also received revenue from fly ash sales listed below:

2018:	$ 0
2019:	$ 0
2020:	$ 9,590
2021:	$38,890
2022:	$17,889

Witness: Christopher A. Warren

IN THE MATTER OF:
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REQUEST NO. 2-60: ***Please refer to Confidential Attachment 1 to your response to JI 1-11. For each of the years 2023 through 2037, please state whether Big Rivers projects that it will receive any revenues for the Wilson plant beyond the beyond the energy, capacity, and ancillary services revenues identified in Attachment 1. If yes, please identify the amount and source(s) of such projected revenues for each of the years 2023 through 2037.***

RESPONSE: In addition to energy, capacity, and ancillary services revenues identified in the attachment to JI 1-11, the Wilson plant projects revenue from fly ash and gypsum sales as listed below:

Year	Gypsum Sales	Fly ash Sales
2023	$0	$ 6,663
2024	[redacted]	
2025		
2026		
2027		
2028		
2029		
2030		
2031		
2032		
2033		
2034		
2035		
2036		
2037		

CONFIDENTIAL
Filed with Motion for Confidential Treatment

IN THE MATTER OF:
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Witness: Christopher A. Warren

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REQUEST NO. 2-61: ***Please refer to your response to OAG 1-8.***

a. Please identify in terms of percent of total system capacity or energy, megawatts, or other quantification measure the amount of "grid-following, inverter-based resources" Big Rivers would consider to be "an excess," and explain the basis for your answer.

b. Please state whether Big Rivers considers battery storage to be a resource that will "complement intermittent renewable resources." If not, explain why not.

RESPONSE:

a. Quantifying a precise amount of "grid-following, inverter-based resources" that Big Rivers would consider excessive is difficult. The point of interconnection to the transmission system and many other factors will significantly impact that determination. Big Rivers is monitoring efforts by both the North American Electric Reliability Corporation (NERC) and the Federal Energy Regulatory Commission (FERC) to address concerns related to the expanded deployment of inverter-based resources.[1]

b. Big Rivers does not consider battery storage a generation resource that will complement intermittent renewable resources. Big Rivers believes resources which make available resilient dispatchable energy best complement intermittent renewable resources.

[1] *See* FERC Order No. 901, Docket No. RM-22-12-000 (Oct. 19, 2023); *Inverter-Based Resource Strategy*, NERC (June 2022) *available at* https://www.nerc.com/comm/Documents/NERC_IBR_Strategy.pdf.

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Witnesses: Christopher Bradley (for subpart a)

Nathanial A. Berry (for subpart b)

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REQUEST NO. 2-62: ***Please refer to your response to OAG 1-9.***

a. ***With regards to your contention that the referenced risk related to solar construction and PPAs is "transient in nature," please identify and explain any working assumption or estimate of by when you anticipate that such risk "will resolve itself."***

b. ***Please state whether Big Rivers believes that there are execution risks associated with the 635 MW NGCC plant included in the IRP. If so, please explain in detail those risks. If not, please explain why not.***

RESPONSE:

a. Big Rivers currently does not have an anticipated time by which the transient risk associated with solar construction will resolve itself.

b. Big Rivers does believe there are execution risks associated with the NGCC. Specifically, the NGCC faces execution risks related to the MISO Generation Interconnection Agreement and supply chain issues.

Witness: Nathanial A. Berry

IN THE MATTER OF:
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REQUEST NO. 2-63: ***Please refer to your response to OAG 1-21.***

a. Please state whether Big Rivers experienced any incidents of low gas pipeline pressure or other gas supply inadequacies at Sebree station during Winter Storm Elliott. If so, explain in detail such incidents.

b. Please identify when and why you explored purchasing firm gas capacity from Texas Gas Transmission, LLC.

c. Please identify the "major system upgrades" that would be needed for firm gas capacity at Sebree station, and the estimated cost of such upgrades.

RESPONSE:

a. Big Rivers did not experience any issues related to gas supply at Sebree Station during Winter Storm Elliot.

b. In December 2016, Big Rivers started conversations with Texas Gas Transmission, LLC regarding firm gas options for Sebree Station. These conversations allowed Big Rivers to thoroughly research firm gas transportation and pipeline reliability. Big Rivers used this research to evaluate a firm gas capacity option when modeling the potential conversion of Green Station's coal-fired units to gas.[1]

[1] *See In the Matter of: Electronic Application of Big Rivers Electric Corporation for a Certificate of Public Convenience and Necessity Authorizing the Green station Units to Natural Gas-Fired Units and an Order Approving the Establishment of a Regulatory Asset*, Case No. 2021-00079 (Mar. 1, 2021).

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c. Please refer to Big Rivers' response to Kentuckians for the Commonwealth /Kentucky Resource Council's Request No. 2-43 for the upgrade details and costs.

Witness: Nathanial A. Berry

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REQUEST NO. 2-64: ***Please refer to your response to OAG 1-27.***

a. Please explain why Big Rivers is considering potential partners/co-owners for the 635 MW NGCC plant identified in the IRP.

b. Please explain in detail the status of Big Rivers' efforts to identify potential partners/co-owners for the referenced NGCC plant and produce any documents used in such efforts.

c. Please identify any partners/co-owners for the NGCC plant that have been identified to date. For each such partner/co-owner, identify the share in MWs of the plant that they would own.

RESPONSE:

a. Big Rivers is considering potential partners/co-owners for the NGCC plant in order to help ensure potential benefits to its Member-Owners through the sharing of costs and output.

b. Big Rivers has, at this time, not had any formal discussions with potential partners/co-owners for the NGCC plant.

c. No partners/co-owners have been identified to date to share in MWs of the NGCC plant.

Witness: Nathanial A. Berry