

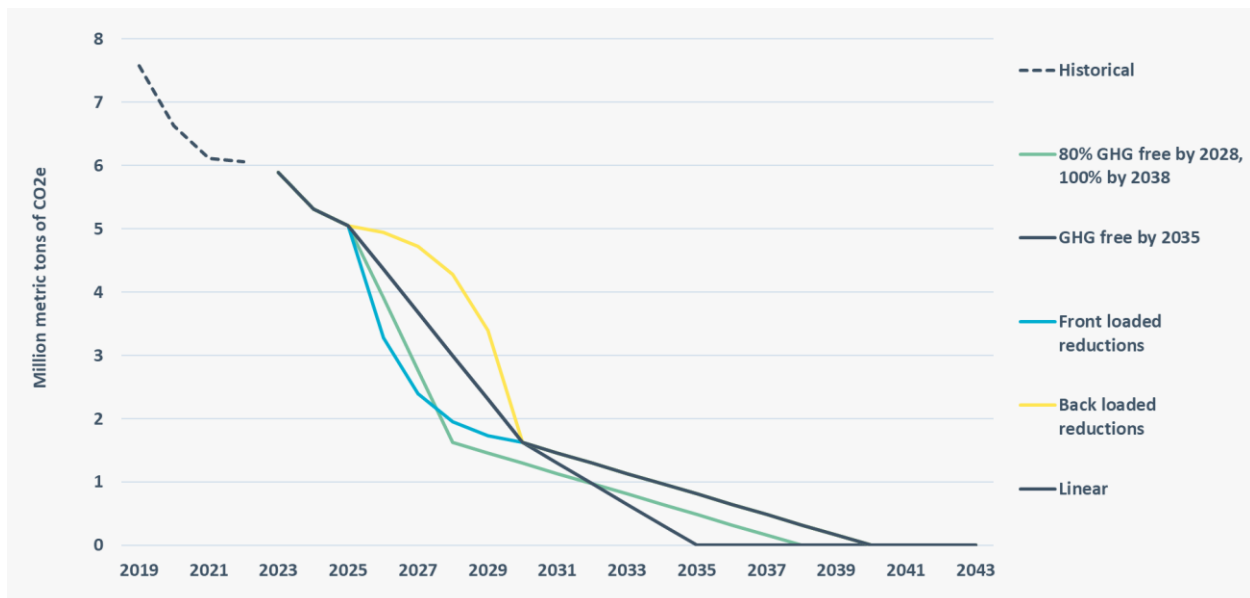
Appendix O. Thermal Operations/ Output

This appendix provides a graphical overview of PGE’s projected retail GHG emissions, emissions and generation by fuel type, heat rate projections by fuel type, and a look at GHG emissions by unit under three different GHG glidepaths.

O.1 PGE GHG emitting resources

PGEs historical retail emissions from 2019 to 2021, as well as IRP forecasts for retail GHG emissions from 2023 to 2043, are shown below in **Figure 175**. The forecast includes five different GHG glidepaths, linear, front loaded (more GHG reductions early), back loaded (more GHG reductions later), GHG free by 2035, and achieving HB 2021 goals two years early.

Figure 175. Annual historical and projected GHG emissions for retail load service



The following graphs (**Figure 176** and **Figure 177**) show total annual GHG emissions and energy generated and purchased by fuel type for resources in the Preferred Portfolio.⁵⁵⁴ Power plant Boardman, which retired in 2020, is in the historical values. Total generation and emissions represent both retail load service and wholesale sales.

⁵⁵⁴ Waste represents a bilateral landfill contract.

Figure 176. Historical and projected total generation and purchases by fuel type from emitting sources

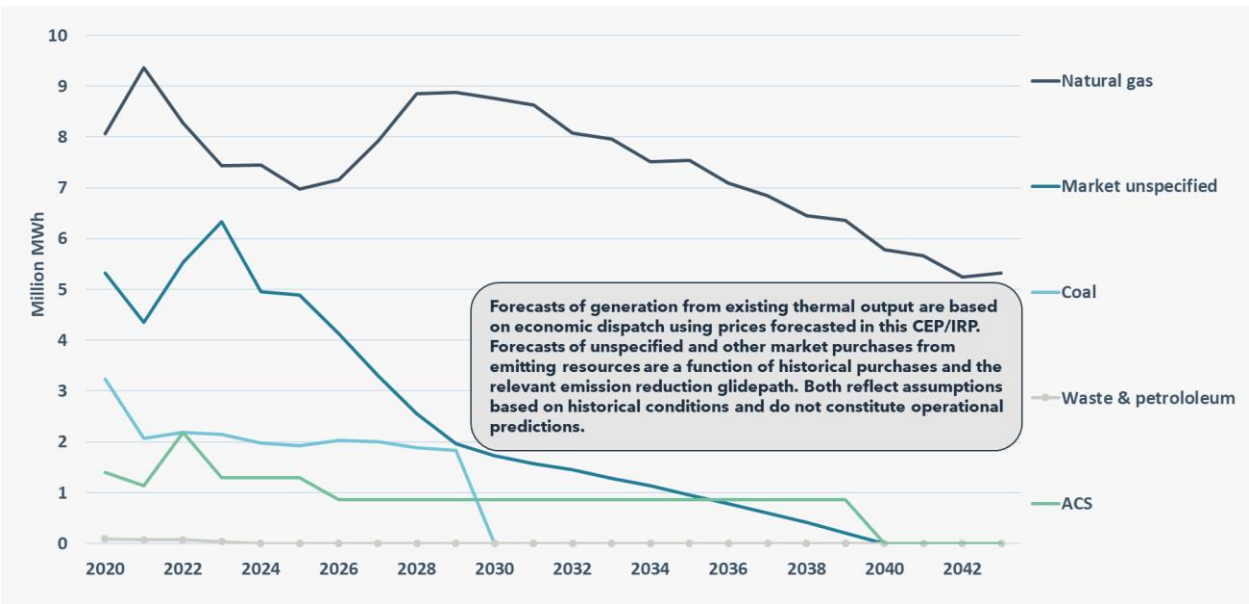
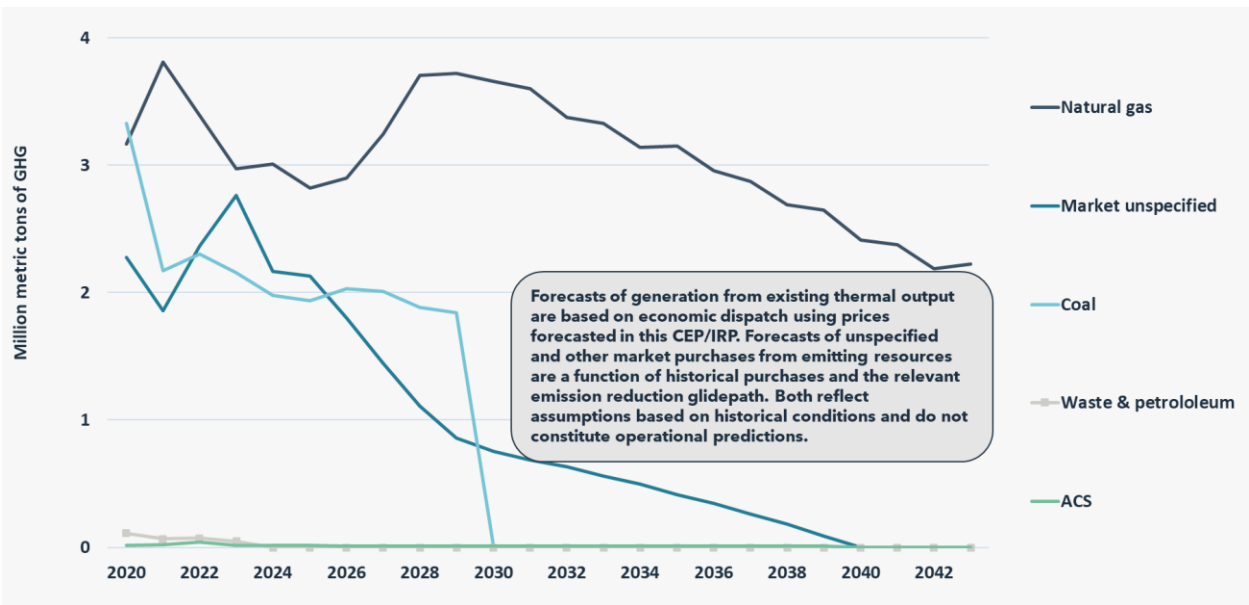


Figure 177. Historical and projected total GHG emissions by fuel type



The following graphs (**Figure 178** and **Figure 179**) show annual GHG emissions and energy generated and purchased by fuel type for resources in the Preferred Portfolio used to serve retail load (power plant Boardman, which retired in 2020, is in the historical values).

Figure 178. Historical and projected retail generation and purchases by fuel type from emitting sources

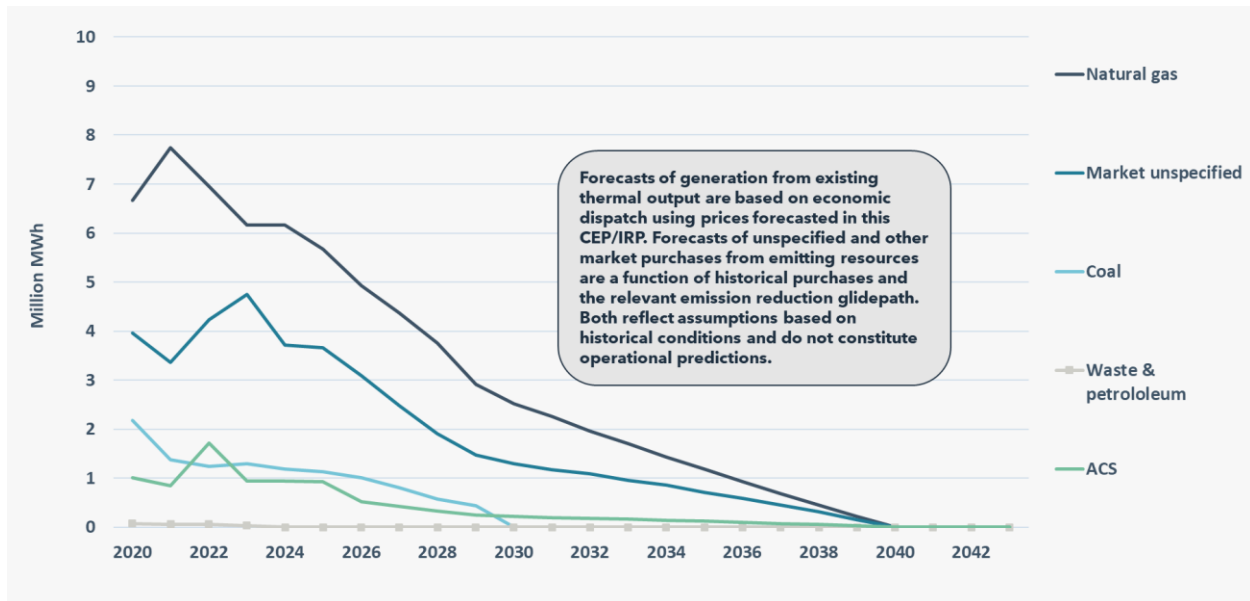
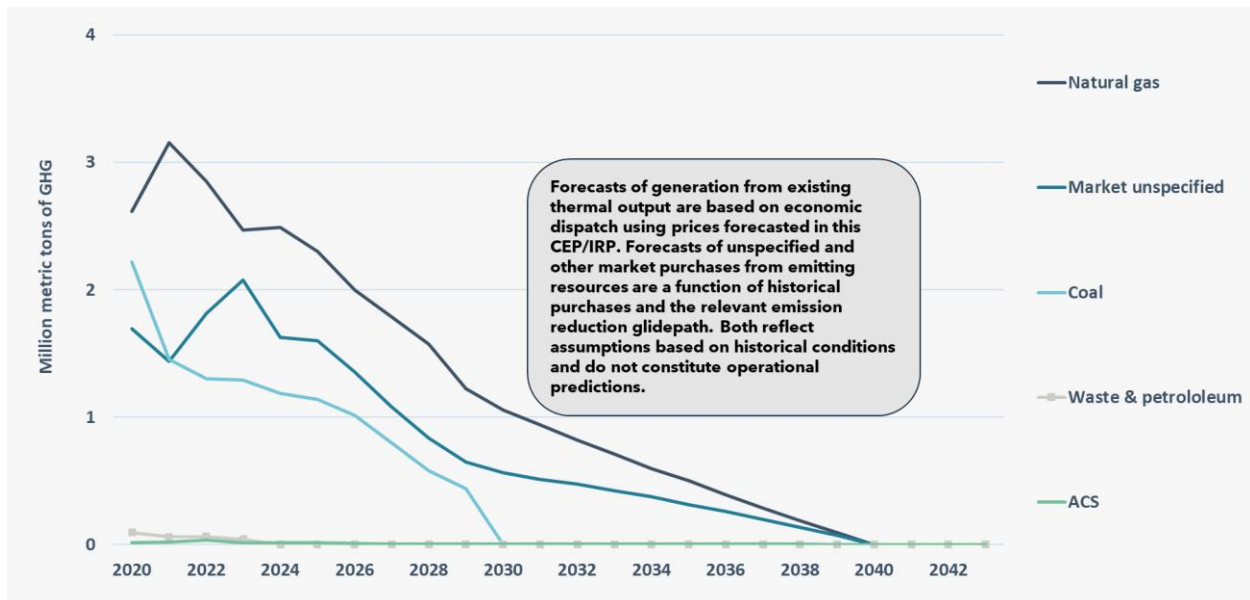


Figure 179. Historical and projected retail GHG emissions by fuel type



The following graph (**Figure 180**) shows the annual weighted average heat rate by fuel type for resources in the Preferred Portfolio. Individual plant heat rates in the forecasted data are static and based on Oregon Department of Environmental Quality (ODEQ) CO₂e intensity values for future years. The future variations in weighted average heat rate are due to annual changes in forecasted economic dispatch. Due to a lack of knowledge of the underlying fuel source market purchase heat rates are not included.

Figure 180. Historical and projected annual weighted average heat rate by fuel

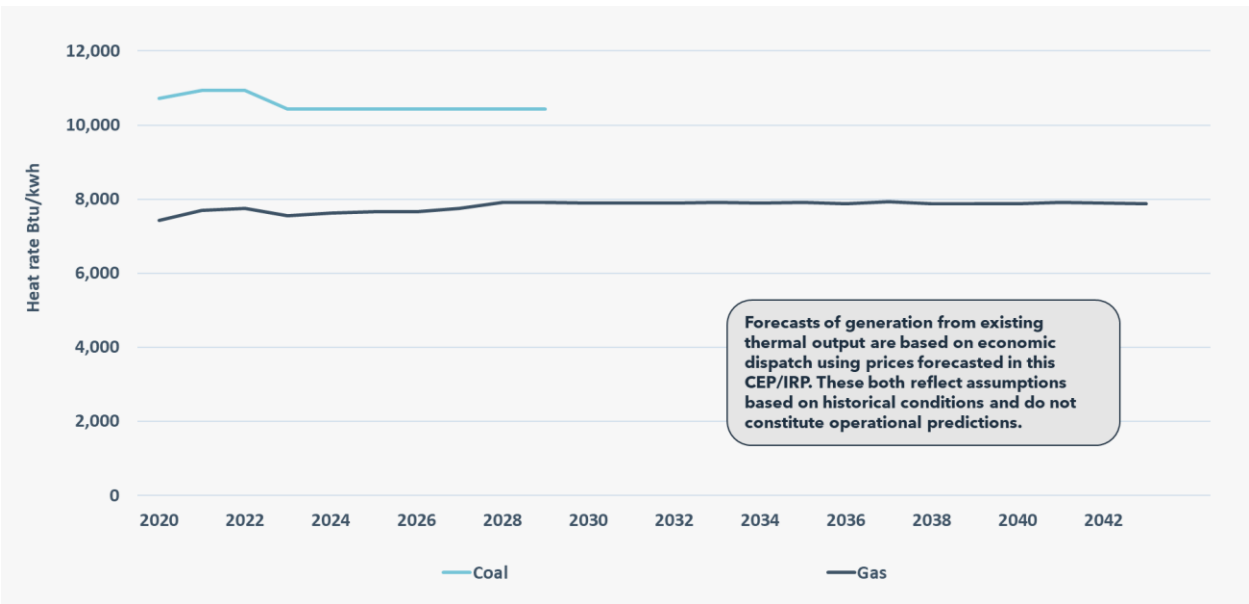


Figure 181-Figure 182 reflect GHG emissions from generation and purchases under three decarbonization glidepaths. The lines specific to individual resources show retail GHG emissions. The wholesale sales category captures GHG emissions from sales from all sources (these are additional to the retail GHG emissions).

Figure 181. Total (retail + wholesale) GHG emissions under a linear reduction glidepath (Reference Case)⁵⁵⁵

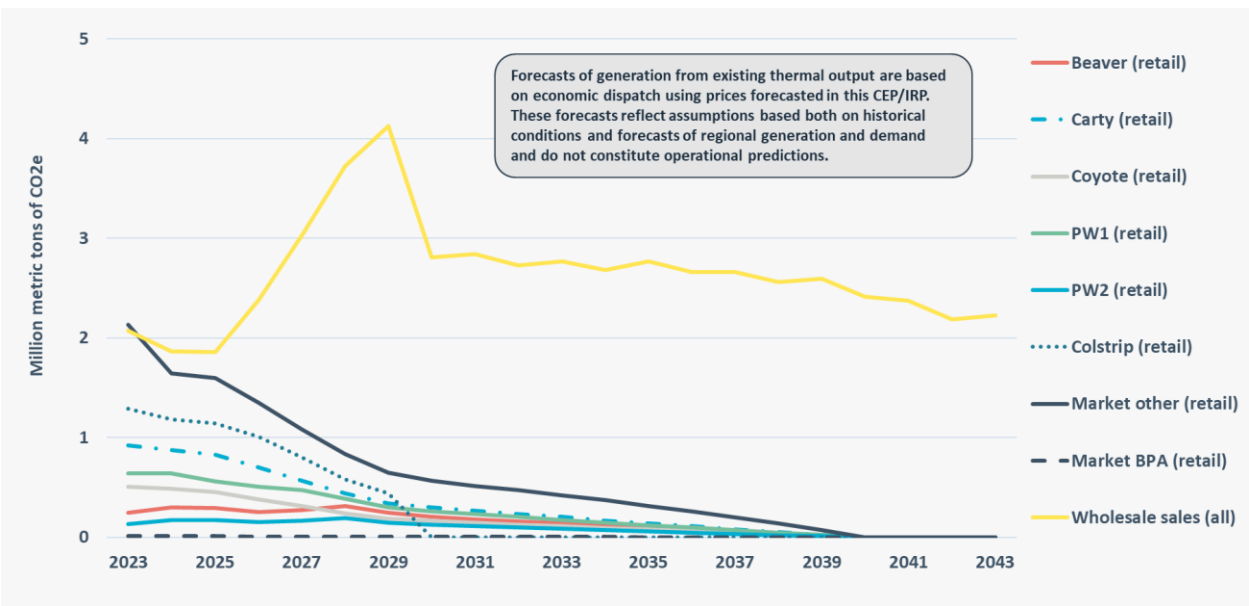


Figure 182. Total (retail + wholesale) GHG emissions under a front-loaded reduction glidepath (Reference Case)

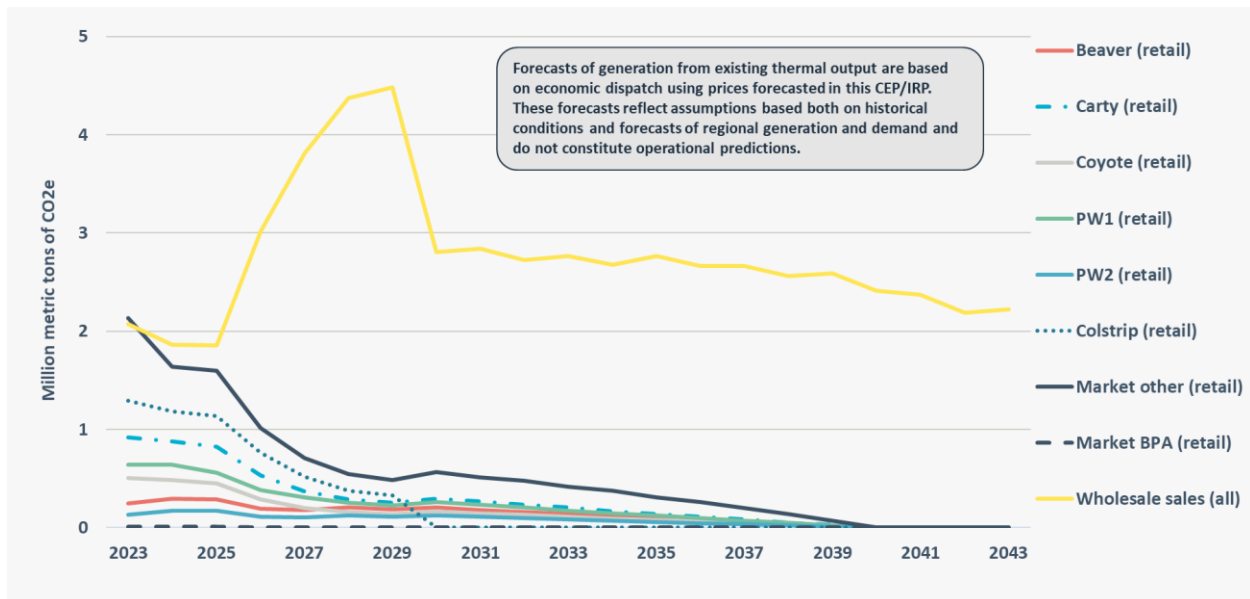
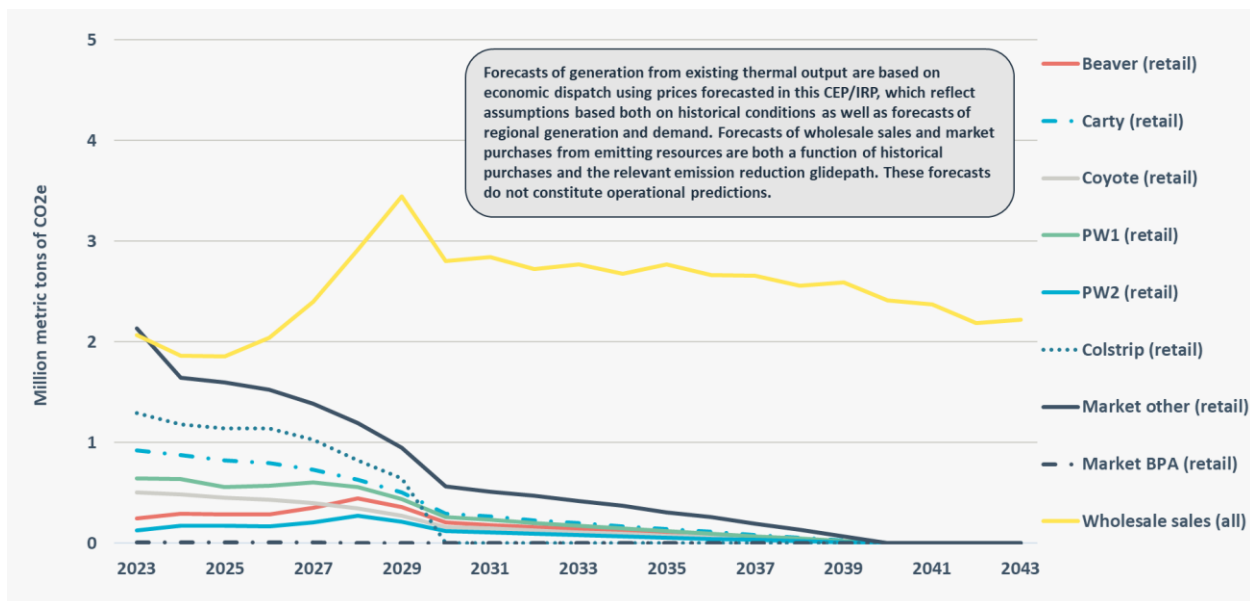


Figure 183. Total (retail + wholesale) GHG emissions under a back-loaded reduction glidepath (Reference Case)



Appendix P. Acronyms

Acronym	Agency/Entity/Term
AC	Alternating Current
ACS	Asset Controlling Supplier
ADF	Augmented Dickey Fuller tests
AEO	Annual Energy Outlook
AI	Artificial Intelligence
aMW	Average Megawatt
ANSI	American National Standards Institute
ARIMA	Autoregressive Integrated Moving Average
ART	Annual Revenue-requirement Tool
ASCC	Associated System Capacity Contribution
ASCE	American Society of Civil Engineers
ATB	Annual Technology Baseline
ATC	Available Transfer Capacity
AUT	Annual Update Tariff
B2H	Boardman to Hemingway
BAA	Balancing Authority Area
BABGI	Building A Better Grid Initiative
BCEM	Business Continuity and Emergency Management Team

Acronym	Agency/Entity/Term
BE	Building Electrification
BES	Bulk Electric System
BESS	Battery Energy Storage System
BFB	Bubbling Fluidized Bed
BIPOC	Black, Indigenous and People of Color
BLS	Bureau of Labor Statistics
BOEM	Bureau of Ocean Energy Management
BOP	Balance of Plant
BPA	Bonneville Power Administration
BPSC	Beaverton Public Safety Center
BTU	British Thermal Units
CA	California
CAA	Community Action Agencies
CAGR	Compounded Annual Growth Rates
CAISO	California Independent System Operator
CARB	California Air Resources Board
CBI	Community Benefit Indicator

Acronym	Agency/Entity/Term
CBIAG	Community Benefits and Impacts Advisory Group
CBO	Community-Based Organization
CBRE	Community-based Renewable Energy
CCCT	Combined-Cycle Combustion Turbine
CCS	Carbon Capture Sequestration
CCUS	Carbon Capture, Utilization and Storage
CDD	Cooling Degree Days
CEAE	Canadian Entitlement Allocation Extension
CEC	California Energy Commission
CELID	Customers Experiencing Long Interruption Duration
CEMI	Customers Experiencing Multiple Interruptions
CEP	Clean Energy Plan
CETA	Washington's Clean Energy Transformation Act
CF	Conditional Firm
CF200	Conditional Firm 200hr Transmission
CHIPS	Creating Helpful Incentives to Produce Semiconductors and Science Act
CHP	Combined Heat and Power

Acronym	Agency/Entity/Term
CIFIA	Carbon Dioxide Transportation Infrastructure Finance and Innovation Program
CO	Colorado
CO2	Carbon Dioxide
CO2e	Emissions of Carbon Dioxide Equivalent
COD	Commercial Operation Date
COP	Construction and Operations Plan
COS	Cost of Service
CPP	Climate Protection Program
CPUC	California Public Utilities Commission
CSO	Community-Serving Organization
CSPV	Crystalline Silicon Photovoltaic
CT	Combustion Turbine
CTWS	Confederated Tribes of Warm Springs
DAC	Direct Air Capture
DC	Direct Current
DEI	Diversity, Equity and Inclusion
DEQ	Department of Environmental Quality
DER	Distributed Energy Resources
DG	Distributed Generation

Acronym	Agency/Entity/Term
DOE	Department of Energy
DOGAMI	Department of Geology and Mineral Industries
DR	Demand Response
DSG	Dispatchable Standby Generation
DSP	Distribution System Plan
E3	Energy and Environmental Economics, Inc.
EDAM	Energy Day-Ahead Market
EE	Energy Efficiency
EFSC	Energy Facility Siting Council
EGS	Enhanced Geothermal Systems
EIA	Energy Information Administration
EIM	Energy Imbalance Market
EIR	Electric Industry Registry
EJ	Environmental Justice
ELCC	Effective Load Carrying Capability
EQC	Environmental Quality Commission
EO	Executive Order
EOH	Equivalent Operating Hours
EPRI	Electric Power Research Institute
ESG	Environmental, Social and Governance

Acronym	Agency/Entity/Term
ESSs	Electricity Service Suppliers
ETO	Energy Trust of Oregon
EV	Electric Vehicle
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
GDP	Gross Domestic Product
GFI	Green Future Impact
GHG	Greenhouse Gases
GMLC	Grid Modernization Laboratory Consortium
GRC	General Rate Case
GW	Gigawatt
H2	Hydrogen Gas
HB	House Bill
HDD	Heating Degree Days
HFRZs	High Fire Risk Zones
HLH	Heavy Load Hour
iCBI	Informational Community Benefits Indicator
IE	Independent Evaluator
IEEE	Institute of Electrical and Electronics Engineers
IEPR	Integrated Energy Policy Report
IIJA	Infrastructure, Investment, and Jobs Act
ILR	Inverter Load Ratio

Acronym	Agency/Entity/Term
IO	Immediate Occupancy
IOC	Integrated Operations Center
IOU	Investor-owned Utilities
IPC	Idaho Power Company
IPCC	Intergovernmental Panel on Climate Change
IQBD	Income Qualified Bill Discount
IRA	Inflation Reduction Act
IRP	Integrated Resource Plan
ISO	Independent System Operator
ITC	Investment Tax Credits
KPSS	Kwiatkowski, Phillips, Schmidt, and Shin tests
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hour
L&R	Load and Resource
LBNL	Laurence Berkeley National Laboratory
LC	Least Cost
LCOE	Levelized Cost of Wind Energy
LDS/LDES	Long-Duration Energy Storage
LGIP	Large Generator Interconnection Process

Acronym	Agency/Entity/Term
LIHEAP	Low-Income Home Energy Assistance Program
LLC	Limited Liability Company
LLH	Light Load Hour
LNG	Liquefied Natural Gas
LOLE	Loss of Load Expectation
LOLH	Loss of Load Hours
LRB	Load Resource Balance
LUCAS	Levelized Utility Cost Aggregator System
LTDA	Long-term Direct Access
LTF	Long-term Firm
MACRS	Modified Accelerated Cost Recovery System
MAIFI	Momentary Average Interruption Frequency Index
MCE	Maximum Credible Earthquake
MED	Major Event Days
MEP	Market Energy Position
Mid-C	Mid-Columbia
Min Avg LT Cost	Minimizing Average Long-term NPVRR
Min Avg ST cost	Minimizing Average Short-term NPVRR
Min Ref ST cost	Minimizing Reference Case Short-term NPVRR
MMBtu	1 Million British Thermal Units

Acronym	Agency/Entity/Term
MMT	Million Metric Tons
MT	Montana
MW	Megawatt
MWa	Megawatt Average
MWac	Megawatt of Alternating Current
MWh	Megawatt-hour
MYP	Multiyear Flexible Load Plan Aka Multi-year Plan
NARUC	National Association of Regulatory Utility Commissions
NASEO	National Association of State Energy Officials
NCE	Non-cost-effective
NEM	Net Energy Metering
NERC	North American Electric Reliability Corporation
NESP	National Energy Screening Project
Net CONE	Net Cost of New Entry
NG	Natural Gas
NITS	Network Integration Transmission Services
NLDA	New Load Direct Access
NM	New Mexico
NOPR	Notice of Open Rulemaking
NPVRR	Net Present Value Revenue Requirement

Acronym	Agency/Entity/Term
NREL	National Renewable Energy Laboratory
NSRDB	National Solar Radiation Database
NTIA	National Telecommunication and Information Administration
NV	Nevada
NWACI	Northwest AC Intertie
NWMT BA	NorthWestern Corporation Balancing Authority
NWS	Non-wires Solutions
O & M	Operations & Maintenance
OAR	Oregon Administrative Rules
OATT	Open Access Transmission Tariff
OCBs	Oil Circuit Breakers
ODOC	Oregon Department of Commerce
OCEWC	Oregon Clean Energy Workforce Coalition
OCS	Outer Continental Shelf
ODEQ	Oregon Department of Environmental Quality
ODOE	Oregon Department of Energy
ODOT	Oregon Department of Transportation
OEQC	Oregon Environmental Quality Commission

Acronym	Agency/Entity/Term
OFA	Over Fire Air
OHA	Oregon Health Authority
OHCS	Oregon Housing and Community Services
OPUC	Oregon Public Utility Commission
OR	Oregon
ORS	Oregon Revised Statutes
OSU	Oregon State University
PACW	PacifiCorp West
PCAM	Power Cost Adjustment Mechanism
pCBI	Portfolio Community Benefit Indicator
PG&E	Pacific Gas & Electric
PGE	Portland General Electric
PGEM	PGE Merchant
PGET	PGE Transmission System
PNUCC	Pacific Northwest Utilities Conference Committee
PNW	Pacific Northwest
POD	Point of Delivery
POI	Point of Interconnect
POR	Point of Receipt
PPA	Power Purchase Agreement
PRM	Planning Reserve Model
PSH	Pumped Storage Hydro
PSPS	Public Safety Power Shutoff
PTC	Production Tax Credit

Acronym	Agency/Entity/Term
PTP	Point-to-Point
PUC	Public Utility Commission
PUD	Public Utility District
PUMS	Public Use Microdata Sample
PV	Photovoltaic
PZM	PGE Zone Model
QF	Qualifying Facilities
rCBI	Resource Community Benefit Indicator
R&D	Research and Development
RC	Reliability Coordinator
RCP	Representation Concentration Pathway
RDPO	Regional Disaster Preparedness Organization
REC	Renewable Energy Certificates
RFP	Request for Proposals
RMJOC	River Management Joint Operating Committee
RNG	Renewable Natural Gas
ROSE-E	Resource Optimization Strategy Engine
ROW	Rights-of-Way
RPS	Renewable Portfolio Standard
RTO	Regional Transmission Organization

Acronym	Agency/Entity/Term
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SALMON	Smart Grid Advanced Load Management & Optimized Neighborhoods
SAM	System Advisor Model
SAP	Site Assessment Plan
SB	Senate Bill
SC-CO2	Supercritical Carbon Dioxide
SCCT	Simple-Cycle Combustion Turbine
SCR	Selective Catalytic Reduction
SE	Southeast
SEC	Securities and Exchange Commission
SGTB	Smart Grid Test Bed
SMR	Small Modular Reactor
SoA	South of Allston
SPP	Southwest Power Pool
SSPC	Salem Smart Power Center
STDA	Standard-term Direct Access
STEP	Strategic Tribal Engagement Plan
STG	Steam Turbine Generator
T&D	Transmission and Distribution

Acronym	Agency/Entity/Term
TE	Transportation Electrification
TEP	Transportation Electrification Plan
TRC	Total Resource Cost
TSR	Transmission Service Request
TSEP	TSR Study and Expansion Process
TTC	Total Transfer Capability
Tx	Transmission
UAMPS	Utah Associated Municipal Power Systems
UGB	Urban Growth Boundary
UM	Utility Matter
URM	Unreinforced Masonry
US	United States
US DOC	United States Department of Commerce
US DOE	US Department of Energy
US DOEE	US DOE & Environment
US EPA	United States Environmental Protection Agency
VER	Variable Energy Resources
VAR	Value at Risk
VOS	Value of Service
VPP	Virtual Power Plant
WA	Washington
WAP	Low Income Weatherization Assistance Program

Acronym	Agency/Entity/Term
WECC	Western Electricity Coordinating Council
WIND	Wind Integration National Database
WM	Wood Mackenzie (consultancy)
WMP	Wildfire Mitigation Plan
WOCS	West of Cross Cascades South
WPP	Western Power Pool
WRAP	Western Resource Adequacy Program
WX T&TA	Weatherization Training and Technical Assistance
WY	Wyoming