



LEI Semi-Annual Regional Market Update and 10-year Energy Price Forecast

US Western Interconnection (excluding California)

1st Quarter 2020

717 Atlantic Avenue, Suite 1A
Boston, Massachusetts 02111
Tel: (617) 933-7200
Fax: (617) 933-7201

390 Bay Street, Suite 1702
Toronto, Ontario M5H 2Y2
Tel: (416) 643-6610
Fax: (416) 643-6611

www.londoneconomicspress.com

Description of Report

London Economics International LLC ("LEI") provides semi-annual regional market updates and 10-year energy price forecasts for major markets in North America and around the world. In addition to providing price projections, the reports highlight major developments in each of the regions as well as the underlying structural dynamics. LEI also provides more detailed regional market price forecasts tailored to a client's individual needs, including longer time horizons and forecasting of plant-specific revenues or the impact of structural or market design changes.

Disclaimer

The contents of this report do not constitute investment advice. The provision of analysis by LEI does not obviate the need for an investor to make further appropriate inquiries as to the accuracy of the information included therein, and to undertake his/her own analysis and due diligence. This report is not intended to be a complete and exhaustive analysis of all the factors impacting the regional market. LEI, its officers, employees, and affiliates make no representations, warranties, or recommendations.

Table of contents

1	MARKET OVERVIEW AND RECENT DEVELOPMENTS	1
1.1	MARKET OVERVIEW	1
1.2	EXISTING SUPPLY AND DEMAND	3
1.3	RECENT DEVELOPMENTS	5
1.3.1	<i>Note on impact of COVID-19</i>	5
1.3.2	<i>Continued growth in renewable generation</i>	5
1.3.3	<i>Continued coal retirements, retrofits and conversions</i>	6
1.3.4	<i>Transmission planning developments</i>	7
1.3.5	<i>Continued regionalization</i>	10
2	MODELING ASSUMPTIONS	13
2.1	MARKET TOPOLOGY	13
2.2	FUEL PRICE PROJECTIONS.....	13
2.3	EMISSION COSTS.....	15
2.4	RENEWABLE RESOURCE BASE	16
2.4.1	<i>Hydrology</i>	16
2.4.2	<i>Wind production profiles</i>	17
2.4.3	<i>Solar insolation</i>	19
2.5	RENEWABLE PORTFOLIO STANDARD REQUIREMENTS.....	20
2.6	MARKET SUPPLY AND DEMAND	21
2.6.1	<i>New entry</i>	21
2.6.2	<i>Cost of generic new entry</i>	23
2.6.3	<i>Plant retirements</i>	24
2.6.4	<i>Import and export flows.....</i>	26
2.6.5	<i>Demand</i>	26
2.6.6	<i>Region-wide demand-supply balance for WECC.....</i>	27
3	10-YEAR PRICE FORECAST	29
3.1	ENERGY MARKET PRICES.....	29
4	APPENDIX A: OVERVIEW OF FORECASTING METHODOLOGY	32
5	APPENDIX B: ABOUT LEI AND WECC EXPERIENCE	33

Table of figures

FIGURE 1. BALANCING AUTHORITIES IN THE WESTERN INTERCONNECTION	1
FIGURE 2. INSTALLED CAPACITY (2019) AND GENERATION (2019), BY MARKET PLAYER	2
FIGURE 3. INSTALLED CAPACITY (END OF 2019) AND GENERATION (2019), BY FUEL TYPE.....	3
FIGURE 4. DIVERSITY OF RESOURCES ACROSS WECC SUB-REGIONS (2019 INSTALLED CAPACITY BY FUEL TYPE).....	4
FIGURE 5. INSTALLED CAPACITY BY NERC SUB-REGION, AND BY FUEL TYPE	5
FIGURE 6. SUMMARY OF RECENT DEVELOPMENTS FOR WECC (OUTSIDE CALIFORNIA)	5
FIGURE 7. WESTERN INTERCONNECTION CAPACITY ADDITIONS IN PAST 5 YEARS (2015-2019) AND UNDER CONSTRUCTION IN NEXT 5 YEARS (2020-2024), BY FUEL TYPE	6
FIGURE 8. EXISTING COAL-FIRED CAPACITY BY AGE (AS OF 2020 Q1)	7
FIGURE 9. LARGEST PROPOSED NEW TRANSMISSION PROJECTS IN THE WESTERN INTERCONNECTION	8

FIGURE 10. PATHWAYS OF PROPOSED TRANSWEST EXPRESS, GATEWAY SOUTH, AND GATEWAY WEST TRANSMISSION PROJECTS	9
FIGURE 11. TIMELINE OF WESTERN EIM DEVELOPMENTS.....	11
FIGURE 12. CAISO EIM FOOTPRINT	11
FIGURE 13. AVOIDED CURTAILMENT IN CAISO DUE TO EIM.....	12
FIGURE 14. REGIONAL TRANSMISSION INTERFACE LIMITS IN THE WESTERN INTERCONNECTION.....	13
FIGURE 15. NATURAL GAS PRICE PROJECTIONS (NOMINAL \$/MMBTU)	14
FIGURE 16. EMISSIONS COST PROJECTIONS (NOMINAL \$/TON)	16
FIGURE 17. MONTHLY HYDROELECTRIC PRODUCTION IN WECC (1999-2018)	17
FIGURE 18. AVERAGE YEARLY HYDROELECTRIC PRODUCTION IN WECC (1999-2018).....	17
FIGURE 19. AVERAGE HOURLY CAPACITY FACTORS FOR WIND PROJECTS BY REGION.....	18
FIGURE 20. AVERAGE HOURLY CAPACITY FACTORS FOR WIND PROJECTS BY SEASON (CHART FOR RMPA).....	18
FIGURE 21. CUMULATIVE INSTALLED CAPACITY OF NEW WIND PROJECTS.....	19
FIGURE 22. AVERAGE HOURLY GENERATION PROFILE FOR SOLAR PROJECTS	19
FIGURE 23. SEASONAL DIFFERENCES IN SOLAR OUTPUT (CHART FOR RMPA)	20
FIGURE 24. CUMULATIVE INSTALLED CAPACITY OF NEW SOLAR PROJECTS	20
FIGURE 25. WESTERN US STATES WITH RENEWABLE PORTFOLIO STANDARDS.....	21
FIGURE 26. RPS REQUIREMENTS ACROSS WECC.....	21
FIGURE 27. CUMULATIVE ADDITIONS BETWEEN 2021 AND 2030.....	23
FIGURE 28. COST OF GENERIC NEW ENTRY ASSUMPTIONS, 2021	24
FIGURE 29. ANNOUNCED COAL RETIREMENTS IN WECC	25
FIGURE 30. AGE OF COAL UNITS NOT RETIRED IN 2021-2030 BY SIZE	25
FIGURE 31. MODELED NET IMPORT OR EXPORT TARGETS FOR WECC (GWH PER YEAR)	26
FIGURE 32. DEMAND FORECASTS FOR THE THREE SUB-REGIONS OF WECC	27
FIGURE 33. DEMAND-SUPPLY BALANCE FOR WECC	27
FIGURE 34. INTERNAL SUPPLY CURVE FOR WECC (2021) (NOMINAL \$/MWH)	28
FIGURE 35. FORECAST ANNUAL AVERAGE ENERGY MARKET PRICES, 2020-2029 (NOMINAL \$/MWH) COMPARED WITH HENRY HUB GAS PRICES (NOMINAL \$/MMBTU)	29
FIGURE 36. ANNUAL AVERAGE, AVERAGE PEAK AND OFF-PEAK ENERGY PRICES FOR DESERT SW SUB-REGION (NOMINAL \$/MWH)	30
FIGURE 37. FORECAST IMPLIED MARKET HEAT RATES (MMBTU/MWH) AND ANNUAL RESERVE MARGINS (%), 2021 THROUGH 2030	31
FIGURE 38. POOLMod's TWO-STAGE PROCESS.....	32
FIGURE 39. LEI'S ECONOMIC, FINANCIAL, REGULATORY, AND STRATEGIC MANAGEMENT ADVISORY EXPERTISE ..	33