EXH. EKH-2
DOCKET UE-210795
2022 PSE CEIP
WITNESS: ELAINE K. HART

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

In the Matter of PUGET SOUND ENERGY, INC. 2021 Clean Energy Implementation Plan	**Docket UE-210795**

FIRST EXHIBIT (PROFESSIONAL QUALIFICATIONS) TO THE PREFILED RESPONSE TESTIMONY OF

ELAINE K. HART

ON BEHALF OF NW ENERGY COALITION AND FRONT AND CENTERED

OCTOBER 10, 2022

Elaine Hart, Ph.D.

MOMENT ENERGY INSIGHTS

Elaine Hart brings over a decade of experience in resource planning, clean energy system computational analysis, renewable integration, flexible resource valuation, decarbonization policy analysis, and resource adequacy. Dr. Hart has driven innovation in resource planning and decarbonization strategy from within a major investor-owned utility and, as a consultant, has assisted regulatory agencies, utilities, advocates, and developers in understanding the challenges and opportunities presented by the transition to cleaner energy systems.

Education

Stanford University

Ph.D., Civil & Env. Engineering 2012
Dissertation: Optimization-Based Modeling Methods for Reliable Low Carbon Electricity Portfolios

M.S., Mat. Science & Engineering 2008

Harvey Mudd College

B.S., Chemistry 2006
Concentration in Political Studies

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Professional Experience

Moment Energy Insights LLC — Portland, OR

Founding Principal 2020-present

- Co-lead of a resource adequacy study of the Western United States with Blue Marble Analytics.
- Consultant to Oregon Public Utility Commission in support of HB 2021 implementation planning.
- GridLab Expert
  - Technical advisor to the NW Energy Coalition on resource planning issues related to implementation of Washington's Clean Energy Transformation Act.
  - Technical advisor to the NW Energy Coalition in reviewing the Northwest Power and Conservation Council's 2021 Power Plan.
  - Technical advisor on issues related to resource adequacy accreditation in California.

Portland General Electric (PGE) — Portland, OR

Manager, Integrated Resource Planning (IRP) 2018 – 2020
Principal Analyst, IRP 2016 – 2018

- Led the development of and regulatory strategy for the 2019 IRP and the 2016 IRP Revised Renewable Action.
- Led internal energy storage modeling for the 2016 IRP and PGE's Energy Storage Potential Evaluation (UM 1856).
- Lead developer for internal resource adequacy (Sequoia) and portfolio optimization (ROSE-E) planning models.
- Supported 2018 Renewable RFP design and scoring and evaluation of capacity products in bilateral negotiations.
- Technical lead for PGE's decarbonization strategy and economy-wide Decarbonization Study.

Energy & Environmental Economics, Inc (E3) — San Francisco, CA

Managing Consultant 2015 – 2016
Senior Consultant 2012 – 2015

- Served as technical lead on renewable integration, clean energy policy, and grid flexibility studies, including:
  - "Feasibility and cost of potential 2030 GHG reduction goals" on behalf of California agencies (CARB, CEC, CPUC, and CAISO)
  - "Western Interconnection Flexibility Assessment" on behalf of the WECC and the Western Interstate Energy Board (WIEB)
  - The first analysis of the impacts of 50% RPS in California on behalf of PG&E, SCE, SDG&E, LADWP, & SMUD
  - Energy storage valuation for a pumped storage developer in California
- Co-developed E3's *RESOLVE* model; developed the electricity system dispatch module within E3's *PATHWAYS* model; and co-developed E3's *REFLEX* model and managed implementation on PLEXOS and ProMaxLT™.

Elaine Hart, Ph.D.

MOMENTUM ENERGY INSIGHTS

Stanford University — Stanford, CA

Research Assistant – Department of Civil and Environmental Engineering 2008 – 2012

- Applied optimization and Monte Carlo methods to quantify renewable integration challenges and carbon abatement potentials at very high renewable penetrations.

Professional Service

- Member, ESIG and GPST Resource Adequacy Task Forces 2021
- Member, Technical Review Committee for the Oregon Clean Energy Pathways study 2021
- Co-chair, Modeling and IRP Working Groups, Northwest Power Pool (NWPP) Resource Adequacy Program 2020
- Member, Technical Advisory Committee for WIEB Western Flexibility Assessment 2019
- Reviewer for *Science, IEEE Transactions on Power Systems*, *Proceedings of the IEEE*, *Energy & Environmental Science*, and *The Energy Journal*

Selected Talks and Panels

Resource Adequacy

- "Evolutions in Resource Adequacy," ESIG Spring Workshop, March 2022.
- "Trends and Regional Challenges in Resource Adequacy," FERC Technical Conference to Discuss the Resource Adequacy Developments in the Western Interconnection, June 2021.
- "Rethinking Resource Adequacy in a Decarbonized World," Building the Decarbonized Grid, GridForward Virtual Summit, June 2021.
- "Do we have enough power and services to meet future electricity needs?" Northwest Energy Coalition Resource Adequacy Virtual Webinar, May 2020.
- "Capacity Realities: Avoiding a Regional Resource Shortfall," Oregon Citizens' Utility Board (CUB) Policy Conference, Portland, OR, November 2019.

Energy Storage and Renewable Integration

- "Resource Planning with Renewables and Storage," NextEra Energy Resources Northwest Storage Summit, Portland, OR, October 2019.
- "The Future of Energy Storage – How Does it Look?" HydroVision International, Portland, OR, July 2019.
- "The Role of Energy Storage in Utility Resource Planning," A Valuable and Timely In-Depth Conference on Energy Storage, Law Seminars International, Seattle, WA, June 2018.
- "Energy Storage Evaluation at Portland General Electric," Energy Storage Association Annual Conference, Boston, MA, April 2018.
- "Energy Storage in Integrated Resource Plans," Western Interstate Energy Board, Fall 2017 Joint CREPC-WIRAB Meeting, Reno, NV, October 2017.
- "How Storage is Being Evaluated in IRPs Today and What's Next," Northwest DR and Energy Storage Summit, Portland, OR, September 2017.
- "Energy storage evaluation in PGE's 2016 IRP," Western Energy Institute IRP Forum, April 2017.
- "Energy storage evaluation in Oregon," North Carolina Sustainable Energy Association's Energy Storage Working Group, January 2017.

ELAINE HART, PH.D.

- "An Economic Framework for Flexible Resource Planning," IEEE Power and Energy Society General Meeting, Denver, CA, July 2015.
- "Computational Methods for Designing and Operating Sustainable Electricity Systems," Mechanical and Aerospace Engineering Seminar, UC San Diego, February 2014.
- "The Role of Meteorological Forecasting in Quantifying the Carbon Emissions Associated with Highly Intermittent Renewable Portfolios," American Geophysical Union Fall Meeting, San Francisco, CA, 2010.
- "An Optimization and Monte Carlo Planning Approach for High Penetrations of Intermittent Renewables," INFORMS Annual Meeting, Austin, TX, 2010.

DECARBONIZATION AND CLEAN ENERGY POLICY

- "100% Renewable Targets: What will be required to achieve the goal? At what cost to ratepayers?" 25th Annual Conference on Buying & Selling Electric Power in the West, Law Seminars International, Seattle, WA, January 2020.
- "The Future of Corporate Decarbonization," NEBC Business & The Environment Conference and Expo, Portland, OR, December 2019.
- "The New Oregon Trail: Decarbonizing the Electric Grid," National Association of State Utility Consumer Advocates Mid-Year Meeting, Portland, OR, June 2019.
- "Deep Decarbonization: From Energy to the Economy," CUB Policy Conference, Portland, OR, October 2018.
- "Decarbonization in PGE's Service Area," NEBC Oregon's Energy Future Conference, Portland, OR, May 2018.
- "Renewable Electricity Systems: How High Can You Go?" Low Emissions Solutions Conference, Climate Week NYC, New York, NY, September 2017.
- "California PATHWAYS: Long-term Greenhouse Gas Reduction Scenarios for California," Special Hearing on Renewable Integration - Ensuring Grid Reliability, California State Assembly Select Committee on California's Clean Energy Economy, Sacramento, CA, August 2015.
- "Modeling pathways to long-term greenhouse gas reductions in California," Stanford Energy Seminar, Stanford, CA, June 2015.
- "Investigating a Higher Renewables Portfolio Standard in California," 19th Annual POWER Conference on Energy Research and Policy, UC Berkeley, March 2014.
- "Low Carbon Pathways Model," California Climate Policy Modeling Forum, UC Davis, December 2013.

SELECTED PUBLICATIONS AND REPORTS

INTEGRATED RESOURCE PLANNING

- "2019 Integrated Resource Plan," Portland General Electric, July 2019, <https://edocs.puc.state.or.us/efdocs/HAA/lc73haa162516.pdf>. *[Primary editor of document; primary author of Executive Summary, Chapter 6 – Resource Economics, Chapter 7 – Portfolio Analysis, Chapter 8 – Action Plan]*
- "Addendum to PGE's 2016 Integrated Resource Plan – Revised Renewable Action Plan," Portland General Electric, November 2017, < https://edocs.puc.state.or.us/efdocs/HAH/lc66hah111459.pdf>. *[Primary author]*
- "2016 Integrated Resource Plan," Portland General Electric, November 2016, <https://edocs.puc.state.or.us/efdocs/HAA/lc66haa144338.pdf>. *[Primary author of Chapter 8 – Energy Storage and Section 5.3 – Flexible Capacity]*

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ENERGY STORAGE AND RENEWABLE INTEGRATION

- UM 1856, "PGE Exhibit 200 – Direct Testimony of Elaine Hart, Tess Jordan, Jay Landstrom," Portland General Electric, January 2018, <https://edocs.puc.state.or.us/efdocs/HTB/um1856htb165749.pdf>
- UM 1751, "Energy Storage Potential Evaluation," Draft report to the OPUC, Portland General Electric, July 2017 <https://edocs.puc.state.or.us/efdocs/HAA/haa115310.pdf> *[Primary author of appendix B.2]*
- N. Schlag, A. Olson, E. Hart, A. Mileva, R. Jones, C. Brancucci Martinez-Anido, B.-M. Hodge, G. Brinkman, A. Florita, and D. Biagioni, "Western Interconnection Flexibility Assessment," E3 and NREL, Report to the Western Electricity Coordinating Council (WECC) and Western Interstate Energy Board (WIEB), December 2015. <https://www.wecc.org/Reliability/WECC_Flexibility_Assessment_Report_2016-01-11.pdf>
- J. Hargreaves, E. K. Hart, R. Jones, and A. Olson. REFLEX: An adapted production simulation methodology for flexible capacity planning. IEEE Trans. Power Systems, 30(3):1306–1315, May 2015. doi: 10.1109/TPWRS.2014.2351235.
- A. Olson, R. Jones, E. Hart, and J. Hargreaves. Renewable curtailment as a power system flexibility resource. Electricity Journal, 27:49–61, 2014. doi: 10.1016/j.tej.2014.10.005.
- E. K. Hart, E. D. Stoutenburg, and M. Z. Jacobson. The potential of intermittent renewables to meet electric power demand: Current methods and emerging analytical techniques. Proceedings of the IEEE, 100(2):322–334, February 2012. doi: 10.1109/JPROC.2011.2144951.
- E. K. Hart and M. Z. Jacobson. A Monte Carlo approach to generator portfolio planning and carbon emissions assessments of systems with large penetrations of variable renewables. Renewable Energy, 36(8):2278 – 2286, 2011. doi: 10.1016/j.renene.2011.01.015.

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- Yeh, S., C. Yang, M. Gibbs, D. Roland-Holst, J. Greenblatt, A. Mahone, D. Wei, G. Brinkman, J. Cunningham, A. Eggert, B. Haley, E. Hart, J. Williams, A modeling comparison of deep greenhouse gas emissions reduction scenarios by 2030 in California, Energy Strategy Reviews 13-14: 169-180, 2016. doi: 10.1016/j.esr.2016.10.001.
- Mahone, A., D. Mahone, E. Hart. What if Efficiency Goals were Carbon Goals? ACEEE Summer Study 2016 Conference Proceedings, 2016. <https://www.aceee.org/files/proceedings/2016/data/papers/9_284.pdf>
- A. Olson, A. Mahone, E. Hart, J. Hargreaves, R. Jones, N. Schlag, G. Kwok, N. Ryan, R. Orans, and R. Frowd. Halfway there: Can California achieve a 50% renewable grid? IEEE Power and Energy Magazine, 13, 2015. DOI: 10.1109/MPE.2015.2423211.
- A. Olson, A. Mahone, E. K. Hart, J. Hargreaves, R. Jones, G. Kwok, N. Schlag, N. Ryan, R. Frowd, D. Korinek, and R. Orans. Investigating a higher Renewables Portfolio Standard in California. Jan 2014. <https://www.ethree.com/wp-content/uploads/2017/01/E3_Final_RPS_Report_2014_01_06_with_appendices.pdf>
- E. K. Hart and M. Z. Jacobson. The carbon abatement potential of high penetration intermittent renewables. Energy Environ. Sci., 5:6592–6601, 2012. doi: 10.1039/C2EE03490E.