

EPRI Energy and Environmental Analysis Group Research on the Value, Costs, and Impacts of Renewable Generation

Last Updated: January 2019

This is a summary of all of EPRI's Energy and Environmental Analysis (EEA) Group's research in the renewable generation space, including work in progress. Web links are included where available. Publications marked with an * are available to the public free of charge, or are published in academic journals. Other publications are available to EPRI member companies that fund certain program(s), as indicated with a number in brackets preceding the publication title and can be purchased by members of the public who may be interested in doing so, subject to EPRI's product distribution requirements. For a full list of EEA research, please visit the EEA public website at <http://eea.epri.com/research.html>.

On the economics of high penetration of renewable generation

* *Decreasing Returns to Renewable Energy*, EPRI Report 3002003946,
<http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002003946>

(103) *Program 103 Webcast on the Economics of Storage and Renewable Generation*, May 2017,
<https://membercenter.epri.com/Programs/109396/pages/eventdetails.aspx?eventID=933B40CA-3F6E-4ECB-9C75-B1C7AAEC9E8E>

(201-C) *Program 201-C Webcast on Economic Drivers of Wind and Solar*, January 2018,
<https://membercenter.epri.com/Programs/109396/pages/eventdetails.aspx?eventID=3EF76A32-FA8A-4664-8553-05C08A602DD2> (webcast recording also available via this link)

(201-C) *Program 201-C Webcast on Regional Renewable Penetration*, September 2018,
<https://membercenter.epri.com/Programs/109396/pages/eventdetails.aspx?eventID=6C586B9D-12E2-474B-8C04-B86F121F4F38> (webcast recording also available via this link)

* *In Progress: Academic paper on "Drivers of Economic Wind and Solar Penetration in the United States" submitted to the Proceedings of the National Academies of Sciences as of December 2018. David Young presented on this topic at the International Association of Energy Economists conference in November 2017*

Responses to the academic literature on '100% renewables'

* *Bistline, J. E. and G. J. Blanford, 2016. More than One Arrow in the Quiver: Why "100% Renewables" Misses the Mark. Proceedings of the National Academy of Sciences, 113(28): E3988,*
<http://www.pnas.org/content/113/28/E3988>

(103/178-B) *Challenges to Very High Renewable Penetration: Critique of Jacobson et al. (2015). EPRI Report 3002008624,* <https://www.epri.com/#/pages/product/000000003002008624/>

On the value of flexible operations and ancillary services under high renewable deployment

* *Program on Technology Innovation: Fossil Fleet Transition with Fuel Changes and Large Scale Variable Renewable Integration*, EPRI Report 3002006517,
<http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002006517>

* *Technical and Economic Challenges of Flexible Operations: Case Studies of California and Texas*, EPRI Report 3002008242, <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=00000003002008242>

(178-B) *The Evolution of Ancillary Services to Facilitate Integration of Variable Renewable and Distributed Energy Resources: A Survey of Some Changes to the Ancillary Services and Ancillary Service Markets*, EPRI Report 3002008987, 2016, <https://www.epri.com/#/pages/product/00000003002008987/?lang=en>

* Bistline, J. E., 2017. *Economic and technical challenges of flexible operations under large-scale variable renewable deployment*. *Energy Economics*, 64:363-372, <http://www.sciencedirect.com/science/article/pii/S0140988317301196>

(178-B) *Impact of Variable Renewable Energy on Fossil Fleet Utilization: Insights for the High Plains*, EPRI Report 3002008450, <https://membercenter.epri.com/Programs/069228/pages/productabstract.aspx?ProductId=00000003002008450>

(178-B) *Economic Value of Increased Operational Flexibility for Fossil-Fired Generation Assets*, EPRI Report 3002013735, <https://membercenter.epri.com/Programs/069228/pages/productabstract.aspx?ProductId=00000003002013735>

* Bistline, J. E., 2019. *Turn Down for What? The Economic Value of Operational Flexibility in Electricity Markets*. *IEEE Transactions on Power Systems*, 34(1):527–534, <https://ieeexplore.ieee.org/abstract/document/8412506>

On renewable mandate policies

* *Systems Analysis in Electric Power Sector Modeling: Evaluating Model Complexity for Long-Range Planning*. EPRI Report 3002011365, 2018, <https://www.epri.com/#/pages/product/3002011365/?lang=en>

(103) *Program 103 Webcasts on True Costs of Renewable Portfolio Standards*, June 2017 (preliminary) <https://membercenter.epri.com/Programs/109396/pages/eventdetails.aspx?eventID=01785E0F-1DA1-49C2-941D-7E78592B9CE6> and November 2017 (final) <https://membercenter.epri.com/Programs/109396/pages/eventdetails.aspx?eventID=C2B6173D-2C33-4574-9EC9-F522A48E27BF>

* Young, D. T. and J. E. Bistline, 2018. *The Costs and Value of Renewable Portfolio Standards in Meeting Decarbonization Goals*, *Energy Economics* 73:337-351, <https://www.sciencedirect.com/science/article/pii/S0140988318301427>

* *The Costs and Value of Renewable Portfolio Standards*, EPRI Program 201 Back Pocket Insight, July 2018, <http://eea.epri.com/pdf/EPRI-P201-Value-and-Costs-of-State-RPS.pdf>

(201-B) *Program 201-B Webcast on Insights into Clean Energy Standards with Restrictions on Eligible Technologies*, October 2018, <https://membercenter.epri.com/Programs/109396/pages/eventdetails.aspx?eventID=577B426F-4774-417D-908E-9495B2339660>

* Academic article “*The Economic Geography of Variable Renewable Energy and Impacts of Trade Formulations for Renewable Mandates*” in revise and resubmit to *Renewable and Sustainable Energy Reviews* as of January 2019

On representing high renewable penetration in capacity planning models

* *Simulating Annual Variation in Load, Wind, and Solar by Representative Hour Selection*, EPRI Report 3002008653, <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=00000003002008653>

* Blanford, G. J., J. H. Merrick, J. E. Bistline, and D. T. Young, 2018. *Simulating Annual Variation in Load, Wind, and Solar by Representative Hour Selection*, *The Energy Journal* 39(3):189-212, <http://www.iaee.org/energyjournal/article/3083>

* *The Role of Input Assumptions and Model Structures in Projections of Variable Renewable Energy: A Multi-Model Perspective of the U.S. Electricity System*, 2018. *Energy Economics* 76:313-324. <https://www.sciencedirect.com/science/article/pii/S0140988318304213> Part of the DOE Inter-model Comparison Study on the Representation of Renewables, co-authored by EIA, EPRI, and NREL.

* *Variable Renewable Energy in Long-Term Planning Models: A Multi-Model Perspective*, NREL Report NREL/TP-6A20-70528, 2017, <https://www.nrel.gov/docs/fy18osti/70528.pdf>. Part of the DOE Inter-model Comparison Study on the Representation of Renewables, co-authored by EIA, EPA, EPRI, and NREL.

On evaluating the potential impact of changes in renewable resources technology cost and performance and changes in future renewables policies on future energy generation and capacity changes

(178-B) 2014 REGEN Scenarios Analysis: *Understanding Key Factors That May Impact Future Electricity Generation*, EPRI Report 3002004880, 2014, <https://www.epri.com/#/pages/product/00000003002004880/?lang=en> .

(178-B) 2015 REGEN Scenarios Analysis: *Understanding Key Factors That May Impact Future Electricity Generation*, EPRI Report 3002005839, 2015, <https://www.epri.com/#/pages/product/00000003002005839/?lang=en> .

(178-B) 2016 REGEN Scenarios Analysis: *Understanding Key Factors That May Impact Future Electricity Generation*, EPRI Report 3002008451, 2016, <https://www.epri.com/#/pages/product/00000003002008451/?lang=en> .

(178-B) 2017 REGEN Scenarios Analysis: *Understanding Key Factors That May Impact Future Electricity Generation*, EPRI Report 3002011044, 2017, <https://www.epri.com/#/pages/product/00000003002011044/?lang=en> .

(178-B) 2018 REGEN Scenarios Analysis: *Understanding Key Factors That May Impact Future Electricity Generation*, EPRI Report 3002013733, 2018, <https://www.epri.com/#/pages/product/00000003002013733/?lang=en> .

Renewable Technology Cost and Performance

(178-A) *Technical Assessment Guide Web (TAGWeb) Database & Software, version 3.5*, EPRI Software 3002012114, 2018, <https://www.epri.com/#/pages/product/00000003002012114/?lang=en>

(178-B) *Forecasting Photovoltaics Market Potential: Methods and Approaches*, EPRI report 3002005775, 2015, <https://www.epri.com/#/pages/product/00000003002015775/?lang=en> (Also available to P174 members)