

12 January 2023

Dear Editors:

My co-authors and I are pleased to submit a pair of original Research Articles to *The Energy Journal*.

**TITLES**

- Energy, expenditure, and consumption aspects of rebound, Part I:  
A comprehensive theoretical framework
- Energy, expenditure, and consumption aspects of rebound, Part II:  
Applications of the framework

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**STATEMENT**

I attest that these manuscripts are our original work, that they have not been previously published in a journal, in whole or in part, and that they are not under consideration by any other journal. All authors are aware of, and accept responsibility for, the manuscript. The authors have no conflicts of interest.

**PREVIOUSLY INVITED SUBMISSION**

In March 2022, we wrote to Professor Yatchew, Editor-in-Chief, *The Energy Journal*, to ask pre-submission advice, as our draft energy rebound article was longer than the normal maximum article length for *The Energy Journal*. We suggested that we could submit as one long manuscript, or split into two parts: Framework and Examples, since there were relevant precedents:

- Thomas and Azevedo's (2013 a,b) 2-part rebound paper in *Ecological Economics*.
- Precedent at *The Energy Journal* with at least two 2-part articles: Hendry and Juselius, (2001, 2002) and Burger *et al.* (2019 a,b).

On 22 March 2022 Prof. Yatchew replied, suggesting that we “...submit it to the *EJ* in its current form. Once it has undergone an initial review, we can make a determination how best to proceed.” Following that advice, we submitted in March 2022. In June 2022, our manuscript was rejected, primarily due to the manuscript length. The editor’s decision letter stated: “A key reason for this is that the referees quickly recognized the submission far exceeded the maximum length of a paper that *The Energy Journal* would usually consider.”

This process has proved very helpful in the long term, as we have used the time June–December 2022 to:

- Submit the single-paper manuscript to the IAEE Working Paper series, as recommended by a referee. (<http://dx.doi.org/10.2139/ssrn.4216051>)
- Split the paper into two parts, as suggested by a referee, each of which is now within *TEJ* requirements of 9,500 words.
- Address the extensive comments from (a) the two anonymous referees of the March 2022 submission and (b) colleagues who read the IAEE Working Paper. (Note that we received detailed feedback from three colleagues, all of whom were highly complimentary of the work. See below.)

#### *RECAP OF RATIONALE*

Amidst ongoing debates over the size and extent of energy rebound effects, energy efficiency measures are expected to contribute a key part of energy-related CO<sub>2</sub> emissions reductions in support of Paris Agreement targets, even while the world economy grows. Therefore, continued work on energy rebound theory and modelling is required to support energy efficiency modelling and policy responses.

For our submission, we took our inspiration from two earlier papers published in *The Energy Journal*. First, Turner (2013) contends that the empirical estimation of rebound has advanced beyond the conceptual framework frontier. We believe that is still true today. Second, Borenstein (2015) made an important contribution to a microeconomic rebound framework. However, we think clarity is needed and more work needs to be done, in particular:

- Linking microeconomic and macroeconomic rebound,
- Providing accessible numerical case studies based on a consistent analytical framework, and
- Bridging the disciplinary divide between energy analysis and economics.

In response, in Part I, we develop a comprehensive conceptual framework with links between microeconomic and macroeconomic rebound effects, written in a detailed-yet-accessible style, to reach out to both energy analysis and economics fields. We focus on energy, expenditure, and consumption aspects of rebound. Second, in Part II, we provide two numerical case studies (of a car and an electric lamp upgrade) and develop novel visualizations of the energy, expenditure, and consumption aspects. We believe the paper brings clarity to the rebound field and contributes to understanding and communication between energy and economics disciplines. We

note that each paper is within the 9500-word limit for *TEJ*: ~8900 words for Part I and ~8700 words for Part II, not counting appendices.

### **KEY CONTRIBUTIONS**

Together, our submissions contain four contributions. First, in Part I we develop the first comprehensive rebound analysis framework that accommodates embodied energy effects, maintenance and disposal effects, non-marginal energy efficiency increases, and non-marginal energy service price decreases. Second, also in Part I, we create the first (to our knowledge) operationalized link between rebound effects on microeconomic and macroeconomic scales. Third, in Part II we provide the first (to our knowledge) visualizations of rebound effects in energy, expenditure, and consumption planes. Fourth, via open access code and an Excel-based calculation file, we provide tools for other researchers to calculate rebound for other EEUs with our framework.

### **CONNECTION TO THE ENERGY JOURNAL AND ITS AUDIENCE**

Firstly, our papers match well the Aims and Scope of *The Energy Journal*, with close alignment to the topic area of Energy efficiency, but also closely related areas including Energy & environmental issues; Transportation; and Carbon emissions reduction. As such, we believe that our paper will be of interest to the wide readership of *The Energy Journal*. Given the contribution from theoretical framework to replicable empirical examples using real-life data, we believe the papers will be of interest to both academics and practitioners alike.

Secondly, many of the most important foundational papers on energy rebound have been published in *The Energy Journal*, including Khazzoom (1980, 1987), Lovins (1988), Turner (2013), Borenstein (2015), and Saunders (2015). Therefore, *The Energy Journal* is both a natural choice for our papers and helps to maintain *The Energy Journal* as the pre-eminent journal in the field of energy rebound.

### **REVIEWER SUGGESTIONS**

As mentioned above, we sent our working paper (<http://dx.doi.org/10.2139/ssrn.4216051>) to several colleagues, none of whom were involved in any aspect of the creation, writing, or analysis of our paper. Three provided helpful and detailed comments, and all would be good reviewers for the Part I and Part II submission to *The Energy Journal*.

- **Jeroen C.J.M. van den Bergh**, Vrije Universiteit Amsterdam, Email: [Jeroen.Bergh@uab.cat](mailto:Jeroen.Bergh@uab.cat). Jeroen's research interests include integrated ecological-economic modelling, the growth-versus-environment debate, evolutionary economics, the transition to a low-carbon economy, and the economic analysis of climate policy. We cite the following papers in our submission:
  - van den Bergh, J.C. 2011. Energy conservation more effective with rebound policy. *Environmental and Resource Economics*, 48(1):43–58.

- Antal, M. and J.C. van den Bergh, 2014. Re-spending rebound: A macro-level assessment for OECD countries and emerging economies. *Energy Policy*, 68:585–590.
- van den Bergh, J.C., 2017. Rebound policy in the Paris agreement: instrument comparison and climate-club revenue offsets. *Climate Policy*, 17(6):801–813.
- Exadaktylos, F. and J. van den Bergh, 2021. Energy-related behaviour and rebound when rationality, self- interest and willpower are limited. *Nature Energy*, 6(12):1104–1113.
- **Harry Saunders**, Carnegie Institution for Science, Global Ecology Group, Stanford, California 94305, USA; Email: [hsaunders@earthlink.net](mailto:hsaunders@earthlink.net). His experience in the topic of energy rebound spans over 30 years, and is one of the foremost researchers in this topic. Some of Dr. Saunders’ relevant publications include:
  - Saunders, H.D., J. Roy, I.M. Azevedo, D. Chakravarty, S. Dasgupta, S. de la Rue du Can, A. Druckman, R. Fouquet, M. Grubb, B. Lin, and R. Lowe, 2021. Energy Efficiency: what has research delivered in the last 40 years? *Annual Review of Environment and Resources*, 46, pp.135-165.
  - Saunders, H.D., 2015. Recent evidence for large rebound: elucidating the drivers and their implications for climate change models. *The Energy Journal*, 36(1).
- **David Stern**, Professor, Crawford School of Public Policy, Australian National University, Email: [david.stern@anu.edu.au](mailto:david.stern@anu.edu.au). David is a very active researcher in this area. His research interests include energy and economic growth, economic development and pollution emissions, climate change, applied time series econometrics, meta-analysis. We cite the following papers in our submission:
  - Berner, A., S.B. Bruns., A. Moneta, and D.I. Stern, 2021. Do energy efficiency improvements reduce energy use? Empirical evidence on the economy-wide rebound effect in Europe and the United States. CEGE Discussion Paper 422.
  - Stern, D.I, 2020. How Large is the Economy-Wide Rebound Effect? *Energy Policy*, 147:111870.

In addition, the following scholars who have not provided comments on the working paper are well-known in the field. Each of these would also be good reviewers.

- **Severin Borenstein**, E.T. Grether Professor of Business Administration and Public Policy in the Economic Analysis and Policy Group of the Haas School of Business at the University of California, Berkeley. Email: [severinborenstein@berkeley.edu](mailto:severinborenstein@berkeley.edu). His current research interests include the economics of renewable energy and economic policies for reducing greenhouse gases. His 2015 paper provides a foundation for our work:

- Borenstein S. A Microeconomic Framework for Evaluating Energy Efficiency Rebound and Some Implications. *The Energy Journal*. 2015;36(1):1–21.
- **Ines Azevedo**, Associate Professor, Energy Resources Engineering, Stanford University, USA. Email: [iazevedo@stanford.edu](mailto:iazevedo@stanford.edu). Her research interest are keenly focussed on energy rebound, with some of her paper providing foundations for this current paper.
  - Azevedo IL, Sonnberger M, Thomas B, Morgan G, Renn O. The Rebound Effect: Implications of Consumer Behaviour for Robust Energy Policies. Report. Lausanne: International Risk Governance Council (IRGC). 2013.
  - Thomas BA, Azevedo IL. Estimating direct and indirect rebound effects for U.S. households with input–output analysis Part 1: Theoretical framework. *Ecological Economics*, 2013;86:199–210.
  - Azevedo IML. Consumer End-Use Energy Efficiency and Rebound Effects. *Annual Review of Environment Resources*. 2014;39:393–418.
- **Reinhard Madlener**, Director of the Institute for Future Energy Consumer Needs and Behavior (FCN), Aachen, Germany. Email: [RMadlener@eonerc.rwth-aachen.de](mailto:RMadlener@eonerc.rwth-aachen.de). His research interests include energy economics, energy management, energy policy-making. He has a wealth of experience in energy rebound, which makes him a very suitable reviewer:
  - Madlener, R., B. Alcott, 2009. Energy rebound and economic growth: A review of the main issues and research needs. *Energy*. 34(3):370–6.
  - Madlener, R., K. Turner, 2016. After 35 Years of Economic Energy Rebound Research: Where do we stand? In: Santar. 2016. 1–26 p.
  - Colmenares G., A. Löschel, R. Madlener, 2020. The rebound effect representation in climate and energy models. *Environmental Research Letters*. 15(123010):1–35.

#### KEYWORDS

- Energy efficiency,
- Energy rebound,
- Energy services,
- Microeconomic rebound,
- Substitution and income effects,
- Macroeconomic rebound

#### REPLICABILITY

A key obligation for research today is that papers should be replicable. In our case, we have made sure that our work is replicable. First, we provide R packages and hyperlinks to GitHub repositories and documentation for the reader. Second, we made available our Excel-based example sheets in a University of Leeds data repository, which has a permanent doi link. Third, all data used in our examples are freely available in the public domain. Last, we have secured open access funds for the papers to encourage their use and to aid replicability.

Finally, we have worked hard to provide twin articles that make key foundational advances in the important field of energy rebound. We believe the articles will be of significant interest to your readership.

Yours sincerely,



Matthew K. Heun

#### REFERENCES

- Borenstein, S., 2015. A microeconomic framework for evaluating energy efficiency rebound and some implications. *The Energy Journal* 36, pp.1-21.
- Burger, S.P., Jenkins, J.D., Batlle, C. and Pérez-Arriaga, I.J., 2019a. Restructuring revisited part 1: competition in electricity distribution systems. *The Energy Journal*, 40(3).
- Burger, S.P., Jenkins, J.D., Batlle, C. and Perez-Arriaga, I.J., 2019b. Restructuring revisited part 2: coordination in electricity distribution systems. *The Energy Journal*, 40(3).
- Hendry, D.F. and Juselius, K., 2000. Explaining cointegration analysis: Part 1. *The Energy Journal*, 21(1).
- Hendry, D.F. and Juselius, K., 2001. Explaining cointegration analysis: Part II. *The Energy Journal*, 22(1).
- Khazzoom, J.D., 1980. Economic implications of mandated efficiency in standards for household appliances. *The Energy Journal*, 1(4).
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- Lovins, A.B., 1988. Energy saving from the adoption of more efficient appliances: Another view. *The Energy Journal*, 9(2).
- Saunders, H.D., 2015. Recent evidence for large rebound: elucidating the drivers and their implications for climate change models. *The Energy Journal*, 36(1).
- Thomas, B.A. and Azevedo, I.L., 2013. Estimating direct and indirect rebound effects for US households with input–output analysis Part 1: Theoretical framework. *Ecological Economics*, 86, pp.199-210.
- Thomas, B.A. and Azevedo, I.L., 2013. Estimating direct and indirect rebound effects for US households with input–output analysis. Part 2: Simulation. *Ecological Economics*, 86, pp.188-198.
- Turner, K., 2013. “Rebound” effects from increased energy efficiency: a time to pause and reflect. *The Energy Journal*, 34(4).