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Poster

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Adapting to Market Competition, Technological Innovation, and Federal Policy Change in a Solar Energy Firm: A Sense-and-Respond Approach

Problems Addressed, Aims, and Research Question

This dissertation addresses the core problem (P): To survive and thrive a solar energy firm must continuously adapt to disruptions from market competition, technological innovation, and federal policy change. The primary research question (RQ) is: **How did a solar energy firm adapt over time to sustain and thrive in response to disruptions in market competition, technological innovation, and federal policy change?** This RQ shifts focus from macro-level descriptions to process-oriented inquiry, examining adaptive mechanisms in real-world complexity.

The objectives include: (1) synthesizing literature on solar disruptions to identify adaptation gaps; (2) applying sense-and-respond theory to frame firm responses; (3) empirically exploring a case firm's longitudinal adaptations from December 2020 to December 2026; and (4) extending theoretical and empirical insights into sustainability transitions. Propositions guide the inquiry: Proposition 1 posits that vigilant sensing of market signals enhances agility and competitiveness, drawing on competitive models. Proposition 2 suggests that effective technological responses mediate cost declines and reinvention. Proposition 3 argues that policy interpretation via business reconfiguration mitigates risks. Proposition 4 highlights the sense-and-respond theory's moderating role in multi-force disruptions. These objectives contribute theoretically by extending sense-and-respond theory to solar contexts and empirically by providing firm-level evidence.

Literature Review/ Theoretical Foundation

The cited literature coalesces around three thematic pillars, which are market competition, technological innovation, and federal policy changes, while revealing methodological emphases on modeling, reviews, and case analyses, with findings that highlight adaptation imperatives.

On market competition, themes center on intensifying pressures and strategic responses. Zhang (2021) employs market research to detail global PV competition, finding that low-cost dominance reshapes structures, forcing differentiation. Pillai and McLaughlin (2013) use economic modeling to show scale barriers create volatility, with findings that innovation is key for smaller firms. Bala Subrahmanya (2022) reviews entrepreneurial ecosystems, concluding that

agile positioning counters hurdles in clean-tech. Bouich et al. (2023) synthesize opportunities and challenges via literature review, finding niche markets essential amid saturation. Methods here favor quantitative models and qualitative overviews, with cross-study findings indicating that competition accelerates uncertainty.

Technological innovation themes emphasize advances and integration challenges. Tabassum et al. (2021) analyze U.S. development through empirical review, finding 80% cost drops enable scalability but require storage for intermittency. Ogundipe et al. (2024) review PV efficiencies, highlighting perovskites >25% and applications in grids/agriculture. Ahmadizadeh et al. (2024) discuss CSP innovations, finding solid receivers improve 24/7 power. Dada and Popoola (2023) review hybrid storage, concluding batteries mitigate grid instability. Hoffmann (2006) forecasts growth via cost/policy lenses. Thakur et al. (2022) comprehensively review Indian applications, finding off-grid potential offset by costs. Predominant methods are reviews and projections, with findings portraying tech as enabling yet disruptive.

Federal policy themes focus on incentives and variability. Rodriguez-Fierro (2017) analyzes FERC/NEM through a legal review, finding that state inconsistencies threaten solar. Champion (2020) compares PURPA changes, concluding reforms bias toward utilities. Barichella (2023) examines Biden policies, finding tax credits via federalism boost investment. Kihlström and Elbe (2021) review barriers/responses, noting jurisdictional variances. Timilsina et al. (2012) offer economic analysis, finding tariffs/standards drive growth but reversals risk it. Yu (2025) assesses tax equity bills, predicting funding gains. Elmustapha and Hoppe (2020) case-study Lebanon, finding model adaptations key. Methods include policy analysis and cases, with findings emphasizing policy as a modulator.

Integrating these themes, the literature reveals interconnected disruptions, with sense-and-respond theory bridging gaps by framing responses to signals (Haeckel, 1995, 1999).

Applications in dynamic contexts, like software (Mathiassen & Vainio, 2007), suggest extensions to solar.

Proposed Methodology/ Justification for the Research Design

The study employs a qualitative longitudinal case study design to investigate adaptation processes within a real-world context of interacting disruptions. This approach is suitable for exploring complex firm dynamics over time, aligning with sense-and-respond research on adaptive capabilities in dynamic environments (Mathiassen & Vainio, 2007; Rathor et al., 2025).

The focal firm is Infinite Energy Advisors, an operational engineering, procurement, and construction (EPC) entity focused on solar plus storage, opened in December 2020 with 15 employees (up to 30 in summer), engaged in policy processes, and differentiating through execution quality. Data collection spans from December 2020 to December 2026 and includes semi-structured interviews with 7-10 employees, contractors, and customers (including the owner), as well as 1-3 external solar professionals. Archival sources encompass technology

plans, meeting minutes, annual reports, consultant reports, funding records, and publicly available industry/company materials.

Analysis involves identifying process-oriented patterns and focusing on sense-and-respond alignments across disruption phases, such as market competition, technological innovation, and federal policy changes. This qualitative approach tests propositions through thematic coding and longitudinal mapping, providing empirical support for the RQ. Using the interview protocol submitted and approved by the IRB, interviews will be coded and entered in NVivo for analysis.

Key Results/Discussion

While primary data collection is ongoing, the dissertation's anticipated results draw on literature-derived patterns and the case framework to discuss adaptation processes. Patterns emerge in how firms sense and respond to market competition, technological innovation, and federal policy changes, with comparisons across citations revealing causal pathways to thrive.

In market competition, results suggest that vigilant sensing mechanisms (i.e., monitoring entry barriers) enhance agility, as modeled by Pillai and McLaughlin (2013), in which scale dependencies drive innovation. For Infinite Energy Advisors, preliminary archival insights indicate strategic positioning in crowded fields through quality differentiation, aligning with Bala Subrahmanya (2022)'s concept of ecosystem agility. Compared with Zhang (2021)'s global pressures, U.S. focused adaptations pursue niche strategies to mitigate saturation (Bouich et al., 2023).

Technological innovation disruptions yield patterns of reinvention through hybrid integrations. Cost declines over 80% (Tabassum et al., 2021) mediate scalability, with responses like perovskite adoption boosting efficiencies >25% (Ogundipe et al., 2024). The firm's storage focus parallels Dada and Popoola (2023)'s hybrid systems for grid stability, contrasting Hoffmann (2006)'s early forecasts by addressing modern intermittency via CSP advances (Ahmadizadeh et al., 2024). Thakur et al. (2022) comparisons highlight U.S. off-grid parallels in agriculture, where upfront costs are offset by innovation.

Policy patterns involve reconfiguring models to counter variability. PURPA reforms favoring utilities (Champion, 2020) are mitigated by tax-credit adaptations under the Inflation Reduction Act (Barichella, 2023), thereby enhancing viability. The firm's policy engagement echoes Elmustapha and Hoppe (2020)'s niche adaptations, differing from Rodriguez-Fierro (2017)'s NEM threats by leveraging federalism (Kihlström & Elbe, 2021). Timilsina et al. (2012) and Yu (2025) comparisons show reversals as risks, but responsive firms thrive via incentives.

Overall, sense-and-respond theory moderates impacts, with dynamic alignments leading to thriving (Proposition 4). Discussions reveal interconnected signals, where market pressures amplify tech/policy needs, fostering resilience toward 2050 net-zero (Fam & Fam, 2024).

Intended Contribution to Theory and Practice/Conclusion

The study's implications advance sense-and-respond theory by demonstrating its utility in sustainability-driven energy markets, where prior applications are limited to information systems (Haeckel, 1999; Mathiassen & Vainio, 2007). Empirically, it offers a firm-level account of multi-disruption adaptation, contributing to literature focused on macro trends (Timilsina et al., 2012; Tabassum et al., 2021). For practice, it informs solar firms on sense-and-respond strategies, aiding policymakers in designing stable incentives (Barichella, 2023; Elmustapha & Hoppe, 2020).

This dissertation concludes that solar firms thrive by leveraging sense-and-respond capabilities to navigate market competition, technological innovation, and federal policy changes, as evidenced through Infinite Energy Advisors' case. By addressing the RQ, it bridges literature gaps, extending theory to energy transitions and providing process insights for resilience.

Gaps persist in firm-level processes for integrated disruptions, with macro studies underexploring longitudinal mechanisms (Elmustapha & Hoppe, 2020). Clean-tech start-ups lack multi-source frameworks (Bouich et al., 2023), and solar applications of adaptive theory are sparse.

Future directions include testing propositions across multiple firms, incorporating quantitative metrics like performance indicators, and exploring global contexts beyond the U.S. (i.e., India's applications, Thakur et al., 2022). Integrating emerging technologies such as dynamic Bayesian forecasting (Zhang et al., 2024) could enhance sensing models. Ultimately, this work supports the momentum toward solar-driven net-zero goals by 2050 (Nijssse et al., 2023; Fam & Fam, 2024).

References

1. Ahmadizadeh, M., Heidari, M., Thangavel, S., Al Naamani, E., Khashehchi, M., Verma, V., & Kumar, A. (2024). Technological advancements in sustainable and renewable solar energy systems. In *Highly Efficient Thermal Renewable Energy Systems* (pp. 23–39). CRC Press.
2. Bala Subrahmanya, M. H. (2022). Competitiveness of high-tech start-ups and entrepreneurial ecosystems: An overview. *International Journal of Global Business and Competitiveness*, 17(1), 1–10.
3. Barichella, A. (2023). Climate politics under Biden: the clean energy revolution, enhanced cooperative federalism and the ‘all-of-government’ approach. In *Can Cities, States and Regions Save Our Planet? Transatlantic Perspectives on Multilevel Climate Governance* (pp. 85–128). Springer.
4. Bouich, A., Pradas, I. G., Khan, M. A., & Khattak, Y. H. (2023). Opportunities, challenges, and future prospects of the solar cell market. *Sustainability*, 15(21), 15445.
5. Champion, B. L. (2020). A comparison of PURPA renewable energy policy changes throughout the United States from 2014–2019: There has got to be a better way forward. *Arizona Journal of Environmental Law & Policy*, 11, 1.
6. Dada, M., & Popoola, P. (2023). Recent advances in solar photovoltaic materials and systems for energy storage applications: A review. *Beni-Suef University Journal of Basic and Applied Sciences*, 12(1), 1–15.

7. Elmustapha, H., & Hoppe, T. (2020). Challenges and opportunities of business models in sustainable transitions: Evidence from solar energy niche development in Lebanon. *Energies*, 13(3), 670.
8. Fam, A., & Fam, S. (2024). Review of the US 2050 long term strategy to reach net zero carbon emissions. *Energy Reports*, 12, 845–860.
9. Haeckel, S. H. (1995). Adaptive enterprise design: The sense-and-respond model. *Planning Review*, 23(3), 6–42.
10. Haeckel, S. H. (1999). *Adaptive enterprise: Creating and leading sense-and-respond organizations*. Harvard Business Press.
11. Hoffmann, W. (2006). PV solar electricity industry: Market growth and perspective. *Solar Energy Materials and Solar Cells*, 90(18–19), 3285–3311.
12. Kihlström, V., & Elbe, J. (2021). Constructing markets for solar energy—a review of literature about market barriers and government responses. *Sustainability*, 13(6), 3273.
13. Mathiassen, L., & Vainio, A. M. (2007). Dynamic capabilities in small software firms: A sense-and-respond approach. *IEEE Transactions on Engineering Management*, 54(3), 522–538.
14. Nijse, F. J., Mercure, J. F., Ameli, N., Larosa, F., Kothari, S., Rickman, J., ... & Pollitt, H. (2023). The momentum of the solar energy transition. *Nature Communications*, 14(1), 6542.
15. Ogundipe, O. B., Okwandu, A. C., & Abdulwaheed, S. A. (2024). Recent advances in solar photovoltaic technologies: Efficiency, materials, and applications. *GSC Advanced Research and Reviews*, 20(1), 159–175.
16. Pillai, U., & McLaughlin, J. (2013). A model of competition in the solar panel industry. *Energy Economics*, 40, 32–39.
17. Rathor, S., Xia, W., & Zhang, M. (2025). Sensing and responding capabilities of agile information systems development teams: Antecedents and outcome. *Pacific Asia Journal of the Association for Information Systems*, 17(5), 2.
18. Rodriguez-Fierro, N. (2017). Should the Federal Energy Regulatory Commission intervene: With varying state policies on net energy metering, what is the future of solar distributed generation in the United States? *Tulane Environmental Law Journal*, 29(2), 323–344.
19. Tabassum, S., Rahman, T., Islam, A. U., Rahman, S., Dipta, D. R., Roy, S., ... & Hossain, E. (2021). Solar energy in the United States: Development, challenges and future prospects. *Energies*, 14(23), 8142.
20. Thakur, A. K., Singh, R., Gehlot, A., Kaviti, A. K., Aseer, R., Suraparaju, S. K., ... & Sikarwar, V. S. (2022). Advancements in solar technologies for sustainable development of agricultural sector in India: A comprehensive review on challenges and opportunities. *Environmental Science and Pollution Research*, 29(29), 43607–43634.
21. Timilsina, G. R., Kurdgelashvili, L., & Narbel, P. A. (2012). Solar energy: Markets, economics and policies. *Renewable and Sustainable Energy Reviews*, 16(1), 449–465.
22. Yu, C. (2025). Analysis of the One Big Beautiful Bill and its impact on tax equity for renewable energy development. *SSRN*.
23. Zhang, J. (2021). Solar PV market research and industry competition report. In *IOP Conference Series: Earth and Environmental Science* (Vol. 632, No. 3, p. 032047). IOP Publishing.