

Research Statement (approx. 1000 words)

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A typical American citizen uses more than ten times as much energy as an Indian citizen and fifty times as much as a citizen of Mali. Billions of people in developing countries demand, justly, to use far more energy, from whatever source, to elevate their standards of living. There is hope that the world can provide this energy while limiting global climate change: we are at the start of a green energy revolution, which may broaden energy access while also pushing down environmental harms. Yet there is, to this point, no precedent—no single country in the world—that has shown how to grow with renewable energy alone.

I am an energy and environmental economist. I study energy markets in developing countries using methods from the fields of development economics and industrial organization. My research helps build the market designs and policy tools needed for a clean energy transition.

The goal of my research agenda is to ground energy and environmental economics in how governments and markets actually work in developing countries. I study the political economy, market failure and governance constraints on cleaner growth. I attempt to show how clean growth could work, and put these claims to the test through deep collaborations with policymakers and regulators. Methodologically, my research combines economic models, field experiments and descriptive data analysis as is appropriate for a given research question.

My research has been supported by the National Science Foundation, the US Agency for International Development, the Jameel Poverty Action Lab and other sources. I have recently been awarded an NSF Career grant on “Institutions for Carbon Abatement in Developing Countries” (SES-2143098, 2022-27).

1 Wholesale energy markets

The first branch of my research agenda studies wholesale energy markets. The global energy transition—the shift from using fossil energy to green energy sources—will require energy markets in developing countries to support vast amounts of new investment.

My research on wholesale energy markets examines how market institutions shape market efficiency. I show that when India opened competition in power generation, the market did not, in fact, become competitive, because power transmission remained a natural monopoly and limited competition (Ryan, 2021a). Market power may be exacerbated by weak contract enforcement. I study contract enforcement in the context of the largest power projects in India. Weak contract enforcement raises the cost of power by allowing politically connected firms to win power projects with artificially low bids (Ryan, 2020). Risk in contracting also hinders green energy (Ryan, 2021). I show that the risk that state buyers of solar power will not honor their contracts raises the price of solar power. The risk of hold-up thereby reduces investment in green energy, hindering India's energy transition. Ongoing work on this branch is studying how carbon offset markets have shaped energy use and carbon emissions in China.

2 Retail energy markets

The second branch of my research focuses on retail energy markets. Energy use is both a cause and a sign of economic development. Governments view access to energy as a right and use energy markets as a means of redistribution. I have shown that this kind of redistribution can be costly because distorted prices undercut energy supply (Burgess et al., 2020).

My work on retail energy markets examines how policies affect household welfare. Many poor households who would not have had electricity a generation ago can now buy their own solar systems, even if the grid has not arrived in their village. In Bihar, India, I use a large field experiment to estimate the demand for electricity for households who can choose between grid

and off-grid sources of power. I find that people strongly prefer to buy grid electricity, but that this advantage is due to government subsidies, without which they would switch to off-grid solar power (Burgess et al., 2022).

If subsidizing energy is wasteful, why do governments keep doing it? A body of work, joint with Anant Sudarshan, investigates the constraints on moving to more efficient energy pricing (this work is supported by NSF SES-1919076 and US AID 7200AA19FA00008). We analyze the rationing of electricity that farmers use to pump groundwater and find this policy limits farmers' water use and ensures that all farmers have access to some water. However, rationing makes farmers as a whole poorer, because it limits the amount of water the most productive farmers use, while propping up less productive farmers (Ryan and Sudarshan, 2022). Ongoing field experiments in the Indian states of Punjab and Andhra Pradesh test whether the voluntary adoption of efficient pricing by farmers can increase the efficiency of water use.

3 Environmental regulation

Developing countries rely on energy use for their growth, but are also disproportionately harmed by the external costs of energy use, like air pollution and global climate change. There is little evidence on why environmental regulation is not working or how it can do better.

I find that subsidizing firm energy audits, which are meant to reduce energy use and emissions, paradoxically may increase energy use, in response to higher energy productivity (Ryan, 2018). In one body of work, my coauthors and I show that environmental auditors falsify reports of pollution to appease client firms, but that a reform of the audit system, to make auditors independent, made reports more truthful and lowered pollution (2013*a*; 2013*b*). We also find that the state's own inspections have a greater effect on pollution emissions when the regulator is given discretion to target the most polluting firms (2018). This paper was cited by the Nobel Prize Committee as an example of innovation in development economics (Nobel Committee, 2019).

The above studies use incremental changes to understand where existing regulations fall short. I have recently studied whether moving to a new, market-based regulatory regime can reduce air pollution (Greenstone et al., 2022). This project involved developing a new market design for air pollution and working with the regulator in the Indian state of Gujarat to test this market, the first of its kind in a developing country. We find that the emissions market achieves near-perfect compliance and reduces air pollution at a low cost. We are working to expand the lessons of this pilot market to additional areas and helping design a new market to cover carbon emissions.

References

- Burgess, Robin, Michael Greenstone, Nicholas Ryan, and Anant Sudarshan.** 2020. “The Consequences of Treating Electricity as a Right.” *Journal of Economic Perspectives*, 34(1): 145–169.
- Burgess, Robin, Michael Greenstone, Nicholas Ryan, and Anant Sudarshan.** 2022. “Demand for Electricity on the Global Electrification Frontier.” *Mimeo*.
- Duflo, Esther, Michael Greenstone, Rohini Pande, and Nicholas Ryan.** 2013a. “Truth-telling by Third-party Auditors and the Response of Polluting Firms: Experimental Evidence from India.” *Quarterly Journal of Economics*, 128(4): 1499–1545.
- Duflo, Esther, Michael Greenstone, Rohini Pande, and Nicholas Ryan.** 2013b. “What Does Reputation Buy? Differentiation in a Market for Third-party Auditors.” *American Economic Review, Papers & Proceedings*, 103(3).
- Duflo, Esther, Michael Greenstone, Rohini Pande, and Nicholas Ryan.** 2018. “The Value of Discretion in the Enforcement of Regulation: Experimental Evidence and Structural Estimates from Environmental Inspections in India.” *Econometrica*, 86(6): 2123–2160.
- Greenstone, Michael, Rohini Pande, Nicholas Ryan, and Anant Sudarshan.** 2022. “Can Pollution Markets Work in Developing Countries? Experimental Evidence from India.” *Mimeo*.
- Nobel Committee.** 2019. “Understanding Development and Poverty Alleviation.” *Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel*.
- Ryan, Nicholas.** 2018. “Energy Productivity and Energy Demand: Experimental Evidence from Indian Manufacturing Plants.” *NBER Working Paper #24619*.

Ryan, Nicholas. 2020. “Contract Enforcement and Productive Efficiency: Evidence from the Bidding and Renegotiation of Power Procurement Contracts in India.” *Econometrica*, 88(2): 383–424.

Ryan, Nicholas. 2021. “Holding Up Green Energy.” *NBER Working Paper #29154*.

Ryan, Nicholas, and Anant Sudarshan. 2022. “Rationing the Commons.” *Journal of Political Economy*, 130(1): 210–257.