# The interview

## Interviewing
# Stanley Reynolds

### Eller Professor of Economics, University of Arizona

**Stanley Reynolds spent two months at EnergyEcolab during the Spring of 2023. Mateus Souza interviews him.**

**Stan, as you know, renewables are expected to be key for achieving ambitious climate goals worldwide. In your view, and given your experience, currently what are the main barriers for the expansion of renewables?**

There has been great recent progress in the development and deployment of renewable energy. However, while renewable energy investment has grown in recent years, the pace of growth has not been fast enough to reduce global greenhouse gas (GhG) emissions. **In my view there are two main types of barriers to more rapid expansion of renewables. The first type is political**. It has proven to be very difficult for major GhG emitting countries (China, U.S., India, Russia, ...) to reach agreement on actual emissions reductions. The recent failure of the U.S. and China to reach an agreement is the latest example. However, evidence regarding the effects of climate change is growing. The world-wide summer heat wave of 2023 is the latest example. As the effects of climate change become more apparent, I'm hopeful that there will be increasing pressure on leaders of these countries from their citizens to enact policies to reduce domestic GhG emissions and to reach international agreements on emissions reductions.

**The second type of barrier is economic. Fossil fuel energy remains relatively cheap and abundant compared to renewable options in many parts of the world**. This has contributed to continued use and even to new investment in fossil fuel energy sources. For example, faced with growing demand for electricity, India and China have invested in over one million megawatts of new coal-fired electricity generation plants in the last 20 years. Presumably

these coal plant investments were judged to be more cost effective than solar or wind generation alternatives. In a similar vein, there continues to be strong global demand for gasoline powered autos and trucks due in part to lack of infrastructure for electric vehicle charging.

**Given these barriers that you mention, what are some important policies or changes that need to happen in order to unlock the expansion of renewables?**

I'm somewhat pessimistic about the prospects of international climate agreements for driving more rapid expansion of renewables. **Ultimately the dominance of renewable energy will likely depend on cost effectiveness**. When renewable energy sources like solar panels and wind turbines can produce energy at lower cost than fossil fuels, economic self-interest will drive rapid expansion of renewables.

I believe that **continued innovation in renewable energy and related technologies is key**. There have been dramatic cost reductions for solar photovoltaic panels and wind turbines. These cost reductions have spurred large new investments in solar and wind. Innovations in battery storage to reduce the cost of grid storage and of electric vehicle batteries will be crucial to support a cleaner electric grid and to reduce vehicle emissions. Innovations will tend to drive substitution away from fossil fuels even in the absence of public policies to address climate change.

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Innovation doesn't happen in a vacuum. Even in the absence of effective international agreements, public policies in individual countries can help drive innovation. **Government support for R&D, government incentives for customer adoption of renewables (such as German feed-in-tariffs for solar and U.S. subsidies for wind**

**and solar), and policies that allow for international trade and knowledge flows across borders can all help spur innovation and falling costs.**

There are a number of other policies that can help speed renewable penetration. Limited access to transmission is a barrier for wind turbine expansion in the U.S. Policies that expedite new transmission development and resolve multi-state disputes over transmission will help speed wind growth. Complementary policies that speed the permitting process for grid access for solar and wind projects will also speed up renewable growth.

### What are some of the related research topics that you are currently working on?

I'm working on a couple of storage related research projects – I believe **development and deployment of large-scale energy storage for the electric grid is critical for a cleaner grid.** One project is an exploration of how hydroelectric resources may be utilized to better manage renewable intermittency. While storage in hydro dams cannot be controlled to the same extent as batteries, hydro dams still have significant energy storage potential. Hydro storage can be used to help manage short term renewable intermittency, such as fluctuating wind turbine generation. This project seeks to characterize optimal hydro management for regions with significant hydro resources. Our analysis takes into account random aspects of seasonal hydro resource availability as well as random variation in short term wind generation and load. This project is joint with Gautam Gowrisankaran of Columbia University, and with Hannu Huuki and Rauli Svento of Oulu University in Finland.

A second project explores the impact of large-scale battery storage on the electric grid. Several recent studies examine the short-term impact of battery storage additions on wholesale electricity market outcomes. The aim of this new project is to capture longer term impacts of adding storage on generation investment. The analysis develops a dynamic competition model that allows for forward-looking storage charging and dis-charging decisions. The Texas ERCOT market will be used as a test bed for the analysis. This is a follow up project to my recent article (joint with Joseph

Cullen) on long term generation investment published in the International Journal of Industrial Organization.

**Could you provide some advice for junior scholars, in terms of how to conduct successful research in energy and environmental economics? What are some of the pressing issues that you think they could focus on?**

First, I suggest taking the concerns of industry experts seriously – read the business press and try to talk to and learn from people who work in the energy sector. **Some of my most impactful research has dealt with issues of concern to the electricity industry**, such as challenges associated with renewable intermittency and cycling costs of conventional electricity generators.

My other suggestion is to examine the innovation process for energy technologies. As I noted above, I think energy innovation is key for success in combatting climate change. There is a large Industrial Organization literature on innovation. I believe this IO literature can serve as a template for insightful studies on energy innovation.

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**Finally, what can you highlight about your visit to Madrid? What can you tell someone who wants to come to EnergyEcoLab?**

I very much enjoyed my stay in Madrid. Madrid is a wonderful city with lots to do. I was able to focus on my research and interact with Professor Fabra and several postdocs affiliated with EnergyEcoLab. **The research group there is working on an interesting range of topics, many focusing on current energy policy debates in Spain and the EU.** I enjoyed and benefited from the opportunity to learn about and discuss the research under way at the EnergyEcoLab. A visit to Madrid is also an opportunity to make professional connections. There are several economists working on energy/environment issues at University Carlos III of Madrid and other universities in the area •