Decarbonizing the grid

Meet GPS's new renewable energy expert, Michael Davidson whose research focuses on deploying low carbon energy in Asia's emerging markets

By Rachel Hommel | GPS News

Originally from Oregon, Professor Michael Davidson is thrilled to be back on the West Coast at the UC San Diego School of Global Policy and Strategy (GPS), with a dual appointment at the Jacobs School of Engineering. An avid cyclist, and soon to be surfer, he thinks most days should be spent outdoors.

"I get the full tour of campus going between my two offices," laughs Davidson. "I'm looking forward to getting pointed to all the fun things and exploring campus more. No board yet but surfing is definitely on my list!"

Davidson's background in physics and love of the environment grew into his passion for working at the center of the renewable grid, where he initially explored fundamental questions at the heart of new energy technologies.

"I was always interested in how energy alternatives could address environmental issues," recalls Davidson. "However, it's not just about coming up with amazing devices in the lab, we also need policies to help shape their development,

commercialization and application at scale."

Studying Japanese and Chinese, as well as living in both countries, he has found a nice marriage between his interests in improving grid operation as well as understanding the diverse cultures and political systems of Asia, gleaning experience from his time at the Natural Resources Defense Council (NRDC) as the U.S.-China Climate Policy Coordinator.

Looking at the variability and uncertainty that comes with renewable energy, his research highlights the politics and policy that comes with the decarbonization challenge. In particular, he examines the electric power system that is imbued with a complex governance and industry structure that protects incumbent firms, defends status quo institutions and is ill-suited to the new demands of low-carbon energy.

"The electric power system is the most complex and interconnected machine that humans have ever invented. Reengineering that to get rid of fossil fuels and bring on low carbon energy is an enormous task," warns Davidson. "The politics and policies of that transition are equally challenging."

When researching some of the largest policy concerns in deploying low carbon energy at scale, his research looks to China and India's electricity sector reforms, two of the largest energy consumers and greenhouse gas emitters. Because they have strong histories of central planning and state ownership, these governments have sometimes fraught relationships with markets designed to improve system operation.

"These countries find it difficult to give up control of the power system to markets since it's so crucial and strategic to the economy," said Davidson. "As a result, markets in practice may have a lot of rigidity that don't reflect the particular set of challenges of renewables. If you don't design markets appropriately, new energies can be disadvantaged relative to fossil fuels."

Integrating renewable energy in an inefficient manner can lead to excess levels of curtailment—or waste—of otherwise available electricity. In China, this is the result of both technical causes such as the inflexibility of coal power plants as well as the way the power sector is managed, such as giving out planning quotas to coal generators and restricting trade between provinces.

Davidson finds that India has a similar set of challenges, with very pressing development issues. While they have started to develop markets, they encounter interstate trade barriers and issues with incentivizing flexible operation to manage the variability of renewables, while switching the energy sector away from fossil sources to new energy.

“India is a very natural extension of my work. It has much lower rates of electrification, yet is growing extremely rapidly,” said Davidson. “We’d expect India to go through a phase that China went through maybe 15 years ago.”

In his forthcoming paper, “Avoiding Pitfalls in China’s Electricity Sector Reforms,” Davidson looks through the lens of international lessons on restricting electricity markets and the fundamentals of the economics, identifying five pitfalls to avoid when building efficient markets that also work for renewable energy.

“Countries are moving more and more away from traditional vertically integrated monopolies to markets because of perceived benefits around efficiency, consumer choice, flexibility and the environmental benefits associated with that,” said Davidson.

As a dual appointment faculty member, Davidson is eager to teach his new course Energy Environmental Policy in Asia in winter quarter, a balanced flavor of the energy and environmental challenges in China, India and neighboring countries. He will also shadow David Victor in his Politics of Energy and Environmental Regulation course.

“My goal is to develop a research and teaching group on campus that is focused

on harnessing the overlapping interests between engineers and social scientists in this transition. You are going to find me working at that intersection a lot," said Davidson.

Eager to meet other students with a passion for the environment, Davidson offers some sage advice on taking advantage of your time at graduate school, and the broad level of expertise offered at GPS.

"Environmental challenges are multifaceted, so make sure you are taking advantage of all the resources on campus," said Davidson. "In addition to generating some general knowledge on the issues, it is important to develop expertise in particular issues or contexts so you can really dive deep and make an impact before your graduate."

3 questions with Assistant Professor Michael Davidson

What is your academic focus?
I look at the engineering implications and institutional conflicts inherent in adding low-carbon energy to the power grid, with an emphasis on areas with market structures that are emerging, particularly in China and India, or rapidly evolving like the Western U.S.

What are the real-world impacts of your research?
Policymakers, regulators and firms around the world are grappling with challenges of bringing online more renewable and low-carbon energy, ranging from where to site these new facilities to how to manage the increasing complexity and uncertainty associated with their operation. My work highlights how moving from 5 to 50 percent share of clean energy and beyond will depend on both engineering and institutional advances, some of which are interdependent.

In particular, countries such as China and India are increasingly turning to markets to help with this transition, but there are many historical legacies that affect market designs and, in turn, alter technology choices and operation. Identifying "second-best" policies that take into account these constraints can help us move more rapidly on pathways to sustainability.

What skills or understanding do you hope students leave your class with?
Infrastructures—such as energy, water and transportation—are the product of interactions among engineering, political and economic variables. They are key to addressing highly salient political objectives such as economic growth and environmental protection, while coming with their own unique sets of engineering realities and economic features. In my teaching and mentoring, I will bring together these three strands in service of making good energy and environmental policy and regulation.

I expect students to be able to articulate the key drivers of specific environmental challenges, explain the evolution of energy governance structures in general and in case countries, and develop a menu of technological and policy solutions fit for context.