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Four Challenges to the U.S. Energy Transition



Efficiently transitioning from fossil fuels to renewable energy means looking at so much more than just the technology we use.

Reliable energy is required to keep safe in cold winters and hot summers, making it a matter of national security. There are also vying economic policies to consider, political and financial incentives to navigate, and questions of social and economic inequality.

Experts in Georgia Tech's Ivan Allen College of Liberal Arts examine the challenges we face with the U.S. energy transition, and work to help make it safe, fair, and effective for all.

Challenge No. 1: Managing National Security

Every country needs an efficient, reliable, and resilient energy supply to keep its population safe, especially those that, like the U.S., experience hot summers and cold winters. These stakes make securing energy a matter of national security, said [Adam N. Stulberg](#), professor and chair of Georgia Tech's [Sam Nunn School of International Affairs](#).

Due to this, countries with the ability to produce and export natural gas and oil historically have enjoyed leverage over the countries that need it. But the rise of liquified natural gas and transition to renewable energy are upending the status quo, he explained.

“The movement from reliance on fossil fuels and a fixed supply of natural gas are creating new political winners and losers, changing the dynamics of global power,” Stulberg said.

For example, the U.S. holds some influence over its European allies because it can provide them with a flexible supply of liquified natural gas as they wean off of cheap Russian gas. However, as Europe’s green energy sector grows and the ability to take and deliver natural gas across the EU improves, that grip weakens, making Europe less beholden to U.S. statecraft.

Stulberg also noted that the green energy transition won’t make countries completely energy independent. Instead, it will replace dependence on foreign oil and gas with a dependence on cross-border power grids and the critical minerals and supply chains associated with renewable technologies. Some see this as just as risky, but Stulberg disagrees.

“These risks are not nearly equal to the immediate and existential threats associated with the disruption of major global oil supply routes or piped gas to highly dependent customers,” Stulberg said.

“Diverse markets and distributed power networks, coupled with deliberate efforts at designing national security criteria into the emerging green energy infrastructure, can provide added resilience,” he added. “Remembering that is important as politicians and corporate leaders weigh how and what types of energy to invest in or divest from to keep our country safe.”



*Adam N. Stulberg is a professor and Chair of the Sam Nunn School of International Affairs.
[Learn more about his work.](#)*



Bijesh Mishra is a postdoctoral scholar in the Jimmy and Rosalynn Carter School of Public

Policy. [Learn more about his work.](#)

Challenge No. 2: Confronting Inequality

[Bijesh Mishra](#), a postdoctoral scholar in Georgia Tech's [Jimmy and Rosalynn Carter School of Public Policy](#), believes the greatest challenge of the energy transition is making sure the new technologies benefit everyone fairly.

Right now, he argues, rural communities are taking on a lot of the new clean energy infrastructure, such as large-scale solar farms. This burdens them with rising land costs and loss of agricultural land, while the nearby urban areas reap most of the benefits.

“So, a just energy transition must go beyond decarbonization,” Mishra said. “It should revitalize rural economies, empower farmers, and foster a self-reliant local economy while integrating local communities to broader regional and global markets.”

In his work, Mishra examines two approaches to help do so.

The first is to replace traditional jet fuel with sustainable aviation fuel (SAF) made from various sources such as corn-based ethanol, leftover plant matter from farms and forests, and used cooking oils and fats. Investing in SAF technologies benefits rural economies by creating a new market for energy crops as well as diverting these currently untapped and wasted resources to SAF production, he said.

The other approach is a practice called agrivoltaics, in which farmers and solar developers strategically combine solar panels and crops in the same piece of land. This practice increases land productivity by using it for both food and energy production. When agrivoltaics is applied, the economic benefits of solar farms are more evenly shared between the solar developers, farmers, and local communities, Mishra explained. It is also an appealing investment for solar developers because it reduces community opposition to solar development.

“Together, these efforts advance a more inclusive, sustainable, economically viable energy transition,” he said.

Challenge No. 3: Choosing the Right Economic Policies

The most important reason to transition to clean energy is to mitigate climate change and reduce pollutants, said [Bobby Harris](#), an assistant professor in Georgia Tech's [School of Economics](#).

That requires transitioning sectors such as transportation, manufacturing, and heating from fossil fuels to electricity, while also making sure that electricity is generated cleanly from renewable or nuclear sources.

The best way to do so?

“Economists agree that carbon taxes are the best, most cost-effective way to achieve a low-carbon future,” Harris said.

Carbon taxes work by putting a price directly on the thing that is causing harm: emissions, Harris explained. This incentivizes companies to avoid the tax by innovating and finding the least costly way of lowering their emissions. It also gives consumers an incentive to avoid the tax by making decisions that lead to lower emissions, such as driving less, living closer to work, or buying products with lower emissions because they would be cheaper.

Opponents to the carbon tax champion other policies, such as green subsidies — government incentives for solar panels and home energy efficiency improvements, for example — or mandates such as the now-repealed federal Greenhouse Gas Endangerment Finding and Corporate Average Fuel Economy standards, which regulated car emissions and minimum average miles per gallon for vehicle manufacturers.

“These policies have been popular and can certainly help lower emissions and encourage an energy transition, but they do so less well and at a potentially much higher cost than a carbon tax,” Harris said. “However, the political advantage is that the cost is more hidden.”

Whereas a carbon tax directly affects the price of goods, these other policies indirectly increase households' costs via higher taxes to pay for subsidies or by encouraging, or forcing, households to buy higher-cost products, such as cars with better fuel economy or electric vehicles.

Harris' work helps guide economic policies by studying our ability to adapt to extreme temperatures and the costs involved. With this information, legislators can better determine which policies are the most effective and how much money is at stake.

"To put a price on carbon emissions, we need to know what the damages from carbon emissions, and thus climate change, truly are," Harris said. "Even if a carbon tax isn't in our future, the numbers still help policymakers determine how much we should prioritize reducing emissions."



Bobby Harris is an assistant professor in the School of Economics. [Learn more about his work.](#)



Kate Pride Brown is an association professor in the School of History and Sociology. [Learn more](#)

[about her work.](#)

Challenge No. 4: Navigating Financial and Political Incentives

[Kate Pride Brown](#), a sociologist at Georgia Tech's [School of History and Sociology](#), notes that the best policies to achieve decarbonization do not necessarily always win out. There are other interests at stake, including the opportunity to make money. Profit can incentivize decisions based on financial gain rather than what's most efficient or technologically sound, she explained.

"There is a lot of wealth being generated in the broader economy right now from speculation and the displacement of risk. Energy is not any different in that regard," Brown said.

Investors, politicians, and regulators may be tempted by clean energy technologies that promise high profits, even if they're not yet proven, such as clean coal. On the other hand, energy users are generally stuck with whatever their utility companies pursue and regulators approve.

This distribution of risk and reward creates a moral hazard, Brown said, where a few people can gamble on costly, high-profile projects, knowing that it is the consumers who will ultimately bear most of the downside if they don't work out.

As a sociologist, Brown emphasizes the importance of taking a wide-angle view of the energy transition, examining social forces beyond the energy industry itself.

"When people make choices about which kinds of energy projects to pursue, they do so in the face of broader economic and political trends that have nothing to do with climate change, technological capacity, or energy independence," she said. "Political ideologies, corporate interests, and personal values all come into play, and these trends shape the direction of energy development. The 'how' of the energy transition matters, often in ways that are only tangentially related to energy itself."

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