

The Steyer-Taylor Center for Energy Policy and Finance

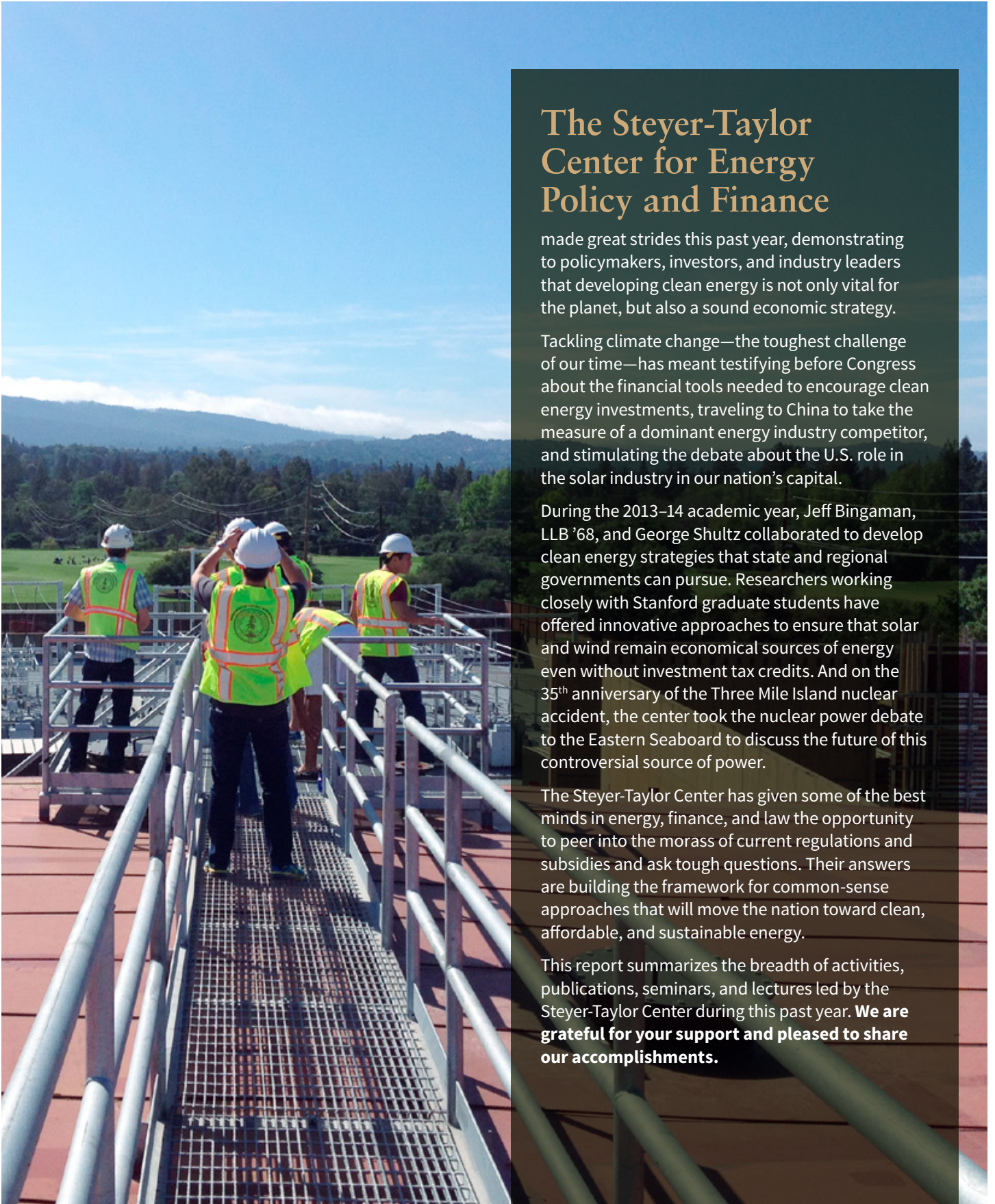
made great strides this past year, demonstrating to policymakers, investors, and industry leaders that developing clean energy is not only vital for the planet, but also a sound economic strategy.

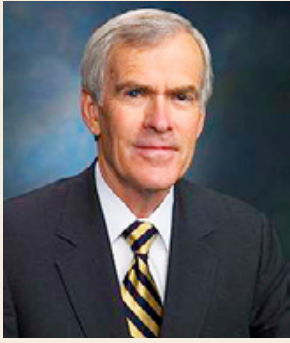
Tackling climate change—the toughest challenge of our time—has meant testifying before Congress about the financial tools needed to encourage clean energy investments, traveling to China to take the measure of a dominant energy industry competitor, and stimulating the debate about the U.S. role in the solar industry in our nation's capital.

During the 2013–14 academic year, Jeff Bingaman, LLB '68, and George Shultz collaborated to develop clean energy strategies that state and regional governments can pursue. Researchers working closely with Stanford graduate students have offered innovative approaches to ensure that solar and wind remain economical sources of energy even without investment tax credits. And on the 35th anniversary of the Three Mile Island nuclear accident, the center took the nuclear power debate to the Eastern Seaboard to discuss the future of this controversial source of power.

The Steyer-Taylor Center has given some of the best minds in energy, finance, and law the opportunity to peer into the morass of current regulations and subsidies and ask tough questions. Their answers are building the framework for common-sense approaches that will move the nation toward clean, affordable, and sustainable energy.

This report summarizes the breadth of activities, publications, seminars, and lectures led by the Steyer-Taylor Center during this past year. **We are grateful for your support and pleased to share our accomplishments.**





Jeff Bingaman is uniquely qualified to transform plans into action. As a member of the U.S. Senate from 1982 to 2013, Bingaman served as chairman of the Senate Committee on Energy and Natural Resources. He played a major role in the passage of the Energy Policy Act of 2005 and was the lead sponsor of the Energy Independence and Security Act of 2007. Prior to his role in the U.S. Senate, he was attorney general of New Mexico.



George Shultz has been lauded for working across party lines to address the challenges presented by climate change. He chairs the advisory boards of two energy research umbrella organizations: Stanford's Precourt Institute for Energy and the Massachusetts Institute of Technology's Energy Initiative. Shultz also leads a group that recently proposed a revenue-neutral federal tax on carbon to slash U.S. greenhouse gas emissions and oil consumption.



STATE-BASED POLICIES FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY

Political gridlock in Washington has shifted the search for renewable, reliable, and affordable energy to state and local governments. In 2013, former U.S. Senator Jeff Bingaman joined the Steyer-Taylor Center as a distinguished fellow to lead the charge on developing and promoting the most effective state-level energy policies.

To help identify which energy policies work and which do not, Bingaman and George Shultz, the Thomas W. and Susan B. Ford Distinguished Fellow at the Hoover Institution, convened a roundtable discussion at Stanford in October 2013. The daylong session involved key stakeholders representing various interests: utility companies from Hawaii, Kansas, New York, Texas, New Mexico, and Washington; corporations including Google and Walmart; and nonprofit organizations such as the William and Flora Hewlett Foundation, the Environmental Defense Fund, and the Natural Resources Defense Council.

These conversations were pivotal to Bingaman and Shultz's joint study published in September: "The State Clean Energy Cookbook: A Dozen Recipes for State Action on Energy Efficiency and Renewable Energy." In the report, the authors say they were encouraged to find that "both red states and blue states are turning green, whether measured in dollar-savings or environmental benefit." The report identifies specific energy solutions developed by individual states that not only reduce energy costs and carbon emissions, but also can be replicated. Shultz notes that the report's goal was "to provide a source for states to compare and contrast innovative policies, so that they can learn from each other." Bingaman calls states "laboratories of democracy" because they have developed groundbreaking programs and policies that could benefit the entire country.

Dan Reicher, executive director at the Steyer-Taylor Center, was involved in the study and notes that the policies outlined in the report have met several tests: They are already on the books, they work, they enjoy widespread support, and they are cost-effective. During the next year, Reicher and Bingaman will use the report to spur adoption of these solutions by state governments across the political spectrum.

Students including Ernestine Fu, '13, MS '13, PhD '19, and Nicole Schuetz, '06, MBA '13, MS '14, also participated in the yearlong project and assisted in organizing the roundtable.



BEYOND 2016: THE SOLAR INDUSTRY AND THE STEP-DOWN OF THE FEDERAL INVESTMENT TAX CREDIT

The downsizing of a valuable tax credit is the focus of a project led by Stefan Reichelstein, the William R. Timken Professor of Accounting. Supported by a grant from the Department of Energy, the yearlong study explores how the drop of the Federal Investment Tax Credit from its current 30 percent to 10 percent on January 1, 2017, will affect the competitiveness of the solar market. Initially adopted in 2005 and extended in 2008, this tax credit has spurred phenomenal growth in the commercial photovoltaic industry. The United States installed 4,750 megawatts of solar photovoltaic panels in 2013—a jump of 40 percent over 2012.

Together with Dan Reicher, Reichelstein is examining multiple financing tools, including alternative incentive mechanisms to mitigate the impact of the lower credit and smooth the pathway to 2017. Reicher, who has testified twice before Congress regarding this topic, told the Senate Finance Committee on July 31, 2013: “Technology is indeed the great driver of progress in clean energy but without smart policy as well as plentiful—and cheap—capital, we’re not going to make progress very fast in this high-risk, high-return, and highly competitive area.

Congress and the administration can do much to advance clean energy through thoughtful policymaking and targeted support of the energy capital markets.”

In September, Reichelstein convened an energy conference titled “The Road Ahead for the Solar PV Industry” to address the cost of solar power for manufacturers and investors in commercial installations. Upon the study’s completion, the Steyer-Taylor Center will be issuing its results to policymakers, the photovoltaic industry, nongovernmental organizations, and universities.

PHILANTHROPIC AND LONG-TERM SOURCES OF CAPITAL IN CLEAN ENERGY FINANCE

To avoid the worst effects of climate change, global investment in renewable energy must more than double in the coming years. The Steyer-Taylor Center has emerged as a leader ready to address the barriers facing philanthropic and long-term oriented investors, who would consider clean energy investments if they had a better understanding of risks and rewards.

Under the direction of Deputy Director Alicia Seiger, MBA ’02, the center has engaged representatives from family offices, endowments, and sovereign wealth funds to discuss how to bolster

confidence in investments in energy innovation and deployment. Several well-attended events provided a forum for investors to speak frankly about why they haven’t pursued renewable energy opportunities. As Seiger noted during one session, family offices have significantly more flexibility, creativity, and conviction to invest in clean energy solutions than larger institutional investors. With better access to networks and knowledge, this group of investors can create innovative financing vehicles with the potential to be replicated and scaled to meet the demands of larger institutions, which must operate under more constraints. These sessions established the Steyer-Taylor Center as a resource for candid exploration of new approaches to innovative sources of capital for clean energy finance.

This work has been done in partnership with PRIME, a nonprofit that enables concessionary investment in energy innovation and deployment; CREO, a network of more than 75 family office investors interested in cleantech, renewables, and environmental opportunities; and Bloomberg LP. The project has also involved many students, including Sarah Penney, ’10, MBA ’15, MS ’16; Nicole Schuetz, ’06, MBA ’13, MS ’14; and Andrew Stevenson, JD/MBA ’15.



COST COMPETITIVENESS OF LOW-CARBON ENERGY TECHNOLOGIES

The Steyer-Taylor Center has developed an array of financial tools to solve a considerable challenge: paying for the technology, equipment, and expertise that will reduce greenhouse gas emissions. A sampling:

Dan Reicher calls his proposal to pay for equipment to capture carbon with tax-exempt bonds a “back-to-the-future” idea. Tax-exempt bonds once rid America’s skies of pollution—and could do it again, he says. In the 1970s and ’80s, the United States issued \$50 billion in bonds to finance pollution control equipment. The bonds provided low-cost, long-term capital that funded state-of-the-art equipment for hundreds of power plants. The bond program ended in 1986 but the regulatory and legal framework still exists; asking Congress to reinstate tax-exempt bonding would jump-start the carbon capture and sequestration industry. The idea has gained support from coal and gas producers, equipment manufacturers, the environmental community, and the financial industry. Jeffrey Brown, an experienced energy investor, worked with Reicher on this project.

A plan developed by **Stefan Reichelstein** and **Stephen Comello, PhD ’13**, a research fellow at the Steyer-Taylor Center, aims to reduce greenhouse gas emissions from fossil fuel-fired plants by 80 percent. Technology to capture carbon dioxide is already available; the challenge is convincing the industry to use it. Reichelstein and Comello propose adopting emission controls now that would become law in 2027, while incentivizing the industry with investment and production tax credits to install the technology starting in 2017. This could result in emissions dropping to 80 kilograms of carbon dioxide per kilowatt-hour, compared to the current average of 800 kilograms per kilowatt hour. In February, the center hosted a faculty workshop at the Knight Management Center to further explore this concept.

Karim Farhat, MS ’11, a graduate research fellow at the Steyer-Taylor Center and a doctoral candidate at Stanford, has developed a novel approach to pay for carbon capture and storage facilities. He proposes exporting coal-generated electricity from Wyoming to power-hungry California, capturing the carbon dioxide to meet California’s environmental regulations, storing it in reservoirs, and then using it to recover oil. His research shows that not only is such a project profitable under current regulations, but it’s also an opportunity to pay for large-scale carbon storage facilities and further develop newly proposed interim storage technology.



PURSuing CLEAN ENERGY IN THE WORLD'S MOST POPULOUS PLACES

China

As China's domination of the solar industry grows, the Steyer-Taylor Center is evaluating how the United States—and the rest of the world—can compete in the race to harness the sun. Jeffrey Ball, scholar-in-residence at the center, argues that understanding the massive Chinese solar market provides insight that can inform the world about all renewable energy sources.

The Steyer-Taylor Center is uniquely positioned to conduct this research, given that Silicon Valley is the headquarters for the U.S. solar industry and the focus of Chinese investment interest. Trips by Ball to Beijing and Shanghai and visits from Chinese officials have strengthened relationships between the center and senior Chinese solar executives and government officials. In addition, a grant from the U.S. Department of Energy has allowed the center to hire two research associates. Ball, along with Dan Reicher, also created a seminar, *China's Solar Industry and Its Global Implications*, that gives students the opportunity to analyze industry and policy data to assess China's competitive strengths in the global solar industry.

This fall, Ball will be issuing reports that outline economic solar strategies for the United States and other countries. They will build on the groundwork laid in summer 2013, when the center and the German Federal Ministry for the Environment co-hosted a workshop called "Avoiding Sunstroke: Assessing National Competitiveness in the Global Solar Race." The workshop attracted 20 top global solar executives; its findings were published in November 2013.

India

Gireesh Shrimali, PhD '08 and a faculty fellow at the Steyer-Taylor Center, is focusing on the world's second most populous country, India. He notes that his research into how India is encouraging the growth of renewable energy will be applicable to other countries in the developing world.

Despite India's ambitious renewable energy goals, the barriers are high. In addition to the cost of capital, India faces a power system ill-suited to transmit energy from renewable resources, uncertain support from government programs, and renewable energy costs that are anywhere from 50 percent to 130 percent more than conventional sources of power. In a paper titled "Meeting India's Renewable Targets: The Financing Challenge," Shrimali outlines several solutions. One step all developing countries can take, he says, is adopting financial policies that reduce the cost of debt through subsidies and extended payback terms.



WRAPPING UP 2013–14

Highlights

JULY 31, 2013: **Dan Reicher**, executive director of the Steyer-Taylor Center, testifies before the **Senate Finance Committee** on principles for energy tax reform.

AUGUST 26, 2013: Reicher is appointed to the **U.S. Secretary of Energy Advisory Board**, an independent advisory committee to Energy Secretary Ernest Moniz.



OCTOBER 2, 2013: Reicher testifies before the **U.S. House Committee on Oversight and Government Reform**.

OCTOBER 7, 2013: **Shisen Xu**, president of Clean Energy Research Institute, China Huaneng Group, visits Stanford and discusses his country's efforts to burn cleaner coal.

OCTOBER 17, 2013: **George Shultz** and **Jeff Bingaman** convene a roundtable with **power industry representatives** to address the gridlock in Washington and discuss sustainable and affordable energy policies.



OCTOBER 18, 2013: **Richard Kauffman**, New York State's energy czar, visits campus to discuss how to scale up clean energy in New York.

NOVEMBER 5, 2013: The Steyer-Taylor Center organizes a "Forum on Financing Clean Energy Technology," a symposium on the challenges of commercializing new technology, at the **National Academy of Sciences** in Washington, D.C. Reicher and **Jeffrey Ball** participate in the forum that includes Moniz; Chris Groobey, a partner with Wilson Sonsini Goodrich & Rosati; and Andrew Brown, vice president of Delphi Inc. and chair of the Board on Energy and Environmental Systems for the National Academies.

FEBRUARY 19, 2014: **U.S. Senator Sheldon Whitehouse** (D-Rhode Island) visits Stanford Law School and discusses the policy—and politics—of climate change with students.

FEBRUARY 24, 2014: **Joel Dobberpuhl**, retired portfolio manager at Jetstream Capital, discusses **social impact investing** at the Knight Management Center.

FEBRUARY 24, 2014: "New Models for Investment Collaboration in Clean Energy" proves so popular that people are turned away due to space constraints. The meeting is hosted by the Steyer-Taylor Center and investors pursuing **cleantech, renewable, and environmental opportunities** (known as CREO).

MARCH 28, 2014: The Steyer-Taylor Center co-hosts "**Three Mile Island 35th Anniversary Symposium: The Past, Present, and Future of Nuclear Energy**" at Dartmouth College.

APRIL 13–18, 2014: The first-ever **Climate Week** at the Graduate School of Business highlights the opportunity and urgency of climate change. George Shultz provides an overview of the business,



policy, and energy sectors. **Alicia Seiger** moderates a panel titled "Risky Business: What do leaders need to know about the economic risks of climate change?"



Publications

“Has India’s Solar Mission Increased the Deployment of Domestically Produced Solar Modules?” by Gireesh Shrimali and Anshuman Sahoo, *Energy Policy* (2014)

“Operational Impacts of Renewable Generation in the California Independent System Operator and the Electric Reliability Council of Texas,” by Sam Steyer and Natasha Whitney, working paper (2014)

“Incentives for Early Adoption of Carbon Capture Technology,” by Stephen Comello and Stefan Reichelstein, *Energy Policy* (2014)

“A State Tax Approach to Regulating Greenhouse Gases Under the Clean Air Act,” by Michael Wara, *Brookings Climate and Energy Economics Discussion Paper* (2014)

“Beyond Tax Credits—Smarter Tax Policy for a Cleaner, More Democratic Energy Future,” by Felix Mormann, working paper (2014)

“Pass-Through of Emissions Costs in Electricity Markets,” by Mar Reguant and Natalia Fabra, *American Economic Review* (2014)

“Financial Assessment of CO₂ Capture and Storage with Electricity Trading in the U.S.: Role of Interim Storage and Enhanced Oil Recovery,” by Karim Farhat, Josh Koplin, Daniel Lewis, Sebastian Peterlin, and Ramon Simms, *Energy Procedia* (2013)

In the News

“Clean Energy Scores a Success with the Master Limited Partnership Parity Act,” by Felix Mormann, Dan Reicher, and Mark Munro, *Brookings Institution Advanced Industries*, December 19, 2013

“America’s Natural Gas Lever,” by Michael Wara, *New York Times*, March 7, 2014

“The Politics of Climate Change Stink. That’s Why ‘Think Globally, Act Locally’ Is Back,” by Jeffrey Ball, *New Republic*, April 21, 2014

“A Better Way to Cut Power-Plant Emissions,” by Stephen Comello and Stefan J. Reichelstein, *Bloomberg View*, April 21, 2014

Real Estate Investment Trust (REIT) Solar Federal Register Notice, published in the Federal Register, May 15, 2014

“Energy Efficient Homes Should Come with Better Mortgages,” by Dan Reicher and Andrew Peterman, *The Hill*, May 19, 2014

“Inside Stanford’s Coal Divestment Decision,” by Alicia Seiger, *Institutional Investor*, May 28, 2014

“Obama’s Climate Plan Will Only Reduce Global Emissions by 1%,” by Jeffrey Ball, *New Republic*, June 2, 2014

Courses

- *Sustainable Energy: Business Opportunities and Public Policy*, Dan Reicher, Stefan Reichelstein
- *Potential Impacts of Highly Innovative Emerging Technologies on Climate and the Economy*, Stefan Heck
- *China’s Solar Industry and its Global Implications*, Jeffrey Ball, Dan Reicher
- *Economics of Competing Energy Technologies*, (online course) Stefan Reichelstein
- *Hot Topics on Major Federal Environmental Statutory Schemes*, Michael Wara
- *Modern Fossil Fuel Extraction*, Michael Wara

WHAT STUDENTS ARE SAYING



“I participated in the China solar policy research group and wrote my master’s thesis on the same topic. Jeff Ball and Dan Reicher have closely guided my research and have used their extensive contacts to invite knowledgeable speakers to campus. I have since established business contacts with these solar industry experts. The center has provided me both a platform to learn and to connect with the energy industry.”

—**Chelsea Chen, JSM ’14**



“In pursuit of my joint MBA/MS in environment and resources, I worked with the Steyer-Taylor Center on two projects and assisted former Senator Jeff Bingaman with his report on state-level clean energy policies. These projects allowed me to focus on the topic I am passionate about: the economic and political constraints of increasing clean power generation. Working with Alicia Seiger and Dan Reicher has led me to a career path that I am uniquely qualified for.”

—**Nicole Schuetz, ’06, MBA ’13, MS ’14**



“The Steyer-Taylor Center has both insight and access to the vast array of resources related to energy and energy policy at Stanford. I have built a small but rapidly growing organization, Independent Energy Standards Corporation, which drives environmental and engineering best practices in oil and gas. Half of our team is from Stanford, many of our investors are from Stanford, and some of our critical partnerships have been through Stanford. Without the Steyer-Taylor Center, much of this would not have been possible.”

—**Jory Caulkins, MBA ’14**



“As research assistant to the Stanford Energy Seminar in spring 2013, I worked with Jeff Ball to co-host a seminar mini-series on China and energy. Jeff effortlessly interviewed his contacts from China during the seminar talks. All of us attending the seminar not only gained a more nuanced understanding of energy issues in China, but also learned how to ask the right questions.”

—**Kirsten Stasio, MBA ’14, MS ’15**

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