



# SUSTAINABLE FINANCE INITIATIVE SPRING 2020 REPORT

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## ABOUT SFI

**Mission:** The Sustainable Finance Initiative (SFI) works to *scale up and accelerate the flow of capital toward the decarbonization of global systems by developing and deploying innovative policies and financial mechanisms, educating leaders, and engaging with the global policy and finance community.*

**Focus areas:** We approach our work across five focus areas: (1) catalyzing private investment, (2) energy business innovation, (3) risk metrics and management, (4) stranded assets and just transitions, and (5) systems transformation and integration.

**Model:** SFI engages faculty, fellows, and students in projects within our five focus areas, though some projects cut across multiple themes. Every project is grounded by a question or problem sourced from the real world. SFI faculty and fellows work directly with key stakeholders where problems are located, and together we drive toward an implementation pathway so that our work has a measurable impact.

## CATALYZING PRIVATE INVESTMENT

### Blended finance

In pursuit of scaling global investment in low-carbon solutions from billions to trillions, climate advocates have looked to so-called “blended finance” as a financial mechanism to leverage scarce public and philanthropic capital to drive private investment in geographies and technologies that are not ripe for pure-play market actors.

SFI’s [Esther Choi](#) has a forthcoming paper exploring the application of blended finance in decarbonization by investigating five areas: (1) the climate finance landscape, (2) the governance of blended finance vehicles, (3) transparency, (4) additionality, and (5) transformative impact. The paper goes beyond typical quantity- and upstream-focused evaluations and instead employs case studies (specifically looking at the Global Energy

Efficiency Renewable Energy Fund, Climate Public Private Partnership, and Climate Investor One) to delineate how and where the flows of capital are organized and directed for climate impact. Esther is exploring a follow-up project on the concept of a deal-sourcing platform. This is not a new idea but despite strong interest from both sides of the market, is one that has yet to be successful at scale. Esther is proposing to identify barriers and key design features in pursuit of a matchmaking platform.

### **Recent publications:**

- Choi, Esther, “Catalyzing Capital for Decarbonization: Blended Finance and Its Way Forward.” [forthcoming May 2020]

**Events:** Together with Bank of America and the World Bank Group, SFI hosted a workshop at Stanford in May 2019 and a follow-up event in September 2019 at Bank of America’s New York office.

**Collaborators:** Bank of America, World Bank Group, European Investment Bank, Climate Fund Managers, UK Department of International Development and Climate Policy Initiative.

### **Risk and return opportunities of ESG investing**

Led by SFI’s [Soh Young In](#), this research aims to clarify the risk-return relationship of low-carbon investing (i.e., whether environmental, social, and governance (ESG) integration can lower risks and/or generate returns), as well as to understand how a firm’s environmental performance and its improvement are perceived in global financial markets. Combining environmental engineering, financial economics, and advanced data technologies, Soh Young is investigating whether and how much integrating environmental factors can provide extra risk-adjusted returns. In their latest study, her team demonstrated positive and statistically significant risk-adjusted return opportunities from low-carbon investing in the US market. Her team will be expanding its analysis to a global scale, and aims to advance the understanding of ESG integration and investing from geological, economic, and social science perspectives.

*“The Sustainable Finance Initiative (SFI) has provided me with an invaluable opportunity to study the critical nexus between finance and climate change. This year, I had the opportunity to work with Soh Young at SFI to understand the asset-level risk of energy infrastructure projects to climate change. It was an invaluable learning experience as we delved into first understanding potential climate risks and then translating those risks into financial impacts at the asset-level. I am incredibly grateful to SFI and Soh Young for giving me the opportunity to learn skills and insights that will equip me well as I begin my post-Stanford career.”*

**Caroline Jo, MS-JD '20**



### **Recent publications:**

- In, S.Y., K.Y. Park and A. Monk, “[Is ‘Being Green’ Rewarded in the Market? An Empirical Investigation of Decarbonization Risk and Stock Returns.](#)” [under review].
- In, S.Y. and K.Y. Park “[When Do Firms Oversell or Undersell Environmental Sustainability?: An Empirical Analysis of Corporate Environmental Communication.](#)” [under review].
- In, S.Y. and K.Y. Park, “Decarbonization, Stock Returns, and Firm Characteristics: Evidence from Global Markets.” [work in progress]

**Events:** Soh Young has presented her work at two recent events, the Principles for Responsible Investment (PRI) Academic Network Conference, “Bridging the Gap between Investors and Academics,” in Paris, France, and the Global Research Alliance for Sustainable Finance & Investment, 2019 Annual Conference, at Oxford.

**Collaborators:** Ashby Monk (Stanford GPC), Ki Young Park (Professor of Economics at Yonsei University). The work has also received financial support from the United Nations Environment Programme Finance Initiative (UNEP FI) and Trucost.

*“The Sustainable Finance Initiative has played a great role in my student experience by allowing me to gain a deeper understanding of the economics of the energy transition and connecting me with relevant academic and industry players. With the support of SFI, I participated in the creation of a partnership between the Stanford Energy Club and the Sustainable Finance Initiative, collaborating with a team of students to study the impact of climate transition risks on energy infrastructure valuation. I hope to continue to leverage this community after graduation in my career at the intersection of finance and decarbonization.”*



**Clothilde Venereau, MS '20**

demonstrating a novel perspective of measuring sustainability, using alternative data, and applying new data technologies, which will broaden the current understanding of ESG and enable more reliable ESG integration.

## Application of advanced data analytics to ESG investing

Led by Soh Young In, this project is developing a conceptual framework to align all material factors in investment analysis and decisions (including environmental, social and governance [ESG] factors, organization culture, and other sustainability indicators) using alternative data. Studies under this project will use new technologies such as machine learning, natural language processing (NLP), and other big data technologies to measure and test the importance of sustainable transition. This approach will contribute to academia and industry by

### Academic publications:

- In, S.Y., D. Rook and A. Monk (2019), [“Integrating Alternative Data \(Also Known as ESG Data\) in Investment Decision Making.”](#) *Global Economic Review*, 48(3), 237-260.
- In, S.Y. and Y. J. Lee, “ESG Integration and its Impact: Scientometric Analysis on 37 years of ESG research.” [work in progress]
- In, S.Y. and Y. J. Lee, “Finding Insights in the Flood of ESG Data: Deeper Analysis of Corporate Environmental Communication.” [work in progress]

**Events:** Soh Young presented this work at two events in November 2019: 1) the Stanford Global Projects Center Institutional Investor Research Club Workshop and 2) SFI’s lunch seminar series.

**Collaborators:** Ashby Monk (Stanford GPC), Dane Rook (Stanford GPC), [Young Joon Lee](#) (SFI Visiting Scholar), Laura Sun (MS&E Masters student), Robert Eccles (HBS professor of practice), and the UN Secretary-General’s Task Force on Digital Financing of the Sustainable Development Goals. Research sponsors include the Long-Term Stock Exchange, MSCI (pending) and ISS ESG (pending).

## Financial innovation for clean energy and climate solutions

Catalyzing private capital for innovative energy and climate solutions is key to driving the transition to a low-carbon economy. Today, early-stage clean energy projects and companies face funding shortages to develop, demonstrate, and deploy new technologies. While consistent and long-term sources of investment capital are needed, current financial intermediaries have failed to effectively channel sources of funding to entrepreneurs. Failure modes include governance—specifically, ineffective intermediation, misaligned incentives, and information asymmetry among different investor categories and companies.

This project investigates ideas to mobilize investment capital to support energy innovation and climate solutions through the design of new financial intermediaries. These new financial intermediaries are tailored to the specific risks and opportunities associated with clean energy technology and climate solutions. We investigate legal, organizational, and institutional barriers in the clean energy investment market and consider new sources of capital and new roles and functions of intermediation to drive positive social and environmental impact alongside financial results. If successful, these new vehicles will redirect capital towards sustainable investments and reshape the financial system to be compatible with a low-carbon economy.

*“The Sustainable Finance Initiative has played a central role in my undergraduate career at Stanford. By connecting with scholars who work at the forefront of market-based solutions for sustainability and climate resilience, I have had the opportunity to support research projects that are re-engineering the financial industry for a better tomorrow. This fantastic community of passionate individuals from across the university and around the world inspires me and many other students to lead careers of meaningful impact.”*

**Thea Rosenberg, BS '21**



A recent success story of this work is the [Prime Coalition](#)'s first-of-its-kind \$50 million impact fund (to be announced in early 2020) that will channel philanthropic capital into tough tech climate solutions with strong market potential. SFI's [Alicia Seiger](#) advised on the creation of this groundbreaking fund in her capacity as a Prime Board Member.

#### **Academic publications:**

- Holland, H., A. Dixon, S.Y. In, A. Monk and R. Sharma (2019), [“Governing Blended Finance: An Institutional Investor Perspective.”](#) *Economics of Transition* [forthcoming].
- In, S.Y. and A. Monk, “Financing Energy Innovation: New Roles and Functions of Intermediation in Clean Energy.” [under review]
- In, S.Y. and A. Monk, “Drivers of Successful Exit: Experience from the Early-Stage Hard-Tech Energy Investment in the US Market.” [work in progress]

**Collaborators:** Ashby Monk (Stanford GPC), Esther Choi (SFI research Fellow), Rajiv Sharma (Stanford GPC), Justine Lee (Graduate student in CEE), Adam Dixon (Professor of Globalization and Development at Maastricht University), Havard Halland (OECD), Fiona Murray (Professor MIT), Sarah Kearney (Prime Coalition), among others. Research sponsors include the U.S. Department of Energy and Activate Energy.

#### **Green Finance in China**

China is the largest source of investment in green finance, particularly in renewable energy and increasingly in electric vehicles. Although Chinese state-owned bank lending has historically been the primary financier of credit, two new sources of capital have exploded in scale in recent years. The first of these sources is green bonds, where Chinese issuances by state, central, and provincial banking institutions constitutes the world's largest pool of green debt securities. The second is a wide array of private wealth vehicles resulting from enormous growth in shadow banking agencies.

SFI is analyzing the empirical reality of these new green markets in two ways. First, working with the Climate Policy Initiative (CPI) and the International Institute for Green Finance (IIGF) at the Central University of Finance and Economics (Beijing), SFI has hosted as a visiting researcher [Mathias Lund Larsen](#) of IIGF, who presented to the Stanford community the databases collected in Beijing and described the special purpose regulatory structure of green bonds. Issues of green bond quality have been at the core of this emergent joint research

with particular focus on the monitoring, reporting, evaluation, and transparency foreseen by the regulatory mechanisms installed for this class of instruments. Continuing study of the incentives and additionality of green bond fund uses remains underway.

Second, SFI has just welcomed a new Visiting Fellow, [Oliver Gottfried](#), in collaboration with the School of Earth Sciences. Oliver will explore and analyze the volumes, organization, regulation, and financial practices of the rapidly expanding Chinese shadow banking sector, where he has been working for the past several years. His work should throw initial light on Green and brown investment activities in this booming financial sector which has to this point received far less attention than it merits in understanding the Chinese financial landscape and priorities.

## **China's Belt and Road Initiative**

For a generation, a rising China has shaped the global environment through its domestic growth. Increasingly, China's chief ecological impact on the world will be its investment in infrastructure abroad. Under an unprecedentedly large foreign-infrastructure-investment program called the Belt and Road Initiative, Chinese companies, supported by Chinese policy, are building power plants, roads, pipelines, and other massive projects around the world. Whether this building boom harnesses low- or high-carbon technologies will shape the trajectory of global carbon emissions for decades to come.

Myriad universities and institutes—in China, in the United States, and elsewhere—are analyzing the environmental implications of the Belt and Road Initiative, known as the BRI. Stanford's project differs in two ways.

First, it seeks to clarify what the BRI is: what sorts of projects and financing it includes and what sorts it doesn't. This seems elementary, but it's the source of major uncertainty, in large part because there's no widely accepted definition—even within China—of what sorts of foreign investment involving Chinese financing are and aren't included in the BRI. Clarifying the BRI's scope is a prerequisite for assessing its environmental impact. The Stanford project is developing a paper on this subject.

Second, the Stanford project seeks to assess the BRI's impact more realistically than others have done. Thus far, most analysts have simply tallied up the total portfolio of global projects the BRI has financed—coal plants versus solar plants, for instance. The Stanford project, by contrast, is focusing on a handful of particularly important BRI-recipient countries to examine, case-study style, whether the infrastructure financed in each country through the BRI is greener or browner than the infrastructure financed in that country outside the BRI, including by non-Chinese actors. Thus the Stanford project aims to compare the greenness of the BRI to that of “business-as-usual” infrastructure development in four countries that are particularly important given both their carbon-emissions trajectory and the amount of Chinese BRI money they are receiving: Kazakhstan, Pakistan, Malaysia, and Indonesia. Papers on this work are planned.

**Events:** The project's leader, [Jeffrey Ball](#), outlined this work at a January lunch at Stanford that drew about 40 students and faculty. He will present it in early March at a workshop held by Stanford's Freeman Spogli Institute for International Studies. The institute is aiming to launch a Stanford-wide research project on non-environmental aspects of the BRI. The Steyer-Taylor Center work could complement that broader Stanford work.

**Collaborators:** Sichuan University, in Chengdu, China. Potentially, at Stanford, professors at the Freeman Spogli Institute and in the economics department.

## ENERGY BUSINESS INNOVATIONS (EBI)

*“Coming from a community that is overburdened with air pollution, my goal in attending Stanford is to study technologies that can help alleviate this burden. SFI has helped me pursue this goal by allowing me to work with the Energy Business Innovations group with whom I am studying the economics of alternative vehicles like hybrid and electric buses. This work has given me a better understanding of academic work and has inspired me to pursue a master’s degree in Atmosphere/Energy where I will continue to study technologies that have the potential to lead us into a clean energy future.”*



**Carlos Ciudad-Real, BSH '20, MS '21**

EBI looks at how the transition to a decarbonized energy future can be accelerated and accepted in the marketplace. Projects supported by the initiative focus on the interplay of business fundamentals, technological innovations, organizations and public policy. EBI is funded by the Steyer-Taylor Center through an allocation that has, since STC’s early days, been allocated to the business school. Because EBI also receives funding from Precourt, EBI operates as a focus area of SFI.

The following are a selection of EBI projects.

### **Levelized cost of miles driven: economic comparison of alternative drivetrains in buses**

Steyer-Taylor Center Faculty Research Director [Stefan Reichelstein](#) and EBI lead [Steve Comello](#) are developing a levelized cost of miles driven (LCOMD) metric in order to compare the cost-competitiveness of alternative drivetrains. The LCOMD metric considers all capital (vehicle, battery), operational, maintenance, fuel, financing and tax costs for diesel, electric and hydrogen drivetrains used in urban bus fleets. The LCOMD model is able to show cost-competitiveness of each drivetrain under various duty cycle/use cases. Duty cycles include such parameters as distance, number of stops, time to complete, number of passengers, number of times run per day or per year, outside temperature, hills, etc. The LCOMD model would also be able to show the various electricity tariff structures required to make electric buses competitive vis-à-vis diesel (for example). Steve and Stefan are applying the LCOMD model to the Stanford Transportation bus fleet.

### **Technoeconomic analysis for valuing battery second life**

Steve and Stefan, together with MS&E Associate Professor [William Chueh](#) and Chemistry PhD student William Gent, are using recently developed high-throughput testing capabilities to investigate the degradation behaviors of battery cells beyond their first life and seek to understand how degradation, and therefore life cycle cost, vary under different second-life use cases. They seek to provide a technoeconomic assessment of alternative repurposing strategies (e.g. module replacement, cell reconditioning, etc.) and thus identify the potential for BEV pack reuse.

More information on EBI’s research, publications and events can be found [here](#).

## RISK METRICS AND MANAGEMENT

### **Assessing climate-related risk exposure of energy assets**

This project assesses the climate-related risk and opportunities of diverse energy assets. In response to financial and stakeholder pressure, investors are reviewing the mix of energy assets in their portfolios. Yet investors lack a transparent tool to accurately assesses the climate-related risk exposure of their energy investments. To fill

this gap, Soh Young is leading work to propose a novel climate-related risk assessment framework to guide the determination of financial risks (and opportunities) of energy projects at an asset level. The assessment model developed from this proposed research will be an innovative, ready-to-use climate risk assessment methodology, which will allow a broad range of investors to price their own climate-related financial risks for energy investments under various climate-aligned policy scenarios.

### **Recent publications:**

- In, S. Y., “Assessing Climate-related Risk Exposure of Energy Investment Portfolios.” [work in progress]
- In, S.Y., I. Monasterolo, and Marco Roberto, “Assessing Risks and Opportunities of Energy Investment Portfolios under Climate-Aligned Policy Scenarios.” [work in progress]
- Moudrak, N., B. Feltmate, S.Y. In, A. Monk, and H. O’Reilly, “Integrating Climate Risk into Institutional Portfolio Management.” [work in progress]

**Events:** Soh Young discussed this work at GPCs Investor Forum in November.

**Collaborators:** Ram Rajagopal (Professor in CEE), John Weyant (Professor in MS&E), Arun Majumdar (Director of PIE, Professor in Mechanical Engineering), Zhecheng Wang (PhD student in CEE), Caroline Jo (Graduate student in Law and E-IPER), Taylor Huff (Graduate student in MS&E), Berk Manav (Graduate student in CEE), Irene Monasterolo, (Assistant Professor of Climate Economics and Finance - Vienna University of Economics and Business), Marco Raberto (Associate Professor of Business and Management Engineering, University of Genoa, Italy), Intact Centre on Climate Adaptation, University of Waterloo, and the Spatial Finance Initiative at Oxford. This work may receive research support from the VALUABLES Consortium (pending).

## **Transition risk analytics toward low carbon economies**

The main policy responses to the growing concern about climate risk to date has been to seek better disclosure from private firms. In leading jurisdictions (namely France and California), private firms and state pensions are required to disclose some of their climate-related exposures and/or their contribution to greenhouse gas emissions. In other jurisdictions, including the UK and Australia, financial regulators in 2020 will apply stress tests to banks and insurers. Even more generally, corporate and financial firms are encouraged by private networks like the Task Force for Climate-Related Financial Disclosures (TCFD) to make disclosures through voluntary reporting standards.

The focus of this climate-risk disclosure activity to date has been on private firms. Indeed, the logic of disclosing climate risk works best for private corporations particularly those that are exposed to debt and equity markets. However, many important organizations exposed to climate-risks are *not* private firms with full exposure to capital markets. There are a range of fully or quasi-public organizations which are significant contributors to global climate change and have massive exposure to it. This includes state-owned enterprises, which, among other things, remain some of the most significant actors in international and domestic energy markets; sovereign wealth funds which hold some of the largest pools of global capital; and government agencies and other government corporate bodies that manage natural resources and assets which both contribute to the greenhouse effect and may be victim to climatic variation it causes. As a result, climate risks that initially appear to fall on firms or banks may actually flow onto state balance sheets and even threaten systemic financial stability.

The incentives, regulatory structures and political economy of public sector organizations differs significantly from private sector firms. As such, deeper thinking is required to better understand the nature of the climate risks facing these public sector organizations and approaches to manage such risks. Although many central banks and financial regulators across the world have been more active than their counterparts in the US, Alicia Seiger was recently invited to give testimony to Congress on potential impacts of this emerging field of work.

Beyond the US, a major new transnational organization of more than 45 central banks and national financial regulators has been formed as the Network for Greening the Financial System (NGFS). With its Presidency in the Netherlands, its Secretariat at the Banque de France, and leading members across the world from the Bank of England to the People's Bank of China to the Reserve Bank of Australia, the NGFS is looking past voluntary disclosure to standardization and macroeconomic instruments to manage effectively the physical and transition risks of shifting from high to low carbon economies. Working with these regulators and the Climate Policy Initiative to bring Stanford's formidable computational and cognitive science capacities to the design and implementation of systems change modeling under deep uncertainty—rapid and multiple disruptive shocks—is at the heart of SFI activities in this frontier area of climate action.

### ***Publications:***

- Seiger, A, "[Examining the Macroeconomic Impacts of Climate Change.](#)" Congressional Testimony prepared for the House Financial Services Subcommittee on National Security, International Development and Monetary Policy, September 2019.

**Events:** On September 11, 2019, Alicia Seiger testified before a House Financial Services Subcommittee at a hearing on the macroeconomic impacts of climate change and in response to proposed legislation from the subcommittee chair to require the US Federal Reserve Bank and the Securities and Exchange Commission to report on and manage climate risk. In November 2019, [Tom Heller](#) and STC research fellow [Arjuna Dibley](#) presented on managing public sector climate risk to government officials and regulators in Canberra, Australia. They met with the Australian Government Climate and Disaster Risk Reference Group and the Council of Financial Regulators.

**Collaborators:** House Financial Services Subcommittee on National Security, International Development and Monetary Policy Chairman Cleaver's office, Network for Greening the Financial System, Centre for Policy Development (Australia), Reserve Bank of Australia, Climate Policy Initiative among many others.

### **Climate risk in the financial system**

Related but distinct from the project above, which considers how climate risk impacts macroprudential regulators and state actors, this work focuses on how climate risk impacts large pools of assets, such as those held by state pension funds, university and foundation endowments, and sovereign wealth funds.

From March 2018 to April 2019, SFI Managing Director [Alicia Seiger](#) served the New York State Comptroller and Governor on the nation's first-ever Decarbonization Advisory Panel. The panel advised the \$210 billion New York State Common Retirement Fund on ways to decarbonize and build climate resilience. Based on the panel's findings, Comptroller DiNapoli issued a Climate Action Plan for the fund in June 2019. This work has formed the basis for educational sessions with other large pensions and endowments including meetings with the Board of Trustees of CalSTRS and Stanford University.



### **Recent publications:**

- Seiger, et al, (April 2019), [“Decarbonization Advisory Panel Beliefs and Recommendation.”](#)
- Seiger, A. (May 2019), [“Mother Nature is Not Calling for Divestment.”](#)
- Seiger and Williams, (May 2019), [“The Work of the NY Common Fund’s Decarbonization Advisory Panel”](#) a four-part series in *Responsible Investor*.

**Events:** Alicia has presented her work for New York Common at dozens of industry events as well as to the Board of Trustees of Stanford University, the Ceres Board, and the Board of Overseers for the California State Teachers Retirement System (CalSTRS.)

**Partners:** New York State Common Retirement Fund, CalPERS, CalSTRS, California Office of Planning and Research, the ImPact, Ceres and others.

## STRANDED ASSETS AND JUST TRANSITION

### **Transition finance in the US**

Led by [Uday Varadarajan](#), this work focuses on developing financial and rate impact models to help regulated utilities in states across the US figure out how to profitably transition to clean energy while saving ratepayers money and providing transition assistance to affected communities—primarily through the use of ratepayer-backed bond securitization with capital recycling. Uday has expanded his analysis to assess performance-based ratemaking (working with Hawaii regulatory staff), developed a method to use market proxies to ensure apples-to-apples comparison of fossil asset replacement with an equivalent value of clean energy resources, and expanded analysis of the tax, credit, and earnings per share impacts of securitization.

### **Publications:**

- Vardarajan, Uday, [Iowa Expert Testimony on Securitization and Coal Plant Economics](#).
- Shrimali, Gireesh, “Making India’s Power System Clean: Retirement of Expensive Coal Plants” [work in progress]

**Recent events:** Renewable Energy Buyer’s Alliance Market Update - “Securitization: Triple Win?”, SFI Lunch Seminar—Making the Clean Energy Transition Work for Everyone, and IEEFA Energy Finance Training. Upcoming Stanford Energy Week Workshop (Power and Money: A Climate Finance Workshop on February 21).

**Collaborators:** Rocky Mountain Institute, Natural Resources Defense Council, Sierra Club, Environmental Law & Policy Center, Iowa Environmental Council, Renewable Energy Buyer’s Alliance, Advanced Energy Economy, Gireesh Shrimali, LBNL, Hawaii Public Utilities Commission, Western Resource Advocates, Energy Innovation

## SYSTEMS TRANSFORMATION AND INTEGRATION

### **Market design and systemic energy reform: India**

Working with Indian government agencies, firms and research groups through the Energy Transition Commission, SFI is building and sponsoring a coordinated team of Stanford researchers and doctoral students to analyze—in

the specific and localized context of Indian resources, institutions, economics and finance—how dispatchable (flexible) power can assure reliability in low-carbon energy systems with a large share of generation from variable renewable energy sources.

Led by SFI Fellow [Gireesh Shrimali](#) in consultation with supervising faculty, this project looks at technology costs in situ, market design to enable cost-effective deployment of alternative flexible service options, reformed business models and new designs for public/private financial structuring better fitted to the different risk distributions associated with lower carbon energy. The project will engage with other university schools and research groups (e.g., Bits & Watts; Storage X; EV 50) to create continuing relationships with host country counterparts. More particularly, in addition to Gireesh, the SFI India team is currently composed of a postdoctoral fellow (energy storage) and doctoral candidates from the School of Earth Sciences (demand side management) and the School of Engineering (value stacking market designs).

*“My time at Stanford as a master’s student has taught me that business and policy interventions are essential to addressing climate change. When I began a PhD here, I wanted my research to reflect this belief. The Sustainable Finance Initiative at Stanford has helped me realize this. I am currently working on a project that is looking at pathways to improve grid flexibility in India. I have learned a great deal being a part of this endeavor and it has opened the door to working on energy and sustainability in India, where I believe a lot of impact can be made.”*

**Sindhu Sreedhara, MS '19, PhD Student**



#### **Publications:**

- Shrimali, Gireesh (2019), “Scaling Reliable Energy Access in India: A Public-private Partnership Model,” revised and resubmitted to *Energy for Sustainable Development*.
- Shrimali, Gireesh (2019), “Making India’s Power System Clean: Retirement of Expensive Coal Plants,” revised and resubmitted to *Energy Policy*.
- Shrimali, Gireesh and Divjot Singh (2019), [“Do Clean Energy \(Equity\) Investments Add Value to a Portfolio?”](#), *Green Finance*, 1 (2): 188-204.
- Shrimali, Gireesh, Vaibhav Singh, and Vinit Atal (2019), [“A Payment Security Mechanism for Off-taker Risk in Renewable Energy Projects in India.”](#) *Journal of Structured Finance*, Summer.

**Collaborators:** Charles Donovan (Imperial College), Nikit Abhyankar (Lawrence Berkeley Labs)

#### **Market design and systemic energy reform: Sichuan Province, China**

In a similar ambition and concept to that of the India energy system transition program—and in parallel with the Steyer-Taylor Center, CPI, the Sichuan Electricity (grid) Company, Sichuan University, CHN Energy Company, Imperial College (UK) and UC-San Diego—SFI contributions to the Sichuan program will focus on the analysis of performance, cost curves, and policy reform of systems integration, as well as flexibility services provision, investment productivity and (hydro) power export mechanisms. Particular attention, as requested by Provincial electricity sector and macroeconomic authorities, will be given to detailed empirical study of carbon capture and sequestration, seasonal flexibility in operations of fossil power units, and inter-provincial dispatch of large hydropower surpluses. Agreement on program design, data availability and multi-institution coordination was reached in December 2019 in Chengdu and work outputs are to be delivered end 2020.

Stay tuned for details on related events, publications and collaborators in late 2020.