Clean Energy Finance Forum: Reading Group and Research Projects  
Fall 2015 - Yale Center for Business and the Environment  
3-credit reading group/independent study

Overview

This reading group/consulting project will be dedicated to exploring topical issues in clean energy finance identified through the Clean Energy Finance Forum (CEFF) and our partnership with the Coalition for Green Capital.

The reading group/independent study will include two components:

- Participation in a weekly discussion group exploring the topics in the news update that is produced twice a month, is read by 6,000 subscribers, and is the top-ranked English-language news source for professionals interested in learning more about energy efficiency and solar finance;
- Development of a research report working with a team of 2-4 students and the Coalition for Green Capital on one of the clean energy finance topics (Low to Middle Income, Clean Energy Financing Solutions, Solar-Plus-Storage Financing, Investment Tax Credit Financing Gap) identified for exploration this semester.

As background on the Clean Energy Finance Forum (CEFF), Yale graduate students and recent alumni write for CEFF on a wide range of topics from distributed generation to property-assessed clean energy. The main objective of the publication is to inform finance professionals in the public and private sectors on the most important developments and news in energy efficiency and solar finance. Our reading material will align with this applied focus, and we will study news articles, reports, and interviews. Occasionally we will look at academic articles, but they will not form the bulk of our reading list.

Logistics

Participation in the group will be worth 3 credit of independent study, with a grade based entirely on completing the reading, showing up for discussion each week for an hour and the successful delivery of the defined research projects. The research projects will be composed of two to four graduate students. Based on student interest two out of the three identified research projects will be selected in the fall semester.

Weekly schedule

- A one hour reading group discussion each week
- A weekly check in call with the alumni research lead
- 5-7 hours of independent/team research and reading per week

Initial organizing meeting – Tuesday, Sept. 8, 4:00 in Kroon G31. At this meeting, we will finalize our regular meeting time, go through the structure of the reading list, establish interests from the group and select the consulting projects that we will take forward for the semester.
Group leader

Stuart DeCew is the Program Director at the Yale Center for Business and the Environment. In this role, Stuart is responsible for overseeing the management, administration, strategy and development of the School of Management and the School of Forestry & Environmental Studies research, education and outreach programs in business and the environment.

Prior to his arrival at Yale, Stuart worked as the National Logistics Coordinator for the Bill Bradley for President Campaign and subsequently served as a Legislative Aide for a member of congress in Washington, DC. He then volunteered for the Peace Corps where he acted as a local governance consultant for municipal and provincial governments in Paraguay. After the Peace Corps, Stuart directed a non-profit campaign to promote sustainable land use practices in Florida. Directly before matriculating at Yale, he was the on-site producer in Cairo, Egypt for Pangea Day, an international documentary film festival sponsored by the TED Prize. Stuart graduated from the joint degree program at the Yale School of Management and the Yale School of Forestry and Environmental Studies in 2011 with a focus in corporate environmental management, energy efficiency and environmental marketing. Stuart holds a BA from the Colorado College in History.

Yale Alumni Research Project Leader

Jeffrey Schub became the Vice President of the Coalition for Green Capital shortly after graduating from the Yale School of Management where he focused on clean energy finance and development. While at Yale, Mr. Schub worked as a Finance & Strategy Associate at Greenskies Renewable Energy, a commercial and utility-scale solar developer in Connecticut. During business school, he also worked at EnerNOC, the leading demand response provider, performing operational efficiency and customer service analyses for critical demand response events. At Yale, he conducted academic research on the on-going market creation and stakeholder engagement of the budding U.S. offshore wind industry.

Prior to that, Mr. Schub was a Senior Analyst at Analysis Group, a leading economic consulting firm. While there, he led dozens of case teams, conducting qualitative and quantitative research and building economic models across a range of industries in support of client litigation, primarily focused on technology and intellectual property. Mr. Schub graduated from Brown University with honors, receiving Bachelor’s Degrees magna cum laude in Economics and Public Policy.
Low to Middle Income Clean Energy Financing Solutions

Though distributed clean energy markets are growing rapidly, thanks to new financial offerings, the low-to-moderate income segment of the country is noticeably being left behind. Residential rooftop solar adoption is highly concentrated among high-income households that have the awareness and credit ratings needed to adopt clean energy. This inequality in access to clean energy is bad for three reasons. The first is that LMI households are the ones with the greatest need for cheaper and cleaner energy. Homes below 80% average median income face a far higher energy burden (energy cost as % of disposable income) that high-income earners. This means a reduction in energy bills is that much more critical for the LMI population. The second problem is that subsidies meant to support clean energy adoption are going to the highest income households, despite all households paying for the subsidies. This amounts to a negative wealth transfer. And the last reason is that as more homes leave the grid with rooftop solar, the fixed costs of the utilities are shifted onto an ever-shrinking base that is least able to absorb increased costs. Therefore there is a serious public policy imperative to bring all households, and not just high-earners, onto the clean energy platform. This requires innovative financing solutions tailored to the specific needs of the LMI community. In this project, students will work with CGC to design and develop financing products that can be used in multiple green banks and/or states to increase the availability of capital for LMI clean energy adoption.

The project will require students to perform a number of research and analytical steps in order to fully diagnose market barriers, identify solutions to those barriers, and develop suitable products/policy concepts to implement the solutions. Tasks include:

- Research of industry resources that identify the obstacles to providing clean energy solutions to the LMI population, with focus on obstacles to financing.
- Landscape analysis of any existing clean energy deployment programs specifically tailored to address the LMI market, with a particular focus on solutions that include financing.
- For existing LMI financing solutions, a deep dive assessment of their offerings, underwriting criteria, practices for building channel partnerships, and methods for building demand.
- Collect market data on credit scores of borrowers based on income level to determine average credit score of potential LMI borrower.
- Based on this analysis and research, develop a list of plausible alternative underwriting methods that can be used to support LMI financing.
- Pair these underwriting criteria with clean energy technologies best suited LMI deployment.
- Design finance product structure (capital source/type/amount) needed to support the LMI product, and produce a cash flow model to project potential savings.

Students will work with CGC staff throughout the project to brainstorm, debrief on findings, and amend next steps as needed. Final deliverable should be a written report describing full findings and specific conclusions on options for alternative underwriting criteria and financing product structures. Report should include quantitative analysis of financing repayments, potential savings, and overall project cash flows.
Solar-Plus-Storage Financing

With the introduction of Tesla’s new Powerwall, the age of mass-marketed solar-plus-storage has arrived. However the addition of a battery to an already expensive solar system means new financing solutions must be developed. For instance, though SolarCity offers the Powerwall along with its Solar Lease/PPA, the customer is unable to finance the battery through the Lease/PPA. Alternative financing is needed. And other customers that may want to own their own system through cash or a loan also now faces an additional cost with no financing solution. In this project, students will work with CGC to understand the economics of solar plus storage and develop financing solutions that can fill this market gap. The project will involve investigating the lifecycle and usage patterns of batteries to develop a usable financing solution that minimizes the LCOE of the battery component of the project. The goal is to allow consumers to obtain resiliency and electricity confidence while still paying the lowest electricity price possible.

This project will require comfort and familiarity with clean energy project cash flow modeling and financing structures. Specific knowledge of the federal Investment Tax Credit and solar lease/PPA structures will be beneficial. As the objective of the project will be to develop a financing structure that minimizes the effective electricity price of solar plus storage, students should have familiarity methods for calculating the levelized cost of energy (LCOE) for a project. Specific tasks will include:

- Analyzing existing battery offerings and their technical specs and lifespan
- Converting that technical detail into an effective LCOE associated with adding a battery to a project, assuming a cash purchase.
- Calculating the LCOE of an additional battery assuming the installation is financed under either a loan or a lease, accounting for tax credits appropriately.
- Developing a standard LCOE model for a residential PV installation without a battery, with the ability to calculate LCOE based on cash purchase, loan or lease purchase model.
- Combine the cash flow analyses to determine cumulative LCOE for solar PV plus battery across different purchase models.
- Compare the minimum LCOE to the price of grid electricity across states to determine viable market.

Final deliverable will include a memo summarizing the analysis and findings, as well as an excel cash flow model that includes the LCOE calculations. The memo should also include a specific recommendation for a financing product/structure that is best suited for solar plus battery storage, and how/where it could plausibly be deployed. Students will work closely with CGC staff to discuss findings, collaborate on calculations and develop a particular recommendation.
**Investment Tax Credit Financing Gap**

With the Investment Tax Credit slated to drop on Jan 1, 2017, the economics of solar with change dramatically in a single moment. Today the ITC is worth 30% of the cost of the system, but it will drop to 10% for third-parted owned (TPO) system financed through a Lease/PPA, and to 0% for customer-owned solar. This means solar prices will jump upwards of 25%, immediately reducing the potential economic viability of projects. In addition, this new policy landscape will give a significant advantage to TPO systems, which already have a significant cost advantage over loans due to variations in the tax code. In this project, students will work with CGC to identify financing solutions that green banks/states can implement to help transition the market through this change and ensure growth does not slow. Solutions may include a low-cost financing offering equal in value to the missing ITC, REC off-take agreements, or other creative market/financing mechanisms. Students may also consider developing offerings that specifically target customer-owned systems that are disadvantaged by the ITC change, in order to create economic balance between TPO and customer-owned systems.

This project will entail consideration of solar project economics, financing and policy. Students will have to weight multiple considerations when designing a solution to address the reduced ITC. Those considerations include:

- How much will the reduced ITC impact the effective solar price (LCOE) to a customer under various ownership models
- How does the resulting price compare to the grid price across markets
- What is the plausible market impact of this policy change (i.e. how much will demand fall due to loss of ITC)
- How much reduction in LCOE, offered by the proposed solution, is necessary in order to minimize the negative market impact of the changing ITC policy
- Can any proposed solution be made temporary, and if so, how can it be scale back as the cost of solar installation declines, thus overcoming the negative impact of the changing ITC policy

Specific tasks on this project will include:

- Comprehensive research based on existing resources of the solar value attributed to the ITC and the potential LCOE impact that comes with the ITC change, across ownership models (cash, loan, lease)
- Historical market analysis of solar installation costs, and plausible projections of future solar installation costs
- Determination of effective jump in installation cost at time of policy change, and assessment of market viability of solar at point of historical equivalent installation cost
- Consideration of various forms of economic support that can be offered (grants, loans, lines of credit) and best point of incidence for economic support (installer, customer, financing partner)

Students will work closely with CGC staff to conduct economic and policy analysis associated with ITC change. Final deliverable will be a report summarizing reports findings and pointing a specific recommendation(s) for a policy tool/financing solution that a state could implement to minimize the negative market impact of the changing ITC policy.
Suggested Topics

Week 1 (week of 9/14):
Introduction / overview

Week 2 (week of 9/21):
Solar Securitization

Week 3 (week of 9/28):
Tax Credits

Week 4 (week of 10/5):
Low to Middle Income Financing

Week 5 (week of 10/12):
Storage

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Week 6 (week of 10/26):
Energy Efficiency – Property Assessed Clean Energy

Week 7 (week of 11/2):
On Bill Financing

Week 8 (week of 11/9):
Tax Equity

Week 9 (week of 11/16):
Green Banks

THANKSGIVING RECESS

Week 10 (week of 11/30):
Innovation in Finance – New Models

Final meeting / celebration: sometime in December