

CORE CURRICULUM OUTLINE

Weekly Modules and Learning Objectives

CBEY Certificate in Financing and Deploying Clean Energy



COURSE	#	WEEKLY MODULE	LEARNING OBJECTIVES
<p>Clean Energy Policy:</p>  <p>How does Policy support or hinder the deployment and financing of clean energy?</p>	1	Why Policy Matters and Energy Policy History	<ul style="list-style-type: none"> Learn about why energy policy matters, which issues energy policies typically cover, and what they often fail to address Review the history of energy and environmental policies in the U.S., as well as the key actors and drivers responsible for shaping current energy policy Discuss policy drivers, policy actors, and branches of government
	2	Electric Utility Policy	<ul style="list-style-type: none"> Examine electricity utility policy, including approaches to deregulation and types of electricity markets Learn the fundamentals of the U.S. electric utilities regulatory framework including key definitions, processes for rate design and utility compensation, liberalization/market restructuring, and fuel neutrality Understand the role of market actors, regulators, and operators in deciding which new assets come online in the short and long term through economic dispatch Submit your first clean energy policy memo
	3	Envisioning the Energy Future: Integrating Renewables	<ul style="list-style-type: none"> Explore how electric systems and needs are broadly changing and how the integration of renewables changes the pricing dynamics of wholesale energy markets Take an economic view of renewables integration, a deep dive into optimal investment strategies for different generation technologies, and the different revenue and cost mechanics driving decision-making Learn how to build and read load duration curves, as well as learn to use total cost curves, price duration curves, and residual load duration curves to visualize the merit order effect on electric systems Explore metrics like LCOE in further depth and approach concepts of efficiency
	4	Approaches to Policy and Regulation	<ul style="list-style-type: none"> Learn about different approaches to policy and regulation, including institutional mechanisms Explore the strengths and weaknesses of different regulatory tools like subsidies, taxes, command and control, as well as market approaches like feed-in tariffs and tax-based incentives Explore differences between feed-in tariffs and net metering, and explore net metering debates and the concept of value of solar Submit peer reviews to classmates
	5	Carbon Pricing: Leveling the Playing Field	<ul style="list-style-type: none"> Understand how carbon pricing mechanisms work and explore the advantages and disadvantages of cap and trade and carbon tax policies in particular, and learn to compare these policies from an economic perspective Explore the concept of social cost of carbon Apply about a political science framework for policy analysis to design more durable and effective policies Submit an analysis of your first policy memo based on what you have learned so far
	6	Policy Tools: Promoting Innovation	<ul style="list-style-type: none"> Learn about different approaches to drive innovation in the private sector, including common approaches like renewable portfolio standards or RPS, and different procurement approaches to clean energy projects, such as auctions and reverse auctions Think through policy tools to manage uncertainty and explore the correlation between commodity markets and wholesale markets Submit your revised clean energy policy memo

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Clean Energy Policy: (continued)	7	Great Debates and Energy Justice	<ul style="list-style-type: none"> • Are natural gas, hydro, and nuclear clean energy? • Explore the great debates that animate the world of energy policy and understand the decisions facing policymakers and the public through two case studies - Nuclear Policy in Connecticut: The Millstone Debate, and Hydro Policy in Maine: The NECEC Debate—as well as a discussion on natural gas • Evaluate your policy proposal with the Energy Justice Scorecard
	8	Beyond National Governance: Global, Local, and Private Sector Action	<ul style="list-style-type: none"> • Explore the broader landscape shaping energy policy and understand the relationship between climate policy and clean energy policy • Understand the role of subnational actors like cities and states, and the private sector, in achieving clean energy policy goals • Submit your final clean energy policy assignment
Technology Transitions  What are current energy models and what are technological and economic challenges to the clean energy transition?	1	Energy Technology and Society	<ul style="list-style-type: none"> • Review the historical context of energy use and start tracing the patterns of energy transitions • Learn about energy systems from a macro perspective, five key facts about world energy use today, and the heterogeneous nature of energy systems • Use the Kaya identity and analyze energy flows through systems
	2	The Current Energy System Part 1	<ul style="list-style-type: none"> • Explore fossil and earth resources, and understand the environmental implications of the use of oil, gas, coal, and biofuel technology • Learn about the role of fossil fuels in our energy system, including its origin and distribution, how long fossil fuels are expected to last, and technological reasons for its widespread use • Apply concepts of energy density
	3	The Current Energy System Part 2	<ul style="list-style-type: none"> • Understand how nuclear and hydro are currently used in producing electricity, and explore their benefits, limitations, and challenges • Learn about the design, installation, and environmental impacts of hydropower, as well as critically examine hydropower and pumped hydro within the current energy landscape and its potential in the future • Apply the hydropower equation
	4	Solar Energy	<ul style="list-style-type: none"> • Understand solar as a resource, and use solar maps to understand factors that influence solar power production • Explore the technical characteristics of photovoltaics, solar thermal heating, and concentrated solar power • Review the critical functions of inverters in solar efficiency • Discuss installations and siting challenges • Use average capacity factors to determine the carbon savings replacing a coal plant with a solar and combined cycle plant
	5	Wind Energy	<ul style="list-style-type: none"> • Understand wind as a resource, airfoil and turbine design, turbine installation on and offshore, modes of failure, and environmental considerations • Explore issues of wind intermittency, statistics, and weather forecasting techniques as well as intermittency in all renewables • Use the wind power equation
	6	Unconventional Renewables and Energy Outlook	<ul style="list-style-type: none"> • Explore waves, currents and tidal energy resources and technologies as well as ocean thermal energy conversion technology • Explore geothermal technologies and heat pumps • Review energy sources, trends and outlook data • Apply concepts of thermal efficiency and fluid dynamics previously examined to unconventional renewables

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Technology Transitions (continued)	7	Transmission, Distribution, Storage, and the Grid	<ul style="list-style-type: none"> Review concepts of grid structure, basics of electricity transmission and distribution Examine the impact of transmission congestion on energy markets Discuss energy storage and battery trends and technologies in depth, including lithium-ion, fuel cells, flow batteries, and other unconventional energy storage technologies Apply concepts of economic dispatch
	8	Transition Drivers and Options	<ul style="list-style-type: none"> Explore social and behavioral inputs to energy systems, and understand life-cycle analysis of energy chains Explore technology options for mitigation, including buildings, materials, transport and negative emissions Use Sankey diagrams
Renewable Energy Project Finance  <p>How are renewable energy projects structured and developed?</p>	1	Fundamentals of Project Finance and Debt Sizing	<ul style="list-style-type: none"> Learn the fundamentals of project finance, including parties and structuring Explore how and how well project finance structures have been used in the past in both non-renewable and renewable energy projects Model debt facilities, size debt capacity, and use financial functions in Excel
	2	Navigating Legal Contracts	<ul style="list-style-type: none"> Understand the contractual framework of project finance and layout the relationship between lenders and the special purpose vehicle Explore basics of loan agreements and practice reading common types of contractual provisions in project finance documentation Build parts of a loan term sheet
	3	Project Revenues	<ul style="list-style-type: none"> Understand the primary drivers of a project's revenue Explore the ways projects sell electricity to the grid and concepts of risk allocation in power purchase agreements Compare power purchase agreements, asset ownership, and leases Build out tools to perform a sensitivity analysis
	4	Project Costs	<ul style="list-style-type: none"> Understand the primary drivers of a project's expenses, including capital expenditures, and operating expenses Understand the role of insurer and credit reporting agencies Explore EPC and O&M contracts Build parts of a power purchase agreement term sheet
	5	Project Risks and Variability	<ul style="list-style-type: none"> Understand the variability and risks associated with renewable energy projects Explore forecasting techniques for wind and solar, including probabilistic approaches Incorporate variability into a dynamic financial model
	6	Financial Modeling	<ul style="list-style-type: none"> Translate financial inputs or cashflows (revenues, costs, and risk) into outputs (balance sheet, income statement) Model seasonality reserves and debt service reserves, both in construction and operation Add a balance sheet to your cumulative solar model
	7	Tax	<ul style="list-style-type: none"> Understand the tax implications of accelerated depreciation and the mechanics of different tax credits Explore tax equity structures and tax modeling Build a model factoring in the impacts of both depreciation and tax credits available for a wind energy project

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Renewable Energy Project Finance (continued)	8	Emerging Markets	<ul style="list-style-type: none"> • Understand how project finance in emerging markets may be subject to different risks • Learn about the techniques and tools used to manage country risks for lenders • Learn about risk management within PPAs
	Innovation  What innovative models can be applied to various stages of investment to accelerate the deployment of clean technology?	1	Why Green Banks
2		Green Bank Transactions	<ul style="list-style-type: none"> • Understand the use of subordinated debt and other approaches to derisking by green banks particularly for large scale renewables • Explore similarities with investment banking and development banking • Use the New York Green Bank as a case study to explore wholesale approaches to green investment banking • Develop a green bank strategy memo
3		Moving to Public Capital Markets	<ul style="list-style-type: none"> • Explore the role of institutional investors and asset managers and understand what tools to use to move clean energy finance from specialized asset class to mainstream investment • Explore green bonds and securitization, including aggregation tools (warehousing) and CPACE securitization
4		Inventing the Grid of the Future	<ul style="list-style-type: none"> • Explore issues with current grid and business model of utilities, integration of distributed generation, and use REV New York as a case study to better understand how policy tools can support adaptation • Explore the impact of shared savings models by delving into a short case study on a non-wire alternative project from ConEd
5		IT	<ul style="list-style-type: none"> • Understand the growing role of information technology in the financing of renewables • Explore the role of information technology in utilities' business model transition • Explore uses of emerging and potentially disruptive technologies like blockchain to create more dynamic and resilient grids • Explore peer-to-peer energy trading, demand response, and the rise of participatory smart grids
6		Carbon Removal	<ul style="list-style-type: none"> • Understand the state of carbon removal technologies and the business models associated with current tech • Start the final group assignment and identify synergies for systematic innovation
7		Nuclear	<ul style="list-style-type: none"> • Understand the technical characteristics of newer nuclear technologies and small modular reactors • Explore the role of nuclear to manage baseload currently and on a 15 to 50-year horizon • Use SMR as a case study to explore stages of industry development • Submit group assignment and start collective assignment
8		Program Review: From Knowledge to Practice	<ul style="list-style-type: none"> • Review challenges and the road ahead, unknowns of policy (and politics), and summarize conditions to deploying at scale • Discuss participants' takeaways and plans to put newly acquired knowledge into practice within their organizations • Submit final collective and personal assignments