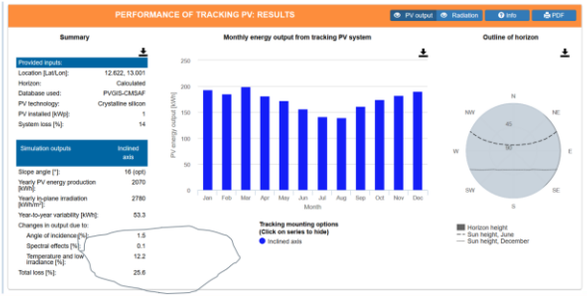
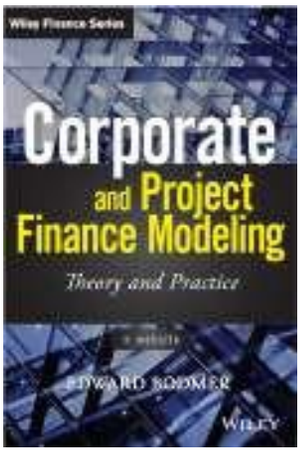
Economic and Financial Analysis of Renewable Energy

Five Days

- Highly Interactive Hands-on Course with Strict Limit on Participants
- All Modules are Live Stream with Your Participation (No Videos)
- You Work on Models During Five Sessions and Course Customised According to Your Pre-Course Question Responses
- Learn How to Be a Creative and Innovative Modeller without the Typical Blah Blah Blah



Faculty: Edward Bodmer



COURSE OVERVIEW

Economic and Financial Analysis of Renewable Energy is a digital class that will work through analysis of different renewable technologies including LCOE, financing, resource analysis and pricing. The course will be hands-on where participants take turns sharing the screen and demonstrate how you can construct renewable analysis that incorporates a variety of economic and financing issues. The course put emphasis on practical techniques with current data. The outline below is separated into five different on-line sessions.

Objectives

- Incorporate storage and battery analysis in analysis of renewable energy from an energy storage perspective and from an ancillary service point of view.

- Learn practical tools to analyse renewable energy including efficient tools to work with wind, hydro and solar data; creating flexible scenario and sensitivity analysis to evaluate resource risk, construction risk, O&M risk and debt structuring; developing techniques to resolve circular references related to funding debt and sculpting debt without copy and paste macros.

- Understand the implications of project finance features in the context of renewable energy (sculpting, debt funding, debt size, DSCR, DSRA, debt tenor, re-financing) on costs and equity returns from renewable energy.

Can divide the energy injected to grid divided by radiation on collectors

	GlobHor	T Amb	Effective irradiance on collectors	Effective Global, corrected for reflection and shadings	Effective energy at the output of the array	Energy injected into the grid
	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh
January	141.20	21.30	180.00	171.00	95.50	91.80
February	154.00	24.10	197.60	188.50	103.40	99.40
March	194.70	28.30	247.10	236.30	125.90	120.90
April	201.50	31.60	252.40	242.00	125.40	120.40
May	208.20	32.40	258.00	246.40	128.90	123.80
June	163.10	28.00	192.40	182.10	98.90	95.10
July	133.30	26.10	155.40	146.70	80.60	77.40
August	130.90	24.80	147.00	138.10	76.60	73.60
September	150.00	25.20	181.60	172.20	94.90	91.10
October	162.00	25.20	202.90	192.90	105.80	101.70
November	139.60	22.80	175.60	166.60	92.90	89.30
December	134.00	21.09	170.10	161.20	90.70	87.20
Year	1912.50	25.91	2360.10	2244.10	1219.30	1171.70
					Capacity	612.00
					Yield	1,914.54
Capacity Factor			26.94%	25.62%		21.86%
Performance Ratio						81.12%

- Develop efficient ways to quickly compute the levelised electricity cost of different technologies using carrying charge factors and alternative financial models.

- Work through resource assessments and compute probability of achieving different levels of production (P90, P75 etc.) using hands-on exercises for different types of projects in order to effectively review consulting studies.

- Create flexible and transparent financial models of renewable energy from A-Z that incorporate resource risk, financing structure, tax treatments, alternative pricing policies and other factors.

- Evaluate the economics of renewable energy (including ancillary services) in the context of merchant markets and review the structure of corporate PPA contracts.

SESSION 1: DEFINITION OF TERMS, RENEWABLE COSTS, LEVELIZED COST OF ELECTRICITY

- **Overview of Terms in Project Finance Terms in the Context of Renewable Energy through Review of Financial Models**
  - Renewable Energy Terms
  - Economic Issues Associated with Renewable Energy
  - Alternative Contract Structures Relative to Conventional Plants
  - Grid Parity
  - Carrying Charge Factor
  - Feed-in Tariff Policy
  - Renewable Energy Pricing versus Multi-part Tariffs in Conventional Energy

- **Drivers of Value in Renewable Energy Projects**
  - Resource Assessment, yield and Capacity Factor
  - Development Cost and Timing
  - Electricity Pricing
  - Capital Costs
  - Operating and Maintenance Costs
  - Capital Recovery Factor, Taxes, Financing
  - Operating Costs, Maintenance Costs and Availability

- **Capital Intensity and Levelized Cost of Alternative Technologies**
  - Definition of Capital Intensity and Cost of Capital
  - Four Factors that Drive Renewable LOCE
  - Capital Cost of Project
  - Capacity Factor or Yield of Project
  - Operation and Maintenance Expenses
  - The Carrying Charge Rate
  - Effect of Batteries and Storage on LCOE

- **Exercise on Computing Grid Parity**
  - Databases for Electricity Costs
  - General Discussion of Cost Trends in Wind, Solar, Coal, Natural Gas and Other Technologies
  - Review Cost Analysis for Various Types of Renewable and Non-Renewable Plants Including On-Shore and Off-Shore Wind, Solar PV, Solar Thermal, Geothermal, Wave Energy, Hydro and Biomass
  - Natural Gas Prices by Region and Over Time
  - Grid Parity with Different Capital Cost, Carrying Charge Rates and Natural Gas Prices

SESSION 2: REVIEW OF COSTS, CAPACITY FACTORS, AND PRICING STRUCTURES FOR ALTERNATIVE RENEWABLE TECHNOLOGIES AND BUILD-UP OF PROJECT FINANCE MODEL

- **On-Shore Wind**
  - Historic and Current Trends in Capital Cost
  - Review of Financial Data for Suppliers
  - Fixed and Variable O&M Cost
  - Capacity Factors and General Discussion of One-year versus Long-term P90, P75 etc.
  - General Contract Terms
  - Feed in Tariffs and PPA Agreements for On-Shore Wind
- **Off-Shore Wind**
  - Capital Cost Data Base, Distance, Depth and Height
  - Balance of System Costs for Off-Shore versus On-Shore
  - Operating Costs and Availability Issues
  - Capacity Factors
  - Feed-in Tariffs
- **Solar Photo Voltaic**
  - General Discussion of Technology
  - Demand and Supply and Changes in German Feed-in Tariffs
  - Review of Solar Companies and Financial Issues
  - Financial Performance of Manufacturers
  - Balance of System Costs and Inverter Costs
  - Performance Guarantees and Other Contract Terms
  - First Solar Case Study

- **Overview of Resource Assessment in Renewable Projects**
  - Resource Assessment of Wind – working with hourly wind speeds, Weibull Distributions and Statistical Analysis (P90, P50 etc.)
  - Resource Assessment of Solar – Direct and Diffuse Radiation, Sunlight Angles and RetScreen.)
  - Resource Assessment of Geothermal and Hydro
  - Probability Distributions of Resources
  - Case Study on Resource Analysis in Loans

- **Modelling Resource Distributions of Solar Power**
  - Data sources for Solar Irradiation
  - Computation of Production from Efficiency with Adjustments for Performance
  - Statistical and Seasonal Distribution of Production Data in Different Locations
  - Computation of P95, P90, P75 and P50 Statistics

- **Case Study on Interpretation of P75, P90, P95 and P99**
  - Review of Credit Analysis for Wind Projects
  - Analysis of Resource Risk in Different Reports
  - P90/P50 for One Year and for Ten Years
  - Case Study on Detailed Calculation of Resource Distribution

SESSION 3: OVERVIEW OF PROJECT FINANCE, COST OF CAPITAL AND PRICING CONTRACTS FOR RENEWABLE ENERGY

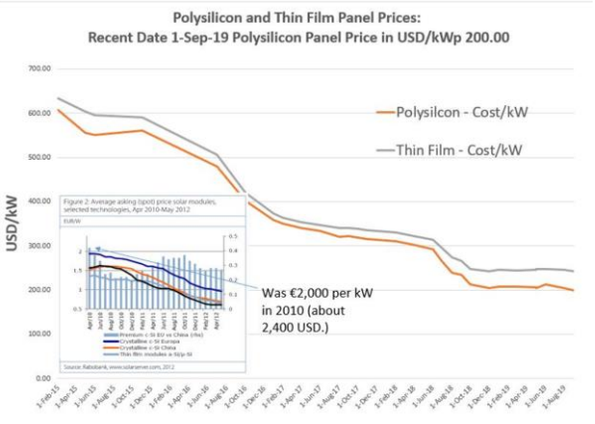
- **Measurement of Value and Risk using Project Finance**
  - Debt Capacity and Credit Analysis of Different Transactions
  - Use of Equity IRR versus Project IRR
  - Relying on External Cash Infusions Rather than Internal Analysis
  - Financing for Different Types of Projects
- **Debt Capacity and Project Finance Terms**
  - Effects of Debt Service Coverage Constraint versus Debt to Capital Constraint
  - Debt Service Coverage Ratio Definition and Targets
  - Debt Tenor, Alternative Repayment Structure, Average Life
  - Credit Spreads and Target Credit Ratings in Project Finance
  - Debt Service Reserve and Maintenance Reserve
  - Covenants, Cash Flow Sweeps and Subordinated Debt

- **Project Finance Valuation for Renewable Energy**
  - Project IRR to Screen Projects
  - Equity IRR to Structure Projects and Minimum Required Equity IRR for Different Renewable Projects
  - Equity IRR Complexities from Re-Financing and Development Fees

SESSION 4: VALUATIONAND PROJECT FINANCE MODELLING FOR RENEWABLE PROJECTS

- **Financial Statement Analysis in Renewable Project Finance**
  - Risks and Stages of Project
  - Source and Use of Funds Statement before Commercial Operation
  - Focus on Cash Flow and EBITDA
  - Interpretation of Cash Flow Statement
  - Reserve Accounts for Debt Service and Other Factors
  - Computation of Equity Cash Flow and Free Cash Flow and IRR versus Return on Investment

- **Model Complexities for Renewable Finance Projects – Accelerated Tax Depreciation, Investment Tax Credit, Production Tax Credits and Renewable Energy Pricing**
  - Mechanics and Rational for Alternative Incentive Schemes
  - Benefits of Investment Schemes Relative to Feed-In Tariffs
  - Effects of Incentives on the Overall Cost and Require Feed-in Tariffs of Different Renewable Projects
  - Flips and Allocations of Cash Flow to Different Equity Investors – Interpretation of Risk and Return with Different Cash Flow Allocations
  - Computation of Project Value Assuming Different Sale Dates and Risk Adjusted Discount Rates from Buyer Perspective as Risk of Project Changes from Signing Contracts, Working Through Mechanical Issues and Demonstrating Cash Flows from Historic Record.
  - Incorporate Refinancing Assumptions in Financial Models through Adding Sources and Uses of Funds Analysis in Alternative Re-financing Periods and Evaluating Different Possible Features of Re-financing.

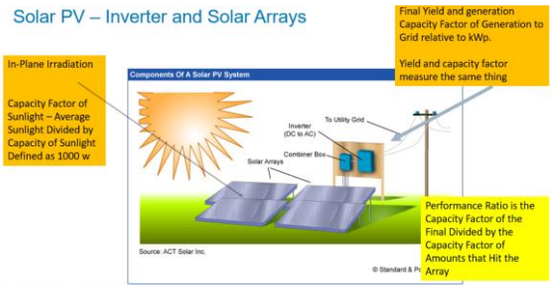


- **General Discussion of Risk in Renewable Energy Projects**
  - Discussion of Differences in the Nature of Risks for On-Shore Wind (Wind Resource), Off-Shore Wind (Maintenance and Life Expectation), Solar (Small Risks become Big with High Leverage), Hydro (Capacity Factor and Merchant Price Risk), Wave (Refurbishment Timing), Geothermal (Development Probability).
  - Risk Matrix, Risk Classification and Risk Mitigation
  - Risk Evaluation Using Break-Even and Sensitivity Analysis
  - Risk Evaluation Using Scenario Analysis with Focus on the Manner in which Bankers Apply Downside Analysis
  - Measurement of Risk Using Structured Master Scenario Page in Excel Model with Options for Adding Sensitivity Analysis to Defined Scenarios
  - Risk Analysis Using Spider and Tornado Diagrams

- **Credit Analysis in Renewable Project Finance**
  - Background on Probability of Default and Loss Given Default
  - Definition and Calculation of DSCR
  - Use of DSCR in Base (P50 Cases) and Downside (P90, P95 Cases) in Determining Debt Capacity
  - Application of LLCR and PLCR

- **Contract Structuring in Renewable Project Finance**

- Importance of EPC Contract in Different Projects (Off-Shore Wind and Hydro)
- Performance Contracts in Solar Projects
- Power Curve and Availability Guarantees in Solar and Wind Projects
- O&M Contracts and Warranties
- Insurance
- Counterparty Risk in Different Projects



SESSION 5: RE-FINANCING, ELECTRICITY PRICING, BIOMASS AND GEOTHERMAL ISSUES

- **Re-Financing for Renewable Projects**
  - Types of projects where re-financing is important – off-shore wind, wave energy, merchant hydro projects and geothermal
  - Effects of re-financing on equity IRR and difficulty of defining the equity IRR with short-debt duration
  - Structuring project finance models and analysis to measure the effect of re-financing on equity returns

- **Electricity Pricing Analysis in the Context of Renewable Energy**
  - Overview of Electricity Prices and Electricity Pricing Designs Around the World
  - Relevance of Electricity Pricing to Renewable Analysis
  - Short-term and Long-term Marginal Cost for Pricing Analysis

- **Pricing Analysis for Biomass Projects**
  - Evaluation of Project Finance Model for Biomass
  - Capital Cost, Heat Rates and Operating Costs of Biomass Projects
  - Examples of Biomass Projects
  - Tipping Fees and Construction of Price Curves from Local Supply and Demand Data

- **Development Costs in Renewable Projects**
  - Development Time Frame and Costs in Wind and Solar Projects
  - Exploration Costs and Time Frame in Geothermal Projects
  - Fees and Compensation for Development and Treatment of Development Fees when Computing
  - Equity IRR.
  - Probabilities of Proceeding Beyond Development
- Value and Costs of Development and Research Stage
  - Value of Development Expenditures versus Construction Expenditure
  - Payment of Development Fees
  - Development Costs and Real Option
  - Valuation of Development as Real Option
  - Compensation for Development Costs

- **Modelling Exploration and Development Options – Geothermal Case**
  - General Cost and Resource Parameters for Geothermal Projects
  - Review of Project Finance Model for Geothermal Project
  - Exploration and Development Cost, Probability Time Frame
  - Segregating Development Phases
  - Discount Rates for Different Stages
  - Computation of Expected Value