

Introduction

This workshop addresses the analysis of PPA Contracts and Off-take Contracts (including corporate PPAs) in different regions of the world and for different types of electricity generation. PPA contracts and technologies discussed will range from wind and solar technologies to batteries, hydrogen and to nuclear power. Case studies will be used from the Europe to the Middle East to Africa and Asia. The PPA contracts course will emphasize underlying theory and rational for contract terms rather than working through specific language (although many actual contracts will be referred to). Contracts will be discussed in the context of project finance objectives that include the two pillars of (1) efficient construction and operation and (2) achieving a low cost of capital. Many carefully selected case studies will be used to guide the discussion including famous historic case studies such as the Dahbol Plant in India, Combined Cycle plants in Ghana, the AES Drax Plant in the U.K. FIT tariffs in Spain and recent offshore wind cases in the U.S. These case studies will be supplemented by more recent PPAs including BESS plus solar PPAs, an offtake contract for Green Hydrogen in the UK and a corporate PPA for a wind that addresses negative merchant prices.

Modules of the course will address the mechanics and strategic implications of alternative contract structures and techniques to assess the risk assessment and allocation of the contracts. Analysis of different PPA contracts involves a variety of economic, financial, policy and legal subjects ranging from assessing the price and provisions of power purchase agreements to evaluating merchant power prices to understanding how power contract provisions affect debt structuring. Selected modelling exercises can be used to demonstrate the effect of nuances in PPA contracts.

The subjects suggested comprise an effective way to understand the principles and the nuances of PPA contracts. We have elaborated a little on each of the subjects as shown in the list below. The detailed outline presents specific theoretical points, case studies and contract terms.

- (1) Key Commercial Terms, History of PPA Contracts and Objectives of Project Finance
Background on Corporate PPA contracts compared to traditional PPA contracts
- (2) Bankability and Risks that Are Difficult for Bankers
- (3) Responsibilities of Different Parties and Connection Between Contracts
- (4) Tariff Types – Single Price, Four- or Five-Part Tariff, Merchant Prices
- (5) Capacity and Energy Charges – Difference in Risk Structure for Contracts in PPA
- (6) Project Execution – Performance Tests, Warranties, Change Orders
- (7) Billing, Payment and Other Provisions of PPA and Other Contracts

Whilst the outline discusses technical subjects and delivery structure during the course, we emphasize that our experience in teaching virtual and in-person tailored courses to different

audiences has demonstrated the importance of pre-course and post-course activity. For virtual courses we send individual messages to participants and if possible, we try to schedule virtual meetings. These meetings and surveys are used to understand the background and interests of participants and to promote participation during the class sessions. To encourage participants to continue learning after the course, participants are provided with sources to detailed videos and a resource library which reviews the subjects and addresses more detailed concepts.

Course Outline

Three Hour Session #1:

PPA History, Capacity vs Energy Charges and Multi-Part Tariffs and Contracts for Difference (LCOE)

Pre-course Reading/Podcast on Contract Structure and LCOE

Part 1 of Session # 1: Key Commercial Terms, History of PPA Contracts and Objectives of Project Finance

- Background on PPA Contracts in for Power Generation with Risk Allocation and a History of Rational for Risk Allocation Through Contracts.
 - a. Original Reason for PPA Contracts in 1970's and 1980's
 - b. Results of Early Contracts
 - c. Merchant Power Phase – Objectives and Results
 - d. Renewable Energy Contracts and Resource Risk
 - e. Battery Contracts and Problems of Merchant Over-supply
- Case Study of Rate Base Regulation for Nuclear Plants in UK
 - a. Importance of Cost of Capital
 - b. Computing Levelised Cost Model of Nuclear with Different Economic Models
 - c. Example of UAE Nuclear based on PPA and Public/Private Partner Structure
 - d. Alternative RAB Model in UK and Low Cost of Capital Objective
- Classic Project Finance Diagrams for Output and Capacity Contracts
 - a. Creating a Picture of Project Contracts
 - b. Demonstration of Risks and Mitigation in Project Diagrams
 - c. Risks that Cannot be Mitigated with Contracts
 - d. Diagram of Resource Based Contract and Dispatchable Contract

Part 2 of Session #1: Capacity and Energy Charges – Difference in Risk Structure for Contracts in PPA

- Fundamental Questions
 - a. Would you pay fireman only when they are putting out fires (this is single price/take AND pay contract)
 - b. Would you pay taxi drivers the same amount if they are driving or not driving (this is multiple price/take OR pay contract)
 - c. Would you pay firemen the same amount if they never came to work (this is availability)
 - d. Should taxi drivers get penalized for not coming to work even if they are not getting paid.
 - e. Should the fireman get penalized more than losing their fixed salary when they do not show up for work
- Notion of Capacity Charge or Availability Contracts
 - a. Necessity to Build Risks into Capacity Payment Contracts
 - b. Economics of Penalties and Bonus in Contracts (Different Availability Penalties by Period)
 - c. Trade-off between Off-taker Cost and Investor Costs
 - d. Example of Combined Cycle Plant Near Petrochemical Plant
 - e. Negotiating Provisions to Optimise Costs of Off-taker and Investor
- Implicit Incentives and Payments in Single Price Contracts
 - a. Would you Clean Panels More if the Price was Very High or Very Low
 - b. Does the Incentive to Clean Panels Correspond to the Incentives of the Off-taker
 - c. What is the Theoretical Solution
 - d. Should Merchant Prices be Used in Incentives
- Battery Analysis, PPAs and Merchant Batteries
 - a. Study of Merchant Prices and Batteries
 - b. Overview of Battery Characteristics – Storage versus C-rate, Price of Battery, Degradation, Cycles and Lifetime, Round Trip Efficiency, Minimum State of Charge
 - c. Incorporating Battery Characteristics in PPA Contract
 - d. Problem of Cycles versus Lifetime and Degradation

Break and Short Quiz

Part 3 of Session #1: Tariff Types – Single Price, Four- or Five-Part Tariff

- Different Tariff Structures in PPA Contracts (Examples)
 - a. Single Price Simple Contracts in FIT with no inflation
 - b. Single Price with Inflation Indexing
 - c. Single Price with Partial Inflation
 - d. Multiple Part Pricing with Heat Rate Incentive
 - e. Multiple Part with Exchange Rate Adjustments
 - f. Partial Merchant Pricing
 - g. Full Merchant Pricing
- Theory Behind Different Tariff Structures
 - a. Single Price versus Multiple Price and who Controls the Knob (who controls the output dispatch)
 - b. Who Likes and Dislikes Inflation Adjustments in Prices
 - c. Real and Nominal LCOE Exercise
 - d. Protection and Risks for Exchange Rate Adjustments
 - e. Use of LCOE to Set PPA Prices
- Settlement analysis and Merchant Pricing
 - a. Settlement risk and differences in quantity
 - b. Shape risk and changes in merchant prices
 - c. Alternative merchant price scenarios
 - d. Financial results with alternative price scenarios

Short Quiz

Open Discussion, Question and Answer for Session #1:

Three Hour Session #2:

Corporate PPA and Merchant Prices, Liquidated Damages in Contracts

Pre-course Reading/Podcast on Liquidated Damages

Part 1 of Session #2: Corporate PPAs and Merchant Prices

- Tariffs and Contracts of Differences in Corporate PPAs
 - a. Review of contract language in CfD
 - b. Difference between CfD and Standard PPA Tariff
 - c. Language in Forward Contracts
 - d. Case Study of Hydrogen CfD Calculation
- Merchant risks in Corporate PPA
 - a. Basis risk and hub price
 - b. Settlement risk and differences in quantity
 - c. Shape risk and changes in merchant prices
- Understanding the difference in Contract for Difference and Swap Contracts
 - a. Traditional Swap contracts for interest rates, exchange rates and commodity prices
 - b. Problem of fixing notional quantity in electricity contracts
 - c. Contract for Differences and uncertain quantity
 - d. Swap contracts and methods for establishing notional quantities
 - e. Examples of pricing in Swap Contracts and Contract for Differences
- Theory of marginal cost and forward pricing for evaluation of Corporate PPA
 - a. Alternative supply curves
 - b. Supply curves with surplus capacity
 - c. Demand profiles and changes in demand
 - d. Changes in fuel prices
 - e. Changes in renewable resources
- Case Study of Merchant Prices
 - a. Acquisition of Data
 - b. Historic Case Studies in Different Regions
 - c. European Prices and Implied Heat Rate
 - d. Transmission and Sensitivity to Gas Prices
 - e. Trends in Negative Prices and Value of Batteries

Break and Short Quiz

Part 2 of Session #2: Connection Between Contracts and Liquidated Damages

- Liquidated Damages and Connections between Contracts
 - a. Damages for Delay in PPA Contract
 - b. Damages of Delay Including Cost of Funding in EPC Contract
 - c. Damages for Performance in NGCC PPA Contract – Heat Rate Example
 - d. Example of PPA Contract Language
 - e. Example of EPC Contract Language
- Theory of Liquidated Damages in Power Contracts
 - a. Notion that penalties should equal off-taker costs
 - b. Inefficiencies when the Penalty is Too High
 - c. Inefficiencies when the Penalty of Incentive is Too Low
 - d. Measuring Off-taker Marginal Cost from Delay
 - e. Measuring Project Marginal Savings from Delay

Short Quiz

Open Discussion, Question and Answer for Session #2:

Three Hour Session #3:

Performance Tests, Warranties, Change Orders, Billing, Payment and Other Provisions of PPA and Other Contracts

Pre-course Reading/Podcast on Liquidated Damages

Part 1 of Session #3 - Performance Tests

Part 2 of Session #3 Warranties, Change Orders

- Importance of Performance Tests
 - a. Testing technical parameters and computation of liquidated damages
 - b. Language of performance tests in PPA agreement
 - c. Language of performance tests in EPC agreement
 - d. Language of performance tests in O&M agreement
- Case Study Example of Performance Tests
 - a. Power Curve in Wind – Supply Contract and Test Definition
 - b. Review of Wind Supply Agreement from Vestas and Power Curve Guarantee
 - c. Performance Ratio in Solar – Adjustment for Temperature
 - d. Heat Rate in Combined Cycle – Effect of Gas Price on Deviation from Target
 - e. Real World Problems with Performance Test – Malaysia Case Study
- Tests of Performance Post-COD
 - a. Examples of Performance Guarantees
 - b. Setting-up Tests
 - c. Problems with Tests – Maintenance Questions
 - d. Problems with Tests – Bankruptcy of Supplier
 - e. Problems with Tests – Arbitration
- Example of Calculation of Penalties
 - a. Calculation of Costs and Penalties for Wind Power Curve
 - b. Calculation of Solar Performance Ratio and Temperature Coefficient
 - c. Calculation of Target Heat Rate in NGCC
 - d. Calculation of Round-Trip Efficiency for BESS

Break and Short Quiz

Part 3 of Session #3 Warranties, Change Orders

- Warranties
 - a. Warranties versus Liquidated Damages
 - b. Examples of Warranties
 - c. Evaluation of Warranty Amounts
- Change Orders
 - a. Language of Change Order Language in EPC and O&M Contracts

- b. Examples of Exposure from Change Orders
- c. Change Order Risk in PPA Contracts
- d. Calculation of Liabilities from a Change Order

Part 4 of Session # 3: Billing, Payment and Other Provisions of PPA and Other Contracts

- Billing and Payment Provisions
 - Examples of Different Provisions
 - Implications of Provisions on Project Economics
 - Working Capital Issues in PPA Contracts
 - Alternative Working Capital Financing Options
- Other PPA Provisions
 - a. Force Majeure
 - b. Default by off taker
 - c. Default by Investor
 - d. Pre-COD Payments
 - e. Dispute Resolution
 - f. Maintenance Scheduling
 - g. Re-financing Savings
- Other Agreements
 - a. Common Terms Agreement
 - b. Shareholder Agreement
 - c. Inter-creditor Agreement
 - d. Model Assumptions Agreement

Short Quiz

Open Discussion, Question and Answer for Session #3:

Three Hour Session #4:

PPA's and Project Finance

Pre-course Reading/Podcast on Finance Theory and Project Finance

Part 1 of Session # 4: Essence of Project Finance

- General Objectives of Project Finance Compared to Other Alternatives (State Ownership, Corporate Finance, Rate Base Regulation)
 - a. Low Cost of Capital
 - b. Incentives Created with Target Incentives
 - c. Verification of Risks by Bankers
 - d. Public Policy Objectives
- Introduction to Banking Analysis and Importance of Lenders in Non-Recourse Project Finance
 - Bank Financing to Objectively Define Risk
 - Why Nonrecourse is a Good Thing to Define Value
 - Target Risk Ratings of Projects
 - Method of Risk Analysis for Banks with DSCR, Tail and Debt to Capital
 - Debt Pricing, Default Risk and Loss Given Default
 - Importance of Loan Terms in Winning Bids
- Analysis of Classic PPA Commercial Terms Using Risk Allocation
 - a. Single Price Payment and Generation Risk
 - b. Construction and Delay Risk
 - c. Performance Ratio and Operation and Maintenance Performance
 - d. Inflation Provisions
 - e. Currency risk
 - f. Exchange rate risk
- Nuances of Risk Allocation and Key Terms
 - a. Uncontrollable Price Risks During Construction
 - b. Market Risks and Merchant Power to Demonstrate Viability (Offshore Wind)
 - c. Transmission Risk

Break and Short Quiz

Part 2 of Session # 4: Bankability and Risks that Are Difficult for Bankers

- Case Study of Risk Analysis by Bank – JPM Solar Case
 - Bank Generally Has More Data on Experience than Developer
 - Importance of Technical Risk and Independent Engineer
 - Creating Downside Case

- Use of Internal Data to Adjust Developer Assumptions
- Risks that Make Bankers Go Crazy
 - Merchant Prices and 1999-2002 Experience
 - Technology that is Not Boring – Proven Technology
 - Transmission Risk
 - Future Expenditures for Things like Inverter Replacement, Battery Augmentation, Major Overhauls
 - Negative Merchant Prices
 - Off-taker Risk
- Case Studies of Off-taker Risks
 - a. Dabhol Case Study – famous case study where contracts were carefully structured, the PPA was guaranteed by the State Government, but the project failed because the cost was not affordable
 - b. Ghana Combined Cycle Plants – case where over capacity and non-availability of natural gas could not be paid by the Government
 - c. Mitigation of Off-taker Risk to Banks – Risk Insurance; Out-clause
 - d. Orsted and Off-shore Wind Case Study – Development Costs and Political Risk (in the US)

Short Quiz

Open Discussion, Question and Answer for Session #4: