



Energy Management Development

Guido Caporilli Razza

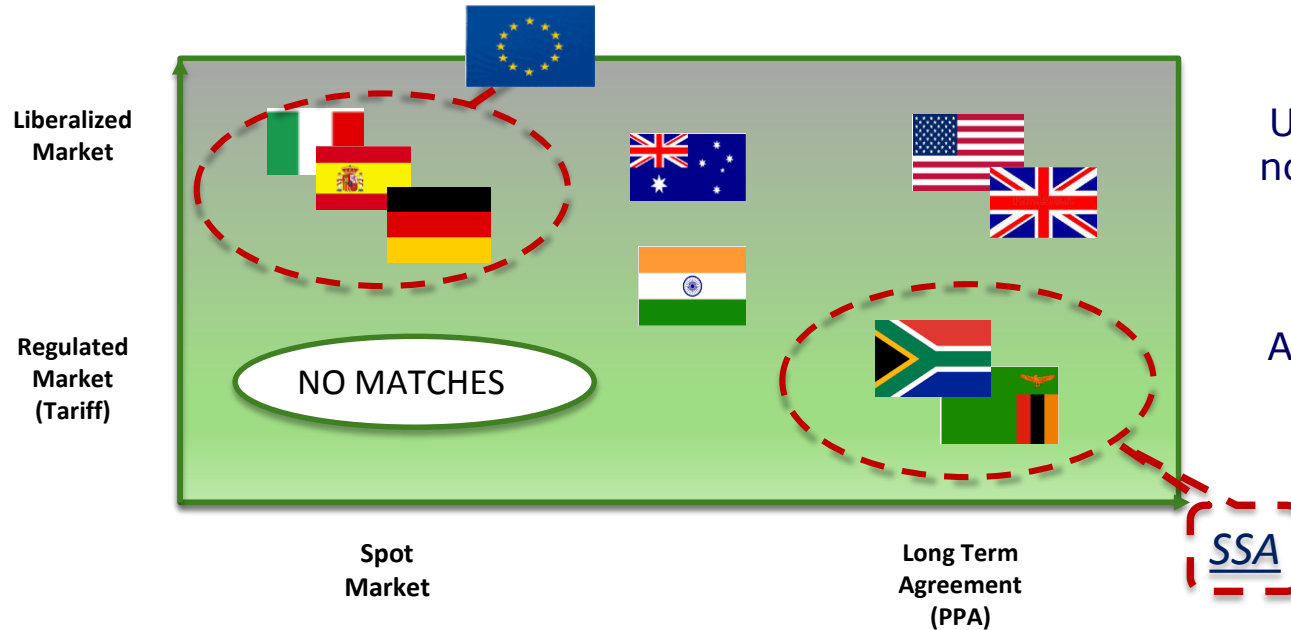
Energy Manager/Commercial Officer

WORKSHOP

NON-DISPATCHABLE RENEWABLE ENERGIES INTEGRATION INTO THE GRID

Lusaka, 5-6 September 2018

Worldwide Energy Markets Framework







Usually, for large assets and not residential customers, EU area has a typical spot&liberalized energy market framework while America and APAC belong to the long term agreement cluster




- Energy Management structure and presence mainly depends on two factors:
- Level of complexity of the agreement between off takers and Generators and
 - Market framework: liberalized or tariff driven for large assets

Volume Risk for RE Generators

Legenda  = YES  = NO

		PPAs DRIVEN	D/A MARKET DRIVEN	ZAMBIA
VOLUME RISK	RESOURCE AVAILABILITY	These risks remain with the generator		
	ENERGY COMMITMENT	Depends if pure or not ToP	Fully Exposed	
	SCHEDULING	Dispatch of renewables determined by ability to find a buyer for the volume	Determined by the bidding strategy	
	CURTAILMENT	Curtailments are managed through the Balancing Mechanism typically via a Balance Responsible party		
	IMBALANCES	Usually not included in the agreement	Given by forecast performance of generator	NO UMBALANCES
	GREEN CERTIFICATES	Generators to find a long term counterparty for certificate sales where a market based incentive mechanism is in place	Traded in the market or covered by incentive mechanism (if there)	NO GCs SCHEME

Price Risk for RE Generators

		PPAs DRIVEN	D/A MARKET DRIVEN	ZAMBIA
Price risk	MARKET ACCESS	Depends if the market is tariff regulated or liberalized	Easy access	
	ENERGY PRICE	Fully partially exposed depending on PPA Terms	Fully exposed	
	GCs PRICE	Fully partially exposed depending on PPA Terms	Fully exposed	NO GCs SCHEME
	IMBALANCES	Up to generators (if there is a market or penalties provision in regulatory framework)	Real Market exposure for generators	NO UMBALANCES
	EARLY TERMINATION PRICE	Depending on counterpart assessment (dd). Cost or revenues based	No counterpart risk for generators. (ISDA Master Agreement, standard contract via brokers)	

Typical Activities

I. Dispatching

- Power Plant Scheduling
- Unavailabilities and Curtailment
- Energy Forecast and Real Time

II. Front Office

- Hedging, Sales of Energy
- Green Certificates Market Management

III. Middle Office

- Performance and Reporting




IV. Back Office

- Contract Management, Invoicing&Settlement

Energy Management for Renewables

	DISPATCHING	FRONT OFFICE	MIDDLE OFFICE	BACK OFFICE
1- Market based	SPOT AND REAL TIME MARKETS UMBALANCING MARKET 	FORWARD MARKET TRADING DESK PORTFOLIO HEDGING GCs MARKET 	REPORTING PLANNING BUDGETING MARKET ANALYSIS 	MANY STANDARD CONTRACTS 
2- PPAs based	SPOT MARKET LONG TERM AGREEMENTS 		REPORTING PLANNING BUDGETING 	HIGH COMPLICATED LONG TERM CONTRACTS 

In regulated
market Energy
Management
activities
collapse into
PPA
Management

-  HIGH EFFORT
-  MEDIUM EFFORT
-  LOW EFFORT

Challenges for Zambia

I. PPA Negotiation

**Long Term clauses improvements for value risk trade off
between Generator and Off taker**

II. Regulatory for RE

**The main objective of power system operation is to keep
the energy supplied in balance with electricity demand**

Long Term Agreements – Basic Concepts

Volume Structure

Pay as generated

Pay as contracted

Take or Pay
(total production, %
of production)

Supply or pay
(Hourly, Monthly,
Seasonal; Yearly)



Volume Risks



No Volume Risk

Intermittency Risk

Shape/Profile Risk

Resource Risk

Volume Risk Mitigation



Weather Derivative

Risk Premium

Price Structure

Fix Price
(Unique, installments)

Linked to
Tariff/Market/Commodity
(discount w/ Floor, other)

Collar
(Unique, Installments)

Price Escalation

No indexation
(Flat Price)

CPI Indexation
(full, partial)

Market Indexation
(full, partial)

Price Location

Same as Project Node

HUB price reference

Currency

Local \$

USD

Price Risk

Basis Risk

Negative Price Risk

Merchant Risk

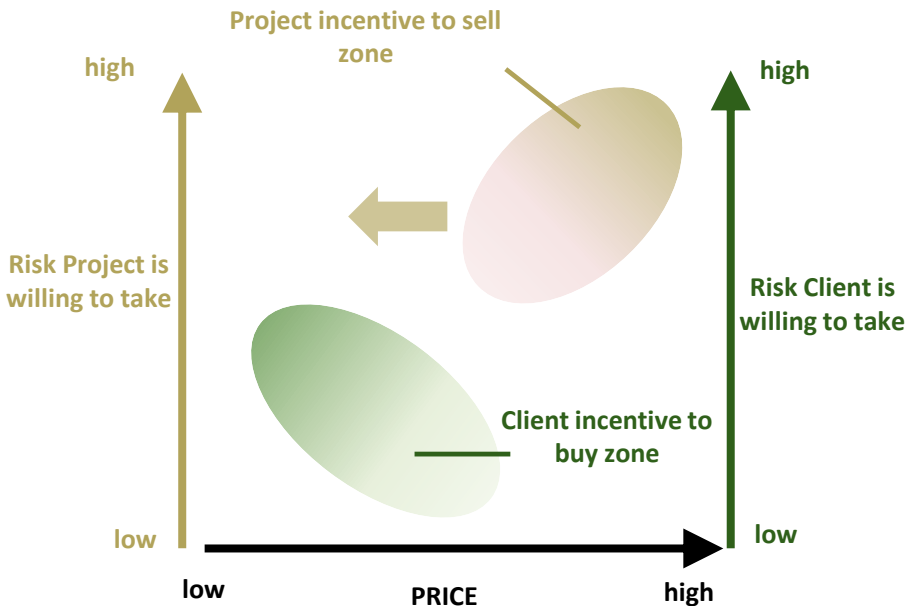
FX Risk

Price Risk Mitigation

Market Hedge

Risk premium

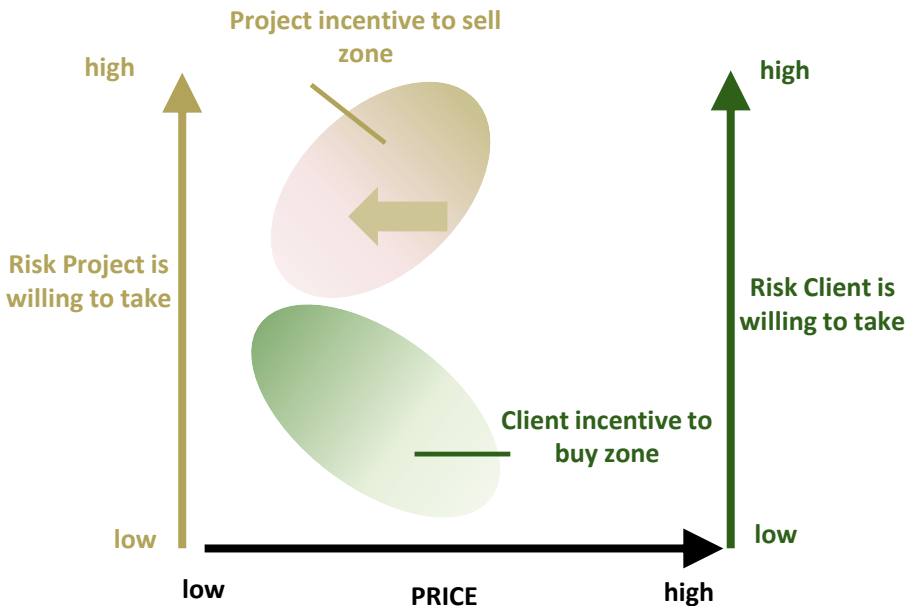
Focus on the Off-taker's incentive to buy



Project must fit the Oftaker's price driver:

- More options, solar, wind, geographically diverse, several partners
- Most competitive one in terms of performance and capex
- Feasibility study. Design to cost
- Economies of scale benefits (Procurement, E&C, O&M value chain)

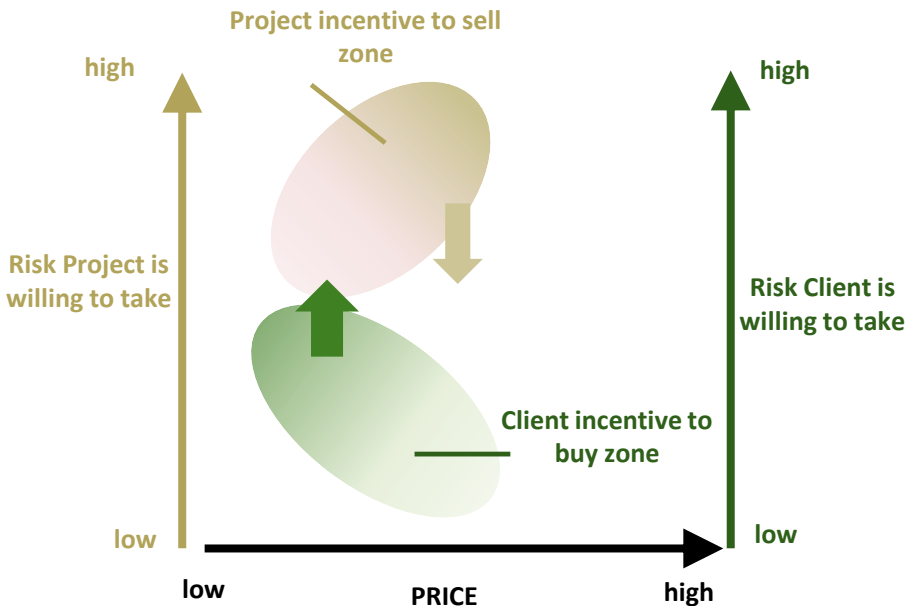
Focus on the Off-taker's incentive to buy



Project must fit the Offtaker's price driver:

- More options, solar, wind, geographically diverse, several partners
- Most competitive one in terms of performance and capex
- Feasibility study. Design to cost
- Economies of scale benefits (Procurement, E&C, O&M value chain)

Focus on the Off-taker's incentive to buy



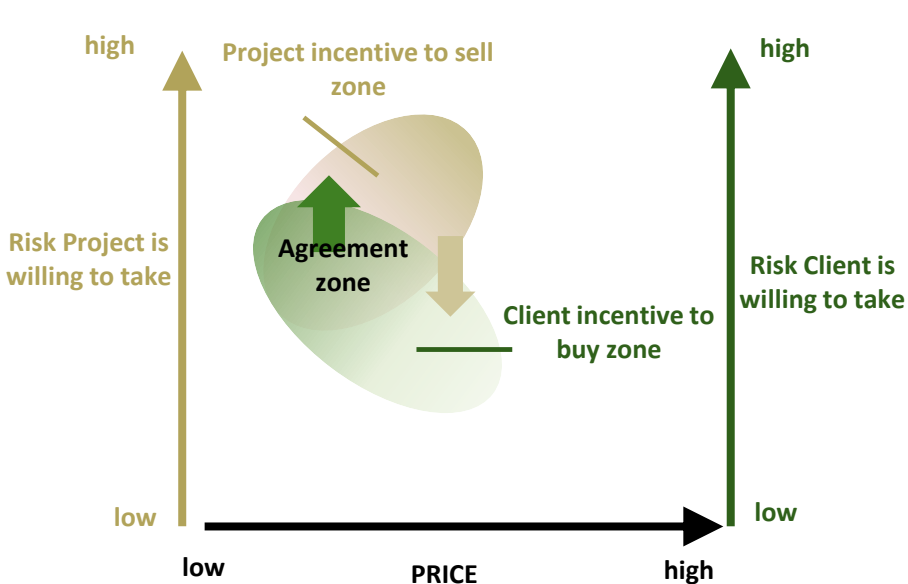
Project must fit the Offtaker's price driver:

- More options, solar, wind, geographically diverse, several partners
- Most competitive one in terms of performance and capex
- Feasibility study. Design to cost
- Economies of scale benefits (Procurement, E&C, O&M value chain)

And always try to match our respective risk aversion levels

- Rappel price installments through PPA term
- Tailor made indexations (metals, diesel, FX, CPI, combination)
- Collar structures (price flexibility between a floor&cap levels)
- Tracking account sharing downsides or upsides at the end of the term
- Basis risk on project side or risk premium sharing
- Flexibilities to meet accounting requirements

Focus on the Off-taker's incentive to buy



Project must fit the Offtaker's price driver:

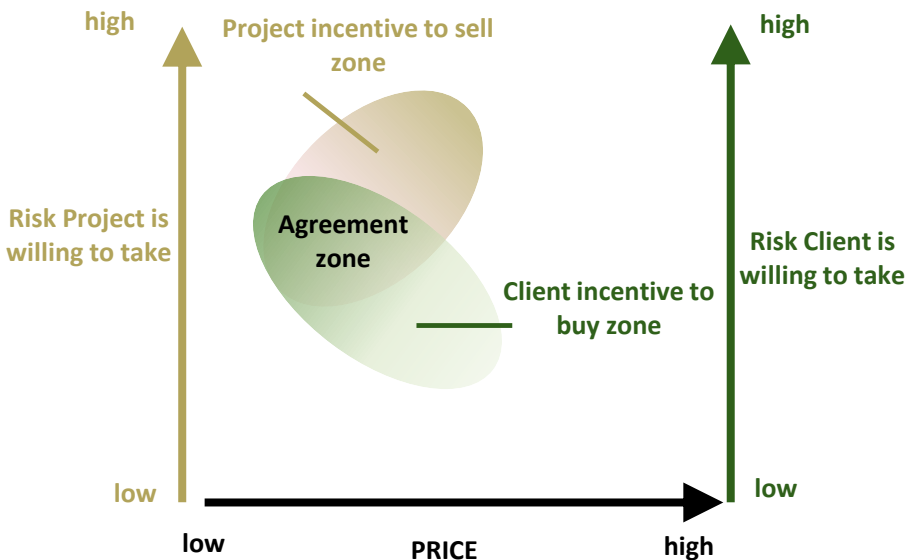
- More options, solar, wind, geographically diverse, several partners
- Most competitive one in terms of performance and capex
- Feasibility study. Design to cost
- Economies of scale benefits (Procurement, E&C, O&M value chain)

And always try to match our respective risk aversion levels

- Rappel price installments through PPA term
- Tailor made indexations (metals, diesel, FX, CPI, combination)
- Collar structures (price flexibility between a floor&cap levels)
- Tracking account sharing downsides or upsides at the end of the term
- Basis risk on project side or risk premium sharing
- Flexibilities to meet accounting requirements

Working together on best PPA 'price' – 'risk sharing' structure definition

Focus on the Off-taker's incentive to buy



Off-taker targets

- Additionality
- Low price
- Positive Net Present Value
- Simplified contracts
- Flexible terms
- Reliable output

Off-taker concerns

- Off-taker demand not enough to find a competitive project for a standalone PPA
- Contract "out of the money" during term:
 - Better future alternatives
 - Market evolving better than PPA price
 - Stuck in a "long term agreement"
 - Project performance
- Project owner default and credit support

Project targets

- Secure long term revenue
- Lower Merchant exposure
- Reasonable asset profitability
- Create shared value

Project concerns

- Project bankability:
 - Volume take or pay and term
 - Remaining merchant exposure
 - Easy termination by the Off-taker
 - Buyer default and credit support
 - Force Majeure
 - Change in law
- Development and construction risks
- Unexpected future costs

It is key to understand interlinkages between commercial terms, price and financing cost

The role of forecasting

System operator must balance ever-changing load with generation in real-time. To ensure that the power system is balanced, it is imperative for the system operator to know what the load is at any given point in time, and ensure that adequate generation is available to meet the demand. As increasing amounts of nondispatchable renewables come online, system operator faces an additional challenge to match supply with demand, in order to avoid curtailment or poor quality of power supply

- ❑ **For a system operator**, a forecasting system provides a very valuable service—sufficient advance notice for a system operator to either increase power from other sources in the face of an expected shortfall from renewable sources, or reduce output or turn off other sources during periods of high renewable energy generation
- ❑ **For a plant operator**, a good forecasting system can help reduce the gap between contracted supply of power and actual provision of power, reducing imbalance costs for the generator

THE ROLE OF FORECASTING

TYPES OF FORECASTING

Forecasting methods can be divided into three broad categories:

- ❑ **physical methods**, which uses weather data to populate a prediction physical model
Numerical weather prediction models uses mathematical representations of the atmosphere to predict future weather conditions. NWP typically used in day-head forecasting
- ❑ and **statistical methods**, which uses historical generation data to estimate future plant output based on statistical methods. Persistence models where the forecast for the plant in the next time interval will be the same as it is right now. Such models typically used for the short term (intra hour) forecasts
- ❑ **Hybrid forecasts** which combines the output from different models into a single cohesive forecast.

THE ROLE OF FORECASTING

TYPE OF FORECAST	TIME HORIZON	KEY APPLICATIONS	MODELS AND METHODS
Intra hour	5-60 minutes	Primary and secondary reserve, real time dispatch, market clearing, congestion management	persistence: statistical methods
Short term	Up to 4 hours	Secondary reserve; Intraday market	Physical and statistical methods
Medium Term	Up to 48 hours	Day head operations, Reliability assessment commitment, O&M operations	Physical and statistical methods
Long Term	Up to 7 days	O&M operations scheduling	Physical and statistical methods



Thank you



Guido Caporilli Razza
Commercial Office
guido.caporillirazza@enel.com
Mobile: +39 320 7790409