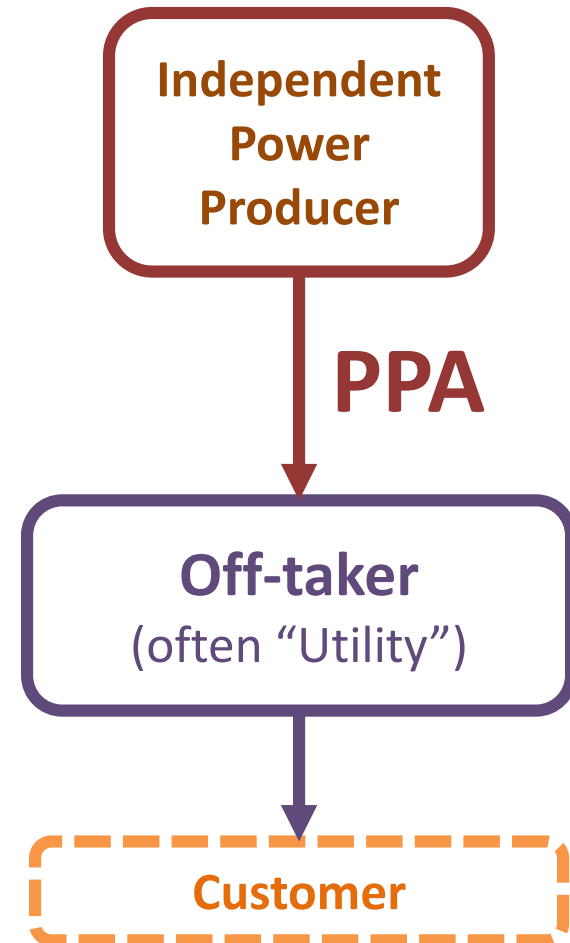
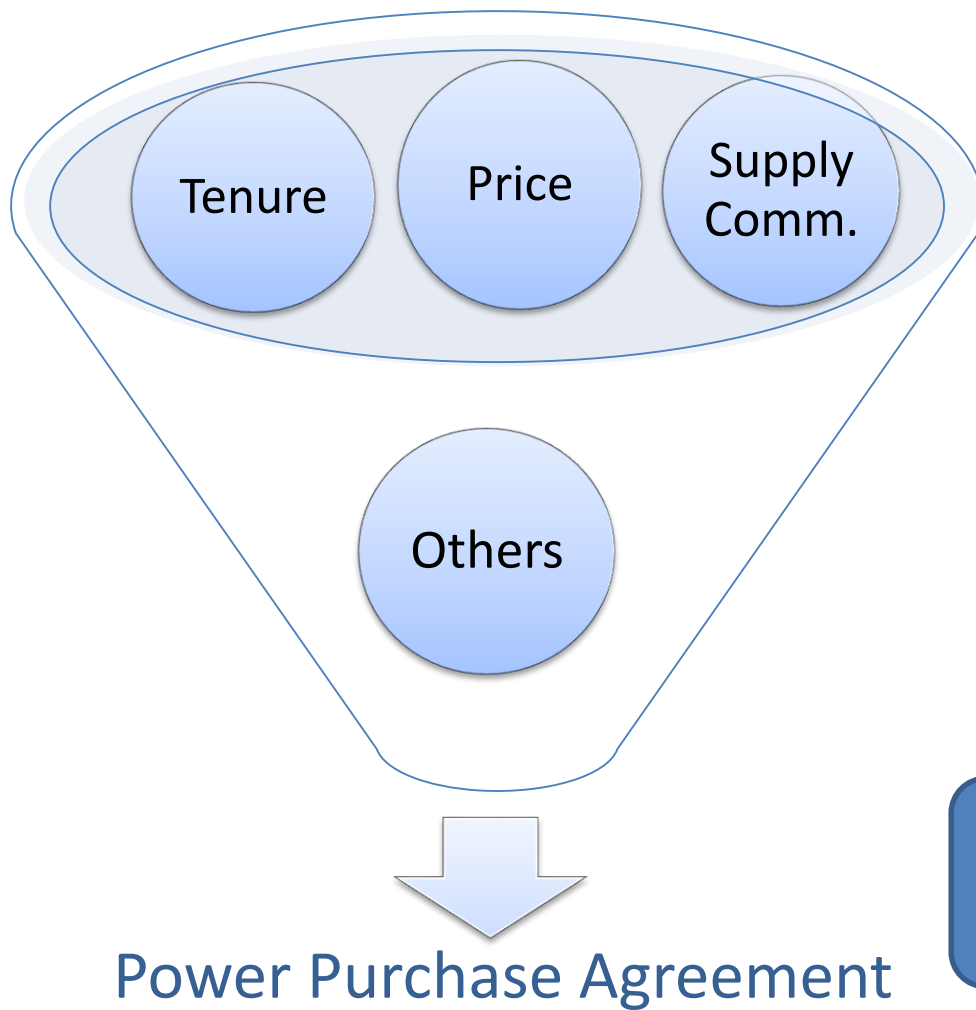


Power Purchase Agreements for Variable Renewable Energy

May 2018

- Power purchase Agreements (PPA) is an important contract that governs the sale and purchase of power
- It is key to bankability of the project
- Addresses both uncertainty in demand and in pricing
- Provides reliable long-term clarity on roles, responsibilities, costs, revenues as well as probability and significance of associated risks for stakeholders





PPA design details vary (examples for wind projects)

Price (USD/MWh)

- » Brazil: 53.9
- » Chile: 45.3
- » Mexico: 35.8
- » Panama: 90.6

Tenure (years)

- » Brazil: 20
- » Chile: 20
- » Mexico: 15
- » Panama: 15

Supply Commitment

- » Brazil: annual
- » Chile: 3 daily blocks
- » Mexico: annual
- » Panama: monthly, 24/7

Others include price adjustment; currency risk; policy/regulatory risks; dispute settlement; ownership transfer

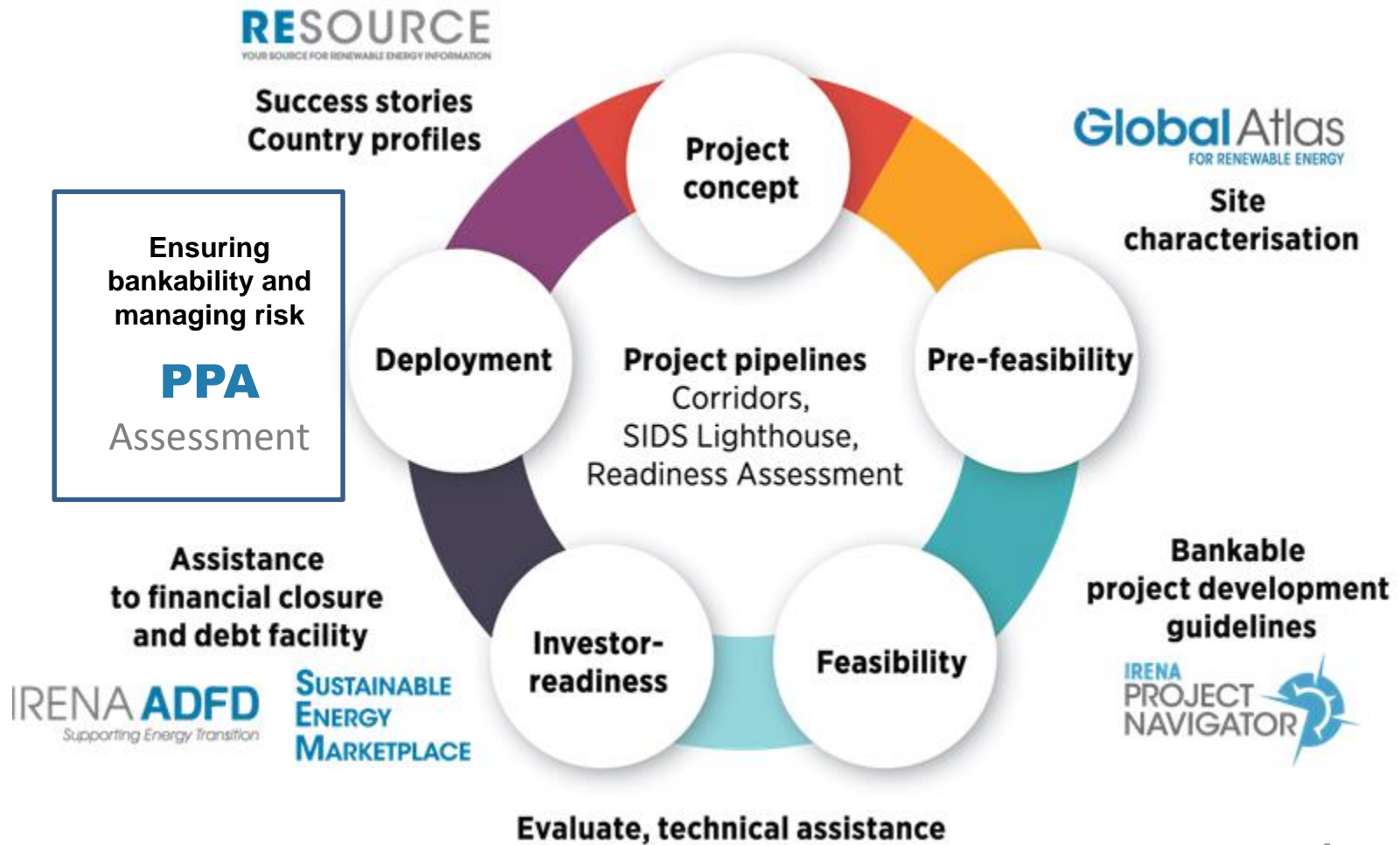
Three unique generation characteristics of wind and solar PV

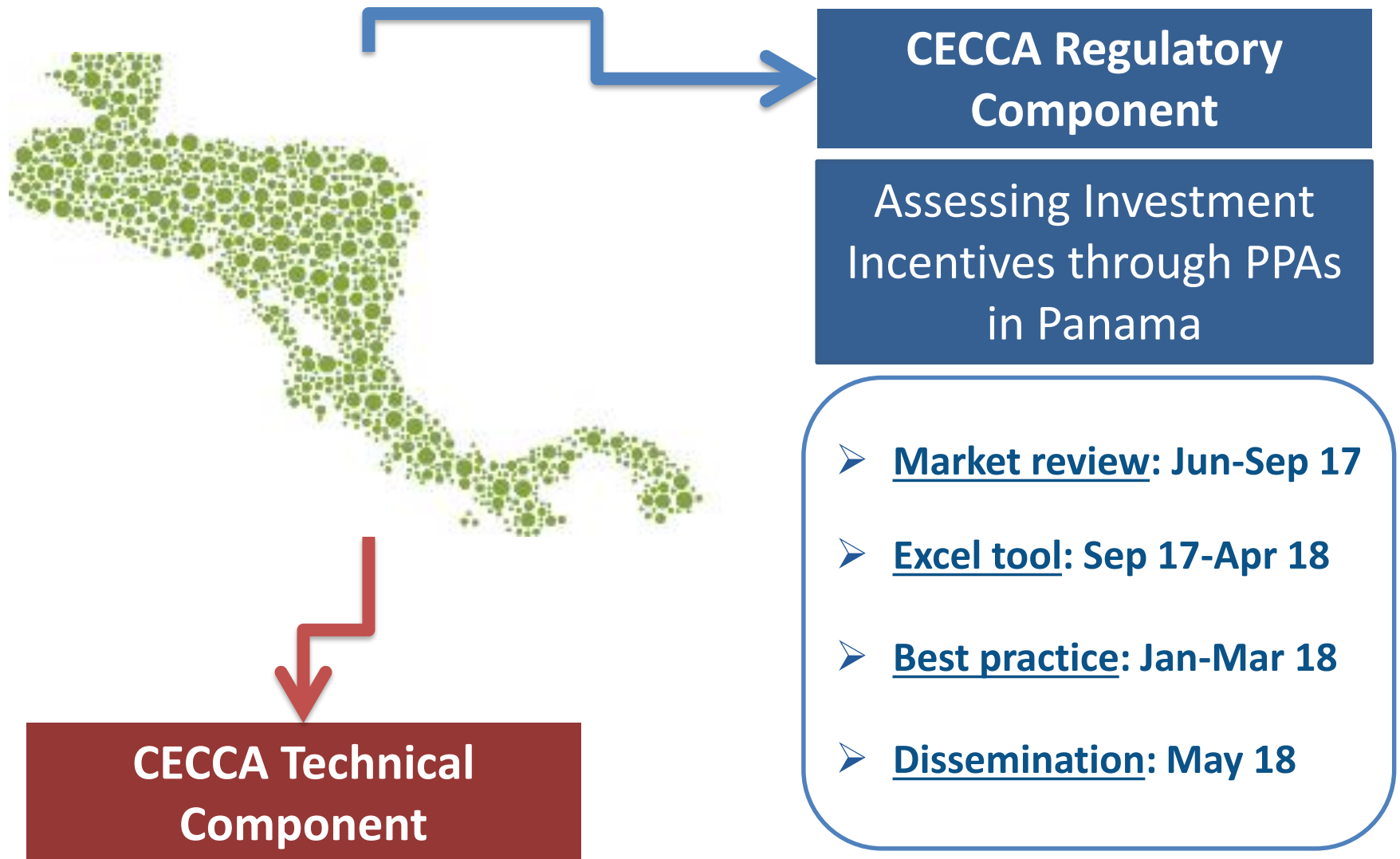
- ❑ Variability (how much generation and at what time)
- ❑ Uncertainty (how predictable the generation)
- ❑ Location-constraint (how to coordinate grid and generation)

→ Supply and purchase commitments

→ Curtailment clauses

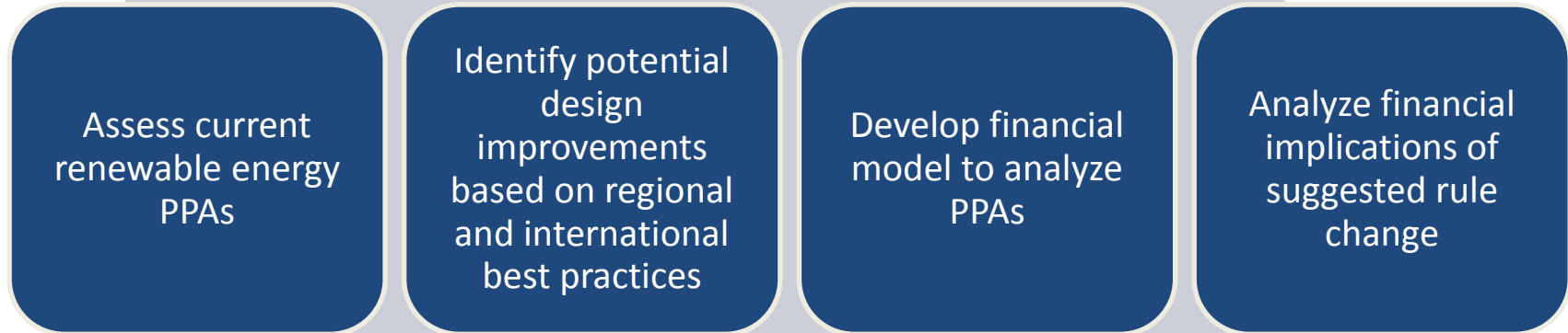
→ Requirements for dispatch procedures





Assessing Investment Incentives through PPAs - Panama

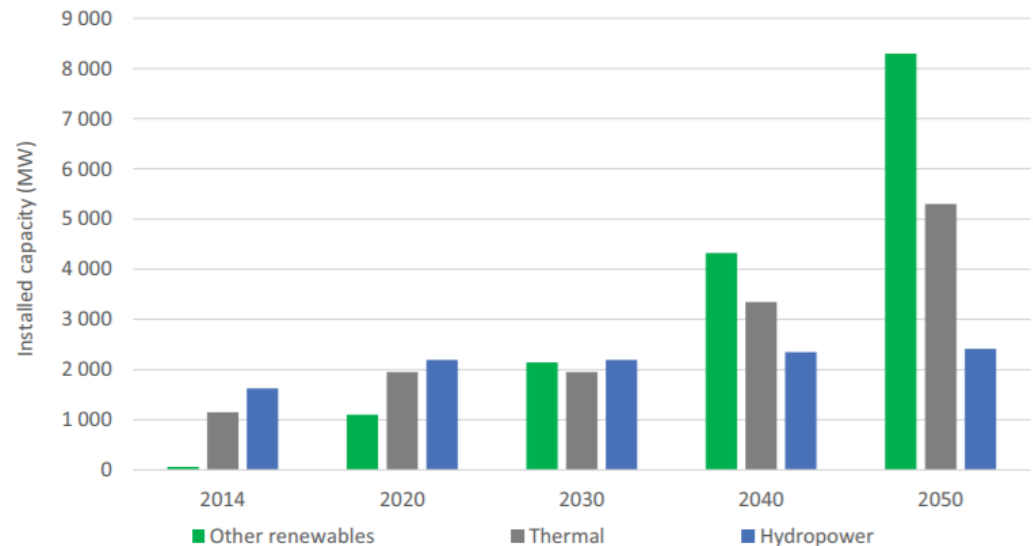
Analyze existing RE PPAs and identify design improvements



Develop financial analysis to assess the impacts of different rule changes

- National Energy Plan:
Alternate scenario - Panama targets 70% of RE by 2050
- High level of RE connection requests (1.5 GW), but low wind and solar implementation
- Process of improving investment environment i.e. improve returns for projects
- PPA design is focused on dispatchable plants, requiring RE projects to procure energy in wholesale market in order to fulfil contract terms e.g. hourly commitment

Alternative scenario: installed electricity capacity (2014-2050)



Based on SNE (2015), Plan Energético Nacional (2015-2050).

2011 Wind PPA Auction

MAIN TAKEAWAYS

- » PPAs for DSOs and producers
- » Offers received: 8
- » Bidders: 4
- » Winning bids: 4
- » Average price: 91 USD/MWh
- » Price range: 95-110 USD/MWh
- » Delivery date: 2014
- » Contracted capacity: 336 MW
- » Commissioned: 270 MW

2014 Solar PV PPA Auction

MAIN TAKEAWAYS

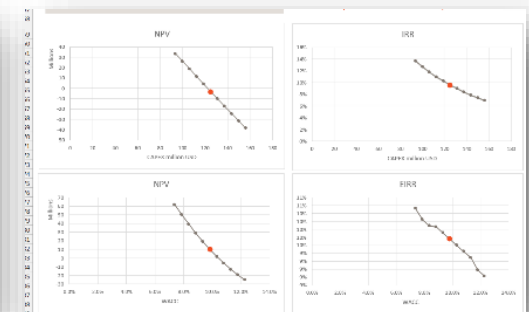
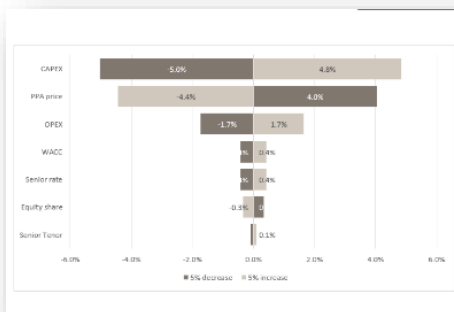
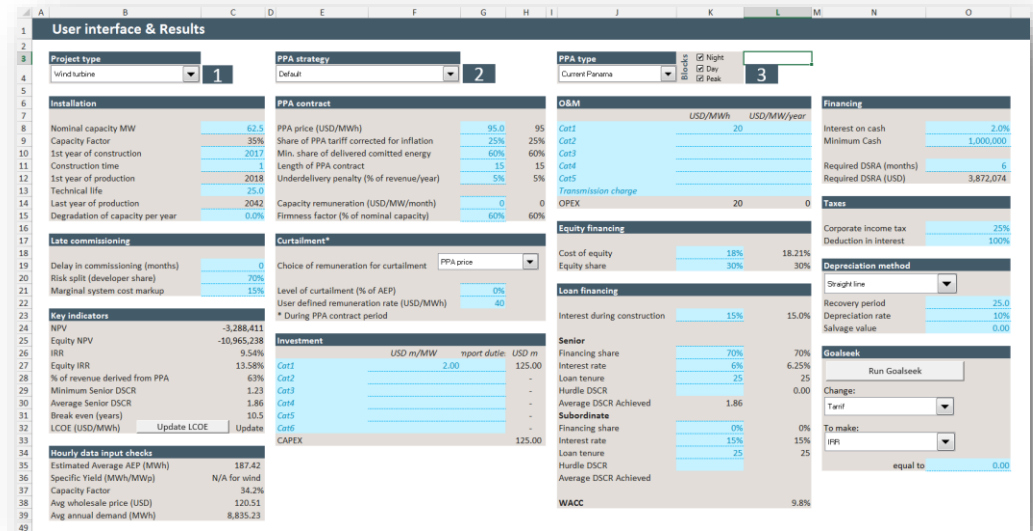
- » PPAs for DSOs and producers
- » Offers received: 31
- » Bidders: 22
- » Winning bids: 5
- » Average price: 87 USD/MWh
- » Price range: 80-105 USD/MWh
- » Delivery date: 2017
- » Contracted capacity: 172 MW
- » Commissioned: 24 MW

IRENA – PPA Assessment Tool

- The assessment tool was developed to analyze the financial implications of design changes to PPAs

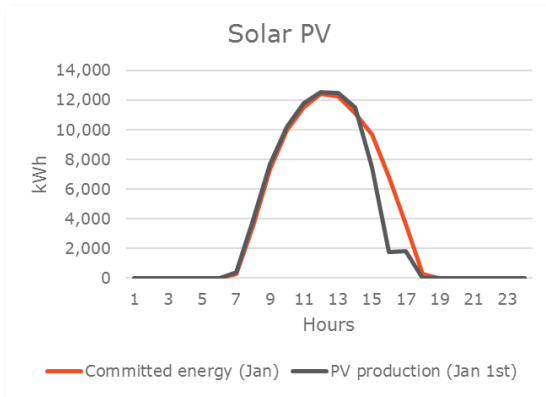
- Developed in Excel for greater flexibility and acceptance

- Designed from the ground up by IRENA with consultants COWI

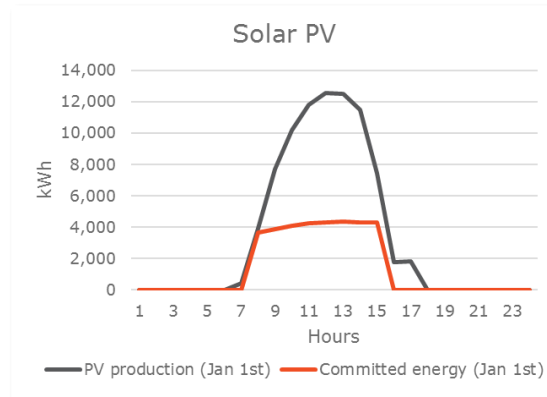


Alternative PPAs Modeled

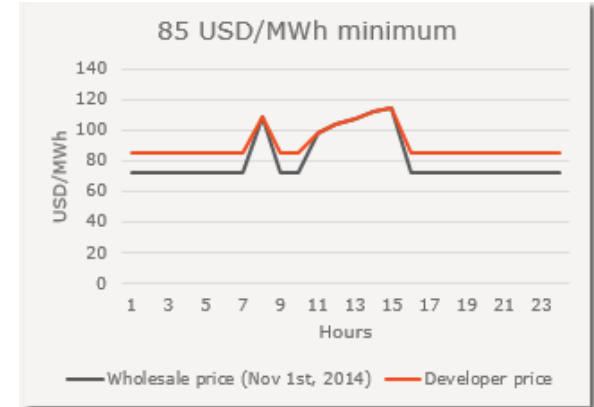
Power Curve Bidding



Time Block Bidding



Guaranteed Minimum Price Bidding



- ❑ Power is committed on an hourly basis in a 24 hour cycle
- ❑ Power curves can either be supplied for each month or as an annual average

- ❑ Power is committed in three time blocks: Night, Day, Peak
- ❑ Energy is only committed in the time blocks that have been chosen

- ❑ Developers are awarded a PPA contract based on the lowest minimum price they require. All energy is traded on the wholesale market
- ❑ If the wholesale price falls below the guaranteed minimum price, the PPA contract pays out the difference

Draft Results from the Assessment

Existing PPA Rules for Solar PV

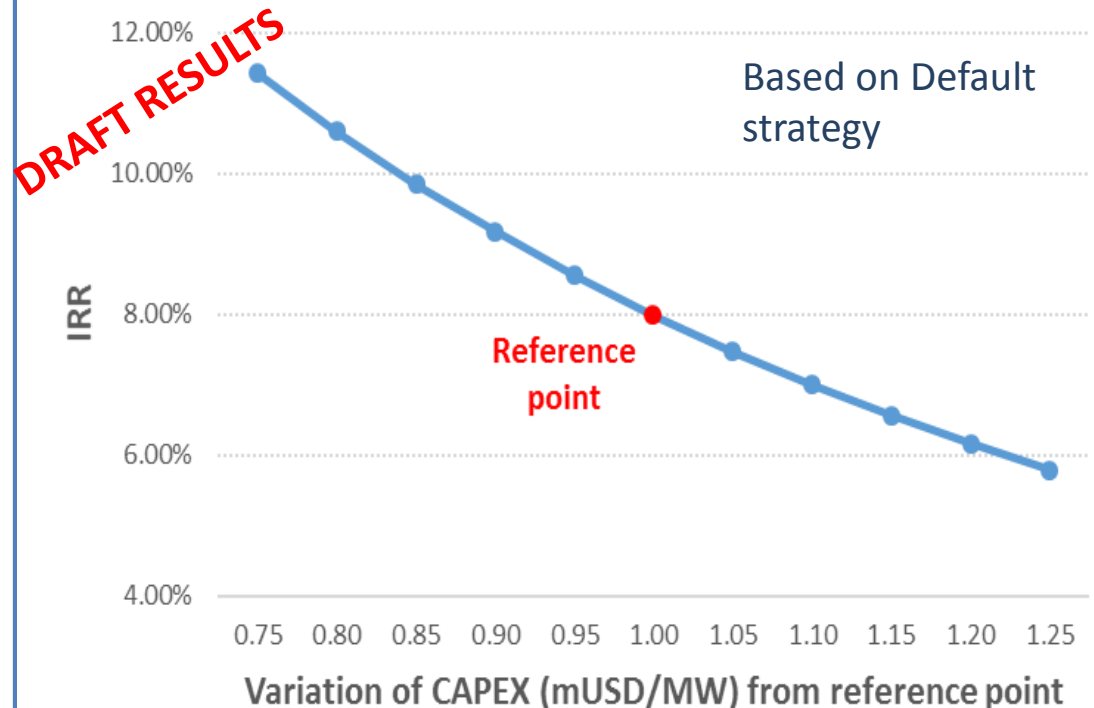
- Evaluation of the financial impact from existing rules, w/o any change
- Backward engineering of solar PV projects (2014 PPA awarding)

PPA Strategies Assessed

- Default
- Deliver > 60% of committed energy
- Deliver 100%
- 100% wholesale market
- Sell at PPA price

Key Assessment Indicators

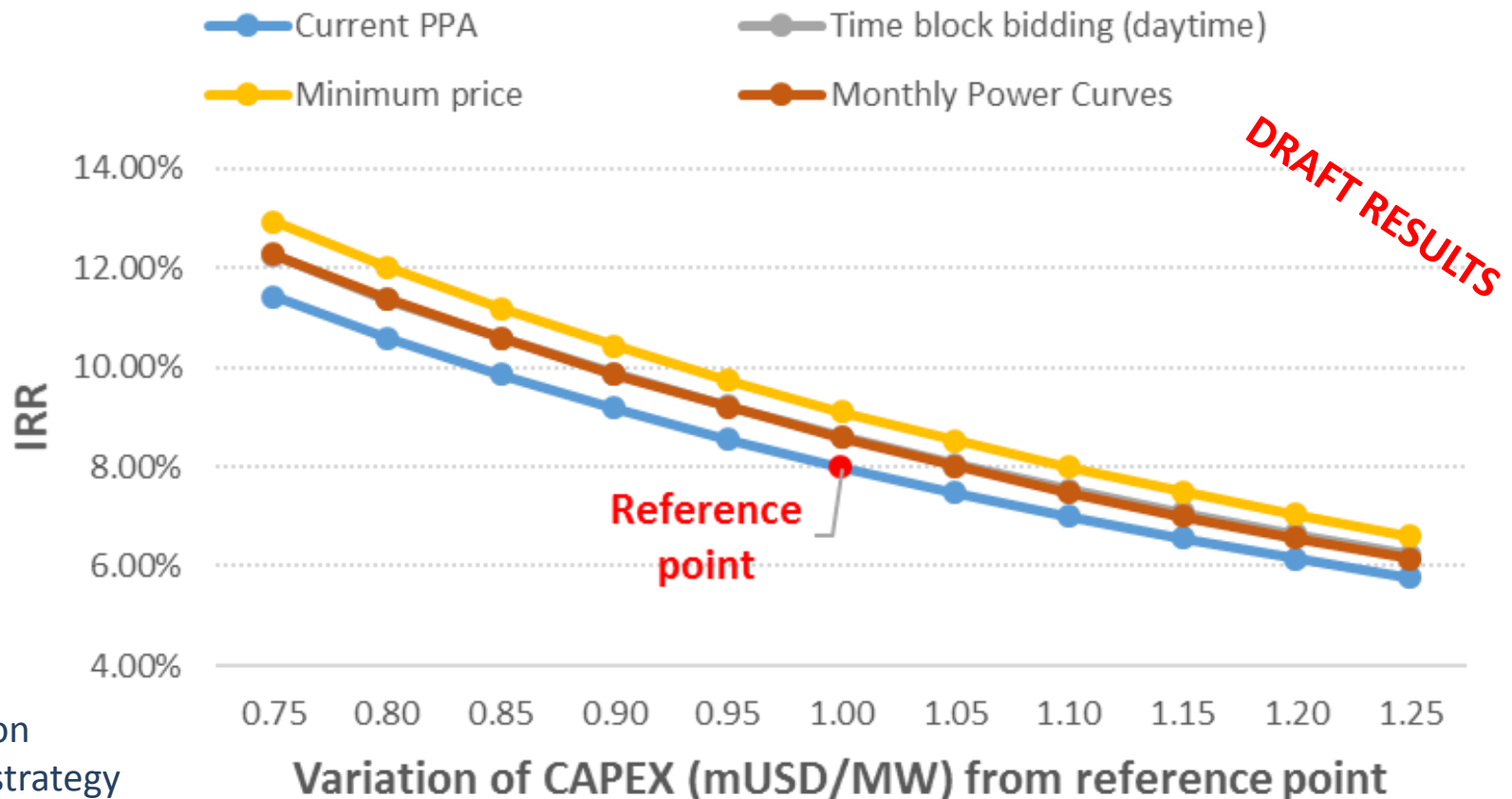
- NPV and Equity NPV
- IRR and Equity IRR
- Min. and avg. DSCR
- Breakeven
- LCOE



Draft Results from the Assessment

Possible Future PPA Rules for Solar PV

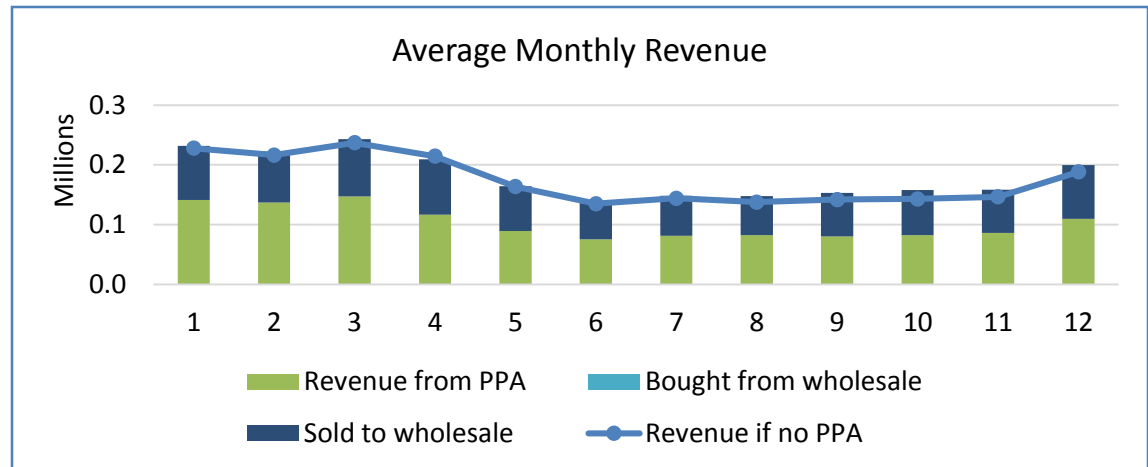
- ❑ Assessment using original results from solar PV projects (2014 PPA awarding)
- ❑ Proposed rules: meet monthly supply commitments; pay taxes and grid costs
- ❑ Additional rules: select time when you have to supply; sell all at min. price



*Based on Default strategy

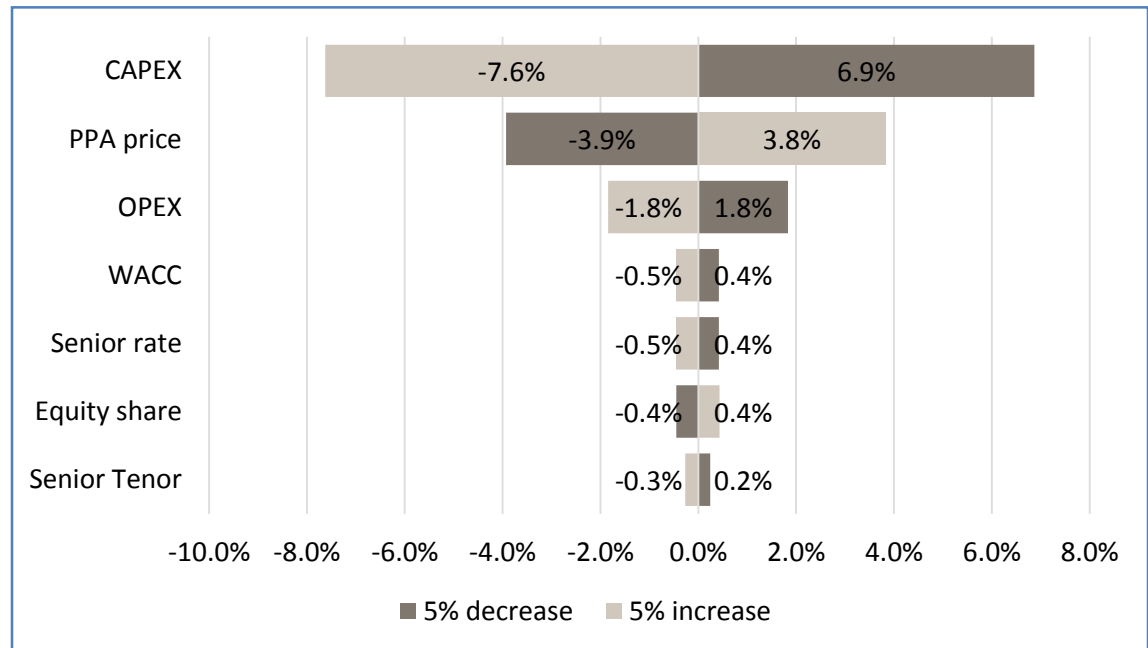
Panama RE Project PPA Analysis

- The tool provides helps with the assessment of current economics for wind and solar PV under current PPA contracts



Sensitivity Analysis

- Sensitivity analysis helps in understanding the complex relationship between the different financial parameters
- Provides a clear indication of which factors impact the outcome of the PPA the most.



Key results

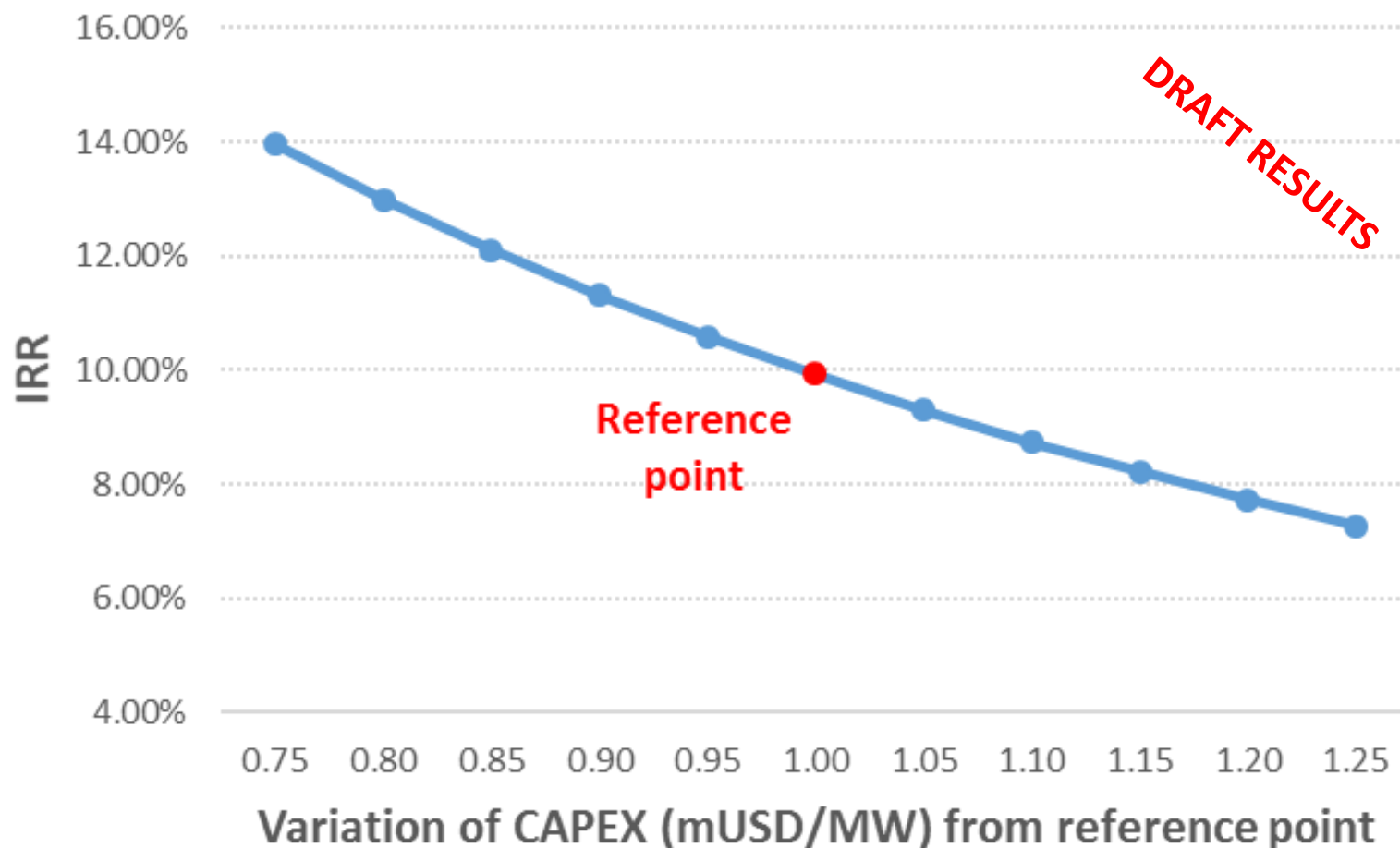
- Excel-based financial model developed to analyse different PPA designs
- Best RE PPA practices from the region and EU compiled and analysed
- Model applied in Panama – results are being finalized
- Contracts that **accommodate the seasonality and daily cycles of RE production** are key to enhancing investment incentive and reduce wholesale market interfaces (risk)

- Validation and feedback from local stakeholders
- Further investigation on time block bidding and power curve bidding contracts
- Developing actionable recommendations for Panamanian policy makers on future PPA design
- Expanding the model to include other RE technologies
 - ➔ Analysis of other CECCA countries and other regions

Backup

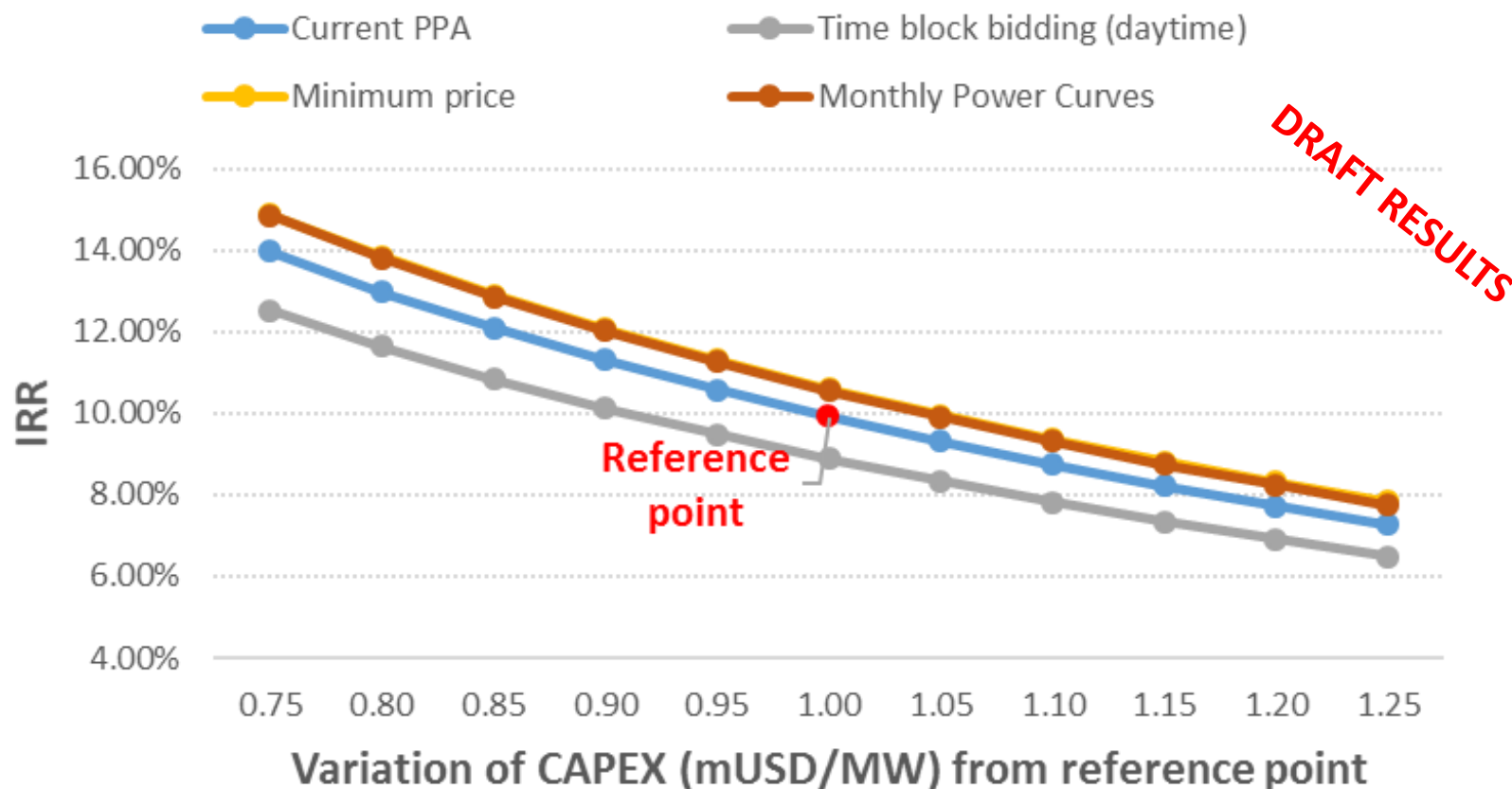
Current PPA rules

- » Evaluation of the financial impact from existing rules, w/o any change
- » Backward engineering of wind projects (2011 PPA awarding)



Possible future PPA rules

- » Assessment using original results from wind projects (2011 PPA awarding)
- » Proposed rules: meet monthly supply commitments; pay taxes and grid costs
- » Additional rules: select time when you have to supply; sell all at min. price



The formulation of CECCA

Dec 2015:
CECCA Strategy
Adopted

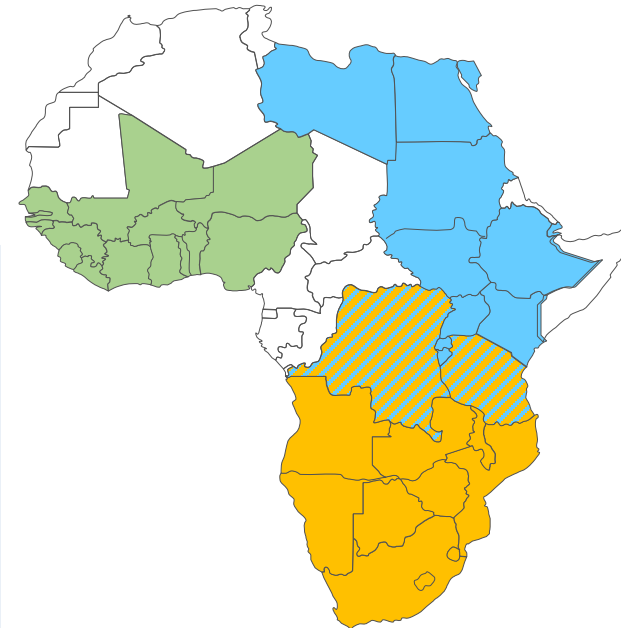
Oct 2016: PPA
Project Scoping
Initiation

June 2017: PPA
Project
Initiation

WACEC Capacity Building on PPAs

- Approved by the Directors of Energy of ECOWAS in April 2016 in Dakar
- Adopted by the Ministers of Energy in December 2016 in Conakry
- Endorsed by the Heads of State and Government in June 2017 in Monrovia and annexed to the ECOWAS Treaty

- Suitability maps
- Site Appraisal Service
- Country and regional planning
 - Development of the “Planning and Prospects for Renewable Energy in West Africa” report
 - Planning support to Sierra Leone
 - Contribution to the update of the West Africa masterplan
- Planned Regional trainings in West Africa on how to collect, process and disseminate RE Data
- Capacity building programme
 - Planning & operation of grids with higher shares of VRE
 - Development of renewable energy PPAs



ACEC

Eastern Africa Power Pool (EAPP)

Southern Africa Power Pool (SAPP)

WACEC

West African Power Pool (WAPP)

Risks to Bankability

- **The PPA is key to bankability of the project.** For the renewable power projects there is usually only one stream of revenue – payment from the buyer under the PPA.
- PPA addresses both uncertainty in demand and in pricing. On the demand side, the PPA establishes a long-term purchase obligation that provides a consistent revenue stream to the producer and a consistent flow of electricity to the off-taker. On the pricing side, the PPA incorporates a tariff formula that is tailored to the technology, operations and debt characteristics of the specific project, which can be modeled over the project lifetime.
- **Risks should optimally be allocated to the party best able to manage such risks!**

Important features to consider for a Bankable PPA

- **Term:** Long enough to allow debt to be repaid
- **Tariff:** It is important that the revenue of any PPA is a fixed amount per kWh generated to adequately cover the cost of operating the facility, repay the debt and provide a reasonable return on equity.
- **Offtaker creditworthiness:** cash-flow readily available, in full, on time; external credit support required to underpin creditworthiness and mitigate risk of non-payment if offtaker is not sufficiently creditworthy.
- **Sponsor Quality:** Experience (track-record), reputation and financial strength of the owners of the SPV shall be assessed by Lenders
- **Billing and Payment:** The billing period should be frequent enough to minimize the risk of failing debt service payments.

Important features to consider for a Bankable PPA

Currency: In order to avoid subjecting the power producer to currency risk, the PPA should be either denominated in or linked to an exchange rate of the currency of the power producer's debt, and there should be no limitation or additional approvals required to transfer funds to offshore accounts as required

Termination: The PPA should set out clearly the basis on which either party may terminate the PPA. Particularly important for lenders is to ensure that seller events of default and force majeure events do not allow the offtaker to prematurely terminate the project.

Change in Law / Change in tax: The PPA should explicitly state which party takes the risk of the law or tax regime changing after the date of the agreement in such a way as to diminish the economic returns of the transaction for such party. Lenders are not in a position to take any risk related to changes in law/tax.

Important features to consider for a Bankable PPA

Remedies upon Buyer events of default: Lenders need the seller to have ability to exercise certain rights, even up to PPA termination, if the offtaker is failing to make payments.

Lender rights: The PPA should allow collateral assignment of the agreement to the power producer's lenders with the right to receive notice of any default and to cure such default. Additional step-in rights are generally set forth in a separate direct agreement between the lenders and the offtaker.

Dispute Resolution: The PPA should provide for offshore arbitration, in a neutral location, under rules generally acceptable to the international community.

Dispatch risk: Take or Pay & Take and Pay

WACEC Capacity Building on RE PPAs



PPA component	Benin	Burkina Faso	Ghana	The Gambia
General suitability for renewable energy procurement at scale	Green	Yellow	Green	Red
Commissioning processes	Green	Red	Green	Red
Connection to the grid	Yellow	Yellow	Red	Yellow
Tariff/ currency	Green	Yellow	Yellow	Yellow
Curtailement	Green	Red	Yellow	Red
Force Majeure	Green	Green	Yellow	Red
Change in law	Green	Green	Yellow	Red
Minimum generation requirements	Red	Red	Red	Red
Buy-out (on termination for off-taker/ government default)	Green	Green	Green	Red
Guarantees	Green	Yellow	Red	Red
Bonds for connection construction	Yellow	Red	Green	Red

Green	Appropriate for the delivery of an RE IPP
Yellow	Provisions need to be improved
Red	Provisions not appropriate for the specificities of RE

WACEC Capacity Building on RE PPAs



28 May - 8 June	1 st Series	Regional market design
		Procurement processes for RE projects
		Pricing of RE IPPs
		Risk allocation
3 - 13 July	2 nd Series	Stakeholder responsibility and outcomes
		Default, non-default, and dispute resolution
		Agreements with important interactions with the PPA
		PPA negotiation