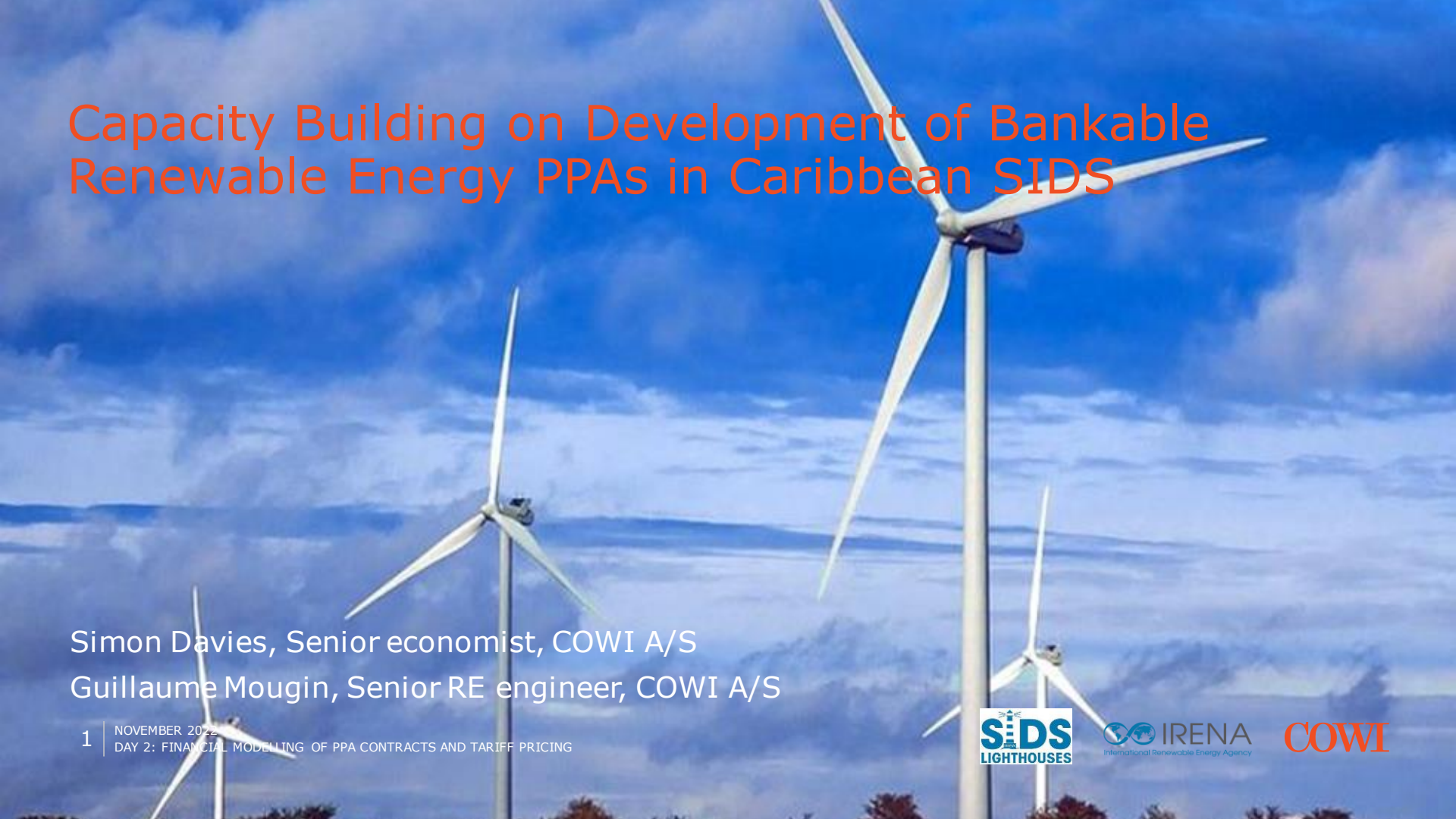
Capacity Building on Development of Bankable Renewable Energy PPAs in Caribbean SIDS



Simon Davies, Senior economist, COWI A/S

Guillaume Mougin, Senior RE engineer, COWI A/S

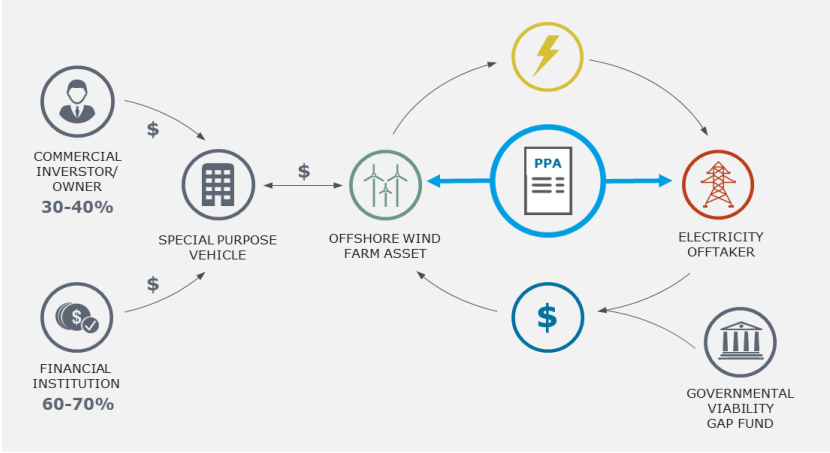
SIDS LIGHTHOUSES IRENA International Renewable Energy Agency COWI

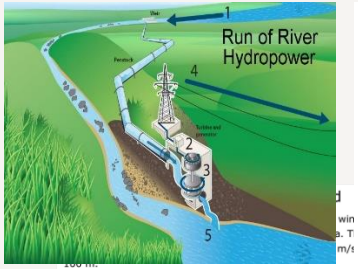
Day 2

Financial modelling of PPA contracts and tariff pricing

- PPA contract elements: penalties, capacity incentives, curtailment, payment lag and indexation
- Exercises focused on PPA modelling

Recap of Day 1





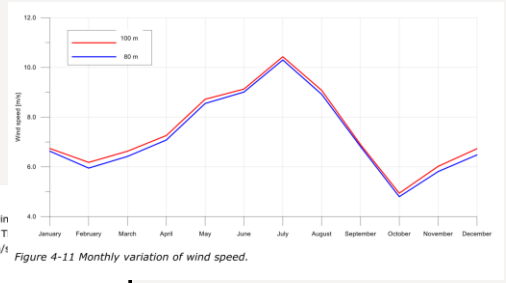


Figure 4-11 Monthly variation of wind speed.

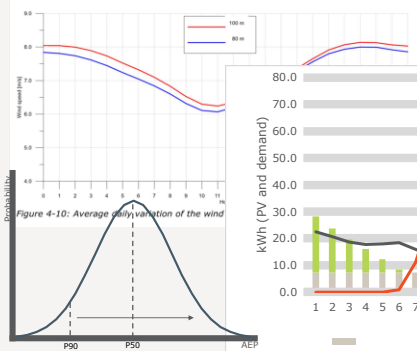
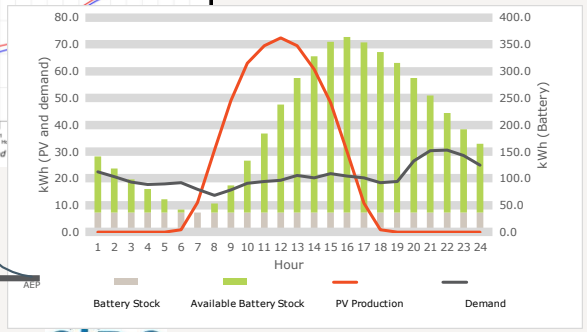


Figure 4-10: Average daily variation of the wind



SIDS LIGHTHOUSES IRENA International Renewable Energy Agency COWI

Recap of Day 1

- WACC
- NPV
- LCOE
- IRR
- DSCR/DSRA

PPA contracts

PPA tariff

- The price per unit of electricity that the developer requires to engage in the project
- A guarantee of reliable project revenue as a basis for loan financing
- The main – but not the only – parameter of competition between developers

- A PPA tariff higher than the base tariff in the grid may lead to considerations on public funding such as a VGF
  - Viability Gap Funding can be applied specially for new technologies, demonstration or strategic projects

Committed energy and capacity

- PPA contracts may require the developer to commit to production targets and availability of capacity
- Commitments can have different time resolution
  - Hourly, daily, weekly, monthly, annually
  - Higher resolution means more predictability for the utility but more risk for the developer

- Not meeting committed targets will often be met with penalties

- Commitments of energy and capacity are difficult for non-dispatchable technologies

Incentives/Penalties

- PPA contracts will often define a number of penalties for non-compliance
  - Over-/underproduction relative to committed targets
  - Under-delivery relative to committed capacity
  - Delays in commissioning
- A PPA contract can also provide economic incentives
  - Compensation for curtailment
  - Indexing of the PPA tariff

Payment lag

- In some countries, there is a considerable delay from delivery of electricity to payment
- Puts a considerable strain on the developer's cash flow
- Delaying revenues by as little as a few months will impact key indicators like NPV and IRR
- The lack of cash flow in the first months of operation may lead to loan financing considerable cash reserves to pay operational costs and service debt

Indexing

- There is no clear consensus on correcting the PPA tariff for inflation
- Over a potentially 25-year long PPA contract, the lack of indexing can constitute a major loss of revenue
- The developer will require a higher PPA tariff to compensate for the lack of indexing

PPA contract elements in the Excel tool

Contract duration

- The length of the contract will impact project revenues *(row 59)*
- Technical life can be longer than the contract
  - Price of electricity reverts to base tariff after end of contract
- Loan financing is often tied to the PPA contract
  - Contract duration will likely impact loan tenor

Contract length		
Length of contract	years	25

Tariff

- The payment per unit of electricity to the developer *(row 64)*

- The PPA tariff is an input
  - BUT: can be estimated by using the calibration/"goal-seek" module in the model

Tariff		
PPA tariff	USD/MWh	93

Indexing

- Inflation impact several cost and revenue items *(from row 67)*
  - OPEX is typically impacted by inflation
  - Base tariff could potentially be impacted by inflation
  - The production tax credit is a revenue and might be indexed
  - The PPA tariff is sometimes partially indexed

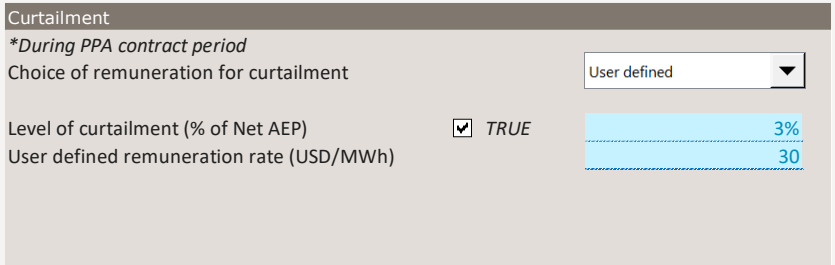
Indexing		
	Include	
Inflation rate		3%
Inflation on OPEX	☑ *TRUE*	
Inflation on base tariff	☑ *TRUE*	
Indexing of PTC	☑ *TRUE*	
Indexing of PPA tariff	☐ *FALSE*	3%
Duration of indexing (years)		25

Payment schedule

- Payment lag can have a big impact on project profitability
- Payment lag is denoted in months *(row 82)*
- Payment lag can be switched on and off by the check box

Curtailment

- The Excel tool offers three option on curtailment *(from row 85)*
  - No compensation
  - User defined compensation
  - PPA tariff, i.e. full compensation
- Share of net AEP that is curtailed is an input
- The user defined compensation is an input



Over-/ underproduction

- This functionality is tied to the use of a time series of AEP rather than a fixed Pxx AEP
- Committed annual energy production determines over- and under production *(from row 95)*
  - Underproduction is penalized by a fixed penalty per unit of energy
  - Overproduction is paid a tariff that is potentially lower than the PPA tariff
  - Both options can be switched on and off using the tick boxes

Over-/underproduction		
	include	
Committed AEP (GWh)		159
Penalty for underproduction (USD/MWh)	☐ FALSE	130
Tariff for overproduction (USD/MWh)	☐ FALSE	93

Capacity remuneration

- Capacity remuneration pays out a fixed amount per year per unit of capacity available at all times *(from row 102)*
  - Both the capacity remuneration and the penalty for shortfalls should be included and defined as input.
- It is possible to include annual variability of the capacity factor. If this is not chosen, the factor is assumed constant.

Capacity Credits		
Activate annual variability in capacity factor	☐ *FALSE*	
Comitted capacity factor (% of nominal capacity)		31%
Capacity remuneration (USD/MW/year)	☐ *FALSE*	10,000
Penalty for shortfalls (USD/MW/year)	☐ *FALSE*	10,000

Late commissioning

- Late commissioning is a problem for the developer AND the grid *(from row 109)*
  - Delay is input in years
  - Penalty is input per unit of capacity per year

Late commissioning		
Delay in commissioning (years)	☐ *FALSE*	1
Late commisioning penalty (USD/year/MW)	☐ *FALSE*	100,000

Exercises Day 2

Feasibility

- What is the internal rate of return (IRR) of your project?
- What happens to IRR when you:
  - Lower CAPEX?
    - *Row 11-16 in the sheet "CAPEX & OPEX"*
  - Lower OPEX?
    - *Row 20-25 in the sheet "CAPEX & OPEX"*
  - Pxx / higher uncertainty on energy production?
    - *Drop down menu, row 9 in the User Interface*
  - Higher PPA tariff?
    - *Row 64 User Interface*
  - Which options are you best in control of?
- How does a higher IRR affect the DSCR? *(see the minimum Senior DSCR in the Main results box)*

Key indicators	
PPA Price(USD/MWh)	**447**
NPV	2,181,781
Equity NPV	-7,495
IRR	8%
Equity IRR	12%
Simple WACC (before taxes)	8%
Compound WACC	8%
Minimum Senior DSCR	1.74
Minimum Junior DSCR	0.00
NPV GBI	0
NPV Investment subsidy	0
Break even (years)	10.5
LCOE (USD/MWh)	423.4

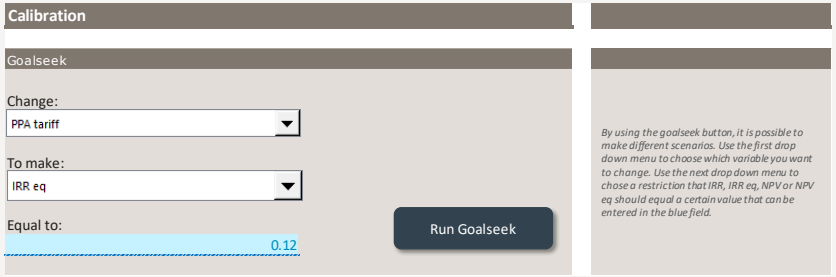
Debt service (Caribbean)

- Try including loan financing of DSRA *(row 177)*
  - How does it affect the NPV?
  - How does changing the contingency cash and interest of cash affect the NPV?

Cash reserves		
Interest of cash		2%
Contingency cash		
Include loan financing of DSRA	☑ *TRUE*	DSRA active
Estimate of DSRA needed	USD	1,509,287
Custom scaling of DSRA relative to estimate		100%

Calibrating the model

- This is a key function in the model
  - Select "Change:" PPA tariff *(row 195)*
  - Select "To make:" IRR eq *(row 198)*
  - Set "Equal to:" the cost of equity set under financing *(row 201)*
- Click the button "Run Goalseek" to find the PPA tariff which provides the developer with the required return on equity
  - See the result in the top line of the Main Results table
- Change a setting, e.g. a PPA contract element
- Click the button again



Scenario analysis

Contract setups

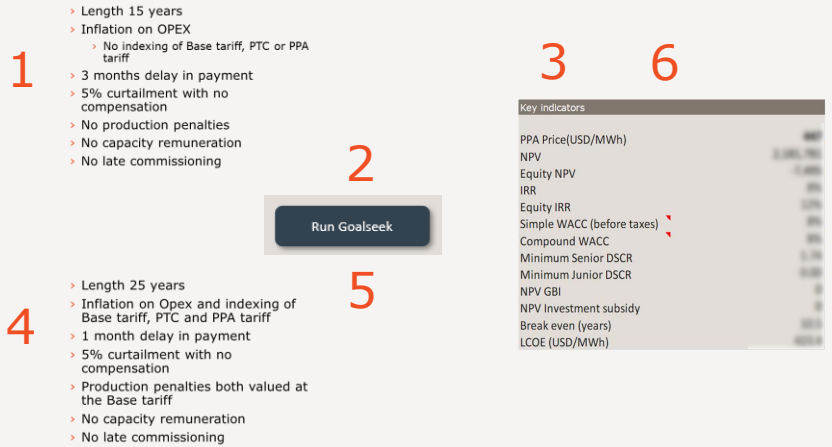
- Length 15 years *(row 59)*
- Inflation on OPEX *(from row 69)*
  - No indexing of Base tariff, PTC or PPA tariff
- 3 months delay in payment *(row 82)*
- 5% curtailment with no compensation *(from row 87)*
- No production penalties *(from row 97, remember to set the committed AEP relative to the net AEP in row 24)*
- No capacity remuneration *(from row 103)*
- No late commissioning *(from row 111)*

- Length 25 years
- Inflation on Opex and indexing of Base tariff, PTC and PPA tariff
- 1 month delay in payment
- 5% curtailment with no compensation
- Production penalties both valued at the Base tariff
- No capacity remuneration
- No late commissioning

Compare the two contracts

- Set up 1 contract
- Find the PPA tariff using goal seek
- Note the PPA tariff
  - e.g. write it down or copy paste value to an empty cell

- Set up the other contract
- Find the PPA tariff using goal seek
- how do the PPA tariffs compare?



- ***Summary:***
- *The second contract had a much lower PPA price. This was achieved only by changing the PPA settings.*

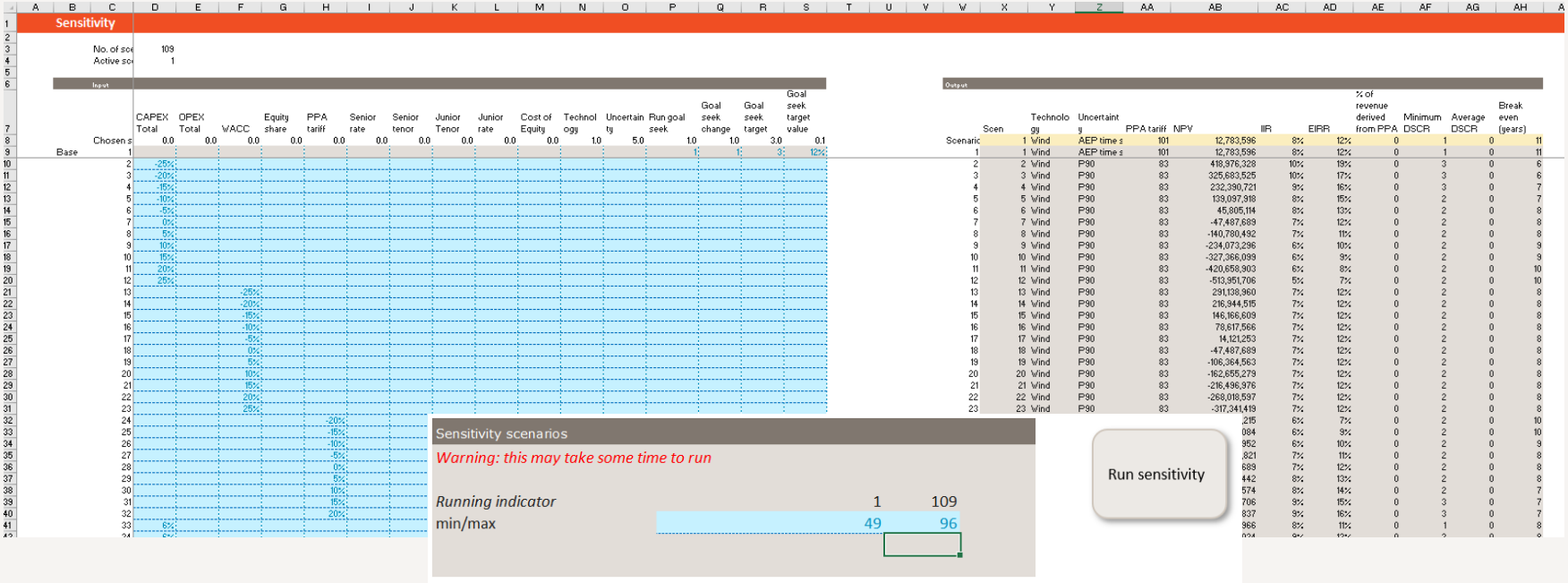
Battery

- Would a battery increase the feasibility of the project?
  - Add a battery and see how the financial KPIs change *(row 18)*
    - Try out different sizes for the battery
  - What happens if you increase curtailment? *(from row 86)*
    - After increasing curtailment, try turning battery on and off and investigating impact on KPIs
- How does adding a battery change the PPA tariff (price)?
  - Use goal seek to find tariff

Sensitivity analysis using the model

Running sensitivities

› The following slides introduces a predetermined set of standard sensitivity analyses

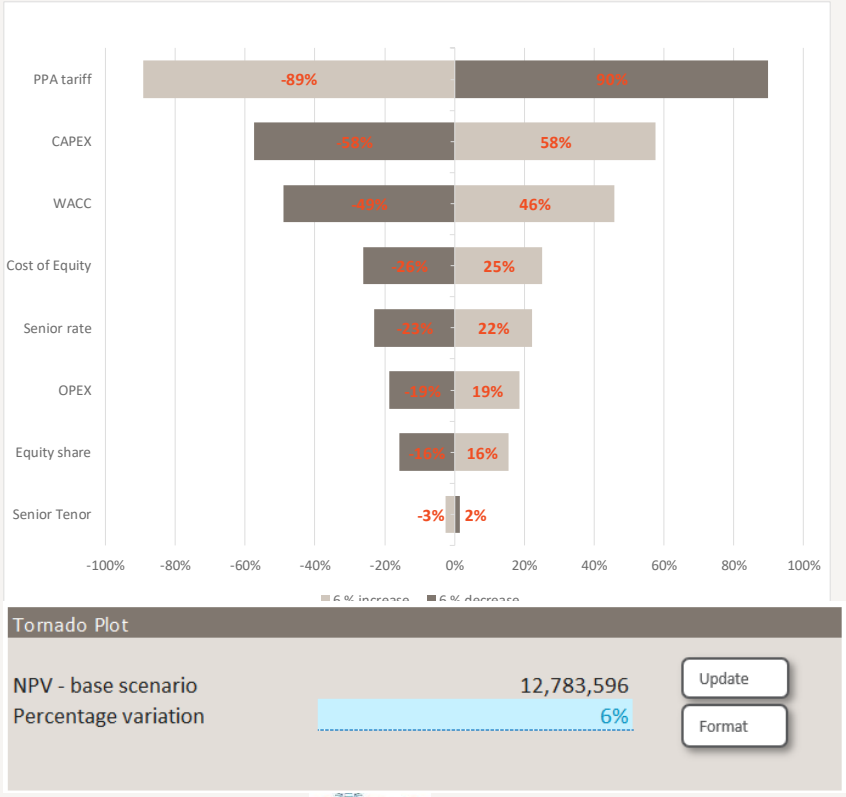


SIDS LIGHTHOUSES IRENA International Renewable Energy Agency COWI

Tornado plot

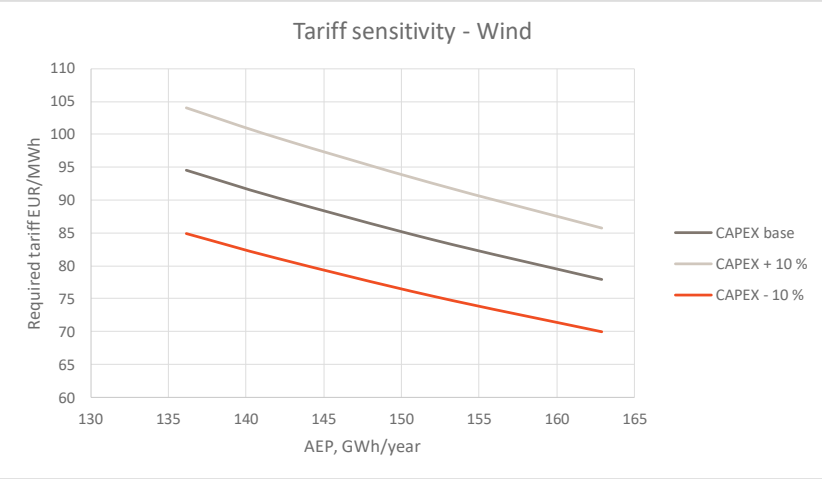
- Predefined functionality
  - Classic tornado plot
  - x% variation in inputs leads to ?% increase/decrease in project NPV
- Indicates which parameters have the biggest impact on the results

- Press the update button
- Change the percentage change
- Try pressing the button again



Tariff sensitivity

- Changes inputs
  - CAPEX
  - AEP
- Re-estimates the PPA tariff
- Shows how sensitive the expected PPA tariff is to variations in CAPEX and AEP
- Define which sensitivity runs to run
  - Start at 49
  - end at 96
- Run sensitivities



Sensitivity scenarios		
Warning: this may take some time to run		
Running indicator	1	109
min/max	49	96