Tool for Power Purchase Price calculation (Power Purchase Tool)

This explanation relates to the Power Purchase Tool provided at the **Mini-Grid Policy Toolkit Portal.** This Tool and further support tools are available for download at **minigridpolicytoolkit.eueipdf.org/tools**

The Power Purchase Tool calculations serve as a pre-condition for the Power Purchase Agreements (PPAs) between contracting parties – small independent power producers (IPP) and a utility purchasing the electricity to meet its customers' needs. The Tool is designed to calculate appropriate data for the basis of PPAs, especially the Power Purchase price for unit of power delivered by the IPP.

The tool determines annual costs of generated power, based on inputs provided: plant characteristics (and technology), investment, operating costs and additional costs (such as network reinforcement costs and costs of transmission losses) and discount rate of the average cost of capital of the IPP for a certain period of time. Based on the annual generation and the annual costs, **the tool calculates PPA prices for the specific technology**, consisting of the **capacity price** (per kW) and **energy price** (per kWh). The initial inputs also allow determining **Net Present Value** (NPV), **Levelised Costs of Electricity** (LCOE) and their **adjustment**.

This Power Purchase Tool is pre-accommodated to diesel, hydro or biomass technology. The Tool was prepared as part of the EUEI PDF project for the Regional Electricity Regulators' Association of Southern Africa (RERA) to establish a framework for attracting increased investment in mini-grids employing renewable and hybrid generation in Southern African Development Community (SADC).

Glossary

Generated power – Available Capacity*Average Plant Utilisation*8760 hours

Annual costs – annual payment amount for a loan for the investment (investment costs) based on an interest rate (discount rate) for the period of the PPA term

Capacity Price[1] – is the element of the PPA price; it is a fixed payment that is paid each period for each kW of available (not dispatched) capacity

Energy Price – is the element of the PPA price; it is paid each period for each kilowatt hour of energy dispatched and delivered at the agreed delivery point during that period

Net Present Value – NPV of a time series of cash flows, both incoming and outgoing, is defined as the sum of the present values of the individual cash flows.

[1] https://www.esmap.org/sites/esmap.org/files/ESMAP%20IFC%20Re%20Training%20World%20Bank%20Nehme.pdf

LCOE - is the price at which electricity must be generated from a specific source to break even over the lifetime of the project, its assessment includes all the costs over its lifetime: initial investment, operations and maintenance, cost of fuel, cost of capital.

Inputs

Enter the expected Plant Characteristics

Plant characteristics				
Type		Diesel	Hydro	Biomass
Firm/Non-Firm		Firm	Firm	Firm
Available capacity	MW	20	10	10
PPA term	years	20	20	20
Average plant utilisation	%	90%	40%	80%

Estimate the Investment and Operating costs paid by the IPP

Investment costs				
Development costs	$m	0,50	3,00	2,00
Construction costs	$m	10,00	23,00	20,00
Connection costs	$m	0,50	2,00	2,00
Total	$m	11,00	28,00	24,00
Operating costs				
Fixed O&M costs	$000/year	100,00	700,00	480,00
Variable O&M costs	$/kWh	0,00	0,00	0,01
Fuel costs	$/kWh	0,32	0,00	0,04

Estimate Additional costs paid by the Network owner (i.e. for reinforcement or transmission losses)

Additional costs to be considered				
Network reinforcement costs	$m	1,00	10,00	1,50
Network reinforcement costs per unit	$/kWh	0,00	0,04	0,00
Transmission losses	%	1%	10%	3%

Expected discount rate of the average costs of capital for IPP

Discount rate				
Gearing	%	70%	70%	70%
Real interest rate	%	8%	8%	8%
Pre tax real ROE	%	18%	18%	18%
WACC (pre-tax real)	%	11%	11%	11%

Calculations

Generation				
Annual power supplied	MWh	157.680	35.040	70.080
Annual costs				
Investment costs	$m	1,38	3,52	3,01
Fixed operating costs	$m	0,10	0,70	0,48
Variable operating costs	$m	50,46	-	3,43
Total	$m	51,94	4,22	6,93
NPV	$m	413,61	33,57	55,17
Reinforcement costs	$m	0,13	1,26	0,19

Outputs

PPA prices				
		IPP 1: (Diesel, 20MW)	*IPP 2: (Hydro, 10MW,*	*IPP 3: (Biomass, 10MW)*
Capacity price	$/kW	74,07	421,61	349,38
Energy price	$/kWh	0,32	0,00	0,05
NPV	$m	413,61	33,57	55,17

Levelised cost				
		IPP 1: (Diesel, 20MW)	*IPP 2: (Hydro, 10MW,*	*IPP 3: (Biomass, 10MW*
Annual power purchase costs	$m	51,94	4,22	6,93
Annual power supplied	MWh	157.680	35.040	70.080
Levelised cost	$/kWh	0,33	0,12	0,10
NPV	$m	413,61	33,57	55,17