

SOLAR TECHNOLOGY

Solar Energy, as defined in R.A. 9513 or the Renewable Energy Law, refers to the energy derived from solar radiation that can be converted into useful thermal or electrical energy.

I. TECHNICAL AND EPC ASSUMPTIONS

A. Installed Capacity – 100.612MWp

For the installed capacity, the Commission used the capacity of the latest Power Supply Agreement at 100.612MWp as a representative project. The representative project will take 24 months from financial closing to construct and has an economic life of 25 years, which is based on the lower limit estimated by NREL¹ experts for various RE technologies as shown in Table 1.

Table 1. Economic Life from NREL

| Economic Life | Years |
|---------------------------------|---|
| Photovoltaic | 25 years to 40 years |
| Biomass Combined Heat and Power | 20 years to 30 years |
| Biomass Heat | 20 years to 30 years |
| Solar Water Heat | 10 years to 25 years |
| Solar Vent Preheat | 30 years to 40 years |
| Ground Source Heat Pump | 20 years for interior components 100 years for ground loop |

B. Net Capacity Factor – 21.33%

For the capacity factor, the Commission derived the average net capacity factors of solar power plants with Power Supply Agreements (PSA) and capacities between 50-100MW, to wit:

Table 2: Capacity Factor of Shortlisted SPPs

| Solar Power Plant | ERC Case Number | Installed Capacity (MW) | Net Capacity Factor (%) | STATUS |
|--|-----------------|-------------------------|-------------------------|--|
| Powersource First Bulacan Solar, Inc. (PFBS) | 2017-012 RC | 80.923MWdc | 22.5% | With Final Authority 28 February 2019 |

¹ <https://www.nrel.gov/analysis/tech-footprint.html>

| Solar Power Plant | ERC Case Number | Installed Capacity (MW) | Net Capacity Factor (%) | STATUS |
|---|-----------------|-------------------------|-------------------------|---|
| Solar Philippines Tanauan Corporation | 2017-014 RC | 50MWac | 20.5% | With Final Authority 28 May 2019 |
| Solar Philippines Tarlac Corporation (SPTC) | 2017-094 RC | 100MWdc | 21.0% | With Interim Relief 20 February 2018 |
| Average | | | 21.33% | |

Thus, the Commission adopted the average net capacity factor of **21.33%**.

C. EPC Cost, Transportation to Project Site, Balance of Plant, Switchyard and Transformers, Transmission Interconnection Cost, Access/Service Roads Cost, Other Development Cost and Initial Working Capital – US\$864.12/kW

The Commission considered the actual Equipment, Procurement, and Construction (EPC) Costs of one solar plant based on its 2020 Audited Financial Statement, to wit:

Table 3. Project Cost

| Project | Amount (PhP) |
|------------------------------------|----------------------|
| Infrastructure and Interconnection | 1,752,292,000 |
| Solar PV Modules | 1,533,065,344 |
| Project Development | 1,164,642,656 |
| Total | 4,450,000,000 |

Note that the above costs are in 2019, thus, the Commission adjusted them to reflect the 2021 cost of solar PV modules. The Commission adopted the information from PV Insights², a premier international solar PV research firm, particularly the trend in the annual cost of solar PV modules. Table 4 shows the cost of PV modules for years 2019 to 2021.

² <https://www.bloomberg.com/news/articles/2021-05-23/solar-power-s-decade-of-falling-costs-is-thrown-into-reverse>

Table 4. Updated Project Cost for 2021

| Year | Price of PV Modules | Solar Panels |
|-------------|---------------------|---|
| 2019 | -12.8% | PhP1,533,065,344 x (1-12.80%) = PhP1,336,832,980 |
| 2020 | -11.5% | PhP1,336,832,979.97 x (1-11.50%) = PhP1,183,097,187 |
| 2021 | 15.4% | PhP1,183,097,187.27 x (1+15.40%) = PhP1,365,294,151 |

Based on the foregoing, the Commission adjusted the amount for EPC; switchyard and transformers; transmission cost; access road cost; and other development cost amounting to PhP4,282,228,807, equivalent to US\$864.12/kWp or **US\$864.118.47/MW** using the 2021 base Peso Exchange Rate of PhP49.2546:US\$¹³, which was the average Philippine Peso per US Dollar exchange rate for CY 2021 as detailed below:

Table 5. Original and Adjusted Project Cost for 2021

| Project | Original Amount (PhP) | Adjusted Amount (PhP) |
|------------------------------------|-----------------------|-----------------------|
| Infrastructure and Interconnection | 1,752,292,000 | 1,752,292,000 |
| Solar PV Modules | 1,533,065,344 | 1,365,294,151 |
| Project Development | 1,164,642,656 | 1,164,642,656 |
| Total | 4,450,000,000 | 4,282,228,807 |
| US\$/kWp | US\$897.97/kWp | US\$864.12/kWp |

D. Value-Added Tax (VAT) on Importation

The Commission used the 12% VAT on importation.

E. Initial Working Capital (% of EPC) – 0%

The Commission removed the initial working capital since this parameter is already part of the EPC cost.

³ <https://www.bsp.gov.ph/statistics/external/Table%2012.pdf>

F. Contingency Allowance (% of total cost) – 0%

The Commission removed the 4% contingency allowance since all cost parameters were identified and with corresponding values.

II. OPERATING ASSUMPTIONS

A. O&M Cost – US\$482,743.12/yr

The Commission gathered the O&M Cost from the submitted 2020 Audited Financial Statement (AFS). The Commission used the annual O&M Fee of PhP23,777,319.15 or **US\$482,743.12/yr**.

B. VAT Recovery Level and Recovery Period

The Commission used a VAT recovery level of 100%, consistent with Sections 21 (a) and (d) of RA9513 on the tax and duty free importation and zero-rated Value Added Tax transactions, respectively. The recovery period was patterned from the FIT2 which was at 5 years after the Commercial Operations Date (COD).

III. DEBT & EQUITY ASSUMPTIONS

A. Local-to-Foreign Capital Ratio – 70:30

The Commission used the 70:30 local to foreign ratio based on the average industry accepted ratio. Local upfront and other financing fees of 2% and local commitment fees of 0.5% were also adopted.

B. Interest Rate Local and Foreign – 5.81%

The Commission used the local interest rates based on Average Bank Lending Rates⁴ from 2015 to 2019 of the Bangko Sentral ng Pilipinas (BSP) resulting to a calculated interest rate of 5.81%.

Table 6. Average Bank Lending Rates (2015-2019)

| Year | High | Low |
|-------------|-------------|------------|
|-------------|-------------|------------|

⁴ https://www.bsp.gov.ph/Statistics/Financial%20System%20Accounts/tab19_dir.aspx

| | | |
|----------------|-------------|--------|
| 2015 | 6.8768 | 4.4706 |
| 2016 | 6.6711 | 4.3001 |
| 2017 | 6.4924 | 4.1375 |
| 2018 | 7.1091 | 4.5735 |
| 2019 | 8.0177 | 5.4968 |
| Average | 5.81 | |

C. Repayment and Grace Periods

The repayment period for local and foreign debts, similar to FIT2, which is 10 years from the end of the grace period was set by the Commission. Grace period on the other hand, remained at six (6) months from commercial operations date.

D. Debt-to-Equity Ratio – 70:30

The debt to equity ratio of 70:30, similar to FIT2, considering that it is consistent with the standard gearing of 60%-70% to 40%-30%⁵ set by the Commission for new power plants in its previous rulings. The same policy was applied in previous issuances of the Commission.⁶

E. Equity Internal Rate of Return – 13.67%

The Commission used a 13.67% cost of equity, computed using parameters based on 2018 data and the Capital Asset Pricing Model (CAPM) formula, to wit:

$$r_e = r_f + \text{Beta}_e \times \text{MRP}$$

Where:

- r_e = the nominal cost of equity
- r_f = risk free rate for the Philippines
- Beta_e = the equity beta for benchmark generation company; and
- MRP = the Market Risk Premium (MRP)

Table 7. Equity IRR

| Particulars | Values ⁷ |
|-------------|---------------------|
| r_f | 7.27% |

⁵ Page 17 of Decision docketed under ERC Case No. 2014-153 RD, entitled In the Matter of the Application for the Approval of the Power Supply Agreement (PSA) Between First Bukidnon Electric Cooperative, Inc. (FIBECO) and King Energy Generation, Inc (KEGI)

⁶ Ibid

⁷ ERC Case No. 2019-003 RC (pp 40-42)

| | |
|-----------------------|---------------|
| Beta _e | 1.00 |
| MRP | 6.40% |
| Cost of Equity | 13.67% |

The table below shows the historical cost of equity from 2012 to 2018.

Table 8. Historical Cost of Equity

| Parameters | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|-----------------------|--------|--------|--------|--------|--------|--------|---------------|
| Risk Free, rf | 6.01% | 5.03% | 5.41% | 3.63% | 3.63% | 5.25% | 7.27% |
| Beta | 1.03 | 1.03 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| MRP | 10.13% | 9.40% | 8.30% | 8.60% | 9.23% | 8.40% | 6.40% |
| Cost of Equity | 16.44% | 14.71% | 13.71% | 12.23% | 12.86% | 13.65% | 13.67% |

Thus, based on table above, the Commission used the **13.67% 2018 Equity IRR**.

The resulting WACC based on the above equity IRR is 8.6%, and is reasonable since it is comparable to the 10% WACC⁸ assumed for the Rest of the World in the calculation of the Levelized Cost of Electricity (LCOE) of Wind Power plants as shown in the table below:

Table 9. WACC of RE Technologies

| RE Technology | Economic Life (Years) | WACC | |
|---------------------------------|-----------------------|----------------|-------------------|
| | | OECD and China | Rest of the World |
| Wind Power | 25 | 7.5% | 10% |
| Solar PV | 25 | | |
| Concentrating Solar Plant (CSP) | 25 | | |
| Hydropower | 30 | | |
| Biomass | 20 | | |
| Geothermal | 25 | | |

*OECD - Organisation for Economic Co-operation and Development

IV. TAX ASSUMPTIONS

⁸ IRENA Report, entitled "Renewable Power Generation Costs in 2018" published in January 2019

The Commission used the following tax assumptions based on the provisions of R.A. 9136, R.A. 9513, the Local Government Code, and the National Internal Revenue Code (NIRC):

- Income Tax Holiday – 7 years from COD
- Income Tax rate after ITH – 10%
- Property tax rate – 1.5%
- Property tax valuation/ assessment level – 80%
- Local Business Tax – 1%
- Government Share – 1%
- ER1 -94 contribution – 1 centavo per kWh
- Withholding tax on interest (foreign currency) – 10%
- Gross receipts tax on interest (local currency) – 5%

V. ECONOMIC ASSUMPTIONS

A. Forward Peso Exchange Rate – PhP51.1501:US\$1

In the evaluation of this parameter, the Commission used the average actual exchange rates for the period 2017 to 2021⁹, and the exchange rate forecasts for the period 2022 to 2025¹⁰, as shown below:

Table 10. Philippine Peso per US Dollar Exchange Rates

| Particular | Year | Exchange Rate (PhP) |
|-------------------|-------------|----------------------------|
| Historical | 2017 | 50.4037 |
| | 2018 | 52.6614 |
| | 2019 | 51.7958 |
| | 2020 | 49.6241 |
| | 2021 | 49.2546 |
| Forecast | 2022 | 52.7750 |
| | 2023 | 53.1775 |
| | 2024 | 50.8775 |
| | 2025 | 49.7808 |
| Average | | 51.1501 |

B. Local and Foreign Inflation Rate

The Commission is in the position that no adjustments shall be made to take into account local and foreign inflation rates.

⁹ <https://www.bsp.gov.ph/statistics/external/Table%2012.pdf>

¹⁰ <https://longforecast.com/usd-to-php-today-forecast>

C. Base PhP to US\$ Exchange Rate – PhP49.2546:US\$1

The Commission used the base Peso Exchange Rate of PhP49.2546:US\$¹¹, which is the average Philippine Peso per US Dollar exchange rate for CY 2021.

D. Base Local CPI – 128.75

For consistency, the Commission used the base local CPI of 128.75¹², which is the average CPI for CY 2021.

Solar GEAR Price

In summary, the following assumptions were used in calculating the Solar GEAR Price:

Table 11. Solar GEAR Price Parameters

| PARAMETERS | GEAR PRICE |
|---|--------------------|
| TECHNICAL & EPC ASSUMPTIONS | |
| 1. Installed Capacity | 100.612 MWdc |
| 2. Project Economic Useful Life | 25 years |
| 3. FIT Period | 20 years |
| 4. Construction Period from finance closing | 24 months |
| 5. Net Capacity Factor | 21.33% |
| 6. Equipment Cost, Transportation to project site, Balance of Plant | US\$864.12/kW |
| 7. Switchyard and Transformers | |
| 8. Transmission Interconnection Distance | |
| 9. Transmission Interconnection Cost | |
| 10. Access/ Service Roads Distance | |
| 11. Access/ Service Roads Cost | |
| 12. Other Development Costs | |
| 13. Value-Added Tax on Importation | 12% |
| 14. Initial Working Capital | 0% of EPC |
| 15. Contingency Allowance | 0% of total cost |
| OPERATING ASSUMPTIONS | |
| 16. O&M Cost | US\$482,743.12/yr. |
| 17. O&M + Spares as a % of EPC,T/line, & Sub-stn | 0.56% |

¹¹ <https://www.bsp.gov.ph/statistics/external/Table%2012.pdf>

¹² Philippine Statistics Authority January2021-December 2021 (2012=100)

| | |
|---|-----------------------------------|
| 18. VAT Recovery Level | 100% of VAT |
| 19. VAT Recovery Period | 5 years after COD |
| 20. CER Proceeds | None |
| DEBT & EQUITY ASSUMPTIONS | |
| 21. Local-to-Foreign Capital Ratio | 70:30 |
| 22. Upfront and other Financing Fees | 2% |
| 23. Commitment Fees | 0.50% |
| 24. Interest Rate – Local Debt | 5.81% |
| 25. Interest Rate – Foreign Debt | 5.81% |
| 26. Repayment Period – Local Debt | 10 years from end of Grace Period |
| 27. Repayment Period – Foreign Debt | N/A |
| 28. Grace Period – Local and Foreign Debt | 6 months from COD |
| 29. Debt-to-Equity Ratio | 70:30 |
| 30. WACC – Pre Tax Rate | 8.6% |
| 31. Onshore Equity IRR – Nominal | 13.67% |
| TAX ASSUMPTIONS | |
| 32. Income Tax Holiday (ITH) | 7 yrs. from COD |
| 33. Income Tax Rate after ITH | 10% |
| 34. Property Tax Rate | 1.5% |
| 35. Property Tax Valuation/ Assessment Level | 80% |
| 36. Local Business Tax Rate | 1% |
| 37. Government Share | 1% |
| 38. ER 1-94 Contribution | 1 centavo per kWh |
| 39. Withholding Tax on Interest (Foreign Currency) | 10% |
| 40. Gross Receipts Tax on Interest (local currency) | 5% |
| ECONOMIC ASSUMPTIONS | |
| 41. Forward Peso to US\$ Exchange Rate | Fixed at PhP51.15:US\$1 |
| 42. Local Inflation Rate | N/A |
| 43. Foreign Inflation Rate | N/A |
| 44. Base PhP to US\$ Exchange Rate | PhP49.2546:US\$1 |
| 45. Base Local CPI | 128.75 |

Applying all the foregoing assumptions and parameters, the calculated **Solar GEAR Price is PhP3.6248/kWh and not subject to any adjustment or escalation.**

Price Comparison with PSA

The Commission also compared the Solar GEAR Price to recently approved PSA's with similar technical and other pending cases before the Commission, to wit:

Table 12. Solar PSAs with Approvals

| Plant Name | ERC Case Number | Proposed Rates | Approved Rates | ERC Status | Date of Approval |
|---|-----------------|--------------------------------------|--------------------------------------|----------------------|------------------|
| | | (PhP/kWh) | | | |
| Kirahon Solar Energy Corporation (KSEC) | 2014-020 RC | 9.68 | 8.75 | With Final Authority | 10/22/14 |
| Philippine Solar Energy One, Inc. (nv vogt SE1) | 2014-048 RC | 9.79 | 7.50 | With Final Authority | 10/25/16 |
| Sun-Asia Energy, Inc. (SEI) - Bukidnon | 2016-099 RC | 9.50 | 8.302 | With Final Authority | 12/05/17 |
| Sun-Asia Energy, Inc. (SEI) - Pangasinan | 2016-154 RC | 7.80 | 6.58 | With Final Authority | 12/19/17 |
| Powersource First Bulacan Solar, Inc. (PFBS) | 2017-012 RC | 4.69 subject to 2% annual escalation | 4.69 subject to 2% annual escalation | With Final Authority | 02/28/19 |
| Solar Philippines Tanauan Corporation (SPTC) | 2017-014 RC | 5.39 subject to annual escalation | 5.39 subject to annual escalation | With Final Authority | 05/28/19 |
| Solar Philippines Tarlac Corporation (SPTC) | 2017-094 RC | 2.9999 subject to annual escalation | 2.9999 subject to annual escalation | Interim Relief | 20/02/21 |
| Solar GEAR Price | | 3.6248 | | | |

Solar GEAR Price vis-à-vis FIT2 Rate

In determining the reasonableness of the Solar GEAR Price, the Commission compared the same with the Solar FIT2 Rate and found that the Solar GEAR Price is lower.

Table 13. FIT vs Solar GEAR Price

| RE Tech | Solar FIT 2 | Solar GEAR Price | Difference |
|---------|-------------|------------------|---------------|
| Solar | PhP8.69/kWh | PhP3.6248/kWh | PhP5.0652/kWh |

Global Levelized Cost of Electricity (LCOE)

The Solar GEAR Price is comparable with the typical global Levelized Cost of Electricity (LCOE) for Solar as reported by International Renewable Energy Agency (IRENA), REN21 Renewables Now¹³ (REN21), and ERC's previously Final Approved Power Supply Agreement for Solar, to wit:

REN21

Figure 1. Total installed cost of electricity by technology, 2010 and 2020.

| | Levelised cost of electricity | | |
|---------------|-------------------------------|-------|----------------|
| | (2020 USD/kWh) | | |
| | 2010 | 2020 | Percent change |
| Bioenergy | 0.076 | 0.076 | 0% |
| Geothermal | 0.049 | 0.071 | 45% |
| Hydropower | 0.038 | 0.044 | 18% |
| Solar PV | 0.381 | 0.057 | -85% |
| CSP | 0.340 | 0.108 | -68% |
| Onshore wind | 0.089 | 0.039 | -56% |
| Offshore wind | 0.162 | 0.084 | -48% |

IRENA

Figure 2. Global Levelized Cost of Electricity from newly commissioned utility-scale Renewable Power Generation Technologies, 2010 and 2020

¹³ <https://www.ren21.net/>

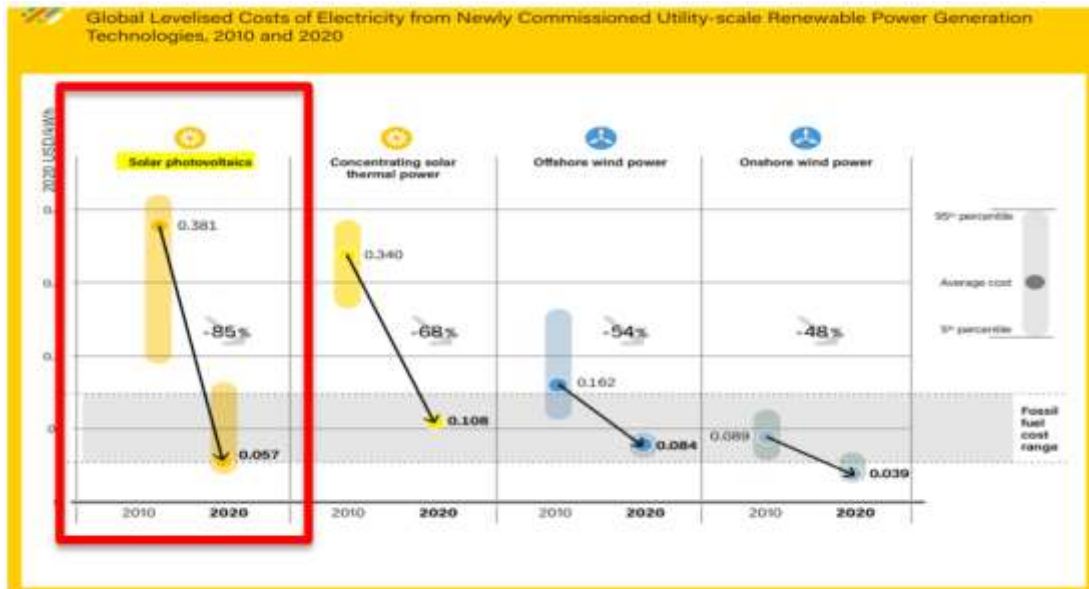


Table 14. Solar GEAR Price vs. Solar Global LCOE

| GEAR PRICE (PhP/kWh) | 2020 Global Solar LCOE (PhP/kWh)* | |
|-------------------------|--------------------------------------|--------|
| | IRENA | REN21 |
| 3.6248 | 2.8075 | 2.8075 |