United Nations ECE/CES/GE.20/2024/19

# Economic and Social Council

Distr.: General
27 March 2024

English only

## Economic Commission for Europe

Conference of European Statisticians

**Group of Experts on National Accounts**

**Twenty-third session**
Geneva, 23-25 April 2024
Item 2 (b) of the provisional agenda
**Towards the 2025 System of National Accounts:**
**Measuring intangible assets and natural capital in 2025 System of National Accounts**

# Valuation of Renewable Energy Resources in Indonesia

**Prepared by BPS-Statistics Indonesia**[1]

*Summary*

Indonesia has many types of energy resources, including non-renewable energy resources and renewable energy resources. BPS-Statistics Indonesia has published asset accounts for mineral and energy resources both in physical and monetary unit annually. However, currently those accounts only covered non-renewable mineral and energy resources. It excluded the renewable energy resources as it was outside of the boundary of mineral and energy resources according to the 2012 SEEA Central Framework. This paper aimed to calculate the monetary value of renewable energy resources in Indonesia. The Net Present Value (NPV) method were applied in estimating the monetary value of renewable energy resources. The main data source for this study was obtained from Electricity Statistics as the renewable energy resources in Indonesia has been mainly utilized for electricity generation.

The results show that the monetary value of Indonesia hydroelectric and geothermal resources in 2022 was Rp113,884 billion and Rp106,986 billion respectively. It constituted only 1 percent of total monetary value of Indonesian energy resources, which also included coal, oil, and natural gas resources. The monetary value of solar energy resources could not be obtained as the resource rent derived from residual value method produced negative value. Meanwhile, this study did not calculate the value of wind energy resources because of insufficient data sources. In conclusion, the monetary value of renewable energy resources in Indonesia was depended on how much economic activities utilized those resources. Furthermore, an in-depth study to the electricity generation establishment was recommended in order to obtain sufficient data, particularly on operating cost, to derive resource rent and to apply NPV method for all types of renewable energy resources.

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# I. Introduction

1. Renewable energy is defined as energy derived from natural sources which has higher rate of replenishment than their rate of extraction.

2. Renewable energy plays an important role in reaching the target of Net Zero Emission (NZE). More than half of greenhouse gas emissions released to the atmosphere in Indonesia were come from the energy sector, which mainly caused by the fuel combustion activities. As the demand of energy would still be expected to increase over time, the strategy toward NZE will be highly depend on the shifting of energy supply from non-renewable energy resources to the non-emitting renewable energy resources.

3. Indonesia is estimated to have huge potential of renewable energy-based power plant, which theoretically could reach 3.6 TW. In 2022, there were many types of renewable energy-based power plant in Indonesia, including hydropower, geothermal energy, solar energy, wind energy, and bioenergy.

4. In accordance with the commitment to reduce greenhouse gas emissions, the Government of Indonesia has set a target for renewable energy mix in the primary energy supply, which is set at 23 percent in 2025. Some policy directions and strategies has been deployed, including the diversification of energy and electricity by increasing new and renewable energy sources, such as geothermal, water, solar, and bioenergy.

# II. Renewable Energy Assets in the Current Accounting Framework

5. The 2008 System of National Accounts (SNA) has classified natural resources as part of the non-produced assets. They have to fulfill two requirements to be considered as economic asset, which are the establishment of ownership right and the capability of bringing economic benefits to the owner. However, in regard to the renewable natural resources, the 2008 SNA only explains about the naturally occurring assets in the form of biota, such as animals and plants. There is no clear explanation on renewable energy even though renewable energy assets could also be regarded as economic assets.

6. The System of Environmental-Economic Accounting (SEEA) describes more specifically about the recording of natural resources in the accounting framework, including energy. Energy is covered not only in the asset accounts as part of environmental assets along with mineral, but also in the flow accounts as an important natural input from the environment to economic activities. Moreover, the United Nations has published a special accounting framework for energy in the form of SEEA for Energy (SEEA-Energy).

7. According to the physical energy flow accounts framework in SEEA-Energy, the flows of energy from natural inputs could be classified into three broad categories:

a. Energy natural resources input;

b. Inputs of energy from renewable sources; and

c. Other natural inputs.

Thus, the contribution of renewable energy to the economic activities is well presented in the physical energy flow accounts.

Table 1
**Energy from Natural Inputs by Type**

| |
|---|
| **Energy natural resources inputs** |
| Mineral and energy resources |
| Oil resources |
| Natural gas resources |
| Coal and peat resources |
| Uranium and other nuclear fuels |
| Natural timber resources |
| **Inputs of energy from renewable sources** |
| Solar |
| Hydro |
| Wind |
| Wave and tidal |
| Geothermal |
| Other electricity and heat |
| **Other natural inputs** |
| Energy inputs to cultivated biomass |

*Source: SEEA-Energy*

8. However, the contribution of renewable energy as economic assets, which could derive economic benefits to the owner, does not have the same visibility as in the energy flow accounts. The energy asset accounts only covered non-renewable energy resources, such as oil resources, natural gas resources, and coal resources.

Table 2
**Classification of Environmental Assets in the SEEA Central Framework**

| | |
|---|---|
| **1** | **Energy natural resources inputs** |
| 1.1 | Oil resources |
| 1.2. | Natural gas resources |
| 1.3. | Coal and peat resources |
| 1.4. | Non-metallic mineral resources (excluding coal and peat resources) |
| 1.5. | Metallic mineral resources |
| **2** | **Land** |
| **3** | **Soil Resources** |
| **4** | **Timber Resources** |
| 4.1. | Cultivated timber resources |
| 4.2. | Natural timber resources |
| **5** | **Aquatic Resources** |

| | |
|---|---|
| 5.1. | Cultivated aquatic resources |
| 5.2. | Natural aquatic resources |
| **6** | **Other Biological Resources (excluding timber resources and aquatic resources)** |
| **7** | **Water Resources** |
| 7.1. | Surface water |
| 7.2. | Groundwater |
| 7.3. | Soil water |

*Source: SEEA Central Framework*

9. Nonetheless, SEEA Central Framework still recognized that renewable energy resources do have value. However, those values are attributed not in the mineral and energy resources class, but in the value of land or in the value of water resources, in case of hydropower.

10. The Government of Indonesia has demanded that renewable energy resources has its own classification in the environmental asset accounts, in which the value of renewable energy resources could be differentiated from the value of land or the value of water resources.

11. Therefore, the methodology to value renewable energy resources needs to be developed and agreed internationally so that the National Statistical Office (NSO) could provide the statistical products related to the value of renewable energy resources based on the internationally agreed standards and accounting framework.

12. This paper aimed to calculate the monetary value of renewable energy resources in Indonesia based on the current availability of the source data, discuss the limitation of the applied methodology, and provide recommendations for future improvements related to the valuation of renewable energy resources.

# III. Scope and Data Sources

13. There are many types of renewable energy and each type has its own functions. This paper only focused on the valuation of renewable energy assets in electricity generation. Therefore, the economic benefits from renewable energy resources which were obtained from the production of other energy products, such as biofuel, was excluded from the scope of this research.

14. Indonesia has a state-owned company which is specialized in electricity supply activities, namely PT Perusahaan Listrik Negara (PLN). However, the electricity generation activities were not only carried out by PLN, but also by Independent Power Producer (IPP) and Private Power Utility (PPU). Nonetheless, both IPP and PPU power plants should sold their electricity to PLN as PLN controls electricity distribution network in Indonesia. Meanwhile, there are also some off grid power plants, which are not integrated with PLN electricity network and usually operates in isolated islands and rural area, but its production only constituted 7.63 percent of total electricity production in 2022.

15. This paper used Electricity Statistics from PLN as the main data source to estimate the monetary value of renewable energy resources in Indonesia. It presents data on the electricity production and operating cost by type of power plant. While the data on electricity production covered five types of renewable energy resources, the operating cost data was limited only for hydroelectric, geothermal, and solar energy.

# IV. Monetary changes in asset value

16. As recommended by the SEEA, which applied the Net Present Value (NPV) method to determine the monetary value of environmental asset in general, the valuation of renewable

energy resources in Indonesia was also carried out by using the NPV approach. This approach would determine the value of renewable energy resources by calculating the sum of discounted value of future income in the future periods.

17. The formula of NPV is as follows:

$$V_t = \sum_{t=1}^{N_t} \frac{RR_{t+\tau}}{(1+r_t)^{\tau}}$$

where

$Vt$ is the value of the resources of period $t$;

$RR$ is the resource rent;

$N$ is the asset life; and

$r$ is the discount rate.

18. Resource rent reflects the gross measure of the return on environmental asset. By considering the availability of the data source, the residual value method was chosen as the method to estimate resource rent.

Resource rent = output

- − intermediate consumption
- − compensation of employees
- − taxes on production
- + subsidies on production
- − specific subsidies on extraction
- + specific taxes on extraction
- − consumption of fixed capital
- − return to produced asset

19. The source data were not able to differentiate the revenue of electricity sales by type of power plant which produced them. Therefore, the value of output for each type of renewable energy power plant was calculated by multiplying the quantity of produced electricity and the highest benchmark price for purchasing electricity. Those prices were regulated in the Presidential Regulation Number 112 of 2022 concerning the Acceleration of Renewable Energy Development for Electricity Supply.

20. The asset life of hydroelectric resources was set to 50 years because the use of lifetime beyond 50 years has small impact on the result of NPV calculation. Meanwhile, the asset life of geothermal and solar energy resources was set to 25 years as the future revenues and costs of such power plants were assumed to be less certain than the hydroelectric power plant.

# V. Results and Discussion

21. The valuation of renewable energy resources in Indonesia only managed to obtain monetary value of hydroelectric and geothermal resources. The monetary value of solar energy resources could not be acquired because the resource rent of solar energy was negative due to high consumption of fixed capital.

22. In 2022, the hydroelectric resources in Indonesia were estimated to have monetary value around IDR 113,884 billion. Meanwhile, the monetary value of geothermal energy resources was IDR 106,986 billion.

23. By considering the monetary value of non-renewable energy resources, comprising of coal, oil, and natural gas; the share of monetary value of Indonesia renewable energy resources in 2022 was only 1.07 percent. The detailed monetary value of each type of energy resources is presented in the Table 3 below.

Table 3
**Classification of Environmental Assets in the SEEA Central Framework**

| No | Type of Energy Asset | Monetary Value (billion IDR) | Share (percent) |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 1 | Coal | 15,178,689 | 73.35 |
| 2 | Natural Gas | 3,019,090 | 14.59 |
| 3 | Crude Oil | 2,275,564 | 10.99 |
| | Sub-Total of Non-Renewable Energy | 20,473,343 | 98.93 |
| 4 | Hydroelectric | 113,884 | 0.55 |
| 5 | Geothermal | 106,986 | 0.52 |
| 6 | Solar Energy | - | - |
| | Sub-Total of Renewable Energy | 220,869 | 1.07 |
| | Total Energy Resources | 20,694,212 | 100.00 |

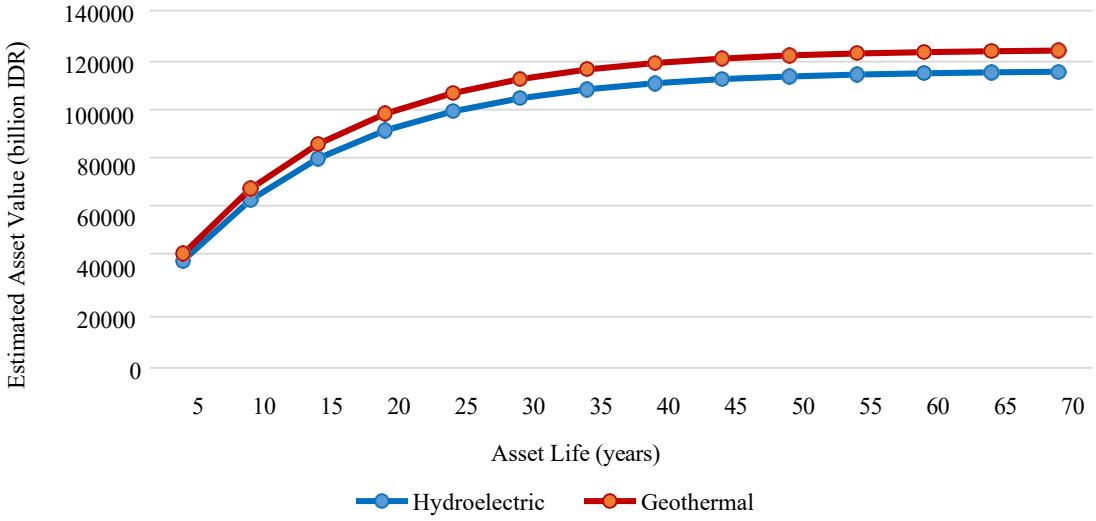
24. However, the monetary value of renewable energy resources in the Table 3 was only limited to the hydroelectric and geothermal energy for electricity generation purposes only. It excluded the direct use of geothermal as well as other types of renewable energy power plant due to the limited data availability. The figure also did not take bioenergy used as fuel into consideration.

# VI. Sensitivity Analysis

25. Sensitivity analysis was conducted to assess the impact of asset life and discount rate to the estimated renewable energy asset values for both hydroelectric and geothermal energy resources. It was not applied to the solar energy resources because the variable of asset life did not affect the value of resource rent, which was already less than zero.

26. The estimates of net present value of renewable energy resources by asset life was as follows:

Figure 1
**Sensitivity Analysis of Asset Life**

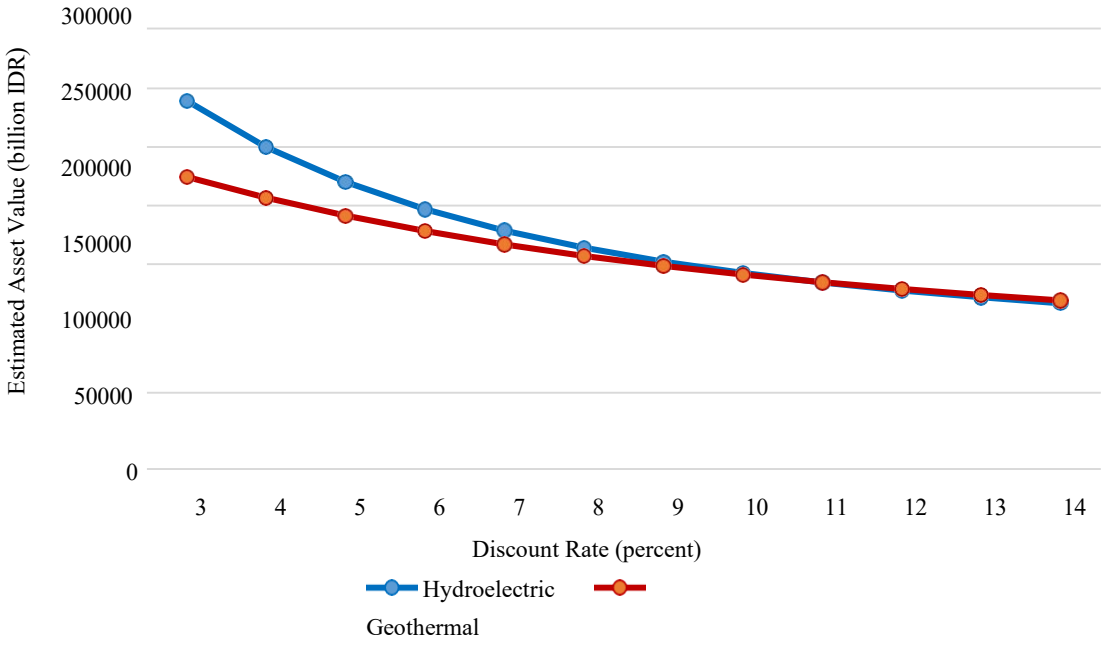



27. From the Figure 1 above, it could be observed that the effect of the use of lifetime beyond 50 years in the NPV calculations was not significant to the estimated asset values. Hence, the decision to set the asset life into some numbers less than 50 years should be made carefully and take many factors into consideration.

28. It is also noted that by applying the same asset life for both hydroelectric and geothermal energy resources, the monetary value of geothermal energy asset would be higher than hydroelectric resources as the geothermal energy asset had higher per unit resource rent.

29. Meanwhile, the choice of discount rate would also influence the estimated monetary value of renewable energy resources as shown in the Figure 2 below.

Figure 2
**Sensitivity Analysis of Discount Rate**



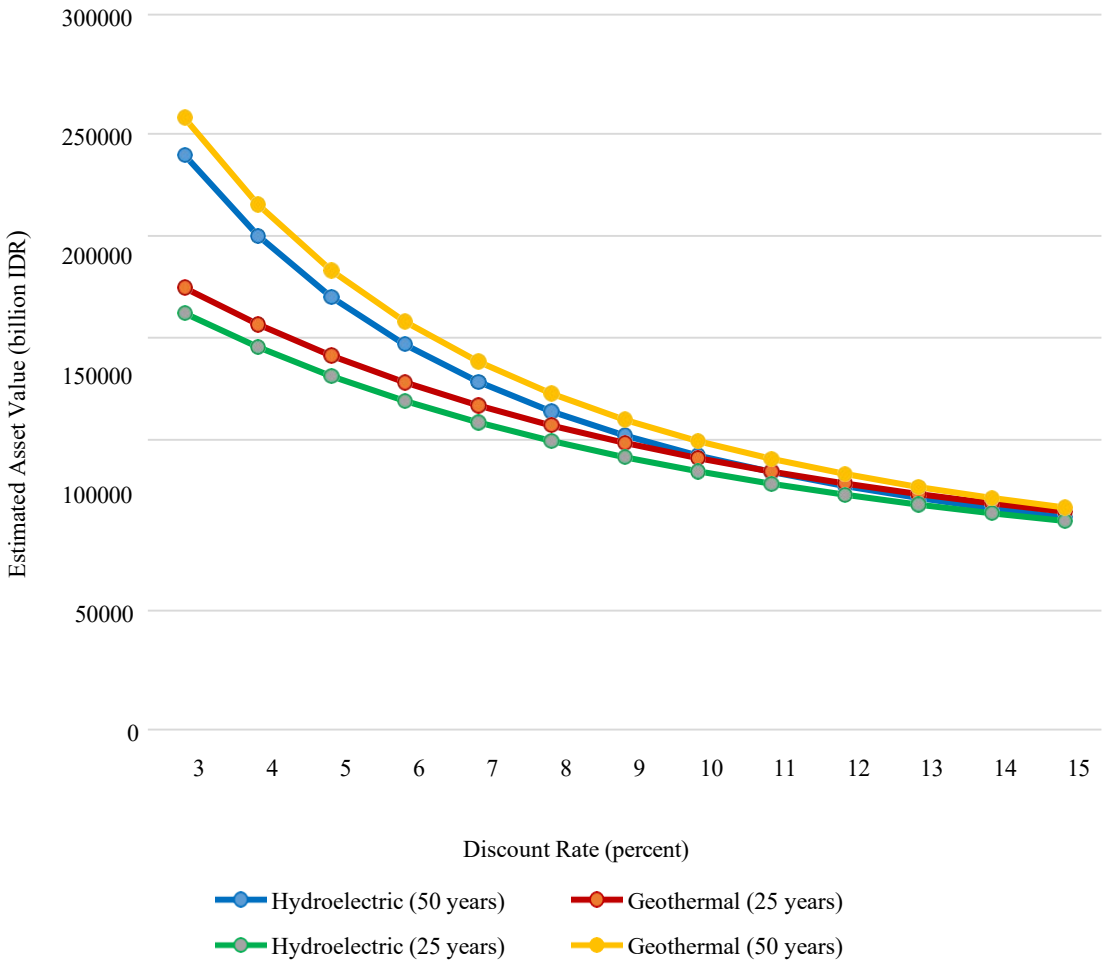

30. This paper chose 8 percent of discount rate, referring to the government bond rate, which used for the valuation of Indonesian mineral and non-renewable energy assets. The result showed that the value of hydroelectric energy resources was higher than the value of geothermal energy resources. However, by applying higher discount rate, the value of

geothermal energy resources might surpass the value of hydroelectric energy resources, which was the case when the discount rate was above 10 percent.

31. The impact of discount rate to the estimated asset value of renewable energy resources was only significant when the choice of asset life was different among the type of renewable energy resources. In the previous figure, the asset life of hydroelectric was 50 years while the lifetime of geothermal energy asset was assumed to be 25 years.

32. By assuming the same asset life for both hydroelectric and geothermal energy resources, the estimated asset value of geothermal energy resources, which had higher resource rent, would still be consistently above the estimated asset value of hydroelectric resources, regardless of the choice of discount rate, as presented in the Figure 3 below.

Figure 3
**Sensitivity Analysis of Asset Life and Discount Rate**




33. Nevertheless, the choice of discount rate still had an impact. The higher discount rate would make the difference between the monetary value of geothermal energy resources and hydroelectric resources smaller.

# VII. Conclusion

34. Even though the potential of renewable energy resources in Indonesia is enormous, the monetary value of renewable energy resources in Indonesia was highly dependent on the installed capacity of renewable energy power plants as well as on the quantity of electricity generation.

35. The high operating cost may also influence the derivation of resource rent from the residual value method. For solar energy resources in Indonesia, the resource rent had negative value due to high consumption of fixed capital.

36. The net present value of renewable energy resources was also impacted by the choice of asset life and discount rate for each type of renewable energy resources.

37. The valuation of renewable energy resources might be better to be carried out by applying bottom-up approach or site-by-site basis. The calculation based on macro data would not be able to take into account the remaining lifespan of renewable energy generation equipment of certain power plant.

38. An in-depth study to the electricity generation establishment was recommended in order to obtain sufficient data, particularly on operating cost, to derive resource rent and to apply NPV method on the valuation of other types of renewable energy resources, such as wind and biomass energy.

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