DISCUSSION PAPER

Methodological Approaches for Compilation of Monetary Asset Accounts of Coal in India

In alignment with the SEEA Central Framework

Government of India

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Disclaimer

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The views and methodological perspectives presented in this paper are exploratory in nature and do not represent the official statistical position of MoSPI, the Government of India, or any other statutory authority.

The paper draws on publicly available information from national and international sources including the National Account Statistics (MoSPI), EnviStats India (MoSPI), Coal Directory of India (Office of the Coal Controller), Geological Survey of India (GSI) and international sources including the System for Environmental Economic Accounting (SEEA), Organisation for Economic Co-operation and Development (OECD), and the World Bank. While care has been taken to ensure accuracy, MoSPI does not warrant the completeness or suitability of the content presented herein for any purpose beyond that stated in this paper.

Feedback, comments, and suggestions from experts, researchers, government agencies, and international organisations are welcomed and may be submitted to the Environment Unit, Social Statistics Division, MoSPI at ssd-mospi@gov.in.

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FOREWORD

The economy and the environment are closely interconnected, with the latter providing essential resources and services that sustain economic activity. Environmental-economic accounts offer an integrated statistical framework to capture both the contribution of the environment to the economy and the impact of economic activities on environmental resources. In this context, India follows the System of Environmental-Economic Accounting (SEEA), endorsed by the United Nations Statistical Commission (UNSC) as an international statistical standard. The SEEA Central Framework (2012) enables a systematic measurement of natural resource extraction, use within the economy, stock levels and stock changes during a specific period, along with related economic activities, in both physical and monetary terms.

Given the non-renewable nature of mineral and energy resources, it is important to systematically account for their extraction, stock levels, and changes in availability over time. In 2023-24, the Mining and Quarrying sector accounted for approximately 1.94% of total GVA in India, with ₹5,32,343 crore of Gross Value Added at basic prices, a 4.24% increase from the previous year. Monetary asset accounts and valuation provide a means to measure the economic value embodied in these resources, thereby enabling a better assessment of their contribution to the economy and supporting informed policy decisions on resource use, depletion, and long-term sustainability.

Coal occupies a unique and strategically important position in India's energy and industrial landscape. As the nation's most abundant domestic energy resource, coal accounts for the majority of India's electricity generation and supports a wide range of core industries. India has achieved record raw coal production of 1047.523 MT, and lignite production of 45.133 MT in 2024-25, in pursuit of energy security and the *Atmanirbhar Bharat* vision. Coal has therefore been used as the illustrative case in this paper, given its strategic importance and need for sustainable management.

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1. Introduction

1.1 Environmental Assets in SEEA CF and the Importance of Mineral Resource Accounting

1. Environmental assets, including mineral and energy resources, land, soil, timber, water, and biological resources, are categories of natural resources specified in the SEEA CF (2012).[1] The SEEA helps to assess the contribution of natural resources to economic growth and well-being, the environmental sustainability of development, and the contribution of economic activities to natural resource use and degradation. Statistics on the level and evolution of stocks of natural resources play a key role in sustainability analyses of economic growth (OECD 2011; Arrow et al. 2004).

2. Mineral and energy resources are of particular significance given their non-renewable character: unlike biological resources, they cannot be regenerated on any human timescale (United Nations et al., 2012). It is therefore important to gather harmonised, systematic data on their rate of extraction, current availability, and monetary value. Accounting for physical stocks of natural resources is a necessary step towards monetary valuation; monetary values, in turn, enable the comparison of heterogeneous assets and the characterisation of the economic benefits these assets provide to society.

1.2 Mineral and Energy Resources: Classification and Scope

3. Five categories of mineral and energy resources are distinguished in the SEEA CF: oil, natural gas, coal and peat resources, other non-metallic mineral resources, and metallic mineral resources. For the purposes of national accounts compilation, the SEEA CF recommends compiling stocks and flows for each commodity, both in physical and monetary units, and distinguishing between three classes of resources: commercially recoverable resources (Class A), potentially commercially recoverable resources (Class B), and non-commercial and other known deposits (Class C). These classes are defined in accordance with the 2009 United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources (UNFC 2009), which India has formally adopted. [2] Consistent with SEEA CF recommendations, the scope of this experimental valuation is limited to the *proved* coal reserves, corresponding to SEEA CF's Class

[1] The seven environmental asset categories in SEEA CF are: mineral and energy resources; land; soil resources; timber resources; aquatic resources; other biological resources (excluding timber and aquatic resources); and water resources.

[2] The UNFC-2009 has been formally selected as the resource classification system of the SEEA CF, adopted as an international standard by the United Nations Statistical Commission. India has adopted UNFC for defining mineral resources and reserves; IBM published the first UNFC-aligned classifications as of 1 April 2000.

A deposits of known mineral and energy deposits under UNFC (2019) categories E1, F1, and G1-3.

4. India produces as many as 95 minerals, including 4 fuel minerals, 10 metallic, 23 non-metallic, 3 atomic, and 55 minor minerals. In 2023-24, the Mining and Quarrying sector accounted for approximately 1.94% of total GVA, with ₹5,32,343 crore of Gross Value Added at basic prices, a 4.24% increase over the previous year (NAS, MoSPI 2025b). There were 1,359 (provisional) reporting mines (excluding fuel, atomic, and minor minerals) in India in 2023-24 (IBM 2024).

1.3 Coal in India

5. Coal is a fossil fuel and a combustible sedimentary organic rock composed primarily of carbon, hydrogen, and oxygen. It is formed from accumulated vegetation that, over millions of years, was buried under layers of sediments and subjected to intense heat and pressure due to tectonic processes. This gradual transformation first converts plant material into peat and subsequently into coal, with its quality determined by the degree of temperature, pressure, and duration of formation, collectively referred to as organic maturity. In the early stages, peat evolves into lignite or brown coal, which is relatively soft and low in carbon content. With continued geological processes, lignite transforms into sub-bituminous coal, and further into harder and more carbon-rich bituminous coal, eventually culminating in anthracite, the highest rank of coal.

6. Coal is classified into two principal categories, namely Hard Coal and Brown Coal, each comprising several subcategories. Hard Coal includes anthracite, bituminous coal, coking coal, and other bituminous coal, while Brown Coal consists of sub-bituminous coal and lignite. In the Indian context, coal (raw) is broadly categorized into two types: coking and non-coking coal, with coking coal accounting for only a limited share of the country's total coal resources. These categories are further subdivided based on specific physical and chemical parameters, in accordance with varying industrial requirements. Apart from raw coal, another type of coal available in India is lignite.

7. Geographically, Indian coal (raw) deposits are primarily concentrated in the Gondwana sediments located in the eastern and central parts of Peninsular India, with additional occurrences in parts of the North Eastern region, including Sikkim, Assam, and Arunachal Pradesh. In contrast, lignite deposits are associated with Tertiary sediments in the southern and western parts of the peninsular shield, particularly in Tamil Nadu, Puducherry, Gujarat, Rajasthan, and Jammu and Kashmir. As of 31 March 2025, there were 192 coal (raw) blocks and 25 lignite blocks in India. Further, in-situ geological resources of raw coal were estimated at 400,715.45 MT, comprising proved resources of 220412 MT (55%), indicated resources of 149048 MT (37%), and inferred resources of 31255 MT (8%). Total lignite resources as on 1 April 2025 were estimated at 47370.54 MT, comprising proved, indicated and inferred resources of 7964.43 MT (17%), 25306.32 MT (53%), 14099.79 MT (30%), respectively. During 2024–25, total production of raw coal (coking and non-coking) in India reached 1047.523 MT, and that of Lignite stood at 45.133 MT. The pit-

head closing stock of raw coal and lignite at the end of 2024–25 were 130.887 MT and 2.58 MT, respectively (Coal Controller's Organisation, 2025).

8. Coal plays a critical role in economic development, being the most widely used energy source for electricity generation and a key input in steel production, along with other industries such as cement, fertilizer, chemicals, and paper also heavily reliant on coal (IBM 2020). As India's energy demand rises rapidly, driven by urban expansion, industrial growth, improved electricity access, and rural electrification, coal remains the most reliable and abundant domestic source of energy. Renewable alternatives including solar, wind, hydropower, and natural gas are expanding steadily; however, coal remains indispensable for stable and affordable power generation across sectors. Therefore, coal (raw coal & lignite), by far the most significant fuel mineral in India's resource endowment, is the focus of this discussion paper.

9. The National Mineral Policy (2019) emphasises sustainable mining practices, making the valuation and environmental accounting of coal resources directly relevant to India's policy framework. Some of the previous efforts at mineral asset accounting in India include the study conducted by The Energy and Resources Institute (TERI 2006) for MoSPI, which prepared physical and monetary asset accounts for coal in selected coal-producing states using the SEEA approach, and Padhan and Das (2022), who compiled national-level asset accounts for bauxite, manganese ore and iron ore using the NPV-RVM methodology.

10. In the present study, conceptual and operational framework have been explored for compiling monetary asset accounts for mineral and energy resources, with coal (raw coal and lignite) as the illustrative case. The National Accounts Statistics (NAS) 2025 (MoSPI) provides data for coal in the aggregated form and does not disaggregate lignite separately. To maintain consistency with the terminology adopted in the National Accounts Statistics (NAS), a key source for valuation and comparison with other monetary indicators, raw coal and lignite have been treated as a single combined asset, referred to as "coal", in the subsequent sections.

1.4 Valuation of Mineral and Energy Resources: Rationale and Approach

11. The primary objective of monetary valuation in the national accounts' context, as stated in the SEEA CF and the 2025 SNA, is to compile market or market-equivalent values, not social values such as consumer surplus or welfare-based measures (UNSTATS n.d.). In the absence of directly observable market prices for in-situ mineral deposits (which are rarely traded), Net Present Value (NPV) method, applied to the expected stream of future resource rents, is the preferred approach (United Nations et al. 2012; United Nations 2025).

12. Resource rent, the economic surplus attributable to the natural resource itself after accounting for all costs of production and normal returns to produced inputs, is the conceptual foundation of this approach.

13. It is suggested that compilers should ideally undertake valuation at the level of individual resource types and, where feasible, specific deposits, before aggregating values upward to the national level (United Nations et al. 2012; OECD 2025). Working at the deposit level allows for heterogeneity in extraction costs to be taken into account, a significant consideration, since deposits with the lowest extraction costs are typically exploited first, implying that current average extraction costs may be a poor predictor of future costs (OECD 2018). Where deposit-level data are unavailable, national-level aggregate approaches using proportionate factor methods, provide a pragmatic starting point.[3]

14. Measuring natural resource asset values is fundamentally dependent on NPV calculations, which require a range of assumptions and projections regarding future extraction rates, prices, costs, and discount rates. Transparency regarding these assumptions and sensitivity analysis of the resulting estimates are therefore considered essential for credible subsoil asset valuation (OECD 2025).

15. International experience with Mineral and Energy Resources valuation under SEEA CF guidelines is growing. Countries including Australia, Canada, Netherlands, United Kingdom, South Africa and Philippines have been compiling the value of mineral and energy resources as the discounted flow of future resource rents for several years. The OECD has maintained a database on stocks and flows of mineral and energy resources covering seven countries and up to fourteen resources, following SEEA guidelines (OECD 2018). The World Bank's Changing Wealth of Nations (CWON) series provides cross-country estimates of natural resource wealth including subsoil assets. In India, MoSPI has published physical asset accounts for coal and other minerals through the EnviStats India series publication, now part of the Energy Statistics India publication. The present paper takes the next step by discussing international methodologies for the monetary valuation of sub-soil assets, and identifying the methodology most relevant and appropriate for the Indian context for potential adoption within India's national statistical framework.

16. The paper is structured as follows: Section 2 elaborates the conceptual framework, introducing the methodological steps of the NPV approach as prescribed by SEEA CF. Section 3 presents a systematic comparison of three methodological frameworks applied to monetary valuation of coal along with a description of potential data sources. This is followed by a discussion on key methodological differences and the preferred methodology for the Indian context.

2. Conceptual Framework and Methodology: SEEA CF Foundations

2.1 The Net Present Value (NPV) Approach

[3] The present paper applies a national-level aggregate approach consistent with the experimental nature of the exercise.

17. Monetary valuation of Mineral and Energy Resources presents considerable methodological challenges. Observable market prices should, in principle, be used; however, markets for in-situ mineral and energy resources are typically underdeveloped or non-existent, and permit-based valuations are feasible only under limited conditions. An alternative indirect approach is the written-down replacement cost method, which measures asset value as the current acquisition cost of an equivalent new asset less accumulated consumption of fixed capital. However, this method does not capture the in-situ nature of the asset and is therefore not preferred for mineral and energy resource valuation. The Net Present Value (NPV) approach, based on the discounted value of expected future resource rents, is accordingly the recommended and most widely adopted methodology for monetary valuation.

18. The underlying economic rationale of the NPV approach is that the cost of purchasing an asset at any stage of its economic life equals the net present value of the expected stream of income arising from its use over the remainder of that life. The value of the stock of a natural resource is thus estimated by discounting the expected stream of future resource rents over the asset's economic life ($\tau = 1, 2, 3, \ldots T$). Formally, the value of the asset at the end of period t (V_t) is:

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

Where, V_t = value of the asset/stock at end of period t; T = asset life; $RR_{t+\tau}$ = real value of expected future resource rents measured in terms of prices of the current period t; r_t = real discount rate in period t.

19. Resource rents are assumed to accrue at the end of each accounting period. Hence, the first period resource rent (RR_{t+1}) is discounted by the factor $1+r_t$. An infinite value of T corresponds to the case of sustainable exploitation of the natural resource. The entire process of building the monetary asset accounts can be deconstructed into few key steps. These include estimation of resource rents, projection of the physical asset account over the expected asset life, computation of unit resource rents with price smoothing, projection of future resource rents, computation of NPV of opening and closing stocks, and derivation of the in-situ price to value all stock changes in the monetary asset account.

2.2 Resource Rents

20. Resource rent refers to the economic surplus attributable to the natural resource itself, after accounting for all costs of production and normal returns to produced inputs. It captures both the *value of depletion* and the *net return accruing to the environmental asset*. Three methods are available under SEEA CF to estimate resource rent: the Appropriation Method (using government revenues such as taxes and royalties), the Access Price Method (using market prices of licences or quotas), and the Residual Value Method (RVM). The first two are strongly shaped by country-

specific institutional arrangements and may not reflect true economic rent. The RVM is thus generally preferred.

21. Under the RVM, resource rents are estimated as the difference between the revenues realized from exploiting the resources and the costs of doing so (World Bank 2024b). As prescribed by SEEA CF, it can be derived from national accounts aggregates of gross operating surplus (pertaining to extraction or harvesting activity) by deducting specific subsidies, adding back specific taxes and deducting the user costs of produced assets (themselves composed of consumption of fixed capital and the return to produced assets), as shown below:

Table 1: Calculation of Resource Rent using the Residual Value Method

Item		Value
Output (sales of extracted environmental assets at basic prices, includes all subsidies on products, excludes taxes on products)		Output
Less: Operating costs		– Operating costs
	Intermediate consumption (input costs of goods and services at purchasers' prices, including taxes on products)	
	Compensation of employees (input costs for labour)	
	Other taxes on production plus other subsidies on production	
Gross Operating Surplus (GOS)		= GOS
Less: Specific subsidies on extraction[4]		– Specific Subsidies
Add: Specific taxes on extraction		+ Specific Taxes
Less: User costs of produced assets		
	Consumption of Fixed Capital (CFC)	– CFC
	Return to Produced Fixed Assets	– (r × K)
= Resource Rent		= RR

[4] Specific taxes and subsidies are those that apply solely to the extracting enterprises and are not generally applicable across the economy. The deduction of specific subsidies from and the addition of specific taxes to the standard national accounts measures of gross operating surplus are such that the resulting measure of resource rent is neutral to these flows, as they are effectively redistributions within the economy and should not influence the estimated return to the underlying environmental asset (United Nations et al., 2012).

Source: Table 5.5, SEEA CF (2012).

22. Resource rent in period t is also expressed as:

$$RR_t = P_{S\,t} \times S_t \quad \dots (2)$$

Where, S_t = quantity of the resource extracted and $P_{S\,t}$ = unit resource rent (resource rent per unit extracted).

2.3 User Cost of Produced Assets

23. The user cost of produced assets, required for the RVM calculation, comprises two components: (i) consumption of fixed capital (CFC), which reflects depreciation; and (ii) the return to produced fixed assets, estimated as the product of the value of produced fixed assets (including mineral exploration and evaluation expenditure) and the rate of return on capital. Capital employed in non-produced assets is generally insignificant or difficult to measure independently and is excluded from the scope.

24. The rate of return on produced assets may be estimated using either an endogenous approach (net operating surplus divided by value of produced assets, not recommended, as it assumes non-produced assets earn no return) or an exogenous approach drawing on an external measure, such as an economy-wide real rate of return based on government bond yields.

2.4 Future Extraction Profile and Asset Life

25. Three assumptions are commonly used for the future extraction trajectory: a constant extraction path (most recent extraction level applied to all future periods); a constant rate of extraction relative to remaining stock; or deposit-specific profiles where technical guidance exists. A constant extraction path is expressed as:

$$S_{t+\tau} = S_t \quad for\ \tau = 1, 2, 3, \dots \quad \dots (3)$$

26. The extraction rate in any period t is defined as:

$$x_t = S_t / X_t \quad \dots (4)$$

Where, X_t is the closing stock of period t. Asset life (T) is the expected time over which an asset can be used in production or the expected time over which extraction from a natural resource can take place. It is derived from the reserve-to-extraction ratio as follows and is also the reciprocal of extraction rate in the same period:

$$T = X_t / S_t \quad \dots (5)$$

2.5 Unit Resource Rent and Price Smoothing

27. The unit resource rent $P_{St} = RR_t / S_t$ serves as a price indicator for the natural resource. Since it may exhibit substantial variability due to unexpected events, it must be estimated over several periods. In the absence of reliable forward-looking price data, SEEA CF recommends using moving averages or regression-based estimates.

2.6 Discount Rate

28. The discount rate converts expected future resource rent flows into a present-period aggregate value.[5] Higher discount rates yield lower asset valuations. Individual discount rates reflect private time preference and investment risk and may be approximated by financing costs such as corporate bond yields. Social discount rates are applied when valuation is undertaken from a societal perspective. It may follow the Ramsey model, incorporating time preference, consumption growth, and the marginal utility of income, or declining discount rate schedules for long-term analyses. Since individuals and firms prefer quicker returns than society, *individual discount rates* are typically higher than *social discount rates*, which incorporate intergenerational perspectives. Real discount rates (nominal rate minus inflation) are applied when future flows are expressed in constant prices, which is the standard practice when reliable long-run price projections are unavailable.

2.7 In-situ Price and Stock Valuation

29. The closing stock value (also the opening stock value of the next period) equals the product of the in-situ unit price and the physical stock:

$$V_t = P_t \times X_t \quad \dots (6)$$

30. Setting inflation to zero (constant price flows), and combining equations (1), (2), and (6) under assumptions of a constant extraction path and constant unit resource rent, the NPV expression simplifies to:

$$V_t = P_t \times X_t = P_{S,\ t+\tau} \times S_t \times \sum_{\tau=1}^{T} \frac{1}{(1+r_t)^{\tau}} \quad \dots (7)$$

31. Equation (7) yields both the stock value V_t and the in-situ unit price P_t. It is essential to note that valuing natural resource stocks using unit resource rents alone is inappropriate: the

[5] Also, discount rates used in the NPV formula can be considered as a rate of return (expected) on non-produced assets. Under perfect competition conditions along with situation wherein assets are identified and measured accurately, it should match the rate of return. For consistency with the general concept of market prices, a market-based discount rate equal to the assumed return on produced assets is generally recommended. The rationale behind being that enterprises should ideally invest provided all assets yield rate of return aligning with the time and risk preference for receiving income.

correct measure is the in-situ price, which incorporates the full discounting structure (OECD, 2025). Further, the above equation also establishes the link between the unit resource rent $P_{s\,t}$ and the corresponding in-situ unit price P_t: the latter reflects the discounted value of former, adjusted by the current extraction rate, S_t/X_t.

2.8 Valuation of Stock Changes and Revaluations

32. All stock changes (including extraction, discoveries, reappraisals, catastrophic losses) are valued using average in-situ prices: $0.5 \times [P_{t-1} + P_t]$.[6] Depletion equals extraction for non-renewable resources. The additional entry, revaluation captures nominal holding gains and losses on environmental assets and is calculated as the increase in value accruing to the owner of the asset as a result of a change in its price over an accounting period:

$$Revaluation = \Delta P_t \times X_t \quad \ldots (8)$$

33. The complete monetary asset account combines opening and closing stock values, additions, reductions, and revaluations, providing a full accounting of changes in the monetary value of the mineral resource stock over the period.

3. Comparison of Methodological Approaches and Potential Data Sources

34. Building on the SEEA CF foundations elaborated in Section 2, this section compares three methodological frameworks: OECD (2025), CWON World Bank (2024), and methodology given by the Mineral Accounts of the Philippines (2022). The selection of these methodologies is guided by the following rationale: the OECD (2025) framework represents the most recent and comprehensive application of the SEEA CF, the Philippines (2024) methodology is selected as a well-documented country practice available on the SEEA website, and the World Bank approach reflects an established international practice, facilitating cross-country comparability. While all three broadly follow the NPV-RVM approach, they differ in their operationalisation across some important dimensions. Table 4 provides a comparative summary of methodological approaches for monetary asset valuation of coal. The section also outlines the data sources that can be used for valuation under these different approaches.

35. Across all methodologies, physical asset accounts for coal form the common foundation for monetary valuation. Table 2 below presents the physical asset accounts for coal in India for the period 2016 (2015-16) to 2024 (2023-24), compiled from EnviStats India 2024: Environment Accounts and Energy Statistics India 2025, MoSPI, aligned with the SEEA CF framework. The data for Coal and Lignite is obtained from the Geological Survey of India. Stocks and flows figures are sum of Coal (Proved) and Lignite (Proved) categories. Sterilisation Loss for Coal =

[6] For a detailed discussion, see SEEA CF (2012), Annex A5.1, paragraph A5.27.

Extraction*3.7 and for Lignite = Extraction*3.46 is applied, consistent with standard coal mining practice in India. Opening stock figures therefore reflect deductions for both extraction and sterilisation losses, and may differ from inventory data in the Coal Directory, which records geological resources without this adjustment (MoSPI, 2024).

Table 2: Physical Asset Account: Coal and Lignite Combined (Proved Category)

Item (Million Tonnes)	2016	2017	2018	2019	2020	2021	2022	2023	2024 (P)
Opening Stock	72,182	75,819	77,510	79,856	83,308	87,723	98,306	1,04,367	1,12,914
Additions to Stock									
Discoveries	6,832	4,971	5,729	7,074	8,038	14,113	9,932	12,931	12,756
Upward Reappraisals	0	0	0	0	0	0	0	0	0
Reclassifications	0	0	0	0	0	0	0	0	0
Total Additions	6,832	4,971	5,729	7,074	8,038	14,113	9,932	12,931	12,756
Reductions from Stock									
Extraction	682	700	722	773	773	753	826	935	1,039
Sterilisation Loss	2,513	2,580	2,661	2,849	2,850	2,777	3,045	3,449	3,835
Downward Reappraisals	0	0	0	0	0	0	0	0	0
Reclassifications	0	0	0	0	0	0	0	0	0
Total Reductions	3,195	3,280	3,383	3,622	3,623	3,530	3,871	4,384	4,874
Closing Stock	75,819	77,510	79,856	83,308	87,723	98,306	1,04,367	1,12,914	1,20,796

36. Physical asset accounts for coal and lignite separately, along with other minerals (fuel) can be sourced from the EnviStats India: Environment Accounts publication (2024), and Energy Statistics publication (2025 onwards) by MoSPI, with supplementary data available from the Coal Directory of India (Office of the Coal Controller) and the Geological Survey of India (GSI).

3.1 Compilation Guide for Monetary Asset Accounts: OECD (2025)

37. OECD (2025) provides the most operationally detailed guidance currently available, building directly on SEEA CF. The NPV formula applied is:

$$V_t = \sum_{\tau=1}^{T} \frac{RR_{t+\tau-1}}{(1+r)^{\tau}} \quad \dots (9)$$

Where, V_t = opening stock value at time t; T = asset life of the natural resource; RR_t = resource rent generated during year t; r = discount rate.

38. Resource rent may be estimated using either a top-down or a bottom-up approach to the Residual Value Method (RVM), as provided in SEEA CF (see section 2). The top-down approach derives resource rent from information readily available in the national accounts, while the bottom-up approach follows the same steps but draws on alternative data sources such as business surveys of industries engaged in the specific activity, deriving GOS or Gross Mixed Income (GMI) specific to the activity in question.

39. The user cost of produced capital is estimated as the product of net stock of fixed assets and the rate of return to fixed capital. For the exogenous rate of return, OECD (2025) discusses four approaches. The *activity-specific rate of return* reflects the actual return an investor obtains from a specific activity; while theoretically preferred, direct measures of this risk premium are rarely available in most countries. The *economy-wide rate of return* is based on the opportunity cost of investing elsewhere in the economy and represents a normal or average return; however, since the net operating surplus of the total economy includes returns to natural resources, the very quantity being estimated, this approach is conceptually unsuitable. The *'Everything but' approach*, suggested by Liu (2023; 2016), addresses this inconsistency by estimating an economy-wide return while excluding natural resource extraction and harvesting activities, making it a more robust and conceptually consistent measure.[7] The *cost-of-financing approach* approximates the rate based on what it would cost to finance such an investment, for example through average borrowing costs; however, this provides only a lower bound and may exhibit volatility, complicating the calculations.

40. OECD (2025) recommends applying the 'Everything but' approach which is considered most appropriate. This method derives the rate of return by dividing the net operating surplus of all economic activities, excluding mining and quarrying (ISIC B), agriculture, forestry and fishing (ISIC A), renewable power generation (ISIC D3512), the central bank (S121), general government (S13), and non-profit institutions serving households (S15), by the net fixed assets of the same scope of activities. As recommended in OECD (2025), the rate of return derived using the 'Everything but' approach should be validated against the rate of return from the respective sector. If the difference between the two estimates is less than 2 percentage points, the 'Everything but' approach may be considered robust and retained as the primary rate of return for resource rent estimation.

41. To build monetary asset accounts of period *t*, OECD (2025) recommends using anywhere between 3-10 years resource rents for smoothing. For example, if we choose three years, resource rents for each of the three years preceding the accounting period (t-3, t-2, t-1) are required. Unit resource rents are then computed for each of these three years by dividing resource rent by physical extraction in each year. Since resource rents are assumed to accrue at the midpoint of the

[7] The economy-wide return and "Everything but" approach resemble the endogenous approach in deriving a rate of return implicitly by dividing the operating surplus by the stock of produced assets, however they are considered exogeneous methods as they use information external to the activity in question.

accounting period, unit resource rents reflect mid-period average price levels. To address price volatility, unit resource rents then have to be smoothed over the past three years after rebasing them to prices of the current accounting period t.[8] The average of these three rebased unit resource rents gives the smoothed unit resource rent $P_{S\,t}$, assumed to remain constant over all future projection periods in the absence of specific policy changes.

42. Future resource rents are projected over the asset life (until projected closing stock becomes 0) by multiplying $P_{S\,t}$ with the expected physical extraction in each future year, assumed to follow a constant extraction path equal to the most recent year's extraction (S_{t-1}). Projected future resource rents are then discounted using a real discount rate. OECD (2025) recommends a rate of 2%, as proposed by the Expert Group on National Capital (EGNC) as a common stable rate; alternatively, countries are allowed to use average yield of government debt securities (real) with a maturity of at least ten years.[9]

43. Since the opening stock is valued as of 1 April (the start of the accounting period) and resource rents are assumed to accrue at the midpoint of the year, the discount factor for the first projection period (τ=1) is halved, yielding a first-period discount factor of (1 + r/2). The NPV of the opening stock of year t is then computed by applying equation (9), yielding an asset value as of 1 April of the current period. The NPV of the closing stock of year t (equivalently, the opening stock of year t+1) is estimated by repeating the full procedure after incorporating new information for period t: updated net OS/MI, net stock of fixed assets, physical asset accounts, and the price deflator. Smoothing for the closing stock uses unit resource rents for years t-2 to t, expressed in mid-(t+1) prices by setting value of price deflator for year t+1 equal to 1.

44. The in-situ unit price of coal in period t is estimated by dividing the NPV of the opening stock by the physical opening stock of year t, and similarly for year t+1. The average in-situ price, the simple average of the in-situ prices in years t and t+1, is used to value all stock changes (extractions, discoveries, reappraisals, and catastrophic losses) during period t, consistent with the assumption of mid-period accrual. Depletion of non-produced natural resources in physical terms is the result of the extraction or harvest of a natural resource beyond economic units occurring at

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[8] This rebasing may be carried out in three steps: (i) price deflators for each of the three preceding years are calculated with reference to the NAS base year; (ii) these deflators are expressed relative to the deflator of the current period t; and (iii) resource rents in current prices of each preceding year are divided by the corresponding rebased deflator to yield unit resource rents in mid-t prices.

[9] Discount rate choices in natural resource valuation vary across two key dimensions: whether the rate is fixed or market-varying over several reference periods, and whether a single rate applies across the entire forecast period or a declining schedule is used. A survey of ten EGNC member countries found that most use real, stable, single discount rates in the range of 3.5–4%, with the United States as an outlier at 7% real, and the United Kingdom as the only country applying a declining rate schedule (3.5% for years 1–30, 3.0% for years 31–75, and 2.5% for years 76–125 years ahead). The rationale for rate selection also differs: several countries anchor their rates to long-term government bond yields, while the UK uses a social rate of time preference (SRTP), both treating the discount rate as risk-free, whereas the United States and some Latin American countries use market-based rates reflecting private sector returns or borrowing costs, thereby incorporating the risks faced by extracting enterprises (OECD 2025).

a level greater than that of regeneration. Therefore, depletion equals extraction for non-renewable resources (United Nations et al. 2012). Revaluation is calculated as the change in the in-situ price multiplied by the average physical stock of the period, capturing the effect of both changes in resource rent and changes in the extraction path to the extent that they alter the asset value.

45. The methodology described above provides the framework for compiling resource rents and full monetary asset accounts for mineral and energy resources, including coal.

3.1.1 Sensitivity Analysis for the Choice of Discount Rate

46. The choice of discount rate has a significant impact on the valuation of natural resource assets under the Net Present Value (NPV) framework. An inverse relationship exists between the NPV and discount rate. A lower discount rates assign greater weight to future rents, yielding higher asset values. The effect becomes more pronounced over longer asset lives. This sensitivity highlights the importance of adopting an appropriate and consistent discount rate. A common, stable real discount rate improves comparability and reduces volatility in estimates. Regardless of the approach adopted, it is recommended that sensitivity analysis be performed and discount rate choices be transparently documented. This strengthens the robustness of estimates and supports clearer policy and valuation decisions.

3.1.2 Potential Data Sources

47. In view of data availability, the top-down RVM drawing on NAS aggregates is considered the most feasible approach for India at present. In absence of mineral-specific disaggregation in NAS, coal-specific estimates may be derived by applying the ratio of coal output to total mining and quarrying output to the corresponding sector-level aggregates. Accordingly, Coal-specific estimates of OS/MI (net) and NFCS can be derived by multiplying mining and quarrying sector aggregates by the ratio of coal output to total mining and quarrying output. The user cost of produced capital can then be estimated as the product of this proportionate NFCS and the rate of return to fixed assets, derived using the ‘Everything but’ approach.

48. The primary data source for implementing the OECD (2025) methodology in the Indian context is the National Accounts Statistics (NAS), MoSPI. Net Operating Surplus/Mixed Income (OS/MI, net of consumption of fixed capital) and Net Fixed Capital Stock (NFCS) for the mining and quarrying sector can be drawn from Statement 1.5 (Output by Economic Activity and Capital Formation by Industry of Use) and Statement 7.4 (Net Fixed Capital Stock by Industry of Use) of NAS. Coal-specific estimates of OS/MI and NFCS may be derived by applying the ratio of coal output, sourced from Statement 8.5 (Outputs and Value Added from Mining and Quarrying) of NAS, to total mining and quarrying output. Price deflators may be constructed from current and constant price coal output data available in the same source.

49. In the Indian context, the application of the ‘Everything but’ approach is constrained by the non-availability of disaggregated data on net operating surplus and net fixed assets for renewable power generation (ISIC D3512), the central bank (S121), and non-profit institutions serving households (S15). Accordingly, the rate of return under the ‘Everything but’ approach may be estimated by dividing the net OS/MI by NFCS of economy-wide totals excluding agriculture, forestry and fishing, mining and quarrying, and public administration and defence, drawing on data from Statement 7.1 and Statement 7.4 of NAS. These estimates may be further refined through suitable approximations and with disaggregated data for the excluded sectors when they become available, enabling a more precise application of the 'Everything But' approach.

3.2 Changing Wealth of Nations (CWON): World Bank (2024)

50. Natural resources generate economic rents precisely because they are not produced, unlike goods and services, where competitive forces expand supply until profits are eliminated, natural resources in fixed supply typically yield returns well above production costs. For non-renewable resources such as fossil fuels and minerals, these rents represent the drawdown of a country's capital stock; when consumed rather than reinvested in other forms of capital to replace what is being used up, they amount to borrowing against future wealth

51. The World Bank's Changing Wealth of Nations (CWON) framework values non-renewable resources viable under prevailing technical and economic conditions, consistent with the Class A scope recommended by SEEA CF. The CWON database directly provides coal rent estimates as a percentage of GDP, computed as the difference between the commodity price and average production cost, multiplied by physical extraction quantities. The methodology underlying these estimates is described below.

52. More formally, the NPV-RVM used to estimate rent for non-renewable resource[10] i in country and year t is:

$$V_t = \sum_{i=t}^{t+T-1} \frac{RR_t}{(1+r)^{i-t}} \quad \dots (10)^{11}$$

Where, R_t is the current year rent; r is the discount rate; and T is the asset life.

The present value of rents is estimated under the assumption that rents remain constant across all future periods at their current-year level. Coal production is standardized based on heat content and is broken down into two general categories: hard coal and brown coal, which are aggregated into a single coal type for the final calculation.

[10] Oil, natural gas, coal, bauxite, cobalt, copper, gold, iron ore, lead, lithium, molybdenum, nickel, phosphate rock, silver, tin, zinc.

[11] In the CWON (2024) technical documentation, the current year rent is denoted as R_t in in the Equations 10 & 12 and as RR_t in the RVM formula, Equation 11. For consistency, RR_t has been used in place of R_t in the present paper.

$$RR_t = TR_t - O\&M_t - (rK_t + \partial_t) \ldots (11)$$[12]

Where, RR_t = residual value estimate of resource rent; TR_t = total revenue from sales of non-renewable asset, less any subsidies on production received plus any taxes on production paid; $O\&M_t$ = cost for labour, materials, fuel and other supplies to operate and maintain the produced assets used in extraction of the natural resource; r = economy-wide average annual rate of return to produced capital in the country (a constant); K_t = total value of produced capital used in extraction; ∂_t = annual rate of depreciation of the produced capital used.

CWON (2024) estimates resource rents bottom-up at the mine level using price and cost data from the Wood Mackenzie Global Economic Model (GEM), in contrast to the top-down national accounts approach adopted by OECD (2025). Resource rent in period t is defined as:

$$R_t = \pi_t \times q_t \ldots (12)$$[11]

Where, π_t denotes unit resource rent and q_t denotes the quantity of resource extracted. Unit resource rent equals unit revenue less unit production costs, where unit costs comprise operational expenditure (opex) and user costs of produced assets. User costs include consumption of fixed capital (depreciation) and a normal rate of return on fixed capital. Resource rents are converted into constant US dollars using country-specific GDP deflators.

53. The user cost of produced capital is estimated as capital stock multiplied by the sum of the economy-wide rate of return and the depreciation rate. Capital stock is derived from mine-level capital expenditure data, disaggregated across thermal, metallurgical, and brown coal, and updated annually by adding capital expenditure and subtracting depreciation, with a depreciation rate of 8.5% applied for non-high-income countries including India.[13] The economy-wide rate of return is estimated using a gap-filled hierarchy, drawing in order of availability on the long-run government bond rate, the real interest rate, and the IRR from Penn World Tables (PWT 10.01).

54. While production subsidies received by extracting enterprises should ideally be excluded from resource rent estimation, CWON (2024) includes them given the practical difficulty of obtaining reliable subsidy data. This leads to higher CWON resource rent estimates than SEEA CF-consistent estimates wherever production subsidies are present.

55. Previous editions of CWON smoothed resource rents using a lagged five-year moving average to address price volatility; however, given uneven application across asset types, this

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[12] Further, in the full technical version of CWON (2024), resource rent is specified as $RR^{nrk}_{t,i}$ denoting the residual value estimate of resource rent for non-renewable resource i in year t. This has been simplified in the present paper, given that the discussion is focussed on to a single non-renewable resource - coal.

[13] Internal gaps in user-costs series are filled with interpolation and extrapolation rules as for the coal production costs. This is followed by estimation of regional and global average user-costs. For countries without user-cost data for any type of coal, the user-costs are gap-filled first with regional averages and then global averages if no regional data is available.

practice has been discontinued from CWON 2024 onwards, resulting in greater year-to-year variability in rent estimates.

56. Unit prices for thermal coal are benchmarked to average export prices from Australia, Colombia, and South Africa (FOB basis), standardised in USD per kcal, sourced from the World Bank's Global Economic Monitor (GEM) Commodities database. Metallurgical coal prices are benchmarked to Australian coking coal export prices sourced from IEA Coal Information reports and the Australian Government's quarterly reports. Prices for both coal types are standardised per kcal using IEA conversion factors.

57. Production cost estimates draw primarily on the Wood Mackenzie GEM database. For countries not covered, including India, costs are sourced from academic studies and industry reports (Bhattacharya, 1995 for 1988; Greenpeace, 2014 for 2013) and gaps are filled using regional and then global averages. For years prior to 1993, costs are extrapolated using the World Bank's Manufactures Unit Value (MUV) index. For thermal coal, average unit costs from Australian (1993–2014) and Indonesian (2000–2014) mines in the Wood Mackenzie database are used as a nominal index to extrapolate cost trends for other countries and years; while for metallurgical coal, nominal unit cost trends for Australian coal over the same period serve as the reference index for other countries.

58. Country-level estimates of unit production costs and prices are used to calculate average rental rates by region for thermal and metallurgical (coking) coal. Average rental rates are weighted by production. Where unit costs exceed unit prices, zero rents are assumed.[14]

59. Time to depletion of coal reserves is calculated as the ratio of reserves to production. Proved reserves data are sourced from the US EIA International Energy Statistics, BGR (2020), and the Energy Institute/BP Statistical Review of World Energy. For countries without reserve data, time to depletion is estimated as the simple unweighted average of the reserve-to-production ratio for other countries in the region, an unweighted average is used to avoid the dominance of major producers such as China in the East Asian regional average. Time to depletion is no longer capped at 25 years from CWON 2024 onwards. Gaps in the reserves series for a country that has reserves data at any other point in time, are filled forwards by deducting production, and gap-filled backwards by adding production.

60. Table 3 below summarises all data sources used in the CWON (2024) methodology for coal valuation.

Table 3: Data Sources, CWON World Bank (2024) Methodology for Coal

[14] More details on data sources can be found in CWON World Bank (2024).

Variable	Primary Data Sources
Coal production	IEA World Energy Statistics; US EIA International Energy Statistics; UN Monthly Bulletin of Statistics; Energy Institute/BP Statistical Review of World Energy
Unit price of coal	World Bank GEM Commodities database; Government of Australia, Office of the Chief Economist, Department of Industry, Innovation and Science, "Resources and Energy Quarterly"; IEA, Coal Information (Paris, OECD: various years)
Unit production costs	Wood Mackenzie Global Economic Model (GEM) database; Case studies from various sources; World Bank MUV Index, Global Economic Monitor Commodities database (Bhattacharya, 1995 for 1988; Greenpeace, 2014 for 2013 - India)
User costs of produced assets	Estimated from Wood Mackenzie GEM database; World Bank Global Economic Monitor Commodities database
Proved reserves	US EIA International Energy Statistics; BGR (2020); Energy Institute/BP Statistical Review of World Energy

Source: Compiled by authors based on World Bank CWON (2024) technical documentation.

3.2.2 Potential Data Sources

61. Absolute coal rent values in Indian rupees may be computed by applying CWON coal rent estimates, published as a percentage of GDP, to GDP at current prices sourced from Table AEQEAFY2605QTR, Annual Estimates of GDP at Current Prices, 2011-12 series, MoSPI.

3.3 Methodology based on Mineral Accounts of the Philippines (2022)

62. Valuation based on the Philippines Technical Report also applies the NPV-RVM approach based on SEEA CF, covering Class A reserves. Resource Value is given by the following NPV equation:

$$Resource\ Value = \sum_{i=1}^{t} \frac{RR_i}{(1 + r)^t} \ldots (13)$$

Where, r is the discount rate and t is the asset life.

63. Resource rents are estimated using the same method as in SEEA CF (2012) and OECD (2025) but with some distinctive features; the return to produced assets is instead estimated as follows:

$$Return\ to\ Produced\ Assets\ =\ Raio_{BVFA}\ \times\ Gross\ Output\ \times\ Treasury\ Bill\ Rate \quad \ldots (14)$$

Where, $Ratio_{BVFA}$ is the ratio of book value of fixed assets to total revenue. Further, an additional term $Ratio_{IE} \times Gross\ Output$ is subtracted in the resource rent calculation:

$$Resource\ Rent\ =\ NOS\ -\ Return\ to\ Produced\ Assets -\ (Ratio_{IE}\ \times\ Gross\ Output) \quad \ldots (15)$$

Where, $Ratio_{IE}$ is the ratio of interest expense to total revenue.

64. Asset life is directly estimated as the ratio of closing stock and extractions. The extraction estimates are based on annual production data reported by mining companies to the Mines and Geosciences Bureau. Two discount rates are used by Philippines: The Treasury bill rate (market-based) from the Bangko Sentral ng Pilipinas and a 10% social discount rate prescribed by the National Economic and Development Authority (NEDA), enabling comparison between private and social asset valuations. The monetary asset accounts are then directly obtained by multiplying the entries in the physical asset account with the unit resource value, given as follows:

$$Unit\ resource\ value\ =\ \frac{Resource\ value}{Closing\ stock} \ldots (16)$$

3.3.2 Potential Data Sources

65. The same data sources may be used for resource rent estimation as those employed under the OECD (2025) methodology specified in Section 3.1. Data on interest expenses and total revenue for the mining and quarrying sector are not available in the public domain and can be separately sourced from the National Accounts Division (NAD), MoSPI. The book value of fixed assets may be estimated by the Net Fixed Capital Stock (NFCS) series. As done previously, coal-specific estimates can be derived by applying the ratio of coal output to total mining and quarrying output. Asset life may be calculated as the ratio of the closing stock to the extraction values from the Physical Asset Accounts provided by the EnviStats India: Environment Accounts publication (2024), Energy Statistics India publication (2025 onwards) by MoSPI. The 364-day Treasury Bill (Primary) yields can be taken from Table 4.13, Economic Indicators, Reserve Bank of India (RBI).

3.4 Discussion

66. The methodological approaches compared in this study (OECD (2025), CWON (World Bank, 2024), and the Philippines-based methodology (2022) along with SEEA CF recommendations, differ across several dimensions that collectively drive divergence in estimated coal asset values. In terms of NPV structure, SEEA CF uses a closing stock convention, OECD (2025) adopts opening stock with mid-period accrual and a halved first-period discount factor, while the CWON (2024) approach leaves the first period's rent undiscounted, making each

sensitive to rent timing in different ways. All four apply variants of the Residual Value Method to estimate resource rent, but differ in operationalisation: OECD (2025) and the Philippines-based methodology use top-down national accounts aggregates, while CWON uses mine-level data, drawing on unit-level price and cost data. The rate of return, the most consequential assumption, is derived most rigorously under OECD (2025) through the 'Everything but' approach; CWON applies an economy-wide hierarchy of bond yields and real interest rates; and the Philippines-based methodology uses the Treasury Bill rates. Only OECD (2025) applies a smoothing procedure, averaging unit rents over a three-year rolling window and rebasing to constant current-period prices, while the other two methodologies use current-period rents directly, giving rise to greater year-to-year variability. Further, CWON (World Bank, 2024) relies on an entirely different set of data sources, both for reserve estimates and for resource rent calculation. Consequently, the substantial differences in resource rents across these approaches may stem not only from differences in methodological choices but also from differences in the underlying data across all stages of estimation.

Table 4: Comparative Summary of Methodological Approaches for Monetary Asset Account of Coal

Dimension	SEEA CF 2012	OECD 2025	CWON WB 2024	Mineral Accounts of Philippines (2022)
NPV Formula	$V_t = \sum_{\tau=1}^{T} \frac{RR_{t+\tau}}{(1 + r_t)^{\tau}}$ Closing stock value; rents accrue at end of period	$V_t = \sum_{\tau=1}^{T} \frac{RR_{t+\tau-1}}{(1 + r)^{\tau}}$ Opening stock value; Mid-period accrual; first-period discount factor halved	$V_t = \sum_{\tau=0}^{T-1} \frac{RR_t}{(1 + r)^{\tau}}$ Opening/ Closing stock; First rent undiscounted; subsequent periods discounted	$Resource\ Value = \sum_{i=1}^{t} \frac{RR_i}{(1 + r)^{t}}$ Current period rent directly discounted
Resource Rent Method	• Appropriation method; • Access Price method; • RVM (preferred)	Top-down RVM using national accounts aggregates (NAS)	RVM; unit prices & costs from Wood Mackenzie GEM, etc.	RVM using data from input-output tables and books of accounts

Rate of Return	• Endogenous (NOS/ Value of produced assets, not recommended); • Exogenous: economy-wide or sector-specific	• Activity-specific rate of return, • Economy-wide rate of return, • 'Everything but' approach (preferred), • Rate based on cost of financing	Economy-wide: hierarchy of long-run govt bond, real interest rate, IRR (from PWT)	Treasury bill rates from the Bangko Sentral
Future resource rent flow & Price Smoothing	Smoothed unit resource rent × extraction; Moving average or regression may be used for smoothing	Smoothed unit resource rent × extraction; Smoothed by averaging unit RR over past 3 years; rebased to constant prices (current year prices)	Unsmoothed; RRs converted into constant US dollars using country-specific GDP deflators	Unsmoothed, Current period RR directly used
Discount Rate	Individual or social discount rate	2% real rate by EGNC; countries may decide their own rates	4% real rate	Treasury bill rates from the Bangko Sentral ng Pilipinas and 10% social discount rate from the National Economic and Development Authority
Sensitivity Analysis for the Choice of Discount Rate	-	Recommended	Not done	Done
Output	Monetary asset account	Monetary asset account	Resource rent as % of GDP	Monetary asset account

<table>
<tr><td rowspan="3">Data Requirements (Annual)</td><td rowspan="3">-</td><td colspan="3">Physical asset accounts (at disaggregate level): Opening/ Closing stock; Discoveries; Upward reappraisals; Reclassifications; Extraction (physical output); Catastrophic losses; Downward reappraisals; Reclassifications</td></tr>
<tr><td colspan="3">Economic variables and others</td></tr>
<tr><td>• Gross operating surplus (GOS)
• Specific subsidies & taxes on products and production
• Value of fixed assets (including mineral exploration)
• CFC (depreciation)
• Rate of return to fixed capital
• Price deflators / current and constant price output
• Discount rate</td><td>• Total revenue from sales of non-renewable asset,
• Subsidies & taxes on production
• Cost for labour, materials, fuel and other supplies for operation & maintenance of produced assets used in extraction
• Economy-wide average annual rate of return to produced capital in the country
• Total value of produced capital used in extraction
• Annual rate of depreciation of the</td><td>• Compensation of employees, CFC, taxes less subsidies, gross output by sub-industry from the Input-Output Table (for computation of OS at annual level)
• Book value of fixed assets
• Total revenue
• Interest expense
• Treasury bill rate
• Discount rate</td></tr>
</table>

			produced capital used • Discount rate	

Sources: Compiled by authors.

67. The methodological frameworks discussed in this paper are subject to certain limitations that should be considered when interpreting and implementing them. The CWON methodology presents several limitations in the Indian context. It provides resource rent estimates primarily as a percentage share of GDP, with limited granularity for detailed valuation exercises. It relies largely on international and non-publicly accessible databases, with limited use of official estimates provided by Government of India. Price and production cost estimates are derived through extrapolation and interpolation techniques, including reliance on data from other countries such as Australia and findings from selected studies, to address data gaps. Further, subsidies paid to natural resource extraction companies are not deducted from resource rent, which may result in overestimation. Additionally, mine-level estimation using the NPV-resource rent method is difficult at present with current data availability of official estimates.

68. The Philippines methodology relies on the Input-Output Table data; however, in the Indian context, detailed books of accounts are maintained largely by registered companies, while a significant informal sector remains outside such reporting systems, likely resulting in underestimation of key variables. Additionally, Input-Output Tables do not contain all variables required for resource rent estimation; accordingly, supplementary data from NAS are required. The methodology also uses Treasury Bill rates as a proxy for the rate of return on produced assets. Since Treasury Bills represent a risk-free return, they may not adequately capture the risk premium associated with mining activities and may therefore not fully reflect the true return on produced assets in this context.

69. Further, in the Indian context, data availability is largely dependent on company financial statements. While registered companies maintain accounts in accordance with prescribed standards, a significant informal sector remains outside this reporting framework. As a result, key variables derived from such data sources are likely to be underestimated. In contrast, methodologies such as OECD (2025) rely on output-based approaches drawing on a wider range of data sources, which may provide more comprehensive estimates.

70. The OECD methodology offers several advantages over alternative valuation approaches. First, it relies primarily on data that are readily available from the National Accounts, thereby ensuring consistency with the National Accounts Statistics (NAS) framework. Second, the methodology incorporates price-smoothing techniques, which help mitigate the effects of price volatility. This represents a significant improvement over other methodologies that rely on prices from a single reference year and are therefore more susceptible to short-term price fluctuations.

71. In addition, the OECD framework recommends conducting sensitivity analyses to account for variations in discount rates across countries and to assess the robustness of valuation estimates under alternative assumptions.

72. With regard to the estimation of the rate of return, the ‘Everything but’ approach appears to be the most suitable option in the Indian context, particularly in view of data availability constraints. Alternative approaches, such as the use of government bond yields, may not adequately represent the risk associated with the rate of return. Similarly, economy-wide rates of return incorporate returns attributable to natural assets and may therefore lead to circularity in the valuation process. Sector-specific rates of return are also not readily available in India, as the Reserve Bank of India (RBI) publishes rates of return primarily at the occupational rather than industry level. Consequently, the "everything-but" approach provides a more consistent and practical basis for estimating the rate of return for natural asset valuation.

73. A further methodological consideration specific to the Indian context concerns the treatment of sterilisation losses in the estimation of the future extraction profile and asset life. Since sterilisation losses occur systematically with each unit of coal extraction and reliable official estimates of the sterilisation-loss ratio are available in India, it is recommended that these losses be incorporated into the asset life projection. Accordingly, sterilisation loss may be similarly projected as extraction, assuming a constant path based on the most recent year's value.

74. On the choice of discount rate, while EGNC, OECD recommends a stable real rate of 2% and CWON (2024) applies 4%, the appropriate rate for India must reflect domestic conditions and policy objectives. In this regard, the Expert Group on Environment Accounts, MoSPI, has recommended the use of discount rates of 6%, 8%, and 10% for the analysis, balancing coal's near-term energy significance, and the need for its sustainable use.

4. Conclusion

75. This paper presents a detailed exposition of the conceptual framework for monetary valuation of non-renewable mineral and energy resources as prescribed in the SEEA CF, alongside a systematic review and comparison of alternative methodologies, including OECD (2025), CWON World Bank (2024), and the Philippines-based methodology (2022). Using coal as an illustrative example, the paper identifies the most appropriate approach for adoption within India's national statistical system and welcomes comments and feedback on the methodology and findings presented herein. While all three broadly follow the NPV-RVM approach, they differ in operationalisation across key dimensions including rate of return derivation, smoothing of resource rents, discount rate, and underlying data sources. Of the three, the OECD (2025) framework is considered most appropriate for the Indian context, given its conceptual rigour, direct grounding in SEEA CF, and feasibility within India's existing data infrastructure. Based on the

recommendations of the Expert Group on Environment Accounts, MoSPI, discount rates of 6%, 8%, and 10% are recommended, balancing India's near-term coal energy requirements, and the imperative of sustainable resource use. This exercise has also helped identify data requirements, potential data sources, and gaps for implementing mineral asset valuation in India, specifically coal. Addressing these gaps, particularly mineral-specific disaggregation within NAS, sector-specific rates of return, and availability of data as required by physical asset accounts, will facilitate appropriate resource valuation.

76. Accurate, transparent monetary valuation of India's coal assets as well as other mineral resources reflecting both their true economic contribution and the irreversible cost of their depletion, is not merely a statistical exercise but a foundational input for evidence-based policymaking and intergenerational sustainability assessment. This discussion paper is issued as an open invitation for expert comments, and the responses received will directly inform the finalisation of a standardised methodology for valuing non-renewable resources specifically mineral resources within India's national accounts framework. This would place India at the forefront of natural capital accounting among emerging economies. Further, it will ensure that today's resource decisions and policies for economic growth are made with full awareness of their consequences for national wealth and the welfare of future generations.

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