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DRAFT OUTCOMES PAPER:

DEPLETION OF RENEWABLE NATURAL RESOURCES & RECORDING CHANGES TO THE STOCK OF NATURAL RESOURCES

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Executive summary

1. The Australian Bureau of Statistics (ABS) presented an issues paper at the London Group meeting in Johannesburg, March 2007[1], setting out preferred responses to options for identifying the income element of resource rent. The recommendation, specifically relating to non-renewable environmental assets used in production, was that part of resource rent should be considered as income and the remainder considered depletion. This recommendation was subsequently accepted by the London Group and UNCEEA.

2. The question then arose as to whether the recommended treatment of resource rent from use of non-renewables is equally applicable to the treatment of resource rent from renewables. Measuring depletion of renewable environmental resources used in production presents a unique problem. Renewable resources are, by definition, able to sustain or increase their abundance through natural growth in excess of natural mortality. What then, is depletion of such resources and how should the value of such depletion be measured? A broader question also arises. If depletion of natural resources reduces income, should additions to natural resources be considered as additions to income?

3. These issues were explored when the ABS presented an issues paper at the London Group meeting in Rome, December 2007[2], on the treatment of depletion of renewable environmental resources. In summary, this paper recommended that when accounting for depletion and natural growth of renewable environmental resources used in production in SEEA accounts, the SNA production boundary be expanded to include natural growth as part of output, while depletion be included as a charge against income, in the same way as for consumption of fixed capital in SNA accounts. The paper further suggested a method for decomposing resource rent from renewable resources into a measure of depletion and a measure of return to the natural resource.

[1] Comisari, P. (2007) *Issues Paper: Depletion in the SEEA—Narrowing Down the Options*.
[2] Bain, D. (2007) *Issues Paper: Depletion of Renewable Environmental Resources*

4. These changes have the effect of creating 'net depletion adjusted' balances in the Production, Generation of income, Allocation of primary income, Secondary distribution of income, and Use of disposable income accounts, using the SNA sequence of accounts as a template. The balance item in the Capital account 'net lending' is unaffected by these changes. The Balance sheets will reflect any excess of depletion over natural growth, or vice versa. The December 2007 meeting of London Group unanimously supported these recommendations. Appendices 1 and 2 provide the background to these decisions.

5. The proposed methodology facilitates accounting for sustainability of use of natural resources in production by providing adjusted income measures that can be compared with similar balances in conventional economic accounts. As such, it supports SEEA's aim of accounting for the use of environmental resources in production. It must be noted though, that the proposed methodology is not a sustainability measure for ultimately determining 'sustainable' or 'unsustainable' use of a renewable natural resource. Any substantial assessment of sustainability of production would need to utilise appropriate bio-economic models.

Recording changes to the stock of natural resources

6. In order to explicitly address the third set of treatment options (recording the additions to and subtractions from the stock of environmental assets) in Chapter 10 of SEEA, the ABS presented an additional paper[3] to the December 2007 London Group meeting. Consistent with earlier ABS work on the SEEA update, it distinguished between renewable and non-renewable resources, and recommended that new discoveries and reappraisals of mineral and energy resources appear as other changes in the volume of assets account, while net natural growth of renewable natural resources is treated as produced output. The December 2007 meeting of London Group unanimously supported these recommendations. Appendix 3 provides further background to these decisions.

Objectives of UNCEEA

7. The treatment of depletion of natural resources must be a key element of a system of integrated environmental and economic accounting such as SEEA. The elevation of SEEA to the status of international statistical standard requires clear, practical and widely accepted recommendations on accounting for depletion of natural resources. Decisions taken by the most recent meeting of the London Group are consistent with the stated objectives of UNCEEA, particularly the mainstreaming of environmental-economic accounting and related statistics, the elevation of SEEA to an international statistical standard, and the promotion of SEEA's implementation at the global level.

8. The December 2007 meeting of the London Group reached a unanimous position on the preferred treatment of accounting for depletion of and additions to renewable environmental resources. This outcome in turn paved the way for unanimous support of the ABS recommendation on recording changes to the stock of natural resources. However, as there has been further discussion on these issues by London Group members, endorsement is not sought at this time. Instead, these outcomes are presented for the information of UNCEEA.

[3] Comisari, P, Cadogan-Cowper, A. (2007) *Issues Paper: Recording changes to the stock of natural resources*

APPENDIX 1. BACKGROUND TO THE DECISION: HOW SHOULD DEPLETION OF RENEWABLE NATURAL RESOURCES BE MEASURED?

1. Chapter 10 of SEEA, 'Making environmental adjustments to the flow accounts' presents sets of treatment options for recording depletion-related transactions in a set of environmentally adjusted national accounts. The treatment options for identifying the income element of resource rent (SEEA Box 10.1) are:

Option A1. All resource rent represents income.

Option A2. No resource rent represents income; it is all a decline in the value of the resource.

Option A3. Part of the resource rent represents a decline on the value of the asset and part is income

2. The ABS presented an issues paper at the London Group meeting in Johannesburg, March 2007, setting out preferred responses to this set of options. The recommendation put forward for 'Identifying the income element of resource rent' was that part of resource rent should be considered as income and the remainder considered depletion (Option A3). While this recommendation was subsequently accepted by the London Group and UNCEEA, the issues paper specifically addressed the treatment of non-renewable environmental assets. The question then arose whether the recommended treatment of resource rent from use of non-renewables, Option A3, is equally applicable to the treatment of renewable environmental assets.

3. A broader question arose from the London Group endorsement of Option A3. If depletion of natural resources reduces income, should additions to natural resources be considered as additions to income?

4. This current paper again addresses Option A3 to explore the question of whether the treatment of depletion for renewable environmental resources used in production is consistent with the recommended treatment for valuing depletion of non-renewable environmental resources used in production. Defining depletion of renewable resources is central to answering the question. Valuing such depletion is also important in providing an answer. A method for valuing depletion of renewable environmental resources that provides a consistent link between the System of National Accounts 1993 (SNA) and SEEA is proposed.

5. The scope of this paper is renewable economic environmental resources used in production, though the proposed treatment of depletion is also applicable to non-renewable resources. Economic environmental resources are assets in the SNA sense.

Renewable and non-renewable resources

6. Of the environmental assets covered in SEEA, mineral and energy resources (*reserves* in the SNA) are considered non-renewable. Once they are used they are gone. The term non-renewable applies even though many of these resources are so abundant that they will not be exhausted in the foreseeable future. Indeed, many mineral and energy resources are identified and measured only so far as mining and petroleum producing companies need to delineate production reserves for the next few years.

7. The other environmental assets in SEEA; soil, water, biological resources, land and ecosystems may be considered renewable resources insofar as if they are used sustainably, they will last in perpetuity. However, renewable resources are not always used sustainably. Fish

stocks, for example, may be exploited to the point of collapse of the underlying resource. Soil is often used to the point of exhaustion, forests are logged out and ecosystems collapse.

8. The SNA is of the view that if an asset used in production is infinitely abundant (or infinitely renewable) any amount of use would not affect its value (which would be zero). Consequently, there is no decline in its current value during the accounting period as a result of its use in production and the entire value of the capital service flows generated from using such an asset in production is an income to the owner of the resource. This condition cannot apply to produced assets but is implicit in SNA's treatment of some non-produced assets. The implication of assuming no decline in the value of natural resources used in production must be that natural growth always keeps pace with harvest of the resource or that there is such an abundance of the resource that it is free and there is no cost to using up this 'capital'.

9. This view does not always reflect reality. When natural resources are used unsustainably or their abundance is reduced, the income generated from their use includes revenue from selling off part of the stock of the resource. That stock will not be available for use in future production. When a natural resource is depleted through its use in economic production, the value of such depletion should be recorded as a cost of production both by the units using the resource and by the economy, i.e., Option A3 in SEEA. The treatment recommended by Option A3 applies to both renewable and non-renewable environmental resources used in production.

Defining depletion

Depletion in the System of National Accounts

10. The SNA provides a variety of ways for an asset to leave the System: through consumption of fixed capital, through withdrawals and recurrent losses of inventories, and through extinguishing financial claims. None of these are applied to natural resource assets. Instead, the *Other changes in volume of assets account* records the departures of these assets in another way–economic disappearance. One form of economic disappearance is depletion.

11. Depletion of natural deposits is the reduction in the value of deposits of subsoil assets as a result of the physical removal and using up of these assets. In principle, the reduction in the value of renewable natural economic assets (natural forests, fish stocks and other non-cultivated biological resources) as a result of harvesting, forest clearance, or other use should also be recorded as depletion.

12. Economic disappearance of natural resources can take other forms as well as depletion, including:

a) Changes in the condition of exploitable mineral and energy reserves (e.g. reductions in the level of proven reserves that reflect changes in technology and relative prices);
b) Changes in the quality of economic use from a higher to a lower value (e.g. from cultivated land to grazing land);
c) Natural mortality; and
d) Degradation due to economic activity (e.g. erosion and other damage to land from deforestation or improper agricultural practices, harmful effects on fish stocks from acid rain or excess nutrients from agricultural run-off).

13. These other forms of economic disappearance are not regarded as depletion in the SNA sense.

14. Catastrophic losses, which may be caused by major earthquakes, tsunami, exceptionally severe cyclones, drought, wild fires and other natural disasters; acts of war, riots and other political events; and technological accidents such as major toxic spills, are recorded as a separate item in the accounts. Catastrophic losses are not regarded as depletion in the SNA.

15. The range of possible additions and reductions to volumes (hence values) of an environmental asset allowed by the SNA and SEEA are set out in matrix form in Annex 2. The matrix presentation shows how changes in volumes of natural resource assets between the beginning of an accounting period and the end of the accounting period are reconciled by the changes occurring in the period. In practice, it is difficult to measure all possible changes to a stock during a period. Some changes will, by necessity, be measured on a combined or a 'net' basis.

16. Distinct from produced assets, environmental assets in the SNA cannot be added to by capital formation or reduced by consumption of fixed capital (so no charge for their using up is recorded as a cost of production). All volume changes in natural resource assets, both additions and reductions are recorded in the *Other changes in the volume of assets account*. Volume changes are also defined to include the effects of quality and classification changes. Effects of pure price changes on asset values are recorded in the *Revaluation account*.

Depletion in SEEA

17. Unlike the SNA, SEEA offers no prescriptive definition of depletion. SEEA notes that depletion is equivalent to consumption of fixed capital on the decline in value of a produced asset, but also notes that the word 'depletion' is commonly used with different meanings. Depletion is sometimes used to denote the total volume of extractions of natural resources multiplied by the unit resource rent and is sometimes used to represent the effect of extractions on the value of the stock of the resource. SEEA uses the words 'extractions' in the first sense, i.e., equivalent to resource rent. The term 'depletion' is used here, as in the SNA, to mean the change in value of the stock of the resource from its use in production. Thus, depletion is intrinsically linked to reductions in volume of the resource and the consequent reductions in expected future income streams through extractions. Depletion excludes non-extractive changes in the stock of a resource.

18. This view of depletion is applied to extraction of non-renewable environmental assets (subsoil assets) in the SNA, represented by the 'Depletion' row in the 'Economic disappearance' column in the matrix in Annex 2. With some modification, the definition of depletion can be extended to the range of renewable natural resources used in production.

Depletion of renewable natural resources

19. With the exception of water, economic renewable natural resources are biological resources, of which fish stocks and natural forests are the most economically significant. The unique feature of renewable natural biological resources is that, under favourable conditions, they are able to sustain or increase their abundance through natural growth in excess of natural mortality. Natural growth is growth without the influence of economic entities, i.e., it is an economic appearance, not economic production in the SNA. If renewable resources are used sustainably they have infinite asset lives, although of course, individual animals and plants have finite asset lives.

20. SEEA aims to account for effects of economic activity on natural resource endowments to facilitate planning for sustainable development. An informed assessment of sustainability of economic activity needs to consider natural growth of renewable natural resources used in production as well as extraction of these resources. Thus, a more meaningful SEEA measure of sustainability of income from using renewable natural resources in production may be to integrate values for natural growth (net of natural mortality) and extractions, which together indicate if depletion of the resource is occurring, into an 'adjusted' measure of resource rent. These elements are shown shaded in the matrix in Appendix 2.

21. This approach leads to three alternative outcomes for attributing resource rent of renewable natural resources in an accounting period:

1. Adjusted resource rent is entirely attributed to income;
2. Adjusted resource rent is split between income and depletion; and
3. Adjusted resource rent is entirely attributed to depletion.

22. Conventionally, natural growth is recorded as an economic appearance in the SNA *Other changes in volume of assets account* and an addition to stock levels from natural growth in a SEEA asset account (SEEA Table 7.5, A SEEA asset account). However, the conventional approach provides no indication of whether income derived from using renewable natural resources in production is sustainable in the long term.

23. Using SNA accounts as a template for SEEA accounts, it is now proposed that the value of net natural growth of renewable natural resources be recorded as an 'other non-market output' in the *Production account*, and the value of extractions be recorded as 'consumption of natural capital', a charge against this output. Domestic product will in turn change to reflect any excess of growth over extraction, or any excess of extraction over growth. Operating surplus and saving will similarly change to reflect the excess position. The value of the net growth is recorded as an 'addition to the value of non-produced, non-financial assets' in the *Capital account* while the value of extractions is recorded as a consumption of natural capital. 'Net lending' will be unaffected by the changed treatment. The *Changes in balance sheet* will record any excess in 'tangible non-produced assets', leading to a corresponding change in the *Closing balance sheet.* Together, these adjusted SEEA accounts will provide a guide to the sustainable use of renewable natural resources in production.

24. Other events impacting on volumes of stocks of the renewable resource, e.g. changes in volumes due to changes in classification or technology, changes due to degradation, or changes due to catastrophic events, etc., are still regarded as 'other changes in volumes of the asset', not depletion. Effects of price changes are not regarded as depletion; they are recorded in the *Revaluation account*.

25. The 'adjusted' approach outlined has the advantage of integrating both values of additions to and extractions of renewable natural resources into an income stream measure that better indicates whether natural resources are being used sustainably (i.e., where growth equals or exceeds extraction) or unsustainably (where extraction exceeds growth).

Consumption of natural capital equated to consumption of fixed capital

26. The SNA defines consumption of fixed capital (COFC) as 'the decline, during the course of the accounting period, in the current value of the stock of fixed assets owned and used by a producer as a result of physical deterioration, normal obsolescence or normal accidental damage.'

27. The concept 'consumption of natural capital' (CONC) reflects the decline during the course of the accounting period, in the current value of the stock of natural assets owned and used by a producer as a result of physical removal, or extraction, from the stock of the asset. In economic terms the effect of extraction of the resource is the same as physical deterioration in COFC; it reduces the future income stream that can be derived from the asset. Thus, the application of CONC to extraction of non-renewable natural resources is clear-cut. However, the application of the CONC concept to renewable natural resources is less clear-cut because of the inherent potential of renewable resources to increase through natural processes.

28. Natural resources used in production, whether renewable or non-renewable, are economic assets. The value of these assets should be recorded in the balance sheets of the units that own them, as well as in the national balance sheet (though there are issues to be resolved around how to appropriately record ownership when assets are owned by one sector and used by another). That such assets are 'non-produced' is immaterial for the owner unit. Their value lies, as for produced assets, in their expected future income flows. Insofar as future income flows are reduced by the using up of the natural resource, whether renewable or non-renewable, CONC is equivalent to COFC.

Degradation is not depletion

29. Degradation may be either an anticipated or an unanticipated consequence of economic activity. Where degradation is anticipated, it should be included with extractions in CONC, again equivalent to the treatment of physical deterioration, normal obsolescence or normal accidental damage in COFC. Where degradation is unanticipated, it should remain as an 'other change' in the volume of the asset. In many cases it will not be possible to identify and partition elements of degradation as either anticipated or unanticipated consequences of production. A practical solution is to record all degradation in the *Other changes in volume of assets account*, reflecting its character as a negative consequence of production rather than an intended using up of an asset in production.

Valuing environmental resources and depletion

30. The SNA's general principle for valuing an item in balance sheets is that it should be valued as if it were being acquired on the date to which the balance sheet relates, including any associated ownership transfer costs. Such valuation relies on prices for these items being available on the balance sheet date, and ideally, these prices should be observable market prices for the item in question. This valuation method is not broadly applicable to environmental resources as market price information is often not available.

31. SNA's next-best option is to approximate market prices by the discounted value of the rent (resource rent) that assets will yield over their effective life–the 'net present value' (NPV) method. The NPV method is used extensively to value non-renewable natural resources on national balance sheets.

Resource rent

32. Natural resources, like produced assets, provide capital services to the economy as they are used and are remunerated in the gross operating surpluses generated by the units that use them. The gross operating surplus of an entity using a combination of produced and natural capital can be divided to show how much is attributable to produced assets and how much to natural assets. The part due to natural assets is 'resource rent'. The other part, the return to produced assets, is 'other economic rent'. In the absence of a market value, the value of an asset used by the entity, whether produced or non-produced, is the discounted present value of the rent expected over its effective life. Resource rent can in turn be decomposed into a return to the owner of the resource and a measure of depletion of the natural resource.

Net present value

33. Economic valuation of subsoil assets has been widely discussed. While issues of measurement, appropriate discount rates, and returns to capital remain to be resolved, there is a general consensus that appropriate values can be assigned to these assets, in the absence of market transactions, by calculating the NPV of the stream of future resource rents the resource will yield until it is exhausted. That is, assets are valued on the basis of the net present value of the expected future earnings. In theory, this is equivalent to the market price of the natural resource stock. The NPV method generally used to determine the present value of net cash flows is represented in equation 1.

$$V_t = \sum_{t=1}^{n} \frac{RR_t}{(1+r)^t} \qquad \text{(equation 1)}$$

where: V = net present value, RR = resource rent, r = discount rate, n = asset life

34. This method assumes that for each year the ongoing resource rent remains constant over the life of the asset (though ideally, factors that may affect future resource rents should be taken into account). The NPV of the asset at the beginning of each year for the remaining asset life is calculated, using the expected life length and (real) discount rate.

35. Economic depletion (consumption of natural capital) in any one year is the change in the value of the resource between the beginning and end of the year arising purely from the extraction of the resource. Economic depletion in the year can also be shown to be equal to the resource rent in the year minus a return (income) on the natural resource asset (equation 2). The income component is at least equal to the interest that could be earned if the asset were sold and then invested at an interest rate equivalent to the real discount rate.

$$d_t = V_{t-1} - V_t = RR_t - rV_t \qquad \text{(equation 2)}$$

where: d = depletion

Non-renewable resources

36. Resource rents are not directly observable but instead are typically derived as the difference between total revenue generated from the extraction of natural resources less costs incurred during the extraction process including the cost of produced capital (which itself includes a return to produced capital). Or, as stated more simply in SEEA, "the value of capital service flows rendered by the natural resources, or their share in gross operating surplus, is

the...resource rent" Depletion is then derived as resource rent minus the opportunity costs of capital invested in the natural resource. Depletion of non-renewable resources represents the reduction in the value of the asset as a result of the removal and using up of the asset.

37. Institutional units may use either produced capital assets or a mixture of produced and non-produced capital assets as factors in the production process. For any enterprise or industry, its gross operating surplus can be decomposed into consumption of fixed capital and net operating surplus. For institutional units or industries using only produced assets as capital inputs, the whole of its net operating surplus is a return to the produced assets employed. For institutional units or industries using a mixture of produced and non-produced assets (natural resources) as capital inputs to the production process, the net operating surplus can be further decomposed into an exogenous return to produced assets and resource rent. Resource rent can then be further decomposed into a return to the owner of the non-produced assets and a measure of depletion.

38. By convention, the measure of depletion has been charged to those industries using non-renewable natural resources, such as the mining industry. The decomposition of net operating surplus into a return to produced assets, to non-produced assets and to depletion is typical of a mining entity extracting subsoil assets.

Renewable resources

39. The value of any asset used in production can be derived from the value of its expected future income stream. When renewable resources are used unsustainably they have identifiable, finite asset lives and can be valued using the NPV approach shown in equation 1. However, when a renewable resource is being harvested at a sustainable rate, its asset life is infinite and the NPV formula reduces to:

$$V_t = \frac{RR_t}{r} \qquad \text{(equation 3)}$$

where: V = net present value, RR = resource rent, r = discount rate

40. The defining characteristic of renewable natural resources is their ability to reproduce, to grow new stock to replenish diminished stocks. Calculation of resource rent for units using renewable resources should reflect the ability of the resource to replenish itself. A method for calculating resource rent for renewable resources is now proposed, based on the concept of 'adjusted' resource rent discussed earlier, where what may usefully be termed 'SEEA depletion' is now defined to be extraction less natural growth (net of natural mortality) of the stock during the accounting period.

41. As noted, where the renewable resource is being used sustainably, there is either no depletion charge or a negative depletion (repletion) value. A depletion adjusted resource rent for utilising renewable resources can be calculated in the same way as that for non-renewable resources by making two additional assumptions:

1. that depletion of renewables is represented by extractions less net growth, as discussed; and
2. where depletion of renewables is zero or negative, all resource rent represents income to the owner of the asset.

42. Recasting equation 2 to represent depletion of renewable resources yields the following equation (4).

$$\check{S}d_t = \check{E}t - \check{G}_t = \check{R}R_t - rV_t \qquad \text{(equation 4)}$$

where: $\check{S}d_t$ = SEEA depletion in t, $\check{E}t$ = extractions in t, $\check{G}_t$ = net natural growth in stock in t, $\check{R}R_t$ = depletion adjusted resource rent, rV_t = return to owner of natural capital in t

43. The net present value of a renewable resource used unsustainably is calculated as in equation 1, except that the expected asset life n is calculated as the total value of (economic) stock at end of period t divided by SEEA depletion ($\check{S}d_t$) in period t, i.e.,

$$V_t = \sum_{t=1}^{n} \frac{\check{R}R_t}{(1+r)^t} \qquad \text{(equation 5)}$$

where: n = asset life = stock/ $\check{S}d_t$

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44. The following questions were put to the December 2007 meeting of London Group:

Question 1: Does the London Group agree that both extractions and natural growth of renewable natural resources should be included in an adjusted measure of resource rent?

45. The December 2007 meeting of London Group agreed with the concept of adjusted resource rent that encompasses both income and depletion elements (consistent with Option A3 SEEA Chapter 10, Box 10.1), and that SEEA accounts should include values for both extraction of renewable natural resources and natural growth of these resources. Natural growth is to be treated as an addition to output (other non-market output) in the Production account and as capital formation (additions to the value of non-produced non-financial assets) in the Capital account.

Question 2: Should extractions be treated as 'consumption of natural capital' (akin to consumption of fixed capital), and natural growth be treated as an 'other non-market output'?

46. The December 2007 meeting of London group agreed that extractions (economic depletion) of renewable natural resources be treated as a consumption of natural capital. Consumption of natural capital should be a charge against gross value added in the Production account and recorded as a change of assets in the Capital account.

APPENDIX 2. CHANGES IN THE VOLUME OF A NATURAL RESOURCE

SEEA asset account			**SNA Other changes in volume of assets account (flow account)**							
			Period 1							
Changes to volume of stock other than from transactions:	SNA equivalents:	**Asset account**	Economic appearance	Natural growth	Economic disappear.	Catastrophic losses	Uncompen. Siezures	Other volume changes	Changes in classificat'n	**Asset account**
		St	K3	K5	K6	K7	K8	K9	K12	
Discoveries	Discovery		X							DIS
Reclassification - function change	Changed conditions		X		X					ΣCCO
	Transfers to/from economic		X		X					ΣTE
Reclassification - quality change	Quality change		X		X					ΣQC
Natural growth & mortality	Natural growth & mortality			X	X					NGM
Extractions	Depletion				X					DP
Degradation	Degradation				X					DG
Catastrophic losses	Catastrophic loss					X				CL
Uncompensated siezures	Uncompens. seizures						X			US
Other changes in classification and structure	Classificat'n changes								X	OCC
	Other volume changes							X		OVC
		St	ΣEA	NG	ΣED	CL	US	OVC	CC	St+1

47. The matrix presentation shows how changes in volumes of natural resource assets between the beginning of an accounting period (St) and the end of the accounting period (St+1) are reconciled by the changes occurring in period 1. These changes can be measured as flows in the SNA *Other changes in volume of assets account*, such that:

$$St+1 = St + \Sigma EA + NG - \Sigma ED - CL - US +/- OVC +/- CC$$

where: EA is economic appearance, NG is natural growth, ED is economic disappearance, CL is catastrophic loss, US is uncompensated seizures, OVC is other volume changes, and CC is changes in classification.

48. Expanding this further, the change in volumes from t to t+1 can also be measured in SEEA asset accounts (SEEA Table 7.5), with SNA equivalents, as:

$$St+1 = St + DIS + \Sigma CCO + \Sigma TE + \Sigma QC + NGM - DP - DG - CL - US +/- OCC +/- OVC$$

where: DIS is discovery, CCO is changed conditions, TE is transfer to economic status, QC is quality change, NGM is natural growth/mortality, DP is depletion, DG is degradation, CL is catastrophic loss, US is uncompensated seizures, OCC is other classification changes and OVC is other volume changes.

APPENDIX 3. BACKGROUND TO THE DECISIONS ON RECORDING CHANGES TO THE STOCK OF NATURAL RESOURCES

1. SEEA 2003 proposes multiple solutions to various environmental accounting issues. If SEEA is to be elevated to an international statistical standard, these sets of options must be restated as univocal accounting recommendations. Box 10.4 (SEEA Chapter 10) presents three options for recording additions and deductions from the stock of environmental assets:

- *Option C1 records the consequences of extraction of natural resources in the extended generation of income account leading to a depletion-adjusted operating surplus, but the corresponding increases in resources are shown in the other changes in assets account.*

- *Option C2 records both the consequences of extraction and additions to natural resources in the extended generation of income account. Additions cover both the natural growth of biological resources and discoveries and reappraisals of subsoil deposits.*

- *Option C3 is one where there are no entries for extraction and addition to natural resources in the extended generation of income account of those assets which have been reclassified as developed natural assets and which are therefore recorded in the same way as produced assets.*

2. As part of the update of SEEA, the London Group has previously considered and concluded on the treatment for *Identifying the income element of resource rent* (Box 10.1, SEEA Chapter 10), and *Recording mineral exploration and mineral deposits* (Box 10.3, SEEA Chapter 10). In particular, option B3 in Box 10.3 proposed the concept of a 'developed natural asset', which involves combining related mineral resource and mineral exploration assets, but this option has been rejected by the London Group. Given that option C3 is the rational consequence of option B3, the rejection of option B3 effectively removes option C3 from further consideration.

Environmental assets

3. In order to appreciate the issues involved, it is essential to identify what constitutes an environmental asset, as well as the renewable / non-renewable distinction. SEEA identifies the following broad categories of environmental assets:

- Natural resources (consisting of mineral, energy, soil, water and biological resources);
- Land and associated surface water; and
- Ecosystems.

4. With the exception of mineral and energy resources, environmental assets are considered to be renewable. If they are used sustainably they have infinite lives. Mineral and energy resources however, are considered to be non-renewable. Once they are used they are gone forever. The renewable / non-renewable distinction is important, and will feature later in the consideration of the various options.

5. It is worth noting that the heading of SEEA Box 10.4 refers to the treatment of 'environmental assets', while each of the descriptions against the individual options relate to the narrower grouping of 'natural resources'. The discussion in this appendix generally relates to 'natural resources'.

Environmental assets and the 1993 SNA

6. In order to promote *integrated* environmental–economic accounting, as far as possible, the SEEA and SNA systems should be either consistent, or readily reconcilable. Where SEEA and SNA concepts differ, there should be sound reasons. For example, while SNA does not recommend applying a charge against production for the depletion of natural resources, SEEA can justify doing so on the basis that this provides a more appropriate view of the sustainability of current production.

7. Some of the SEEA environmental assets are also economic assets according to the 1993 SNA (i.e. they are entities functioning as a store of value over which ownership rights can be enforced by institutional units and from which economic benefits may be derived by the owner from holding or using it over a period of time exceeding one year). Clearly, much of mineral and energy resources fall into this category. Importantly, some biological resources are also economic assets, for example, fish raised on a fish farm, or plantation forests cultivated by an institutional unit. Where natural resources are economic assets, it is appropriate to follow SNA principles in recording changes to asset stocks.

8. The general position of the 1993 SNA is that a purely natural process without any human involvement or direction is not production in an economic sense (paragraph 6.15). For example, the growth of trees in a natural forest is not economic production, while the growth of trees in a timber plantation is production. As a consequence, the formation of mineral and energy resources does not constitute economic production as defined by the SNA. Similarly, natural growth of renewable natural resources does not constitute economic production unless it is organised, managed and controlled by institutional units.

9. The 1993 SNA treats the natural growth of 'cultivated assets' such as crops, trees, livestock or fish which are organised, managed and controlled by institutional units as economic production (paragraph 6.94). Generally, SNA requires that natural growth in these cultivated assets be recorded as an increase in inventories (work-in-progress). Such growth thereby enters the output of the producing unit (i.e. output as the value of sales plus changes in inventories including additions to work-in-progress). The exception to this rule applies where natural growth relates to cultivated assets that are 'capital' in nature i.e. assets that are used repeatedly or continuously for a period of time exceeding one year to produce other goods or services. Examples would include grape vines, dairy cattle and nut trees. Natural growth of such assets is recorded as own account capital formation (1993 SNA, paragraph 10.84). Therefore, whether the growth relates to cultivated assets of a current or capital nature, SNA requires that output be recorded as being produced continuously over the period of production.

10. The draft SNA93Rev.1 reaffirms these recommended treatments of the 1993 SNA.

Are non-renewable natural resources produced assets?

11. The question of whether non-renewable natural resources should be treated as 'produced' or 'non-produced' was not explicitly decided upon at the London Group meeting in March 2007. However, that meeting considered and rejected SEEA Chapter 10 option B3 (a position later endorsed by UNCEEA). This option required that the sum of mineral exploration expenditure and the mineral resource be attributed to a "developed natural asset" which would be recorded as a tangible produced asset. That is, option B3 effectively assumed that mineral exploration expenditure gives rise to (and forms part of the valuation of) the new mineral and energy discovery. The relevant issue paper presented to the March 2007 London Group meeting (*Depletion in the SEEA - Narrowing down the options*[4]) also suggested rejecting option B3. Its principal supporting argument was that discoveries of mineral and energy resources are not produced assets, and should therefore not form part of output and income. A summary of this argument follows.

12. The draft SNA93Rev.1 explicitly describes discoveries as non-produced, and accordingly recommends they enter the balance sheet through the SNA *other changes in volume of assets account*. Nevertheless, there are arguments against this treatment. In particular, other changes in volume of assets are considered to be beyond the control of the units involved, which suggests they are unexpected. However, in practice, new discoveries are often considered to be predictable, certainly not accidental or unexpected. New discoveries are also dependant on dedicated mineral exploration, which is clearly a productive activity.

13. The alternative is to treat new discoveries as produced assets, yet this appears to be even less desirable. To treat discoveries as produced assets requires the identification of a productive activity, and then the determination that the discoveries are in fact an output of that activity. It might be argued that new discoveries are the output of mineral exploration activity. But it is difficult to conceive of how the mineral exploration asset 'produces' new mineral and energy resources. Production is typically thought of as a process of *transforming* inputs into outputs. Using a conventional economic accounting perspective, it is difficult to conceive of how newly discovered mineral and energy resources have been produced at all, let alone by a process utilising knowledge assets.

14. Also, if mineral exploration 'produces' the new mineral and energy resource, the value of discoveries should be the price charged by the exploration enterprise to perform the exploration. That this is not true (in the great majority of cases) suggests that new discoveries are not the output of mineral exploration. Instead, it could be said that the output of mineral exploration is knowledge gained about the existence and nature of the deposit, rather than the deposit itself. And that this knowledge asset is used as part of the subsequent process of extracting the discovered deposits.

15. Had option B3 been accepted by the London Group, extractions and additions to mineral and energy resources would have been treated as if these resources were produced assets. That is, new discoveries would have been treated as the produced output of a capital good, and extractions treated as consumption of fixed capital. The rejection of option B3 effectively rules out option C3, a point made in SEEA (paragraph 10.67).

[4] Comisari, P.

16. If we conclude that non-renewable natural resources are non-produced assets, an apparent asymmetry is introduced to our treatment of natural resources in the environmentally adjusted *production account* and income accounts. That is, we would require a charge against production and income to account for depletion of non-renewable natural resources, but would not consider new appearances of the same resources to be part of output.

17. When considering this 'asymmetry' in the proposed treatment, it is worth drawing an analogy with the treatment of produced capital in the SNA. If an entity received a capital good as a gift (much in the same way that the environment provides 'gifts' of natural capital to the economy), how would this be treated? The capital good will not form part of the output of the receiving enterprise, nor is it recorded as income of the entity, though the entity may generate income from its use in production. The receiving entity will record this gift as a capital transfer received and as part of its stock of produced fixed assets in its balance sheet. Although the receiving entity records no output or income in respect of the capital transfer, it nevertheless records income and consumption of fixed capital (analogous to depletion) in its production account as the capital good is used in production.

18. While the discussion above makes specific reference to mineral and energy resources, these are effectively synonymous with 'non-renewable natural resources'. And in any case, the treatment would extend to any other natural resources defined as 'non-renewable'.

Depletion of renewable natural resources

19. The ABS presented a paper titled *Depletion of renewable environmental resources*[5] to the December 2007 London Group meeting in Rome. The paper proposes that a meaningful measure of the value of depletion for SEEA may be to integrate values for net natural growth of renewable natural resources into resource rent, which is in turn offset by the value of economic depletion of these resources. This approach leads to three alternative outcomes for attributing resource rent of renewable natural resources in an accounting period:

1. Adjusted resource rent is entirely attributed to income;
2. Adjusted resource rent is split between income and depletion; and
3. Adjusted resource rent is entirely attributed to depletion.

20. These concepts and calculations can also be applied consistently to measuring depletion of non-renewable resources. As there is no natural growth/mortality recorded for non-renewable resources, revenue is split between income and depletion.

[5] Bain, D.

Growth in renewable natural resources – an addition to output?

21. As with non-renewable natural resources, there is no question that appearances of renewable natural resources must be reflected in the national balance sheet. The balance sheet is thus a powerful tool for analyses of sustainability. Our question here is one of how these appearances enter the balance sheet – since renewable natural resources fall within SEEA's asset boundary, their appearance must take the form of either: an 'output' (i.e. via the SNA *production account*); or an 'other volume change' (i.e. via the SNA *other changes in volume of assets account*). As stated, the SNA position is that purely natural growth in a renewable natural resource does not constitute economic production. However, the treatment of cultivated natural resources in the 1993 SNA appears to provide some justification for SEEA to more generally treat growth in renewable natural resources as part of output and income.

22. As stated earlier, the 1993 SNA recommends that natural growth in 'cultivated assets' be treated as a process of production in the economic sense (paragraph 6.94). Because this natural growth is subject to direct ownership and control of institutional units, it is not considered to be a purely natural process lying outside the SNA production boundary.

23. Consequently, the case for treating growth of renewable natural resources as 'output' is stronger than for non-renewable natural resources. On the one hand, institutional units do not universally organise, manage and control the natural growth of renewable natural resources. However, if renewable natural resources are used sustainably, they potentially have infinite lives. That is, it is possible that human intervention may support growth of renewable natural resources and sustainable harvest. In that sense, natural growth of renewable natural resources is a process potentially strongly influenced by human actions, even if it is not necessarily subject to the direct ownership and control of institutional units.

24. With cultivated natural resources such as fish in a fish farm, or trees in a timber plantation, there is a strong degree of certainty that the enterprise that owns the resource will generate output and income from its natural growth. For fish stocks in the open sea or for native forests, the degree of certainty is not always as strong but there is nevertheless a reasonable expectation that much of these resources will ultimately be harvested. The expectation will be stronger for certain types of resources in certain locations. For example, there is a reasonable expectation that much of the growth in South-East Asia's hardwood forests and certain fish species in Europe's North Sea will ultimately be reflected as output of economic production.

25. However, even where there is no realistic expectation that a renewable natural resource will ultimately be harvested, SEEA could nevertheless choose to treat natural growth as part of output. One of the central tenets of sustainable development is the notion of maintaining natural capital ('keep capital intact'). Therefore, an information system (such as SEEA) used to inform our performance against the objective of maintaining natural capital for sustainable development, needs to fully account for natural capital formation. Natural capital formation must enter the SEEA system either as an 'output' of production or as an 'other volume change'. The 1993 SNA provides guidance on what constitutes an 'other volume change' and it is primarily about "the effect of unexpected events on the economic benefits derivable from assets" (paragraph 12.41). Examples of these types of changes overwhelmingly relate to decreases in assets, though increases in assets are certainly possible. But SNA makes clear reference to 'other volume changes' as being 'unexpected', 'untimely', 'unforseen'. It is clear that natural growth in renewable natural resources is generally neither unexpected, untimely nor unforseen. This suggests the appearance of a renewable natural resource could be viewed as a form of output within SEEA.

26. There is a key distinction between renewable and non-renewable natural resources which is relevant to this discussion. The *extant* stock of non-renewable natural resources cannot increase (except in geologic time frames) regardless of human intervention. That is, the extant stock of non-renewable natural resources is fixed. Human intervention can physically remove non-renewable natural resources, but cannot facilitate its growth. Discoveries and reappraisal of these resources do not affect their extant stock; they merely alter human perception of this stock. The same is not true of renewable natural resources, the growth of which can clearly be influenced by human intervention.

27. Treating the appearance of renewable natural resource as a form of output ensures symmetrical treatment of additions to, and removals from, renewable natural resources. That is, the removal of renewable natural resources is treated as a charge against production, and its net natural growth is treated as output of production. There is an intuitive appeal to this symmetry.

28. While it is suggested that net natural growth of renewable natural resources be treated as produced output, this does present a range of practical difficulties. A number of these difficulties are explored below.

29. The treatment of fish stocks, in particular, presents clear examples of the difficulties of regarding natural growth as production. Assume for example there is an increase in a fish stock such that net natural growth exceeds the harvest; should there be a positive adjustment to production and income? A positive adjustment to production and income within SEEA would raise the gross operating surplus of the fishing industry in the SEEA accounts above that recorded in the corresponding SNA accounts. The SEEA accounts could thus be interpreted as saying that income earned from the fish harvest is more sustainable than indicated in the corresponding SNA accounts. Since the SNA (implicitly) assumes that fish stocks in the open sea are infinitely abundant, this is a difficult result to interpret.

30. The mobility of many fish species is a particular issue. It is not only conceivable but very likely that growth in fish stock within the territorial waters of one country might be harvested by another country. For example, tuna stocks regularly move through the territorial waters of various South Pacific islands, but the major fishers of this tuna stock are from outside the South Pacific. If growth of tuna fish stock occurs in the territorial waters of a South Pacific island nation, what analytical purpose is served by increasing the environmentally-adjusted GDP of this nation, if another nation ultimately harvests this tuna stock?

31. Since water resources are both a SEEA natural resource and an SNA economic asset, it follows that treating uncontrolled growth in a renewable natural resource as output implies that rainfall constitutes a produced output (1993 SNA, paragraphs 1.23 and 1.24).

32. Does uncontrolled growth in renewable natural resources meet the test of Hicksian income? J.R. Hicks (1939) broadly defined income as that which we can consume today without becoming less well-off tomorrow. Since natural capital is included in our notion of wealth, it could be argued that anything which increases natural capital gives rise to income (in a Hicksian sense).

33. A closer examination of Hicks's thinking, however, raises some questions as to whether all increases in natural capital should qualify as income. Hicks stated that "The purpose of income calculations in practical affairs is to give people an indication of the amount which they can consume without impoverishing themselves". And that income should be a "guide for prudent conduct" in relation to consumption. Consequently, there is every justification for incorporating depletion of non-renewable natural resources into a Hicksian definition of income, because the using up of these resources leaves us demonstrably less well-off in the future. However, basing consumption behaviour on a notion of income that might include the value of rainfall and the movement of fish stock into our territorial waters does not appear to meet Hicks's view of 'prudent conduct'.

Applying options C1 and C2

34. Option C1 charges the consequences of extraction of natural resources against income, giving rise to a depletion-adjusted operating surplus. However, this option does not consider additions to stocks of natural resources to be the result of productive activity. Instead it records additions in the SNA *other changes in volume of assets account*. For non-renewable natural resources, this treatment is the logical consequence of London Group's decision to reject option B3 at its March 2007 meeting.

35. This issue paper has contended that non-renewable natural resources are not produced assets and therefore new discoveries and reappraisals of these assets do not form part of output and income. If we accept this position, then option C1 proposes a treatment that is appropriate for non-renewable natural resources.

36. Applying option C1 to renewable natural resources however, gives an inappropriate measure of depletion because it excludes additions to renewable natural resources (e.g. net natural growth of forests and fish stocks) from the calculation of depletion. For renewable natural resources, these additions are required to develop an appropriate measure of a depletion-adjusted operating surplus. Net natural growth in renewable natural resources represents a physical increase in the asset, unlike discoveries of non-renewable natural resources which simply reflect improved human knowledge of mineral and energy resources. By ignoring net natural growth in renewable natural resources, the use of option C1 could result in large estimates of depletion, when in fact the stock of the renewable natural resource is increasing.

37. Option C2 also charges the extraction of natural resources against income, resulting in a depletion-adjusted operating surplus. However, unlike option C1, option C2 records the effects of additions (such as natural growth, discoveries and reappraisals) against output and income.

38. For non-renewable natural resources, this is contrary to the recent London Group decision that concluded reappraisals and discoveries of mineral and energy resources are not the result of productive activities, and therefore should not form part of production and income.

39. In the case of renewable natural resources, option C2 is conceptually appropriate. Additions such as regrowth of forests and fish stocks do indeed add to the stock of the asset. If the depletion measure is meant to represent the 'using up' of a resource, then net natural growth in renewable natural resources needs to be offset against the harvest of these resources in arriving at a depletion-adjusted operating surplus. This provides a more appropriate measure of the sustainability of production and income.

A fourth option

40. Following the discussion above, it is suggested that neither option C1 or C2 is universally appropriate. Specifically, option C1 is appropriate for non-renewable natural resources, but not for renewable natural resources. Option C2 is appropriate for renewable natural resources, but not for non-renewable natural resources. As such, a fourth option is proposed:

- *Option C4 considers separately the cases of renewable and non-renewable natural resources. For non-renewable natural resources, the consequences of extraction are recorded in the extended generation of income account leading to a depletion-adjusted operating surplus, but corresponding increases in these resources are shown in the other changes in volume of assets account. For renewable natural resources, both the consequences of extraction and net natural growth are recorded in the extended generation of income account leading to a depletion-adjusted operating surplus.*

41. By recognising the inherent differences between renewable and non-renewable natural resources, option C4 overcomes the limitations of options C1 and C2. In the case of non-renewable resources, recording discoveries and reappraisals of subsoil deposits in the SNA *other changes in volume of assets account* ensures this option is consistent with the thinking behind London Group's decision to reject option B3.

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42. The following questions were put to the December 2007 meeting of London Group:

Question 1: Do members agree that London Group's earlier rejection of option B3 effectively removes option C3 as a possible option?

43. At the December 2007 meeting, London group members unanimously agreed that in light of earlier recommendations to reject option B3, option C3 was no longer a possible option.

Question 2: Do members agree that SEEA should, in principle, view net natural growth in renewable natural resources as part of produced output?

44. At the December 2007 meeting, London Group members unanimously agreed that net natural growth of renewable natural resources be considered a part of produced output.

Question 3: Do members agree that option C4 is an appropriate alternative that overcomes the limitations of the existing options?

45. At the December 2007 meeting, London Group members unanimously agreed to the recommendation that option C4 is an appropriate treatment for recording changes to the stock of natural resources.

DRAFT OUTCOMES PAPER:

RECORDING THE OWNERSHIP OF MINERAL-RELATED ASSETS

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Paper prepared for UNCEEA meeting. New York, 26-27 June 2008.

Executive summary

1. The December 2007 meeting of the London Group in Rome took a unanimous position on the attribution of ownership of mineral-related assets. This paper reports on that outcome.

2. A characteristic of SEEA-2003 is its provision of multiple solutions to various environmental accounting issues. The proposed elevation of SEEA-2003 to an international statistical standard requires that these options be replaced with unambiguous accounting recommendations.

3. Chapter 10 of SEEA-2003: "Making environmental adjustments to the flow accounts" contains five sets of treatment options in its section on depletion. These relate to the following topics.

i. Identifying the income element of resource rent (for both renewable and non-renewable natural resource).

ii. Recording mineral exploration and mineral deposits.

iii. Recording the additions to and subtractions from the stock of environmental assets.

iv. Recording ownership of mineral-related assets.

v. Recording depletion—asset recorded in the legal owner's balance sheet.

4. This outcomes paper reports specifically on London Group's consideration of the fourth set of options 'recording ownership of mineral-related assets'. An issue paper devoted to this topic was presented to the recent London Group meeting in Rome where a unanimous agreement was reached.

5. Consistent with the draft System of National Accounts 1993, Revision 1 (1993 SNA, Rev. 1), London Group has rejected the notion that the mineral exploration knowledge asset be combined with the mineral resource to form a "developed natural asset". Instead, in all cases, the mineral exploration knowledge asset is recorded in the balance sheet of its legal owner. UNCEEA endorsed this position in June 2007.

6. For the mineral resource itself, attributing ownership is less straightforward. London Group in December 2007 nevertheless unanimously agreed that under conditions typically governing the use of a mineral resource, it is appropriate to effect a partitioning of ownership of the asset between the extractor undertaking the development and the legal owner of the resource.

7. The value of a mineral resource is equal to the present value of expected resource rents arising from its use, therefore the value of resource rents expected during the period of the extractive lease agreement is attributed to the extractor, and the value of resource rents after the period of the extractive lease is attributed to the legal owner. A financial lease is imputed, under which the expected rental (royalty) payments to the legal owner (the 'lessor') provide the basis for imputed interest and principal repayments. The December 2007 meeting of the London Group endorsed this position.

8. In the period since London Group's decision on this issue, however, the position of draft 1993 SNA, Rev. 1 has been clarified. In short, draft 1993 SNA, Rev. 1 now clearly advocates attribution of ownership of the mineral resource asset to its legal owner, and not a partitioning as endorsed by the December 2007 meeting of London Group (for the updated SEEA). Nevertheless, there are entirely valid reasons why SEEA and SNA could (and should) adopt different treatments. In particular, the updated SEEA needs to reflect the rundown in mineral resource wealth (i.e. depletion) in the extractor's production account—it is inappropriate to record depletion in the balance sheet of one sector (e.g. government) and in the production account of another sector (e.g. mineral extractor). This is a pivotal distinction between the SNA and SEEA systems.

9. Discussion after the December 2007 meeting of the London Group suggests that the issue of attribution of ownership of mineral-related assets needs further consideration and will therefore be placed on the agenda for the next meeting of London Group. This outcome paper is presented to UNCEEA for information and consideration.

Objectives of UNCEEA and outcomes on recording ownership of mineral-related assets

11. The stated objectives of UNCEEA's work program involve a number of elements—one element of particular relevance to the London Group is UNCEEA's role in reviewing proposed solutions in the update of SEEA-2003. The role is challenging because proposed solutions must deliver a final product that can realistically be 'sold' to the international statistical community, that is, SEEA should provide information valuable to policymakers, it should be integrable with other international statistical standards and it must be capable of being implemented by various national statistical agencies.

12. Attribution of ownership of mineral-related assets is an important element of SEEA. The method chosen must reflect underlying economic realities and the treatment of various flows (e.g. rentals) and charges (depletion) must provide a cohesive picture. The methodology chosen will have potentially important implications for sectoral measures of wealth and of productivity.

13. The December 2007 London Group decision on attribution of ownership of the mineral resource differs from the treatment now recommended in the draft 1993 SNA, Rev. 1 and there are valid reasons for this. SNA attributes ownership of the mineral resource to the legal owner, which for many countries will be the government. In the context of SNA this is an acceptable solution. However, SEEA is required to account for consumption of natural capital (i.e. depletion) in much the same manner that SNA accounts for consumption of fixed capital—this is required in order that SEEA better indicate the sustainability of income generated from production.

14. Under arrangements typical of resource extraction, this depletion charge should be made against the output of the extractor since it is the extractor who generates output and income from using the resource. SNA does not allow for (nor does 1993 SNA, Rev. 1 propose) a charge for depletion against output and income in its production and income accounts. SEEA does require a depletion charge against output and income and therefore we need to consider the important questions of who owns the mineral resource and how various related flows (e.g. depletion, rentals/royalties) are to be accounted for. SEEA requires a complete and cohesive accounting of all these elements, and the December 2007 meeting of the London Group agreed that a partitioning of the mineral resource using an imputed financial lease provides the necessary cohesion and completeness.

15. While London Group's recommended treatment is a conceptually elegant solution, it will not necessarily be straightforward to implement. It will be important to consult with national accountants to explain why London Group has taken its position. Furthermore, the support of national accountants will be important during the implementation phase. Implementing a partitioning of mineral resources using an imputed financial lease arrangement is likely to involve a reasonably significant learning process and during this process, London Group has the opportunity to play the key role of promoting and facilitating the sharing of country experiences.

16. Appendix 1 describes the background to the London Group decisions and is substantially taken from the relevant issue paper presented to the December 2007 London Group meeting.

Appendix 1: Background to the decisions on recording ownership of mineral-related assets

Introduction

1. SEEA 2003 presents two options for recording the ownership of mineral-related assets:

Option [D1] *shows mineral exploration in the balance sheet of the extractor and the value of the deposit in the balance sheet of the legal owner. If the agreement between the owner and the extractor allows for the extractor to retain some of the resource rent coming from the asset, the ownership of the asset should be partitioned accordingly.*

Option [D2] *shows both the mineral exploration and deposit as being in the* de facto *ownership of the extractor. In addition the extractor has a financial liability towards the owner corresponding to his share of the resource rent. This amount is also shown as a financial claim in the balance sheet of the owner.*

2. Both options deal with sectoral allocation in the balance sheet of two distinct assets: the mineral exploration expenditure; and the mineral resource. The options therefore deal with two distinct questions: what is the appropriate sectoral allocation of the mineral exploration knowledge asset; and what is the appropriate sectoral allocation of the mineral resource? For both questions there is no issue with sectoral allocations where the extractor and the owner of the asset are the same entity, though for mineral resources this is not usually the case.

Background to the decision: how to assign ownership of mineral exploration asset?

3. Dealing first with the question of how to allocate the asset 'capitalised mineral exploration expenditure', the London Group / UNCEEA response to SEEA chapter 10 options B1, B2 and B3 largely determines our response to this question. SEEA option B3 considered that the mineral exploration knowledge asset should be combined with the mineral resource asset to form a "developed natural asset". Had this position been accepted, it would follow that the mineral resource and the mineral exploration knowledge asset must both appear (combined) on the balance sheet of the same entity. The decision to treat the mineral exploration knowledge asset and the mineral resource as separate assets is consistent with draft chapters of 1993 SNA, Rev. 1 and removes the requirement to record both these assets in the balance sheet of a single entity.

4. Typically an asset is recorded in the balance sheet of the entity that purchases and uses the asset. Usually, but not always, the owner is both the legal and 'economic' owner. The draft 1993 SNA, Rev. 1 (Chapter: 'Flows, stocks and accounting rules', paragraph 21) defines the legal owner of an asset to be the institutional unit entitled in law and sustainable under the law to claim the benefits associated with the asset. By contrast, the economic owner of an asset is entitled to claim the benefits associated with the use of the asset in the course of an economic activity by virtue of accepting the associated risks.

5. In many cases, the most obvious example being assets subject to a financial lease, the economic owner of the asset is not the legal owner. From an SNA perspective, the more important consideration is 'economic' ownership, that is, which entity is accepting the risks and rewards of ownership?

6. Mineral exploration knowledge assets are usually developed either by the extractor (as own account production) or else produced by a specialist exploration enterprise for sale to an extractor. It is clear that a business purchasing (or creating on own account) a mineral exploration knowledge asset for use in their extractive activities is both the legal and economic owner of the mineral exploration knowledge asset and that the asset should be recorded in their (the extractor's) balance sheet. It is appropriate to record the asset in the balance sheet of the legal owner, which in the vast majority of cases, will be the extractor.

7. While the above situation is quite clear, there is a potential complication for our sectoral balance sheet allocation when mineral exploration knowledge assets must be made freely available to the public. For example, in Australia the detailed results of past mineral exploration must be provided to the government, which makes this information publicly available. Though the national balance sheet in the Australian system of national accounts records the mineral exploration knowledge asset as owned by the extractor, is there a case for allocating ownership to government?

8. The requirement to make the information publicly available reflects government regulation, rather than any attempt by government to assume ownership of the asset. The economic effect of this requirement is simply one of reducing the resale value of the mineral exploration knowledge asset—it does not affect how we assign ownership of the asset. Also, an extractor typically enters into an arrangement with the legal owner (often the government) to secure exclusive access to the resource in question and therefore the mineral exploration knowledge asset provides ongoing benefits to the extractor holding an extractive licence regardless of whether or not that information becomes publicly available.

Background to the decision: how to assign ownership of mineral resources?

9. Recognising that mineral exploration and mineral resources are separate assets, and that mineral exploration is to be recorded on the balance sheet of the extractor, we now focus on mineral resources.

Using natural resources

10. To begin, it is useful to examine the use of mineral resources in the broader context of natural resources. The draft 1993 SNA, Rev. 1 (Chapter 17: 'Cross-cutting and other special issues', paragraph 303) identifies three sets of conditions that may apply to the use of natural resources:

1. The owner may permit the resource to be used to extinction;
2. The owner may allow the resource to be used for an extended period of time in such a way that in effect the user controls the use of the resource during the time with little if any intervention from the legal owner; or
3. The owner may extend or withhold permission to continue use of the asset from one year to the next.

Using natural resources - mineral resources

11. Looking at the various possible arrangements to use mineral resources, the first option, whereby the resource is permitted to be used to extinction, clearly represents the sale of an asset. The draft 1993 SNA, Rev. 1 states that when a unit owning a mineral resource cedes all rights over it to another unit, this constitutes the sale of the mineral resource. This is not considered to be a typical arrangement for ownership and usage of mineral resources.

12. The second set of conditions effectively represents a shift in economic ownership (i.e. the risks and rewards of ownership) from the owner to the user. The great majority of arrangements for the extraction of mineral resources are expected to be governed by these types of conditions. One potentially important consideration is the question of who is responsible for the costs of mine decommissioning. If decommissioning costs are wholly or mainly met by the government, then a potentially substantial portion of the risks of owning the mineral resource also reside with the government.

13. Finally, the third set of conditions suggests that the legal owner maintains economic ownership by assuming most of the risks and rewards of ownership. In particular, the users' absence of long term control and access to the resource points to a simple operating lease type of arrangement. In practice, given the often very significant start-up and operating costs associated with mineral extraction, it is unlikely that a lessee would commit to this type of lease arrangement.

14. Until an arrangement has been made with an extractor, ownership of the mineral resource continues to reside with the legal owner. By extension, ownership of the mineral resource resides with the legal owner at the conclusion of the extractive licence.

Balance sheet allocation of mineral resource ownership

15. Under the first and third sets of conditions, the allocation of ownership of mineral resources in the balance sheet is relatively straightforward (the extractor under first set of conditions, and legal owner under the third). In practice, the second set of conditions is the most likely to apply to mineral resource deposits and it also represents the more challenging and contentious of the sets of conditions from an environmental-economic accounting perspective. It crosses into the area of leases, licences and permits which was one of the more contentious areas of economic accounting during the most recent SNA update process. Under the second set of conditions, there are three distinct possible options to allocate ownership of the mineral resource:

1. record on the balance sheet of the legal owner;
2. record on the balance sheet of the extractor; or
3. partition ownership between the extractor and the legal owner.

16. The following sections provide a brief description of how these options would work in practice. Two possible treatment options are suggested for partitioning ownership of the mineral resource. In each case, a simple representation of relevant balance sheet entries is provided. The data used in these representations are consistent with the data contained in the numeric example provided in appendix 2.

Recording ownership on the balance sheet of the legal owner

17. One widely considered option is to simply record the mineral resource on the balance sheet of the legal owner. It represents current practice within a number (perhaps the majority) of statistical agencies, including the Australian Bureau of Statistics (ABS). Using data from the example in appendix 2, the relevant balance sheet entries for this approach are shown in table 1.

Table 1: Recording ownership on the balance sheet of the legal owner

Balance sheet: legal owner

	Assets	Liabilities
Mineral resource	910	

18. Under this approach, the flow accounts record actual rentals (royalties) paid to the legal owner by the extractor. The charge for depletion, however, is applied to the production / income of the extractor.

Recording ownership on the balance sheet of the extractor – SEEA option D2

19. **Option [D2]** *shows ... the ... deposit as being in the* de facto *ownership of the extractor. In addition the extractor has a financial liability towards the owner corresponding to his share of the resource rent. This amount is also shown as a financial claim in the balance sheet of the owner.*

20. Option D2 attributes the entire ownership of the mineral resource to the extractor. Again, the flow accounts record actual rentals (royalties) paid to the legal owner by the extractor. The charge for depletion is applied to the production / income of the extractor.

21. This option requires that the extractor record a financial liability on their balance sheet equal to the NPV of their expected future rentals (royalties) on the mineral resource. The legal owner records a corresponding asset on their balance sheet. The relevant balance sheet entries are as shown in table 2 below, utilising data from the example in appendix 2.

Table 2: Recording ownership on the balance sheet of the extractor

Balance sheet: legal owner

Assets	Liabilities
NPV expected rentals (royalties), mineral resource 270	

Balance sheet: extractor

Assets		Liabilities	
Mineral resource	910	270	NPV expected rentals (royalties), mineral resource

22. A characteristic of this approach is that the mineral resource recorded on the balance sheet of the extractor is at least partially off-set by the future obligation to make rental (royalty) payments to the legal owner. And the legal owner will show a decline in wealth as extraction proceeds over time. However, the item 'NPV of expected future rentals (royalties) on the mineral resource' is potentially subject to significant revision throughout the life of the extractive licence.

Partitioning the mineral resource – SEEA option D1

23. **Option [D1]** *shows … the value of the deposit in the balance sheet of the legal owner. If the agreement between the owner and the extractor allows for the extractor to retain some of the resource rent coming from the asset, the ownership of the asset should be partitioned accordingly.*

24. Option D1 suggests recording the mineral resource on the balance sheet of the legal owner. However, it further states that where the extractor is permitted to retain some of the resource rent, ownership of the mineral resource should be partitioned. Given that, in most cases, the extractor could be expected to retain some of the resource rent, option D1 will generally result in a partitioning of ownership.

25. If rental (royalty) payments equal or exceed the resource rent, the legal owner is deemed to also be the economic owner for balance sheet purposes. However, this approach acknowledges that rental payments made by the extractor do not always cover the full value of the resource rent and that therefore some of the benefits (and risks) of ownership of the asset may reside with the extractor. Where this is the case, it is considered appropriate to perform a simple partitioning of the mineral resource based on the relative shares of expected resource rents and expected rental (royalty) payments. If the mineral resource is already being valued using NPV of expected resource rents, it is a relatively straightforward method to apply in practice. Balance sheet entries shown in table 3 below (using data from appendix 2) illustrate this approach.

Table 3: Partitioning ownership between the legal owner and extractor – SEEA option D1

Balance sheet: legal owner

	Assets	Liabilities
Mineral resource	700	

Balance sheet: extractor

	Assets	Liabilities
Mineral resource	210	

26. The share of the mineral resource 'owned' by the legal owner commands the payment of rental (royalty) from the extractor. While the share attributed to the extractor requires no explicit payment.

27. Under option D1 new discoveries and reappraisals enter the balance sheet through the *other changes in volume of assets account*, but do not elsewhere impact on the flow accounts. New discoveries and reappraisals will alter both the value of the mineral resource itself and value of expected rental (royalty) receipts. A new sectoral partitioning of the mineral resource will therefore be reflected in the balance sheet as a result of new discoveries and reappraisals. Changes to the value of the mineral resource (nationally, and by sector) between balance sheets are accounted for in the *other changes in volume of assets account*.

Partitioning the mineral resource – financial lease option

28. This option also potentially results in a partitioning of the ownership of the mineral resource between the legal owner and the extractor under conditions typically governing the use of a mineral resource.

29. The SNA defines financial leases as those leasing arrangements where the lessor, as legal owner of an asset, effectively passes economic ownership to the lessee who then accepts the operating risks and receives the economic benefits from using the asset in a productive activity. Under a financial lease, the legal owner is shown as issuing a loan to the lessee with which the lessee acquires the asset. Thereafter the asset is shown on the balance sheet of the lessee and not the lessor. The corresponding loan is shown as an asset of the lessor and as a liability of the lessee.

30. When using an imputed financial lease approach to partition the mineral resource, there is a question of precisely what asset is subject to the financial lease. Is the entire mineral resource deemed to be leased to the extractor, or just a portion of this amount?

31. A financial lease arrangement could operate as follows. The mineral resource is valued according to the NPV of the future expected stream of resource rents arising from its use, and the benefits arising from use of the resource beyond the life of the current extractive licence are attributed entirely to the legal owner. Benefits arising during the life of the present extractive licence are attributed entirely to the extractor. The extractor makes rental (royalty) payments to the legal owner which may or may not equal the benefits secured. For example, where the extractor makes rental (royalty) payments that are less than the benefits secured, the legal owner has effectively provided a 'gift' to the extractor equal to the difference between rentals paid and benefits secured. This 'gift' requires no explicit accounting.

32. On the other hand, it does not make economic sense for an extractor to pay rentals for a resource they already 'own'. Instead, we can think of the rental (royalty) payments as being repayments for a loan used by the extractor to purchase the mineral resource. These 'repayments' are comprised of imputed principal and interest components, consistent with a financial lease arrangement. That is, the share of the mineral resource assigned to the extractor could be treated as being subject to a financial lease arrangement with a schedule of imputed interest and principal repayments. Appendix 2 provides a more detailed presentation of how this method would operate in practice. But, using data consistent with appendix 2, attribution of ownership of the mineral resource will broadly operate as shown in table 4.

Table 4: Partitioning ownership between the legal owner and extractor – financial lease approach

Balance sheet: legal owner

	Assets	Liabilities
Mineral resource	430	
Loan, mineral resource	270	

Balance sheet: extractor

	Assets	Liabilities	
Mineral resource	480	270	Loan, mineral resource

What is the position of the draft 1993 SNA, Rev. 1?

33. Since the December 2007 meeting of London Group, the position of the draft1993 SNA, Rev. 1 on attribution of ownership of the mineral resource has been clarified and refined. Draft 1993 SNA, Rev. 1 provides relevant guidance in chapters 13 ('The balance sheet') and 17 ('Cross-cutting and other special issues'). Paragraph 13.50 relates to non-produced natural assets, specifically mineral and energy reserves, and addresses the fact that the owner and extractor of the resource are frequently different entities. This paragraph states that the entire mineral reserve should be recorded as a balance sheet asset of the legal owner because

"there is no wholly satisfactory way in which to show the value of the asset split between the legal owner and the extractor"

34. Draft 1993 SNA, Rev. 1 Chapter 17: 'Cross-cutting and other special issues' also discusses attribution of ownership of the mineral reserve. It contains a section on 'mineral deposits' which states that

> *"the wealth* (of the legal owner) *is being liquidated with the rent payments covering both a return to the asset and compensation for the decline in wealth. Although the decline in wealth is caused by the extractor, even if the deposit were shown on the balance sheet of the extractor, the rundown in wealth would not be reflected in the extractor's production account and thus not subject to consumption of fixed capital….For these reasons, simple recording of payments each year from the extractor to the owner as rent and changes in the size and value of the deposit as other changes in the asset accounts of the legal owner is recommended."* (Paragraph 17.332)

35. In short, draft 1993 SNA, Rev. 1 advocates attribution of ownership of the mineral resource asset to its legal owner. SNA is able to take this position specifically because "even if the deposit were shown on the balance sheet of the extractor, the rundown in wealth would not be reflected in the extractor's production account and thus not subject to consumption of fixed capital". That is, SNA implies that these natural resources are so abundant that no depletion need be charged against production. In contrast the updated SEEA does need to reflect the rundown in wealth (i.e. depletion) in the extractor's production account. That is, in the updated SEEA, the mineral deposit is subject to consumption of natural capital (i.e. depletion, which is analogous to consumption of fixed capital in the SNA). This is presently a pivotal distinction between the SNA and SEEA systems. As a result attributing ownership of the mineral resource entirely to its legal owner is not a completely satisfactory option.

36. Since SEEA does require a depletion charge against the output and income of the resource extractor, it is therefore necessary to present a treatment of mineral resource ownership that is cohesive with the treatment of various related flows (e.g. depletion, rentals/royalties). The evolution and clarification of SNA's position on this topic subsequent to the December 2007 meeting of London Group provides no basis for altering the decision taken at this meeting.

The 'least bad' solution?

37. Four possible options have been identified for attributing ownership of the mineral resource. All these solutions have drawbacks and our task appears to be one of finding the 'least bad' solution. A primary guiding principle should be that the accounting treatment reflects economic and environmental realities underlying the legal constructs.

38. In the first instance, the legal owner has clear ownership claims to the mineral resource, and assigning complete ownership to the legal owner is certainly a straightforward solution to the problem.

39. Recording the mineral resource on the balance sheet of the legal owner is simple to implement, which is an important consideration because, unlike produced assets, natural assets are not necessarily mainly located in those developed countries with sophisticated statistical agencies. For this and other reasons, it is desirable to promote an integrated environmental economic accounting that is achievable in as many countries as possible. It could be argued that recording the mineral resource on the balance sheet of the legal owner (i.e. consistent with the treatment recommended by the draft 1993 SNA, Rev. 1) is therefore a defensible option, or at least a defensible fall back option.

40. Where the legal owner of the mineral resource is the government and where the extractor is not required to put up a bond as surety against future decommissioning costs, it could be argued that the legal owner has retained a substantial portion of the risks of ownership of the mineral resource. While not conclusive of itself, this nevertheless represents a potentially important consideration in attributing ownership.

41. Recording the mineral resource on the balance sheet of the legal owner avoids some of the complexities of other possible solutions. See, for example, some of the concerns outlined in the discussion of imputed financial leases below. Nevertheless, it too has its own set of drawbacks. In the first instance, net worth of the legal owner (generally, government) is inappropriately inflated when mineral resources belonging to the extractor (as economic owner) are attributed to the legal owner.

42. It also makes sense to charge depletion of the mineral resource against the production of the extractor, since this is the entity undertaking the relevant productive activity. That is, the extractor is generating resource rent through extractive activity and depletion is a component of this resource rent. Attributing depletion to the extractive activity leads to appropriate industry measures of income and operating surplus. However, if the mineral resource is recorded on the balance sheet of the legal owner, depletion is charged to the production account of the extractor and to the balance sheet of the legal owner (in SEEA only—SNA requires no charge for depletion in the production account). This treatment is untidy and has no clear parallels within SNA or SEEA.

43. Recording the mineral resource on the balance sheet of the extractor recognises that the extractor has taken on the risks and rewards of owning the asset during the life of the extractive licence even though another entity retains legal ownership.

44. Due to the usually very significant start-up costs associated with mineral extraction, the extractive licence will generally be long term. There is also typically a pre-agreement on the method of calculating the value of payments to be made by the lessee to the lessor under an extractive licence which significantly transfers economic risks and benefits to the lessee. Additionally, an extractive licence is often transferable to another party, including through merger and acquisition. Recording the mineral resource against the balance sheet of the extractor may also sit reasonably closely with commercial accounting. In Australia, for example, the value of the extractive licence (though not the value of the mineral resource itself) is recorded in the balance sheet of the extractor. All of these factors point to the lessee effectively assuming economic ownership under an extractive licence.

45. Assigning the entire economic ownership of the mineral resource to the extractor, however, does not satisfactorily show the link between rental income (royalties) received by the legal owner, and the decline in the value of the asset. Under this approach, the legal owner commands rentals (royalties) for an asset which does not belong to them (according to the national balance sheet). And the extractor is suffering both a decline in asset wealth and making rental (royalty) payments in relation to their extractive activity – a situation contrary to SNA principles. Simply recording the mineral resource on the balance sheet of the extractor results in zero wealth from the mineral resource being attributed to the legal owner, which means that the recorded wealth of the legal owner is completely unaffected by levels of extractive activity—again, an incongruous result.

46. Attributing economic ownership of the entire mineral resource to the extractor is not ideal for productivity analyses where, ideally, we want to compare output generated from extractive activity with relevant assets of the extractor. It is appropriate to include only those mineral resources over which the extractor holds economic ownership.

47. In order to partially counteract the above issues, option D2 requires that the extractor record a financial liability on their balance sheet equal to the NPV of their expected future rental (royalty) payments to the legal owner. The legal owner records the corresponding asset on their balance sheet. This means that the mineral resource recorded on the balance sheet of the extractor is at least partially off-set by the future obligation to make rental (royalty) payments to the legal owner. And the legal owner will show some decline in wealth as extraction proceeds over time. Introducing this financial asset/liability therefore better reflects the net position of both the legal owner and the extractor.

48. The extractor will typically lease the mineral resource for only a portion of its expected life. Expected resource rents for the period beyond the life of the extractive lease unambiguously belong to the legal owner of the mineral resource. However, option D2 implicitly assigns expected resource rents beyond the expiry of the extractive licence to the extractor.

49. In addition, the balance sheet items 'NPV of expected future rentals (royalties) payable and receivable on the mineral resource' are somewhat contingent in nature and the 1993 SNA (paragraph 13.22) recommends against recording such items on the national balance sheet. Of course, there is no reason why these items could not feature in an alternative analytical framework (such as SEEA), but the required data would not typically be produced within the national accounts. It's likely that these items would be subject to significant revision throughout the life of the lease agreement. Rental (royalty) payments are frequently levied as a proportion of the value of extractive output, or as a fixed amount per unit of physical output, though other arrangements are possible. (For example, in Australia, royalties on petroleum resources are levied as a proportion of profits arising from petroleum extraction.) In any case, the value of expected future rentals (royalties) arising from the use of a mineral resource would be dependent on a range of factors which are unlikely to be forecast with great precision. Such factors would include: changes in production rates; changes in market prices; changes to production methods/costs; among other things.

50. Under the type of lease arrangements typically governing the extraction of a mineral resource, it is reasonably clear that economic ownership of the resource resides with the extractor for the duration of the extractive lease agreement. Beyond the life of the lease arrangement, ownership of the mineral resource clearly resides with the legal owner. Therefore, any proposal to assign the entire ownership of the mineral resource to either the extractor or the legal owner is not ideal.

51. Because mineral resources are, in practice, usually valued as the NPV of expected resource rents arising from the extraction of the resource, it is possible to assign a value to the mineral resource pertaining to the period of the lease agreement, and to the period beyond the lease agreement. A partitioning of the mineral resource therefore looks achievable as well as appropriate. Two possible approaches to the partitioning of the mineral resource are described in this paper. Both are workable solutions.

52. Option D1 is arguably the simpler of the two partitioning methods discussed here because it avoids the imputations of a financial lease (i.e. its imputed interest and principal repayments). Instead, it involves a simple partitioning of the mineral resource based on relative shares of expected resource rents and expected rental (royalty) payments.

53. While option D1 results in a partitioning of the mineral resource, unless the rentals (royalties) charged by the legal owner approximate the value of the resource rents, it could result in a poor representation of the partitioning. For example, if rentals (royalties) are less than the resource rents generated during the period of the extractive licence, then option D1 will understate the share of the mineral resource over which the extractor exercises economic ownership.

54. The proposed financial lease approach partitions ownership of the mineral resource according to the NPV of expected benefits during the period of the extractive licence (attributed to the extractor) against the NPV of expected benefits beyond the period of the extractive licence (attributed to the legal owner). Since the extractor is effectively the economic owner of the mineral resource for the period of the extractive licence, this approach provides the more appropriate partitioning.

55. An important feature of this financial lease approach is that it supports appropriate depletion adjustments to various accounting aggregates. This is because the NPV of resource rents for the period of the extractive licence rests entirely with the extractor. That is, the extractor assumes economic ownership of the mineral resource for the period of the extractive licence. Therefore, it is a straightforward matter to generate depletion adjusted output, income and saving of the extractor. And the utility of data outputs for various analytical purposes (sustainability, productivity etc.) is thereby maximised.

56. During the life of the extractive licence, it is likely that the mineral resource in question will be subject to new discoveries or reappraisals. Proposals to account for these factors usually involve direct revisions to the balance sheet through the *other changes in the volume of assets account*. Ideally, the flow accounts should also reflect revised measures of benefits secured by the extractor. Under the financial lease approach, new discoveries or reappraisals associated with the mineral resource in question are readily reflected in revisions to expected rental (royalty) payments by the extractor within the flow accounts. Of course, in many cases the rentals (royalties) will be less than the expected resource rents and therefore the flows will not reflect the full market value of the mineral resource.

57. The treatment of new discoveries and reappraisals under the financial lease approach does not amount to bringing these items within the production boundary of SEEA / SNA. New discoveries and reappraisals continue to enter the balance sheet through the *other changes in the volume of assets account*. They are not the output of an economic production process. The financial lease approach simply allows relevant transfer items within the flow accounts to reflect relevant asset values.

58. While the financial lease approach is relatively complex, it nevertheless provides an elegant solution to appropriately represent partitioning of ownership between legal owner and extractor under the types of conditions typically governing mineral resource extraction. It also maintains an appropriate partitioning throughout the entire life cycle of the mineral resource asset, and thereby provides the appropriate measures for such things as analyses of wealth and resource productivity. It readily deals with new discoveries and reappraisals of mineral resources within the various flow accounts. Importantly, it supports a sequence of transactions in the flow accounts that reflect and explain economic reality, for example transactions related to depletion and to rental/royalty payments.

Appendix 2: Ownership of the mineral resource under an imputed financial lease arrangement

Period of the extractive lease agreement					
Expected:	Year 1	Year 2	Year 3	Year 4	Year 5
NPV – resource rent	100	98	96	94	92
NPV – royalties	56	55	54	53	52
Depletion	20	20	20	20	20
Income from extractive activity	80	78	76	74	72
Period beyond the extractive lease agreement					
Expected:	Year 6	Year 7	Year 8	Year 9	Year 10
NPV – resource rent	90	88	86	84	82
NPV – royalties	na	na	na	na	na
Depletion	20	20	20	20	20
Income from extractive activity	70	68	66	64	62

na not applicable

NPV (resource rent) of mineral resource	910	
NPV (resource rent) of mineral resource period of lease	480	Allocate ownership to extractor, balance sheet year 1
NPV royalties (period of lease)	270	
Balance NPV lease period	210	i.e. 480 - 270
NPV mineral resource)beyond life of lease)	430	Allocate ownership to legal owner, balance sheet year 1

ASSET

Mineral resource: Legal owner	430
Mineral resource: Extractor	480

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