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Outcome Paper**

Outcome Paper for Global Consultation

Issue #13: Recording of Depletion for Non-renewable Resources¹

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¹ This outcome paper has been prepared by the SEEA Editor. It is based on papers presented to the London Group of Experts on Environmental Accounting and discussions among those experts. Investigation and research for this outcome paper was led by David Bain and Peter Comisari of the Australian Bureau of Statistics.

A. Introduction

1. A characteristic of the System of Environmental and Economic Accounts (SEEA) 2003 is the provision of multiple solutions to various environmental accounting issues, including for a number of aspects of natural resource depletion. The proposed elevation of SEEA-2003 to an international statistical standard requires that these options be replaced with unambiguous accounting recommendations.

2. Chapter 10 of SEEA-2003: “Making environmental adjustments to the flow accounts” is comprised of three sections—depletion, defensive expenditure and degradation. The five sets of treatment options in the depletion section relate to the following five topics:

- i. Identifying the income and depletion elements of resource rent.
- ii. Recording mineral exploration and mineral and energy resources.
- 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.

3. This outcome paper discusses the first three of these topics. Topics (iv) and (v) are covered in an outcome paper for Issue #15a: Recording the ownership of mineral related assets. It is also noted that for the third topic there is a difference in treatment according to whether the natural resource is renewable or non-renewable. This paper limits its scope to the discussion of non-renewable natural resources. The treatment for renewable natural resources is considered under another outcome paper for Issue #14: Recording of depletion for renewable resources. Given the interconnections between these various issues it is recommended that reader consider all three of these outcome papers in a joint fashion.

B. Topic 1: Identifying the income and depletion elements of resource rent.

4. Resource rent represents the earnings of an extractor of a natural resource after deducting all costs of extraction including the costs incurred in the use of produced capital. There is debate as to what extent these earnings represent the income of the extractor or reflect a cost to the extractor. The cost is equal to the reduction in future income that occurs because the natural resource has been extracted and does not replenish. This cost is generally referred to as depletion and reflects the change in the value of the natural resource due to the physical removal of the resource.

Options for treatment within SEEA

5. SEEA-2003 provided three options for the allocation of resource rent between income and depletion.

SEEA-2003 Option A1: All resource rent represents income.

6. The first option outlined in SEEA-2003 (Box 10.1), that the entire resource rent represents income, is the implied position taken by the 1968 System of National Accounts (SNA). The 1993 SNA and the 2008 SNA take a similar stance within its production account, where the derived value added by definition includes depletion of natural resources. That is, depletion is not recognized as a cost of production.

7. As SEEA-2003 (para 10.27) states, this position of the SNA implies that natural resources are infinitely abundant and hence do not change in economic value over time. This view is evidently not true for a great number of natural resources. The view of the London Group is that the cost of using this type of asset should be reflected in the accounts because if extraction of a natural resource reduces potential production in the future then an economic cost has occurred. Of course, in situations where no depletion can be identified then by definition all resource rent will represent income.

SEEA-2003 Option A2: No resource rent represents income; it is all a decline in the value of the resource.

8. The second option, described in SEEA-2003 (Box 10.1) is that none of the earnings from extracting natural resources is income from production and therefore all such earnings should be excluded from output and value added of the extractive industries. The whole of the resource rent should be treated as the depletion of the natural resource.

9. Vanoli (1995, pp128-129) supports this position and states that earnings from mining activities is akin to financing consumption expenditure out of a reduction in net worth from asset sales. That is, 'income' from extractive activity is not income at all but simply the sale of a non-produced asset; and the sale of an asset does not constitute economic production. Vanoli reasons that extractive activity does not physically transform the natural resource, rather that this activity has more in common with transport or retail and wholesale activities. Therefore he deems it appropriate to exclude the value of natural resources sold by the extracting industries from the output of such industries thus reducing by this amount the value of output as currently measured in the national accounts. This position (option A2) is taken not only in respect of mineral and energy resources, but also for earnings arising from the use of renewable natural resources (attributed to Vanoli in SEEA-2003, para 10.28).

10. One of the implications of this approach, i.e. reducing the value of output by the value of the natural resource sold, is that the price received by the extractor for the product they produce is no longer equivalent to the price paid by the purchaser. This 'price wedge' introduces a further level of complexity into the process of balancing the supply and use of products in the national accounts. In order to maintain a balanced system, adjustments would need to be made to the expenditure side of the national accounts, for example, to exports that would result in a different balance of trade. Although it is possible to compile balanced estimates on the basis of this option, the impact on a number of balances within the system as well as the impact on the detailed balance of products needs to be considered carefully.

11. One way option A2 can be made to 'work' in an accounting sense is by treating resource rent as a withdrawal from inventories, thereby removing the value of resource rent from measured output. However, in a note written in 2000, Peter Hill emphasises that stocks of natural resources must be clearly distinguished from inventories. All goods held as inventories can be immediately withdrawn and sold on the market, if desired. On the other hand, quantities of a natural resource cannot all be immediately extracted and sold on the market but are instead delivered through a costly and time consuming process of production. This is a crucial economic difference between natural resources and inventories. The cost to the owner of the natural resources of extracting some quantities now (i.e. depletion) is less than the current market value of the quantities extracted. This is the basis of the owner's operating surplus. Therefore extraction of natural resources should not be treated in the accounts in the same way as withdrawals from inventories.

12. The complete removal of resource rent from measures of income may give rise to problems in the national accounts. If resource rent is not considered income then logically certain flows associated with the resource rent should be removed from the current accounts and somehow accounted for in the capital accounts. A failure to do so will lead to serious distortion of net saving recorded for the extractive industries. For example, income tax paid by a mining company would need to be partitioned into that which is attributable to depletion-related activity and that which is attributable to other activity (e.g. mineral exploration). The range of adjustments required come with a number of serious practical difficulties making them problematic to implement. They would also reduce the utility of the national accounts because they are so far removed from generally accepted business and government accounting principles.

13. Because this option removes the entire resource rent from the output and value added of (particularly) the extractive industries, it also does not recognise the often substantial incomes that resource-rich countries generate from these activities. As stated, it therefore widens the

gap between income measures in business reporting and in the national accounts and distorts the financial reality of extractive industries as an often significant base for government revenue, among other things.

14. All of these factors suggest that option A2 would undermine the practical value and relevance of the accounts.

SEEA-2003 Option A3: Part of the resource rent represents a decline on the value of the asset and part is income.

15. The third option presented in SEEA-2003 (Box 10.1) views part of the resource rent as representing income and the remainder representing the using up of the natural resource (i.e. depletion). Under this option revenue produced from the use of a natural resource in an accounting period is split into two elements: a return to the owner of the natural resource; and an element representing the change in value of the natural resource. As a natural resource becomes scarcer, the share of income diminishes until, in the period in which the natural resource is finally exhausted, all the revenue represents the value of withdrawal of natural capital (Harrison, 1999).

16. The values of both fixed assets and natural resources depend upon their contribution to production and these values are realised only if their owners use them in a process of production. The relevant economic characteristic of both fixed assets and natural resources is that they are typically not used up in a single year but instead deliver services to their owners over a long period of time. This suggests that while natural resources are neither fixed assets nor inventories, they have more in common with the former and their treatment should follow that of fixed assets rather than inventories.

17. The value of a fixed asset can be understood as the net present value of the expected stream of benefits flowing from its future use. An entire natural resource cannot be extracted within a short period of time, regardless of the asking price. Therefore the value of the natural resource to its owner is not equal to the physical quantity multiplied by the current price of a unit extracted. Rather, it is valued in the same way as fixed assets, i.e. quantities scheduled to be withdrawn in the future must be valued at their present value so that the average price for all the quantities making up the stock will be lower than the current market price (Hill, 1998 p3). In fact, within the current period, the current value of the quantities extracted (at a resource rent unit price) minus the decline in the present value of the total stock, constitutes the income receivable by the owner of the stock.

18. If SEEA-2003 serves the role of an analytical framework supporting a sustainable development information system (Smith, 2005 p12) then option A3 displays a strongly intuitive sequence of adjustments within such a framework. It appears to send the appropriate message to policymakers, that is, the depletion of a non-renewable natural resource over time will have an increasing negative impact on NDP. The impact becomes more marked as complete exhaustion of the natural resource is approached. As a signal to alert policymakers to an emerging impact on production and income, this appears to be a wholly appropriate accounting sequence.

Recommendation: That the income and depletion elements of resource rent be treated in line with SEEA-2003 Option A3 whereby part of the resource rent represents a decline in the value of the natural resources and part is income.

The measurement of income and depletion elements in an NPV framework

19. While there is a clear case for the recommendation of allocating resource rent between a depletion element and an income element it is less clear exactly how this allocation might be best undertaken. A variety of methods have been developed and the general conclusion from an assessment of the methods is that the use of Net Present Value (NPV) techniques allows a coherent estimation of the value of the underlying resource, the depletion and the income

elements. The following presents a short summary of the key elements of the approach. An important caveat to the presentation is that the following derivations ignore the impact of price changes. Ultimately these price changes need to be taken into account but the underlying logic of the approach will still hold.

20. Following the NPV framework the value of a natural resource can be described in the following formula

$$V_t = \sum_{s=1}^N \frac{RR_{t+s}}{(1+r_t)^s} \quad (\text{Equation 1})$$

where: V = net present value, RR = resource rent, r = discount rate, N = asset life. Note that the time period "t" refers to the accounting period in respect of RR and r but for V it refers to the balance sheet date at the end of the accounting period – i.e. this formulation gives an estimate of the value at the end of period t.

21. Recognising that the concept of depletion is related to the change in the value of a natural resource due to the physical removal of the resource, the following result can be defined

$$d_t = V_{t-1} - V_t = RR_t - r_t V_{t-1} \quad (\text{Equation 2})$$

Rearranging terms

$$RR_t = d_t + r_t V_{t-1} \quad (\text{Equation 3})$$

22. Therefore, via the NPV framework the resource rent can be shown to be composed of a depletion element, d_t , and an income element, $r_t V_{t-1}$ where the income element is defined as the rate of return multiplied by the value of the natural resource at the beginning of the period.

23. As a simple, stylized example assume that we have a natural resource with a life of 5 years which generates resource rent (RR) of 100 per year. Assume the rate of return, r, is 5%pa.

24. Using the NPV equations the value of the resource at the beginning of the 5 year period, V_0 , is 432.95. The value at the end of the first period, V_1 , is 354.60. Depletion, d, is equal to V_0 less V_1 , or 78.35.

25. The income element can be calculated residually as $RR - d (= 100 - 78.35 = 21.65)$. Or it can be calculated directly as $r * V_0 (= 0.05 * 432.95 = 21.65)$.

26. In practice there are a range of measurement issues that need to be considered before a full NPV based allocation can be determined. However, for the purposes of understanding the underlying logic of the discussion in the outcome paper this stylized example is sufficient.

The measurement of income within resource rent in the case of no extraction

27. The estimates that emerge from the use of NPV are necessarily based on a number of assumptions regarding the resource life, the physical size of the resource, extraction rates, the flow of resource rents over the resource life and discount rates that reflect the greater value of returns earned in the current period compared to those earned in later periods. Work has shown that in cases where these assumptions do not reflect the underlying reality implausible outcomes can arise.

28. Implicitly the plausibility of NPV estimates relies on the forecasts of future income and extraction being relatively smooth over the resource life – often they are assumed to be constant based on current levels of resource rent and extraction rates. A particular concern has arisen that is focused on understanding the implications for NPV estimates of a sharp decline in extraction in a particular period to zero or very small amounts. When this occurs, for example due to a mine accident or worker's strike or collapse in mineral prices, then the use of a zero value for extraction within a longer run NPV formula will continue to generate estimates of income and depletion in that period. Indeed the estimates of depletion will be negative implying an increase in the value of the resource.

29. It can be shown mathematically that the negative depletion is reflective of the so called time passing effect which is that, all else being equal, the value of a natural resource will rise if the income stream to be earned in the future is one period closer to realization.

30. Some accounting solutions to this problem have been proposed whereby the extent of the time passing effect is not treated as either income or depletion but is treated as a holding gain in the revaluation account or as an other change in the volume of assets. In both solutions the odd impact on the production and income accounts is removed and the change in the value of the natural resource is accounted for.

31. Discussion within the London Group concluded that these accounting approaches did not lead to sound outcomes in terms of the new entries and the time passing effect was not considered to be a revaluation or an other change in volume.

32. Instead the London Group concluded that the 'time passing' effect is not passive and that value does not simply accrue because the income flow is one temporal step closer to realisation. The value of the natural resource (and of the 'time passing' effect) are rooted in an expectation that the owner of the natural resource will use it according to an identified schedule of production, with expected output prices and production costs (among other assumptions). The calculation of natural resource values (and therefore depletion) is entirely based on an expectation of benefits arising from a defined schedule of extractive activity.

33. There is typically an expectation that production will continue without significant pause throughout the life of the mining or other extractive activity. However, when operations cease for a period of time (for example, due to a natural catastrophe) and there has been a change to the expected schedule of extractive activity this should be reflected in the NPV model and the NPV model should be re-estimated to reflect changes to the schedule of extractive activity.

34. Therefore where it is known that the extraction is zero in a particular period then the process of NPV calculation should effectively be suspended for one period such that no income or depletion estimates are calculated.

35. It is noted that the adverse impact of ceased production on NPV calculations is more likely to be felt when there are a limited number of mines and mineral types. Under other circumstances—e.g. where a country hosts a significant number of diverse extractive operations—the NPV model might reasonably be expected to deliver defensible results across the extractive industry as a whole.

Recommendation: That, in the absence of market valuation, NPV approaches be considered the best way to measure the value of natural resource and the associated income and depletion; noting that care should be taken in the application of NPV approaches such that the estimates that emerge from the model reflect the underlying observed extraction patterns.

C. Topic 2: Recording mineral exploration and mineral and energy resources

Background

36. SEEA-2003 (Box 10.3) sets out three options for the recording of mineral exploration and mineral and energy resources. The central question is whether mineral and energy resources are the output of some type of productive activity as defined in the 2008 SNA or whether they constitute non-produced assets. If the former, it is necessary to identify the productive activity that gives rise to the mineral and energy resources and to determine whether the value of discoveries of mineral and energy resources is the value of the output of that activity.

37. The 2008 SNA records new discoveries under 'other volume changes' which implies that they are not the result of transactions attributable to economic activities such as production and capital formation. This is not a perfect solution for a number of reasons. Firstly, it seems the case that new discoveries of mineral and energy resources arise from dedicated action by

particular units, that is, discoveries are not accidental. In particular, discoveries are dependent on mineral exploration that is recognized as a productive activity, and discoveries are not generally totally unexpected. On the contrary, discoveries may be fairly predictable.

38. However, the alternative treatment looks less satisfactory. If new discoveries are outputs, it is necessary to identify the productive process giving rise to the entry of this natural resource on to the balance sheet. It has been argued that the activity of mineral exploration gives rise to the output of mineral and energy resources. However, the treatment of new mineral and energy resource discoveries as 'produced' by the activity of mineral exploration raises a number of questions. How is the mineral exploration asset used, that is, what production process does this asset facilitate? Is this asset used to 'produce' new mineral and energy resources previously unknown, or is it used in the subsequent process of extracting the discovered mineral and energy resources?

39. One argument concerning the appropriate treatment is that the output of mineral exploration activity is information and knowledge about mineral and energy resources — not the resource itself. That is, the mineral exploration asset is used as part of the subsequent process of extracting the discovered mineral and energy resources. For example, knowledge of the characteristics of a mineral and energy resource (such as its magnitude, structure and composition) could clearly be useful in the mineral extraction process.

40. Under the 2008 SNA, the fee charged by the mineral exploration firm gives rise to an intellectual property product in the accounts of the extractive firm that purchases the mineral exploration asset. If the firm undertaking the mineral exploration and the mineral extraction is the same unit, then the exploration activity is treated as own account gross fixed capital formation. Even under an own account production scenario the activities of mineral exploration and mineral extraction are nevertheless completely separate.

41. The activity of mineral exploration can thus be seen as distinct from other activities of the extractor. The exploration activity may be undertaken by a specialist mineral exploration enterprise that is completely separate from the mining company, with the value of mineral exploration output equal to the fee charged by the exploration enterprise. The specialist exploration company has no claim over any discovered mineral and energy resources, and therefore cannot be considered to have sold or somehow passed on the mineral and energy resource itself to the extracting enterprise purchasing the mineral exploration services. It would be reasonable to associate the mineral exploration produced asset with the process of mineral extraction, rather than with new discoveries of mineral and energy resources.

42. Based on discussion of these issues the conclusion of the 2008 SNA is that new mineral and energy resources are not the output of mineral exploration activity but instead enter the system through the 'other changes in volume of assets account' as a non-produced assets. Mineral exploration expenditure is viewed as a form of gross fixed capital formation giving rise to an intellectual property product

Options for treatment within SEEA

SEEA-2003 Option B1: Is to record values for both the mineral exploration and the mineral deposit which come from independent sources, neither depending on a calculation of the resource rent of the deposit. There is no guarantee in this case that the sum of the assets will exactly match the net present value of the stream of resource rents: the total may be either greater or smaller than this depending on the assumption underlying the value of the deposit. (SEEA- 2003, Box 10.3)

43. Valuation of assets should generally be equal to the future stream of benefits expected to flow from their use in production. Option B1 is not necessarily consistent with this principle. It involves recording values for both the mineral exploration and the mineral and energy resource using independent sources, with neither component being systematically linked to the derivation of the resource rent. SEEA-2003 (paragraph 8.55) speculates that values derived from a market for discovered natural resources are likely to be higher than the net

present value of the resource rent for the mineral and energy resource because these values reflect the combined asset value of the mineral exploration and the mineral and energy resource. In other words, the recorded asset values will tend to double-count the value of the mineral exploration asset because mineral exploration is recorded as a stand-alone asset and also (most likely) as a component of the reported value of the mineral and energy resource. If this does occur, the value of the mineral and energy resource will not equal the expected future stream of benefits (resource rent) arising from its use; an inconsistency with SNA accounting principles.

SEEA-2003 Option B2: Is to record the value of mineral exploration based on either market prices or costs (depending on whether it is carried out by a contractor or on own account) and to base the value of the mineral deposit on the net present value of the resource rent calculated to exclude the value of mineral exploration. (SEEA-2003, Box 10.3)

44. An advantage of option B2 is its capacity to minimise the risk of double counting mineral exploration with the associated mineral and energy resource. This can be done by including the value of mineral exploration as a cost of production in deriving the estimate of the resource rent that is then used in calculating the value of the mineral and energy resource.

SEEA-2003 Option B3. Leads to identical values as option B2 but treats the sum of the two values as attributed to a "developed natural asset" which would be recorded as a tangible produced asset. By contrast, in the SNA mineral exploration is classified as an intangible produced asset and the mineral resource as a tangible non-produced asset. There is no impact on the asset account or on the balance sheet of this change (except for the headings used) but there are changes implied for the flow accounts. (SEEA-2003, Box 10.3)

45. This option combines the value of mineral exploration expenditure with the value of the associated new mineral and energy resource discoveries to form a 'developed natural resource' that is classified as a produced asset. In effect it assumes that mineral exploration expenditure gives rise to (and forms part of the valuation of) the new mineral and energy resource discovery.

46. One attraction of this option is that it provides a means of accounting for new discoveries of mineral and energy resources (as well as depletion) in the capital and production accounts. If discoveries of mineral and energy resources were the 'output' of mineral exploration activity (which is an acknowledged SNA production activity) then new discoveries of mineral and energy resources could readily be recorded as outputs in the production account. There is strong intuitive appeal in achieving a symmetrical recording of both new discoveries and depletion of mineral and energy resources in the system.

47. However, option B3 is inconsistent with the 2008 SNA because it implies that discoveries of mineral and energy resources are an 'output' of mineral exploration activity. The 2008 SNA Chapter 10: The Capital Account very clear in explicitly stating that the value of the mineral exploration asset is *not* measured by the value of new mineral and energy resources discovered. The 'developed natural resource' is clearly a combination of an SNA intellectual property product (mineral exploration and evaluation) and an SNA non-produced asset (mineral and energy resources).

48. Further, the use of option B3 requires amortisation and depletion of the 'developed natural resource' which looks difficult to justify in concept and in practice even harder to measure. One component of the 'developed natural resource' value relates to knowledge about the mineral and energy resource and the remainder to the value of the resource itself. However, knowledge assets do not suffer physical decline, the amortisation of these assets is entirely due to obsolescence of the knowledge. This is in contrast to mineral and energy resources that are characterised by a progressive physical reduction in the quantity of the mineral and energy resource available to extract. The value of these two assets will not always decline at the same rate. It would seem a very difficult task to depreciate the 'developed natural resource' in an appropriate manner given its composition.

Recommendation: That the value of mineral exploration be based on either market prices or costs depending on whether it is carried out by a contractor or on own account and that the value of mineral and energy resources should be based on observed market value or, where this is unavailable, on the net present value of the resource rent. Further, the value of mineral and energy resources should be calculated to exclude the value of any associated mineral exploration.

D. Topic 3: Recording additions to and subtractions from the stock of environmental assets

49. Within the broad category of natural resources there are a number of categorisations that are relevant. The first categorisation is into natural resources that are produced and non-produced. The general position of the 2008 SNA is that a purely natural process without any human involvement or direction is not production in an economic sense. 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 discussed earlier in this paper, the formation of mineral and energy resources does not constitute economic production as defined by the SNA. Similarly, natural growth of renewable natural resources such as fish stocks does not constitute economic production in the SNA unless it is organised, managed and controlled by institutional units.

50. The second categorisation is to separate between non-produced natural resources that are renewable and those that are non-renewable. Aside from mineral and energy resources that are considered non-renewable, all non-produced natural resources are considered renewable since there is the potential for there to be additions to the resource over time.

The treatment of flows of non-produced natural resources

51. SEEA-2003 (Chapter 10, Box 10.4) presents three options for recording additions to and subtractions from the level of natural resources. The three options are:

- i. 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.*
- ii. 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.*
- iii. 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.*

The treatment of flows of non-renewable natural resources

52. The question of whether non-renewable natural resources should be treated as 'produced' or 'non-produced' has not been explicitly considered earlier in this paper. However, in the section in which the recommendation was made regarding the treatment of mineral exploration and mineral and energy resources, the conclusion was that mineral and energy resources – and hence all non-renewable natural resources – should not be treated as a type of developed natural resource.

53. Consistent with this recommendation is the conclusion that mineral and energy resources themselves are not formed through a process of production and hence cannot be considered to be produced. As a consequence option C3 regarding the treatment of flows of natural resources must be rejected. Further, option C2 requires the recognition of discoveries of mineral and energy resources in the income account that implicitly extends the production

boundary of SNA in a similar way to option C3. Given this situation, option C2 is also rejected for the treatment of flows of non-renewable natural resources.

54. However, it is recognized that if it is concluded that non-renewable natural resources are non-produced, 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.

55. While this asymmetry may be present, one of the key motivations for developing environmental and economics accounts is to determine approaches by which the cost of using natural resources – i.e. depletion - can be reflected within the traditional economic accounts. Hence, presenting a measure of depletion adjusted value added and operating surplus is an important objective.

Recommendation: That the additions to and subtractions from non-renewable natural resources be treated in line with SEEA-2003 Option C1 whereby the depletion of natural resources is recorded in an extended generation of income account leading to a depletion-adjusted operating surplus, and the increases in non-renewable natural resources due to discoveries are shown in the other changes in assets account.

The treatment of flows of renewable natural resources

56. The proposed treatment of flows of renewable natural resources is discussed at more length in a separate issue for global consultation – Issue #14: Recording of depletion for renewable resources. The ultimate conclusion for that issue is that the flows should be recorded consistent with SEEA-2003 Option C2 whereby both the consequences of extraction and the net natural growth of renewable natural resources are recorded in the extended generation of income account leading to a depletion-adjusted operating surplus.

57. Readers are referred to the outcome paper for Issue #14 for an in-depth explanation of this proposed treatment.

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