Aligning SNA with SEEA

A Layout for the Evaluation of the Guidance Notes in the SNA Update Process[1]

(work in progress)[2]

London Group Meeting, Siegburg Germany, 26-29 September 2022

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[1] The usual disclaimer applies.

[2] The ambitions of this paper could not be fully met within the time limits of the London Group Meeting therefore it should be noted that this paper is *work in progress*. Nevertheless, we would like to share our view and receive useful comments for further refinement of the structure, content and our conclusions.

Introduction

1. The issue of integrating environmental issues in the System of National Accounts (SNA) has been on the agenda ever since the 1980-ies. At the same time, the work on developing what has become the System of Environmental-Economic Accounting (SEEA) started. The SNA and SEEA have thereafter developed in parallel but not being wholly aligned with each other.

2. In the update of SNA at that time, work of solving some issues regarding the asset boundary was also on the agenda. This work was done from a different perspective (Marginal Theory) than the ideas behind the original national accounts framework (Keynesian), which still provide the bone structure of it. This mix has over the years led to confusion and some animated discussions, in particular, over the definition of income and environmental issues like the recording of depletion and degradation (SNA §§ 29.120 ss).

3. The asset boundary of the SNA is restricted to the assets on which economic agents have ownership rights. This is a clear restriction for the inclusion of environmental assets in the framework. In the 1993 update, ownership was clarified to mean the economic agent that benefit from the use of assets in production. By defining the economic owner, the issue of financial leasing was solved, but the word *benefit* still raises some problems in the understanding of the concept *economic ownership*. This has not the least become obvious in the discussions of natural resources. It is even more evident in the discussion of ecosystem services, where the notion of benefit tends to be extended and stretched far beyond what's commonly understood as economic benefit and the SNA. Ecosystem services are not in the scope of the current SNA revision but they may be in a next round, if the current trend of progressive shift towards the marginal theory is confirmed.

4. In the current updating process of the SNA there should be no surprise that the greatest challenge lies in the integration of some environmental issues. Guidance notes (GN) have been issued on four major topics to be regarded for revision in 2025. The topics are: WS.6 GN on Accounting for the Economic Ownership and Depletion of Natural Resources, WS.8 GN on Accounting for Biological Resources, WS.10 GN on Valuation of mineral and energy resources, and WS.11 GN on the Treatment of Renewable Energy Resources as Assets.

5. Furthermore, there are also some other topics that need to be reconsidered in order for SNA to be internally consistent and – possibly – aligned with SEEA. These topics include WS.7 GN on the Treatment of Emission Trading Schemes and the recording of Radio Spectra currently included in the SNA. The latter however is not an issue in the research agenda of the ongoing revision.

6. The outline of this paper is as follows. First, we turn to the basic ideas of SNA information system and focus on the relation between nature and the economy in terms of volume. After that we visit the ideas of the Marginal Theory approach, an alternative perspective on the economy and clarify the difference in relation to SNA. Then we shortly present the SEEA information system, separate but basically consistent with the SNA. In connection to this we also make a comparison between the asset boundaries in the SNA and SEEA CF including a proposal to exclude Radio spectra from SNA. Having laid the ground for different perspectives on accounting we turn to the issue of aligning SEEA with SNA and what might be the important issues in this respect. Before we scrutinize the current proposals for revising SNA there is a small note on valuation that points at some problems in the understanding of SNA. Finally, we make some remarks on the current proposals for revising SNA and in particular the guidance notes mentioned above.

The System of National Accounts

7. The main purpose of national accounts framework is to support a statistical approach to the measurement of economic activity by estimating the volume of value added that sums up to the GDP aggregate. SNA states explicitly that it is not intended as a framework for the measurement of welfare (cf. SNA2008 §1.1 and § 1.75) and it does not even need to mention that it is not fit for resource use and environmental sustainability analysis. This purpose of the SNA is important for the understanding of the asset boundary in relation to SEEA and the possibilities of aligning SNA with SEEA, which complements the SNA precisely in relation to the limitations just pointed out. Another important purpose is the overarching ambition of providing a social accounting framework.

Nature in the SNA

8. The creation of value added is a human activity. Nature is in no respect regarded as an economic agent that is contributing to the output of a productive activity in the economy. But nature is the source of all inputs transformed into assets and consumption goods. Nature is vital for the working of the economy and is treated in the SNA as a free resource to mankind.[3] This view on nature as a free resource is a cornerstone in social accounting. Free does not mean that nature is not changed by economic activity, but only that no matter whether there is much or little, whether the change induced is from an economic perspective bad (degradation, depletion) or good (spontaneous or assisted regeneration), there is no human input in whatever nature is available, by definition of nature (any human inputs is "subtracted").

9. Nature is free to mankind as a whole, however, but not necessarily for all economic agents: if property rights are enforced, income can be derived by nature's owners directly by giving access to it to others. Property rights are always enforced on derived products, so economic owners (users with free access) of nature may be able to reap rents from the competitive edge given by their exclusive or privileged access to nature. These rents are a consequence of the social relationship established by the institutional settings concerning property rights and free appropriation, determining monopoly-like market power on non-produced items that are used in production. They participate in the distribution (allocation) of the results of human activity applied to nature (value added) but do not represent a direct, nor an indirect (as in the case of produced capital), human contribution to the generation of output.

10. In a social accounting framework the result of human interaction and in particular transaction values are recorded. On the market people and their organisations meet and interact resulting in transactions valued according to their different interests and possibilities to influence the outcome (market power). The exchange values are recorded in NA irrespective of the market situation. The values should reflect the current situation in the accounting period and not include historical values or forecasts. In a statistical system no regard is taken to whether the prices and values are optimal from the perspective of economic and social policy or any other interest, nor if they are "equilibrium" or rapidly adjusting prices, nor if they are determined by the speculation movements of a few large oligopolists or by a large number of small producers and consumers with no market power.

11. The scope of NA is further restricted to economic agents producing for the market thus excluding most output of household activities that primarily are aimed for own final consumption. This restriction also applies in the case of establishments for their output of intermediaries like pulp and energy in a combined pulp and paper plant. All extensions beyond the market (e.g. public administrations' activity for collective consumption, household own-production of final goods), are justified by the observability of the flows between different units and/or limited by the "third party criterion" (SNA 6.16).

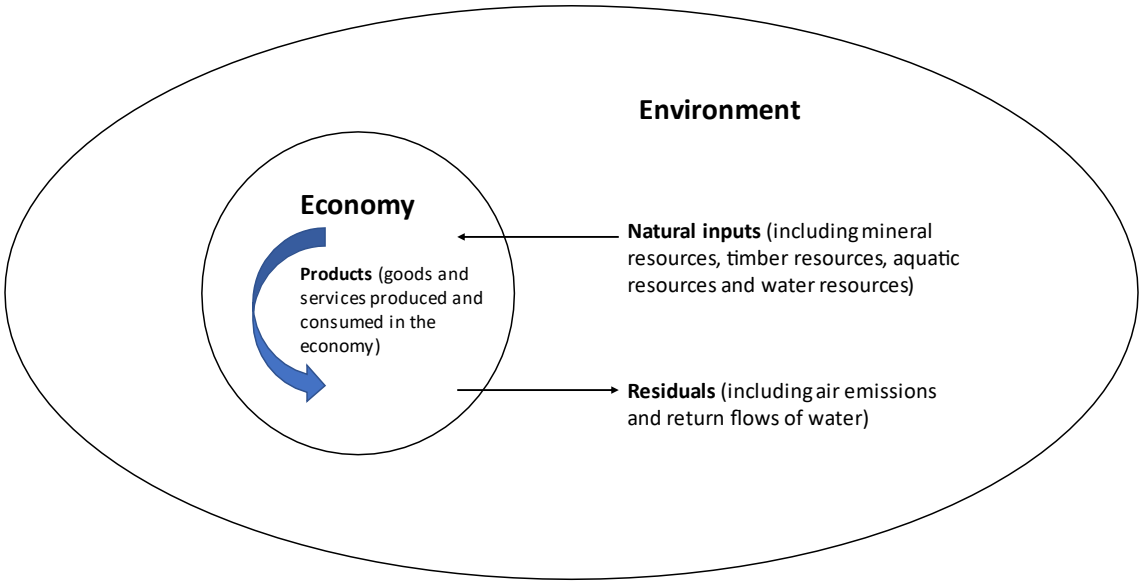
12. A clue to the understanding of National Accounts (NA) is to separate the physical or volume component of output from prices. If we as a starting point focus on the physical relations in the economy this will be illuminating of the accounting structure and balancing items included in the NA. The distinction between generation and allocation of income will be better understood in this way.

[3] A reference to the view of Richard Stone can be found in Vanoli (2005) p. 335. Keynes (1997), p. 213 expresses the same view as Stone on natural resources.

13.Natural resources enter the realm of the economy in two ways: by extraction (appropriation) and as functions like space claimed to undertake productive activities including the activity of extraction. The interaction between human and nature is physical and not social. There is no exchange of values only appropriation of natural resources by man. Values are created in the marketplace where the resources are offered at prices that in normal situations cover the costs of extraction, production, transport and sales costs.

14.In figure 1 a stylised relation between the economy and the environment is pictured. The figure is taken from SEEA2012. It shows the flows of natural inputs of different resources into the economy. This reflects the concept that it is flows of inputs from nature and not stocks of natural resources that enters the economy. It is the catch of fish that fishermen appropriate and not the sea or fish stock. This interpretation follows from the physical relation between man and nature. The sea is needed as space for the crew of fishing vessels to operate the fishing activity. This is consistent with the SNA.

Figure 1: The relation between the economy and the environment as pictured in SEEA figure 2.1 of physical flows of natural inputs, products and residuals.



15.The physical relation is the same as when raw food is taken out from the refrigerator in order to prepare a meal. Nature is like a pantry to humans. If this is a good description of the relation it should also be made explicit in the SNA. The appropriation of natural resources (extraction of minerals, harvesting of timber, fishing, hunting and pumping of water) means that we move resources from the nature's pantry into the inventories of the economy where they can be valued and used in further processing activities.

16.Assets in a physical sense are those objects that repeatedly are used to create new objects to satisfy human needs. Assets also includes objects that can be stored and used in later periods. Natural resources that have these properties become economic assets when they enter the realm of the economy. In nature they have potential value but only after extraction they become goods aimed for the market and will have actual value evidenced by their exchange value. Ownership rights makes it possible to sell the right to make use of the resources and realise the potential values on the market.

17.The SNA does not acknowledge non-provisioning ecosystem services and ecosystems, but it would in principle be consistent to deal with them in the same way, to the extent they are made subject to legal ownership and exchange ("capitalised").

18.Our understanding of the SNA is that natural resources and ecosystems can only be regarded as assets in case there exists legal ownership rights to a specific resource. In many countries, for animals moving around in relative freedom this is evidenced by a tag. Assets also include means of production under legal ownership, notably land, that can be exchanged between economic agents on regular basis. This is an important criterion for land and other resources that do not contribute in a physical sense to output. Transferability between agents is a necessary condition for the possibility of transferring purchasing power into future periods (saving).

19.Ownership rights differ among jurisdictions so there is no general rule to determine the natural resources that are included in the asset boundary of a particular economy. Natural resources that lack a specific owner like fish in the high sea and wild animals are not part of the asset boundary. They appear in the economy with their exchange value after extraction (fishing, hunting, harvesting etc.). In such cases, fishing and hunting quotas are treated as separate assets in the same way as logging rights. They consist of the right to use a natural resource but are not ownership rights to the underlying resource itself.

20.The inclusion of sub-soil resources as a separate item in the SNA asset boundary is *from the perspective of production* somewhat counter intuitive. A sub-soil resource can be regarded as an inventory of natural resources that, first of all needs to be taken out of the inventory (extracted) and then used as input in production. Before that ownership rights cannot be established on sub-soil resources as a separate entity from land. A right to use the sub-soil resource can be created as a separate transferable asset. But this is a contract stipulating the rent to be paid and not the natural resource over which the transferable contract is valid.

21.In the current SNA natural resources are treated as free resources to the society. This has the advantage of making the total value added at market prices (GDP) equal to total exchange value of final expenditures. Keeping this identity will put a restriction on the possible accounting solution for depletion, requiring that depletion does not have an impact on GDP. But this is contrary to the role of inputs that natural resources actually have in production. Natural resources are like inventories but taken out of nature instead of from a warehouse. Accounting for this as capital consumption is an ad hoc solution, that by-passes the restrictions of the NA framework. However, these restrictions provide meaning and consistency to the framework, and by-passing them is not necessarily a good idea.

22.In short, assets according to the SNA are either made up of durable resources that are used in the production of goods and services without physically being part of the output or durable resources used for saving purposes. Land is in relation to this a special case. Regarding land as providing the necessary space needed for plants and other production facilities, it does not take part in the transformation process in an active sense. Since space is needed for any kind of human activity, this is a general prerequisite also for production. Land like other natural resources are used without any cost in terms of human labour time. By the possibility of buying and selling, land can also be used for saving purposes.

23.When land is rented the payment is recorded as allocation of income in the SNA. So, payments for the use of land are not treated as costs of production. Production costs only include payments for the output of human productive activities used in the creation of value added. The payments for the right to use natural resources in general is treated in the same way as rent. The prices of output are regulated by market conditions. The exchange values are recorded in the NA regardless of the market condition. In case there is an excess demand this might translate into above average profits for the producer. Translating, we can consider higher than normal profits, as an evidence that the natural resources used have increased in value only if we make additional assumptions on the working of the economy.

The NA as a statistical framework

24.The NA as a statistical framework implies that we put observable data in the accounts in order to derive information about the economy. This information is also derived as balancing items in the NA. What we want to know have background in accounting principles and are in many cases, like value added, not possible to observe. What can be observed at the level of an establishment is wages paid to the employees. But the NA does not assume that individual wages are paid in relation to the contribution

to output made by each and every employee. Wages represent the cost of using labour to the employer. By subtracting wages from value added we derive the operating surplus. In the cases of the operating surplus (a balancing item that is also derived and a non-observable) the NA does not go any further because at the level of the statistical unit (establishment) it is not possible to establish a correspondence between operating surplus and observable data. To make such correspondence we need an economic theory and that is exactly that kind of assumptions we try to avoid in the statistical process of compiling NA data.

25. The national accounts framework is not very well suited for the inclusion of a wider perspective on human life and nature than what is represented by the values created by human activity. This means that the cost of natural resources as well as the benefits nature provide us with are outside the scope of NA. If there is no human cost of creating natural resources, there cannot be a cost for depletion when a resource is used up in production.

26. Goods and services cannot be used prior to their production. This translates into that not even restoration costs due to damage of the environment are recorded at the time of the event. Costs for the restauration of nature are recorded in NA only, if and at the time, the restauration work will be undertaken. What can be recorded is the obligation to undertake restoration work or pay compensation for damage. But this can only be done for restoration that follows from legal commitments. Other restoration costs that we would like to record as an environmental debt in the balance sheet must be recorded outside the NA framework.

27. The income can be allocated to compensate for the use of, damage to and depletion of natural resources. Such payments depend on legal ownership rights and control of natural resources. The legal owner can exclude economic agents from using the resource and charge for the right to use. This is true except in those cases the government has the right to allocate the use of the resource. The fact that some units receive income from putting natural resources at the disposal of economic agents does not evidence that the resources contribute to value added as defined in the SNA. The interpretation of SNA should be that labour, assisted by fixed assets, is the sole producer of value added.[4] This view is supported by the distinction made in SNA between generation of income versus allocation of income.

28. The current version of the SNA is not harmonised with the original and prevailing core principles of NA. In the latest revisions some ad hoc amendments have been made to make SNA more relevant for the analysis of environmental and productivity issues. At the heart of the problem lies the definition of assets and the inclusion of some objects in the asset boundary that hardly fit the purpose. The definition of assets is unclear and probably made to fit a specific view on productivity, that regards all contributions to value added, as originating from different kinds of assets including natural capital and human capital.

29. The alternative we face due to the rigidity of the NA is either to make a basic revision of the SNA foundation to make it in line with the ad hoc amendments or – which is our preference – to create a new separate information system. The latter can be done as a satellite account included in SNA or preferably as a separate framework.

Marginal Theory: an alternative view on accounting for the economy

30. There are user needs that would benefit from a welfare approach to the measurement of the economy. The IPCC uses a model approach to estimate the net present value of future consumption utility (welfare). Future utility is maximised under the restriction of damage to nature in relation to the output of current and future consumption goods. IPCC uses a standard Marginal Theory approach for the estimation of the utility of future consumption.[5] Asset values according to Marginal Theory are regarded as a present value of the possible future utility that can be generated. So, a different way of looking on

[4] This view is not novel Keynes (1997), p. 213 refers to it.

[5] Cf. Nordhaus (2008), appendix on the DICE-model, pp 205-208.

the future utility of consumption is to estimate the total value of all resources that can provide utility. In this sense the future welfare due to climate change depends on the value of existing assets including natural resources.[6]

31. There is an obvious need for data to support analyses like the one made by IPCC and other research initiatives. The problem is that in the case of IPCC the SNA is not the best place to search for the information needed. One way of dealing with this is to expand the SNA with additional information in satellite accounts. Regarding the importance of the data needed and the challenge of incorporating Marginal Theory within the SNA it would be preferable to create a separate information system based on the principles of Marginal Theory.

32. The alternative view on accounting for the economy that refers to the Marginal Theory is not a statistical description of the economy. Instead, it rests on some specific assumptions of how the economy is working and how values are created. The most basic idea is that the economy is always moving in the direction of a general equilibrium (GE). In GE the production factors are remunerated according to their contribution to value added. Economies of scale and other problematic features of a real economy are usually assumed not existing or at least not influencing the prices and economic values to any greater extent.

33. The scope of the Marginal Theory is not restricted to monetary transactions as in the SNA. All relations, activities and transactions that can be defined as done for the own benefit in a broad sense are economic. This includes transactions between household members, relations between humans and nature and so forth. Proposals to expand the scope of SNA to include activities within the household have not been consistent. To this end the household as the statistical unit needs to be replaced by the individuals. The theoretical scope of the Marginal Theory should not be confused with the more practical ambitions of measuring the economy laid down in the SNA.

34. One major difference in relation to SNA is the concept of income. When relative prices change, this makes some richer and others poorer in terms of the real purchasing power their assets are possessing. When for example car prices go up while other prices remain the same, an existing car can be exchanged for a larger basket of other goods. The issue of recording real holding gains as part of income in the SNA has been discussed at length without a satisfactory solution.

35. More interesting is the view on the distinction between generation of income (production of value added) and allocation of income (distribution of value added). Marginal Theory looks upon natural resources as factors of production in the same way as labour and capital. They are all actually treated as different forms of capital: human capital, produced or industrial capital and natural capital. This is probably the origin to the idea of recording natural resources in the SNA in the same way as for example machinery.

Table 1: Comparison of concepts and valuation used in the SNA and according to Marginal Theory

	National Accounts, SNA	**Marginal Theory**
Output and input	Volume, aggregated with prices as weights.	Real value, i.e. nominal value adjusted with the overall price change (inflation).
Definition of productive assets	Objects that assist in production of output in volume.	Objects that provide the owner with a flow of income allocated from production.
Value of fixed assets	Exchange value or capitalised production costs.	Present value of future net income.

[6] This view is used in a recent report, Dasgupta (2021) and has been rejected as being inappropriate for analyses of the climate system and biodiversity, cf. Radermacher and Steurer (2015), p. 11.

Income generated in the economy	Value added.	Value added, including the holding gains and losses on goods, inventories and assets held during the period.
Measurement	Actual exchange values or production costs.	General equilibrium prices.
Important valuation principle	Replacement costs, comparison of the same alternative at two different points in time.	Opportunity costs, comparison of two different alternatives at the same point in time.

36. Payments for the use of natural resources, as for any other form of capital, corresponds in this view to the contribution of the resource to value added. This is due to the dual character expressed in the production function. Generation and allocation of income are in this sense two ways of expressing the same thing, what you get is what you have created. The distinction between generation and allocation of income is from this theoretical point of view therefore not interesting.

37. Allocation is the main interest and in particular, how optimal allocation of resources can be achieved by using the price mechanism. With this view on the issue of climate change, information will be needed on prices and values of natural resources. The price structure must fulfil the criteria of GE otherwise we cannot be sure that the estimated future consumption in the IPCC model is done under optimal allocation of available resources.

38. Notwithstanding the inconsistency between the approaches, the Marginal Theory has been very successful in influencing the revisions of the SNA asset boundary. It has led to the inclusion of other non-produced assets besides natural resources. One of these is trademarks which in the current update process of SNA is proposed to be included as a produced asset (GN G.9 Marketing Assets).

39. This issue is illustrative of the difference in perspective. The trademark does not change the physical characteristics of a consumption good it rather increases the loyalty of the consumer and maybe changes the perception of the good, enabling the producer to charge higher prices. The trademark has a clear impact in the price domain of exchange values but not on the volume of the good, at least not in the SNA sense. If changes in relative prices have an impact on the purchasing power of value added this is regarded by Marginal Theory as a volume impact because it changes the real value of the nominal value added. The ultimate volume is the utility of goods and services and utility is related to relative prices. The difference between these two perspectives, SNA versus Marginal Theory, is how price changes are taken care of. In SNA volumes are estimated by adjusting each product group of total output by the price change of the very same product group whereas according to Marginal Theory the change in nominal value of each good and service is adjusted by the overall inflation.[7]

40. In this way resources that have an influence on the prices can be regarded as assets because they contribute to the real value of output (utility). Assets in the SNA, on the other hand, refers to resources used to transform the volume of input into volume of output. Resources like trademarks that only have impact in the price domain can only be regarded as assets if they can be used for saving. This requirement implies the existence of designated markets with regular trade activity in trademarks.

41. The alternative view translates into recording the payments of rent made for the use of environmental resources as the provision of transformation (capital) services. This will make the current distinction in the SNA between generation and allocation of income irrelevant. Every agent that receives a share of the value added does in this sense contribute to production by a transformation service of the same value. This seems to be in line with the SNA definition of assets used in production. But that is only true if we look at the total value of output and do not make a distinction between output in volume and the movement of prices.

[7] Cf. Denison (1972), who use the SNA volume concept and comments on Jorgenson and Griliches that "Our statistical measures of total output diverge because different price indexes are used for deflation;/…/", p. 37 and O'Mahony and Weale (2021), pp. 10.

42. This perspective has been extended and used in the SEEA Ecosystem Accounts. Human labour is no longer the only producer of value added. Bees provide a pollinating service and forests a service of storing carbon. Since humans do not pay, there is no market value to be recorded for these services, so they need to be residually estimated under the assumption of GE.

43. The difference in perspective is a matter of which domain is regarded important. SNA has the focus on volumes and disregards the payment for the use of natural resources as something that only have impact in the price domain of exchange values. Marginal Theory on the other hand, has focus on relative prices and the real purchasing power (utility) and therefore the price domain is essential. Producers need to cover payments for natural resources and in that respect these payments will influence the exchange values. In SNA prices are used as weights in the aggregation of volume of products into GDP.

44. The view that all objects that can be used by their owners to claim part of the national income are productive assets is also evidenced in productivity analyses.[8] The standard Multi Factor Productivity (MFP) relation explains the growth of value added by the input growth of labour and capital weighted by their corresponding shares of income. In order to include that the economy is dependent on the environment, the MFP relation has been expanded to include natural resources in the same manner as capital.[9] This captures the view of a private investor that has to pay both for the access to land and machinery. From the point of the society there is a difference which is captured in the SNA. Land is free of charge and is allocated by the price. This is done by the price mechanism and payments for the use of land are recorded in the SNA as a distribution of income rather than a payment for some kind of input. Machinery on the other hand needs to be constructed and this is the task of human ingenuity and skill.

45. The difference in the perspectives on production between Marginal Theory and SNA is in a sense the same as the difference between the perspective of a private investor and the society. Land to the private investor plays the same role as machinery since they can be used to generate a flow of income by charging the producer a fee for the use. The value of the asset to the investor depends on the income flow. To the society the assets might have different functions in the value-added creating activity. Land is providing space for labour to operate the machinery and transform inputs into output.

46. Depending on which of the perspectives we use, the accounting framework and the values will differ and thus give different descriptions of the relations in the economy, how the economy develops and the possible causes. Mixing these two perspectives, as is done for the definition of productive assets, and the valuation of natural resources thus considered productive, is inconsistent. Machinery is valued according to SNA and sub-soil resources by estimating the Net Present Value of future resource rent under the assumption of GE.

47. To summarise the main differences in relation to SNA. For the possibility of estimating utility by market prices the Marginal Theory rests on the assumption of GE. Since market prices corresponds to utility, a relative price change also changes the relative utility of goods and services. Taking relative price changes into account means that the real value is the measure that compares volumes of utility between periods. Holding gains and losses translates into increases or decreases of income and finally real income is the volume measure of output.

The System of Environmental-Economic Accounting

48. The SEEA is basically also a statistical framework like the SNA, one in which we put observable data in order to derive information about the relation of the economy with the environment. Like in the SNA, however the mix with marginal theory – especially where the valuation of environmental assets is concerned – leads to confusion.

[8] In O'Mahony and Weale (2021) it is stated that it is the net income that is the object of the growth accounting exercise.
[9] An example of this can be found in Brandt et al (2017).

49. The main objective of SEEA CF is "/…/the assessment of trends in the use and availability of natural resources, the extent of emissions and discharges to the environment resulting from economic activity, and the amount of economic activity undertaken for environmental purposes." (SEEA CF, preface §5).

50. As for "the assessment of trends in the use and availability of natural resources, the extent of emissions and discharges to the environment resulting from economic activity", the SEEA connects the economy as defined in the SNA to the non-produced, pre-existing natural environment by describing physical exchanges and changes in stocks of natural resources in physical units. The SEEA takes quite a broad view on these assets, which are considered from perspectives other than production, income and storage of value, but from a physical perspective in the first place, as pre-requites of, and entities affected by, all human activity. The SEEA CF and the SEEA EA present two different partitions of environmental assets, one based on, and expanding, the traditional "reductionist" SNA approach, dealing with specific material and space resources (whose exchange value is observable in transactions, and which are used as stores of value by individual units); the other taking a wholly different approach, starting from ecosystems as unitary assets, but then reducing them, for the purpose of monetary valuation, to a bundle of repeated yields of final ecosystem services. Both SEEA CF's "use and availability of natural resources" and SEEA EA's "ecosystems and their repeated yield of services" concern non-produced items, which exist prior to economic activity, whose existence is an essential pre-requisite of economic activity[10],and for which can be transformed into assets (from the income and store of value perspectives, first, and then through the marginal theory also into productive ones) only by subdividing them into chunks and establishing property rights on them. Physical flows and stocks are determined and affected by SNA activities *but are not the object of the SNA which, as said, concerns human activity only*.

51. As for "the amount of economic activity undertaken for environmental purposes", the SEEA CF remains strictly within the SNA boundaries, and mostly follows its conventions – but maybe for the recording of some intra-activity flows that are not accounted for in the SNA.

52. Most relevant for the present discussion, is the fact that the SEEA CF also concerns the *value of environmental assets*. This is the part of the SEEA candidate for uptake in the SNA, and not surprisingly the one where the marginal theory strongly enters into play, through the identification of the income (rent) of the owners of assets with the value of the latter, as well as through the NPV method. The same theory enters, in its utility version, in the valuation of ecosystems and their services in the SEEA EA. The latter, indeed, goes beyond the identification of the appropriated share of GDP with a contribution to production, by allowing also for the estimation and accounting of additional, out-of-market, hypothetical value-added-like output directly supplied by nature to consumers, i.e. accounting for elements of welfare (contributions to benefits) that clearly are outside the scope that statistical systems can cover.

53. The use of assumptions from the marginal theory is questionable also in the case of the SEEA, as it also has the aspiration of being a statistical framework for objective observation. In this sense, it may be limited to physical measurements of natural resources, ecosystems and material, space and energy flows and to detailed monetary flows relating to environmental protection, "green economy", environment-relevant economic policies and the like, strictly following the SNA. This is a great and extremely useful deal of information already, which supports all kinds of sustainability analysis and further calculations, without assuming the calculation of welfare- and/or sustainability-adjusted measures of income as an objective of official statistics. The legitimacy of such an objective, indeed, is quite doubtful in view of the need to heavily rely on some theory – which inevitably means, eventually, relying on some policy doctrine.

54. In relation to SNA it is stated that SEEA CF "/…/ applies the accounting concepts, structures, rules and principles of the SNA to environmental information." (SEEA CF §1.36). This is achieved by e.g.

[10] The reader may want to extend this reasoning to things such as so-called human, social and institutional capital. While we sympathise with such an extension, it is important to note that it is not relevant here whether and how far such an extension is legitimate, as while human, social and institutional elements of life may, in some respect, be considered as "produced" (they are the result of human action), this is never the case – by definition – for natural resources and non-artificial ecosystems.

attributing physical flows and environmental assets to economic units, based on the obvious correspondence with economic activity as for physical flows and based on (economic) ownership as for physical stocks. The SEEA EA still needs clarification in this respect, as it is not always clear who the users of ecosystem services and the owners of ecosystem assets are.

Differences between the SNA and the SEEA asset boundaries

55. The current recommendations in SNA and SEEA CF respectively are not wholly aligned. There is some coordination work that needs to be done regarding the classification of assets and maybe also regarding valuation of assets. In the SEEA EA the ecosystems are recorded providing services to humans. Among ecosystems we find elements such as the oceans that have properties similar to environmental assets except that they are problematic from the ownership perspective.

56. The SNA asset boundary includes the radio spectrum as a natural resource used in production. Radio spectrum is explicitly mentioned in the SEEA CF as outside the asset boundary. A look at the classifications of assets used in SNA and SEEA CF (table 5.1) respectively reveals problems in coordination that will hamper the possibility of combining information in particular from the SNA with data in SEEA. SEEA has a more detailed classification, but this helps not very much in using data from SEEA at the level of SNA.

Table 2a: Classifications of environmental assets in SNA and SEEA CF

SNA	SEEA-CF
Cultivated biological resources	6 Other biological resources (part) 5.1 Cultivated aquatic resources (the part used for breeding purposes)
Work-in-progress on cultivated biological assets	6 Other biological resources (part) 4.1 Cultivated timber resources 5.1 Cultivated aquatic resources (part)
Land including surface water	2 Land (space) 3 Soil 7.1 Surface water (part) 7.3 Soil water
Mineral and energy reserves	1 Mineral and energy resources
Non-cultivated biological resources	4.2 Natural timber resources 5.2 Natural aquatic resources 6 Other biological resources (part)
Water resources	7.1 Surface water (part) 7.2 Groundwater
Other natural resources Of which: Radio spectra	Not included

57.The classifications of SNA and SEEA regarding environmental assets are not easy to align. A first step of increasing the correspondence would be to use the sub-division of other biological resources, already included in the SEEA, into cultivated and non-cultivated parts as well as surface water into what is included in the SNA land values and other surface water. An alternative would be to group land and water resources together. SNA on the other hand should skip the category of other natural resources.

58.The sub-division in fixed assets and inventories is of importance for the SNA but not really in SEEA. Skipping this sub-division for the moment we can make a simplified correspondence of environmental assets between SNA and SEEA.

59.The reason for skipping the Radio spectra from the SNA asset boundary is that the Radio spectra is not a genuine asset. It is not even a natural resource, but an electro-magnetic phaenomenon. The Radio spectra consists of a band of frequencies. Each frequency defines a distance between the nodes of the propagation wave. The propagation wave is not like a road waiting for a truck to carry the cargo. The wave is created by the transmitters. Transmitters that are a construct of human ingenuity and skill.

60.Relating the Radio spectrum to the atmosphere is also wrong since electro-magnetic waves can travel through vacuum. By using different frequencies, the risk that waves will be interfering with each other and information packages getting lost is minimised. The reason government has intervened in the distribution of Radio frequencies is to create an open process for the allocation of the restricted bandwidth.

61.The payments made for the access to useful bandwidth is neither a rent for the use of a natural resource nor a sale of an asset by government. The payment done by auctioning the right to use a specific frequency tends to be far higher than the government costs for administrating the system. This points to the alternative of recording this as other taxes on production. There are actually some similarities with emission permits. The allocation of emission permits is a way of distributing a restricted volume of greenhouse gas emissions into the space in order to reduce the externalities of production.

Table 2b: Example of simplified classification of environmental assets in SNA and SEEA CF.

SNA	SEEA-CF
Cultivated biological resources	4.1 Cultivated timber resources 5.1 Cultivated aquatic resources 6.1 Other cultivated biological resources
Land including surface water	2 Land (space) 3 Soil 7.11 Surface water, related to land 7.3 Soil water
Mineral and energy reserves	1 Mineral and energy resources
Non-cultivated biological resources	4.2 Natural timber resources 5.2 Natural aquatic resources 6.2 Other natural biological resources
Water resources	7.12 Surface water, other 7.2 Groundwater

62.The Radio spectra case reveals two important relations in the economy that are not described in a proper way in the SNA. The fact that government receives payments for the access to radio frequencies does not imply that the redistribution of income is for the lease or sale of a non-produced natural

resource. The current interpretation of the Radio spectra has focused too much on the payment and in the spirit of Marginal Theory assumed it must be for the use of a natural resource and included it in the asset boundary. The second relation regards the government role in the economy as an agent that promotes the functioning of the economy by allocating bandwidth by economic means, in order to avoid chaos in the telecommunication industry and restricts the emissions of greenhouse gases, by allocating the right to the producers with the highest needs evidenced by their willingness to pay. This role goes beyond the financing of government consumption by taxes.

Coordinating the SNA and SEEA frameworks

Introduction

63.Now, after we have laid out the background of the accounting frameworks, we can turn to the issue of aligning SEEA with the SNA and vice versa, other than the classification of assets as seen above.

Purpose

64.The main reason for coordinating the SNA and the SEEA and other information systems is the possibility of combining information from several statistical areas in order to make broader analyses of the society. With this said it is also important to establish how far the coordination can be taken without losing the specific character of an information system. Each system has its own specific purpose that impacts the content and the design of the system. What is recorded as a cost of using natural resources in the SEEA should not necessarily be included in the SNA, and it should be clear that the two systems are compatible to a certain extent. In particular, that SEEA values, based on the income/marginal theory perspective, cannot be subtracted from GDP in order to get a depletion adjusted GDP, as long as GDP is not built around the same theory. By the same reason, some assets in the SEEA are excluded from the SNA.

65.Coherence refers to the possibility of combining data from several information systems in a meaningful way. This means that data should represent the same statistical object or group of objects and be presented in a way that make it possible to combine them. A typical mistake users might do is combining functional data with institutional data. An enterprise group (institutional unit) might have establishments (functional units) undertaking activities other than the main production activity of the group. Institutional units in the Structural Business Statistics (SBS) might be presented by the same activity classification (ISIC) as activity units in NA, but still, units of the same industry in these frameworks do not represent the same group of statistical objects. Another example concerns the use of e.g. transport emission and energy use data, taken from UNFCCC reports and energy balances (instead of from Environmental accounts) in combination with NA data on the transportation industry.

66.Coherence does not imply that the same data need to be recorded in more than one information system. If we want to combine physical data from SEEA with the corresponding values in the SNA coherence of data will make it possible. Aligning SNA with SEEA therefore first and foremost means that we should increase the coherence of these two information systems. To pursue the coordination further than necessary to accomplish good coherence is not regarded meaningful.

67.When it comes to aligning SNA to the current SEEA and SEEA to the revised SNA respectively, there are several aspects that need to be considered. First and foremost, we need to regard the part of the reality each information systems intends to cover with its descriptive statistics (the scope). Secondly, we should ask whether it is possible to coordinate the statistical units used in the collection of data by each of the statistical frameworks. A third aspect is to what extent common classifications can be used for identification and presentation of the data and statistics of each framework. Last but not least, combining different measures for the same object, like the value and area of land creates relations that

are useful. In case values for the same object are included in several statistical frameworks, comparability will benefit by the use of uniform valuation methods.

68. At this point we assume that the coordination of the reference period (annual and quarterly) as well as the geographic boundaries (regions and countries) the data refer to does not pose any problem from the point of coherence. In the following the main interest will be on natural resources used as assets which also is one of the main topics in the SNA update.

Scope and statistical units

69. The description in the NA refers to human activity devoted to the refining and use of natural resources within the realm of the economy. The description is based on the independent economic agents (institutional units) that are supplying goods and services on the market. The Environmental Accounts describe, among other things, the state and change of nature based on the administrative division of the earth surface in real estates.[11] In case the area is a real estate with an owner it will be possible to link information in the SNA with SEEA by the real estate.

70. Nevertheless, it is worth noting that real estates are excluded from the NA if they for some reason are not integrated in the market economy. This is first of all the case for protected areas like national parks and areas not economically profitable to exploit. To include these areas, even with a zero monetary value, means that the scope of the NA is changed. Even though this change in scope might seem innocent because it does not change any aggregate values it will create an ambiguity of the descriptive purpose of NA.

71. SEEA has a different scope regarding flows of goods and services. In the functional description SEEA includes all own account goods and services used within an enterprise not only those for own final use as is the case in the SNA (SNA §1.42). This recording implies that aggregate data of establishments (functional unit) at the enterprise level gives higher quantities and values in the SEEA in relation to SNA but the value added is still the same. This is a matter of granularity needed for the scope of SEEA and lies outside the analysis of this paper.

Classifications

72. Coherence of the data from several information systems requires that the data be made public by the use of common classifications, such as the one shown above for environmental assets looked at from the "specific resources" perspective that is common to the SNA and SEEA CF. The economic agents in NA are grouped according to the institutional sector they belong to. In the same way the real estate owned by the agents are grouped according to the same sector as the owner. Information in SEEA related to real estates is thereby possible to combine with data from NA regarding the sector the owner belongs to. This will work as long as none of the two information systems has introduced some special treatment that deviates from the classification of institutional sectors.

73. It is also necessary to decide on which level of detail the common classifications should be used in relation to different measurement units. It might not be meaningful to make the same detailed breakdowns in all information systems and for all measurement units. Regarding the availability of market information, it is more convenient to estimate the value of an entire real estate than for its different functions (space, hunting rights) and resources (soil, timber, wind and solar energy). Other classifications that need to be coordinated includes the division of the environment into different ecosystems and the nomenclature of goods used for the description of material and energy flow balances.

[11] This concerns the spatially explicit accounts of the SEEA. In the SEEA there is no deeper discussion regarding statistical units but implicitly it can be concluded that the real estate and parts of the real estate for example in the form of ecosystems is the main object for the data collection. As in the NA there are also other objects information is needed for. In the case of SEEA this regards for example the oceans and the atmosphere (cf. SEEA2012 §2.127 and § 5.476).

Valuation and measurement units

74.One of the most discussed topics regarding the coordination of SNA and SEEA is probably valuation of natural resources. The use of statistical methods to compile data on asset values and values of natural resources should in normal cases pose no problems for comparability and coherence. The problems occur when there is a lack of data. A statistical system will have restrictions and shortcomings due to lack of data. Some of the missing information of a statistical unit can be filled by imputations if information has been provided earlier or by similar units. But, data that never have been collected can hardly be imputed by statistical methods when missing.

75.Market transactions in natural resources made on regular basis are only made in few of the environmental assets in the SEEA classification. There is no simple solution to this problem since what we would like to have is a valuation based on the interaction of economic agents (objective valuation). Instead, we need to refer to indirect methods based on assumptions and other subjective input to valuation. This will impact the reliability and comparability of the estimated asset values and might also hamper coherence.

76.Measurement unit is not a main issue of coherence since combining monetary information with physical data is possible as long as the data can be sufficiently identified by relevant classifications. Coherence means that also different measurement units should be possible to combine in a meaningful way. For the coherence of the statistics the use of the same measurement units in SNA and SEEA is not necessary. Nevertheless, using the same measurement unit is a convenient way of making links between objects that primarily are estimated in different units in the two information systems respectively. In the case of SNA the unit of measurement is monetary values, number of employees and hours worked. SEEA primarily records physical measurement units and for the convenience of the user also include monetary values

Valuation

Introduction

77.Valuation is probably the single most problematic issue in the field of environmental accounts. SEEA refers to the principles of the SNA. Still, some interpretation of the principles in SNA needs to be done, in order to implement a sound valuation of natural resources, if possible.

78.In the NA as in other statistical frameworks problems occur between what can be observed on objective grounds and the desired information and data needed for descriptive purposes.[12] This means that it sometimes will be necessary to make exceptions from the main principle of observability and objectivity. Such exceptions also creates internal problems regarding comparability of data and should as far as possible be avoided.

79.The NA frameworks draws the line at costs and expenses that can be observed or estimated by other observations. Costs are in most cases based on market transactions making the departure from the main principle small. Unfortunately, there are reference made in the SNA to indirect valuation methods when data is missing, notably the NPV-method. If transaction values never have existed for a specific asset this instead is a sign of the asset not being a separate economic asset or not an asset at all in the strict SNA sense.

80.Regarding SEEA CF and SEEA EA we have noticed that the interpretation of the SNA they are based upon is in the case of valuation of assets more aligned to Marginal Theory than to basic principles of the SNA. Regarding the restrictive view taken in the SNA it is not astonishing that borrowing ideas from elsewhere is tempting. Nevertheless, attributing the proposed valuation methods to the SNA is misleading and we will try to show this in two cases. One refers to SEEA CF (NPV) and the other to SEEA EA (replacement costs).

[12] Cf. Vanoli (2005), pp. 176

The net present value approach (NPV)

81.It has been discussed at length whether it is appropriate to use the NPV in environmental accounting and there might not be anything new to add. Still, we think some issues needs further clarification in relation to SNA. First of all, the issue we have pointed out in this paper is that the definition and valuation of assets from the income received is not appropriate from the SNA point of view.

82. Assets are defined in the SNA by their role in production. There are a lot of natural resources that give benefit to humans, but it is when they enter the realm of the economy they should be included in the NA. This would be a strict application of SNA as the statistical information system for the economy.

83.The value of assets is established on the market and for produced assets the price is closely related to the production costs. The value of natural resources enters into the accounts when they are transacted for the first time. If there have not been any transactions in a specific kind of resource this is an indication of that this kind of resource might not be transferable. Maybe, like wild animals such resources should not appear as assets in the NA at all.

84.In case there is no relevant information on transaction values the NPV-method is recommended to be used to calculate an approximate market transaction value.

85.In the SEEA the use of NPV-method might not pose a consistency problem since only natural resources are included in the framework. But, combining data from SEEA with data from SNA will pose problems of comparability and coherence. Since NPV is a forward looking (ex-ante) concept based on opportunity cost, it is at odds with the recording of past events (ex-post) in the national accounts and in statistical frameworks in general. Capital formation is the result of past events and at the best estimated by exchange values. In GE this value in a theoretical sense corresponds to the discounted value of future income. This is the rationale of the NPV-method for natural resources.

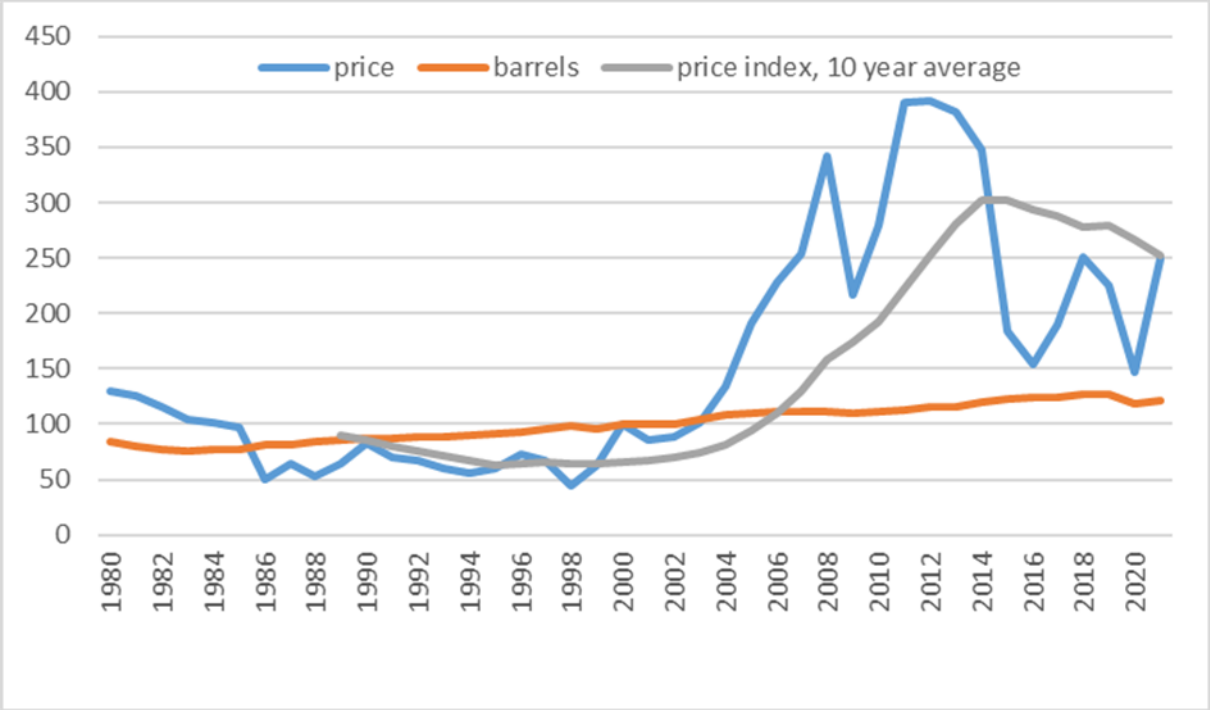
86.In relation to the valuation of produced fixed assets in SNA this is not consistent. Produced assets are not valued according to the income they provide to their users and owners.[13] Improvements in productivity spill over to the value of natural resources used in extraction whereas in a business only using produced assets there is no impact from productivity on the asset value. This is the case unless we do not swap SNA for the Marginal Theory also for valuation of produced assets. The productivity increases according to Marginal Theory, translates in capital deepening, an increase in the volume (quality) of assets since the owners receive higher real income at the assumed discount rate.

87.Maybe it is needless to point out that NA does not care for the market situation. When the resource rent changes between years this should be taken into account in the asset valuation. This is the implication of valuation at current prices in the SNA. In relation to the method proposed in the SEEA CF this would mean that the asset value of each year starts with the current price estimate of the resource rent and assumes it being constant or that it increases by inflation in future years in order to calculate the NPV.

88.For the following year a new current price estimate of the resource rent should be applied with future resource rent being assumed constant or increasing with expected inflation in relation to the estimated value. The movement of output prices for raw materials is volatile which is exemplified by the figure 2 for oil prices. Production cost move more slowly. This results in a situation where the resource rent, more or less, will follow the path of output prices and the asset value per unit of the resource will approximately follow the same pattern.

Figure 2: Index of oil spot prices (Brent) and oil production volumes in barrels 1980-2021, year 2000=100. 10 year average of oil price index, 1989-2021.

[13] Cf. Robinson (1956), pp. 117-121



Data source: British Petroleum (BP) Statistical Review 2022.

89. Smoothing of the resource rent has been proposed as a way of reducing the volatility of the estimated resource values. In figure 2 this is illustrated by a 10 year average of past years prices. In relation to NA this is not a recommended method. Smoothing has the disadvantage of blurring the current price values and creates additional errors in balancing supply and use by product. In the SNA it is accepted to smooth non-life insurance benefits due to volatile payments. This should be regarded an exception. The correction is made in order to have a more accurate estimate of the output value. For these periods the alternative method could be to estimate output in non-life insurance by production costs and a historic mark-up.

90. Deviating from the actual market prices on output means that we should adjust value added and operating surplus as well. The correspondence between the asset value and the current resource rent will otherwise, be lost. The current price valuation of assets is assumed to be consistent with the assumption that the resource rent consists of two parts: value of depletion and return to the value of the resource being depleted. Either or both of them will be affected if we use the average resource rent as starting point of the calculation. The interpretation of this difference is not clear, not the least since the NPV-method depends on GE. The bottom line is that there is no good way of escaping the volatility of raw material prices.

The replacement costs approach

91. The replacement cost is hypothetical since it asks what price would induce a producer to supply a new unit of the same asset, or as Keynes originally put it:

'/…/ we have the *supply price* of the capital-asset, meaning by this, not the market-price at which an asset of the type in question can actually be purchased in the market, but the price which would just induce a manufacturer newly to produce an additional unit of such assets, *i.e.* what is sometimes called its *replacement cost*.' [14]

This is a way of grasping the price change of a specific kind of asset, no longer produced but still in use, in order to revalue the asset in the balance sheet. This is clearly not the same as the actual market price for an existing unit of the asset produced in a previous period. An obvious difference is that the

[14] Keynes (1997) p. 135, please note: emphasis as it appears in the original version of the text.

market price of used assets is reduced by the value of consumption of fixed assets. But, the market price of existing assets also includes the impact of unforeseen obsolescence and other value changes not related to the production of the asset.

92.In SEEA EA replacement cost is regarded the price of a similar good or service, a substitute (cf. SEEA EA complete draft §§9.46-47). This is not a correct interpretation since replacement cost intends to capture the price change of exactly the same good or service. The misinterpretation might be due to practical implementation of the replacement cost approach. In praxis prices of close substitutes are used for example when the price change of a later car model represents the price change of a previous model. This is done under the assumption that production costs of close substitutes move in the same direction.

93.In the SEEA EA the idea is that the substitute should provide the same functions. This is a comparison of outcome (benefit of the functions) rather than output (production costs). When a producer for economic reasons is forced to use a substitute for a genuine ecosystem service this will normally increase the production costs. The producer will need to increase the output prices or otherwise face a lower operating surplus. High-cost producers will in the long run be forced out of the market by producers who still have free access to the ecosystem services needed.

94.The point made here is that the replacement cost approach is not a valuation method relevant for ecosystem services. Replacement cost is used to *compare the same alternative between two different periods*. In SEEA this has been interpreted as the comparison of two different alternatives (close substitutes) in the same period. The cost of producing the substitute is always positive, even for the least cost alternative. Ecosystem services simply cannot be *replaced* in the original sense – if they could, they would come for free, as ecosystem services, by definition, are provided by nature for free.

Guidance notes in the current SNA revision process

Some general observations

95. First of all, it should be noted that the issues under discussion are complex and the GN might not be entirely clear on all the aspects of a specific proposal. The comments below are tentative in the sense that there might be some misunderstandings in relation the intentions the authors behind the GN have. A general reflection is that many of the proposals in the SNA 2025 revision process uses an alternative perspective on the NA than the original. This is evidenced by proposals to amend, replace or delete some basic relations incorporated in the current SNA. These include among all the following proposals:

a) Recording of depletion and natural growth of natural resources in the production account.

b) The distinction between generation and allocation of income should be deleted.

c) Assets should be defined according to the income received by the owner/user, and no longer according to their role in production.

d) Introduction of the possibility that economic ownership of assets can be split between the user and the owners.

e) The distinction between cultivated and non-cultivated natural resources should be deleted.

f) Include renewable energy resources as assets.

96. Some are motivated by aligning SNA with SEEA (a, d and e). Other try to solve recording issues from the perspective of Marginal Theory (b, c and f) and at least one is motivated by problems of identification and measurement (e).

97. Before the discussion of GN it is good to repeat that aligning SEEA with SNA is best achieved by increasing the coherence and not necessarily by extending the SNA asset boundary to the same as used in the SEEA. Coherence means that data from the two can be combined in a meaningful way. This necessitates above all the use of the same statistical units, classifications, and when relevant the same valuation methods. It should be recognised where system boundaries and reference frameworks differ

and makes the aggregation of data from the two systems meaningless. First, we regard the relevance of including the proposed changes in volume terms of the SNA and in the corresponding physical accounts of SEEA and finally we will turn to the valuation issue.

WS.6 GN on Accounting for the Economic Ownership and Depletion of Natural Resources

Short summary of the GN

98. This GN covers two important topics of great principal implications: ownership of assets and costs of using natural resources. The GN proposes that in certain cases of ownership when two or more units benefit from the same natural resource the ownership of the resource should be split in proportion to the share of the resource rent received by each unit. The standard example of this situation regards sub-soil mineral resources but in the GN this is proposed to be extended to all natural resources. The other main proposal is that depletion should be included in the SNA in the same way as in SEEA, i.e. as a cost of using capital in production. Depletion is also proposed to cover a wider group of resources including biological resources.

99. Regarding the ownership issue the GN refers to SEEA CF for an example of an accounting standard that recommends the partitioning of resources according to income received. One reason is that the arrangement creates a situation where both the owner and the extractor "will have substantial assets in the form of expected future incomes from the extraction /…/" (SEEA §5.217). In the GN this approach is also recommended for biological resources. The resources in mind are those with government responsibility and control but mainly operated by private enterprises.

100. Asset values that are split between institutional units will in case government is one part and a private corporation the other be split up between these sectors. The GN does in one respect discuss another option than a split of assets to deal with the issue of government receiving payments for the use of sub-soil and other resources. The units sharing the income could be regarded forming an unincorporated joint venture (UJV). This treatment is according to the GN supported by SNA (SNA §17.347). If an UJV is regarded a non-financial corporation the problem of splitting the asset between units and sectors will cease to exist.

101. The GN also proposes the same treatment regarding depletion as recommended in SEEA. This is motivated by the inconsistency of recording depletion in the accounts of the government owner when it is caused by extraction undertaken by a private producer. The producer usually being part of a different sector than the owner makes this relation visible in the accounts. This issue is also recognised in the SNA research agenda (SNA §A4.51).

102. In SEEA depletion is used to account for part of the difference in the value, of environmental assets in general, at the beginning and end of an accounting period. This means that net value added and net operating surplus are adjusted at the level of industries and institutional sectors. The proposed recording in NA will in this sense be identical to the SEEA recording of depletion as a sort of capital cost in the production account thus having an impact on net values only.

Consistency in the SNA and SEEA CF information systems respectively

103. Earlier attempts to include costs for the use of natural resources in the SNA production account have failed. The reason for this is simple, the NA framework is designed to only include costs related to output produced by human activity (labour). When the owner of a natural resource gets paid for putting the resource at the disposal of another unit this is recorded as rent included as part of the allocation of the income generated by the other unit. From the perspective of the society there is no economic cost in terms of labour resources actually paid of using natural resources and, as long as SNA has the ambition of being a social accounting framework, this perspective remains. This is also in line with the fact that SNA does not recognise externalities. The physical depletion of a natural resource is analogous to an externality that affects other producers and future generations by exclusion.

104. Recording depletion in the owners account and not in the account of the units benefitting from the use of the natural resource is not an error in the SNA. It is a matter of perspective on accounting for the

economy. It has been pointed to as an inconsistency only because the idea of defining assets from the perspective of the income received differs from the SNA. This view and the idea of treating natural resources as fixed assets has its origin in Marginal Theory. This perspective is used in the SEEA which not the least is obvious from the quote above (§99). Assets are defined by the fact that the owner or producer is expected to receive income from future activity. In relation to fixed assets it might also be a logical step to account for depletion in the same way as consumption of fixed assets, as a cost of production in the accounts of the user.

105. In the SNA ownership normally refers to legal ownership. Some exceptions to this have been made in past revisions. One in particular regards assets under financial lease. Financial leasing is in SNA viewed as a way of financing the investment rather than a long-term operational lease. The term economic ownership was applied to make a distinction between the formal legal owner and the unit acquiring and using the asset in economic activity. For natural resources economic ownership is not an alternative. When the user is another unit than the owner a rent payment is recorded. A rent payment is a payment for the right to make use of the resource and not a way of financing an ownership transfer.

106. Whether the rent payment also covers compensation for extracted minerals and damage to the property depends ultimately on the national legislation and the rent agreement. If the owner has a perception of losing purchasing power by the renting of the natural resource this can be offset by saving part of the received rent. The loss in market value due to extraction or degradation should be recorded as other changes in volume. This because there was no loss in human labour input only of the free natural resource. This is the rationale of the current recording in the SNA.

107. One way to understand the split asset approach is to understand the relation between inputs of capital and the income received according to MFP-models. The risk we face as compilers of NA is that by moving part of the value of a natural resource into the accounts of the user this will strengthen the correlation between the value of natural capital and the income. This will rather be confirming one particular theory than making data useful for describing the economic realities in general.[15]

108. Productive assets in the SNA are defined by their role in producing value added (generation of income) and not according to the income the owner might receive (allocation of income). Marginal theory has assumed away this basic distinction of the SNA accounting framework. Owners of natural resources can gain from their use by charging the producer a rent. This is a way of sharing the income generated between the owner and the extractor. Whether the natural resource is used as an asset or not depends on whether it is just another input in the production activity or if it actually is used to transform nature into more useful goods.

109. The treatment of natural resources in the same way as fixed capital is misleading. Natural resources are not used in production to transform inputs into output, they are the very inputs to be transformed by fixed capital and labour. A more appropriate way would be to record these resources as inputs from a non-produced inventory. This could imply that depletion will have a negative impact on GDP. On the other hand, the inconsistency of recording a free good as a cost when used in production will not be solved by this.

110. The starting point of NA is the cost of using human resources preferably valued by the outcome of the interaction of economic agents (social valuation). The actual costs in the case of natural resources extraction do not refer to the depletion of mineral resources but rather to the restoration of the extraction site in order to minimise the long run impact on ecosystems. The alternative is not to extract and let the resource stay in the ground, but for what reason if demand pays for all the costs? There is of course one obvious reason and that is the harmful consequences on nature by the use (emissions, waste, toxics etc.). In case the extractor has an obligation to restore the site these costs can be taken into account for the same period the extraction takes place (accrual). If there is no obligation this will be an externality that hits the landowner. In the end this is a matter of national legislation.

111. The proposal of split ownership is also a consequence of the perspective on assets defined by the allocated income and not primarily on the relation between the owner and the user of the asset in

[15] Cf. the quotation from Stone in Vanoli (2005), pp 455-456.

production. A common set up between government and private corporations is by establishing a joint venture (JV). The government has a share in the joint venture but does not engage in the production activity. In its construction the government receives income in the form of withdrawals from the income of the JV. The income is distributed according to the shares in the JV. Even in cases when the JV does not have a strict legal form and only is set up in the form of mutual agreement, a contract, between the parties of the JV, this kind of arrangements should be regarded as a separate institutional unit.

112. The income claimed by the owner of natural resources should in normal cases be recorded as payments of rent. In case the government is the owner, and the agreement cannot be treated as a rent or a JV, the payment might instead be regarded as a tax. In such a case the government is acting on behalf of the society in allocating the resource to the economically best use. In case the payment received by government is large in relation to the costs of administrating the allocation process including surveillance and control of the proper use of the resource, a tax payment is the recommended recording in the SNA.

Improved coherence of data

113. Since it is proposed that SNA should go even further and expand the partitioning of ownership to biological resources, the ownership issue will also impact the SEEA. This is at least the case if full alignment with the SNA is the only option. Regarding that SEEA already includes the principle of split ownership this will only be a matter of practical implementation.

114. From a consistency point of view of the SNA, depletion should not be recorded in the proposed way. Data from the SEEA on the value of depletion can still be used in combination with data from SNA provided that the data refers to the same statistical units, in the two frameworks respectively and it is clear they are calculated from two different perspectives. One particular problem is the split of assets between sectors, this will reduce coherence if different approaches are used in SNA in relation to SEEA. How data are combined and what they might tell is a matter of the perspective taken in each specific analysis.

115. So, in short, the data in each framework need to be consistent but how research fellows make use of data is not a statistical issue. If data on the value of natural resources are of badly need this can be achieved by the creation of a separate information system designed for that purpose.

<u>WS.8 GN on Accounting for Biological Resources</u>

Short summary of the GN

116. The GN on biological resources includes several proposals for changes of the current SNA. These include changes of the asset boundary, exclusion of the distinction between cultivated and natural resources and recording the rent payment as a payment for a service instead of as allocation of income, it is further proposed that the value of fishing quota should represent part of the total value of the fish resource, and to include in the SNA recording of natural growth and depletion in the production account.

117. The proposed change in the asset boundary implies inclusion of wildlife in the SNA even if they have no economic value. This would fully align the SNA asset boundary for biological resources with SEEA. It is a little bit unclear if the GN also propose to include the habitat of wildlife in the asset boundary as well. This would at least include oceans but maybe not the atmosphere.

118. The exclusion of the distinction between cultivated and natural biological resources is motivated by problems of making the distinction in praxis and that it is the estimation and recording of output that is the primary interest and less problematic. It is proposed that by creating a separate asset category of natural assets the distinction between produced (cultivated) and non-produced (natural) biological resources can be removed. Migrating animals, except when under a quota regime, are to be excluded from the economic assets anyway, since in this case collective ownership control is lacking. A further consequence of excluding the distinction between cultivated and natural resources would be to record rent as the provision of a service (output) and not as sharing the income generated by the producer (allocation of income).

119. In case of transferable permits on quotas (fishing quotas) these will, according to the GN, have a value in relation to the natural resource value exclusive of rent payments. Therefore, they have to be taken into account in estimating the asset value.

120. The recording of depletion of biological resources follows the same path as for the natural resources dealt with in the GN WS.6. In this case we are also faced with possible growth, offsetting part or more than depletion. In the proposal, net growth is recorded as output added to the stock of assets. This follows from the current treatment of cultivated assets and forest in particular. Now this treatment will be extended to all biological resources with the only difference that for one off yields the inventory will be increased/reduced whereas for the underlying asset (land, sea or whatever) growth will be recorded as gross fixed capital formation and depletion in the same way as consumption of fixed assets.

Consistency in the SNA and SEEA CF information systems respectively

121. Since the proposals on biological resources are made in the spirit of increasing the SNA asset boundary to include more of the natural resources of the SEEA, there is no problem of coordination created by the GN. The distinction between cultivated and non-cultivated as applied in the SNA is not really needed in the SEEA. It is mere a borderline between natural resources with a positive value that needs to be aligned with the SNA and other natural resources not valued according to the SNA.

122. There is one complexity in this proposal and that is the view on oceans and international waters as being the underlying assets of the harvested aquatic resources. It has not been regarded meaningful from an analytical point of view to include such large resources as the oceans and the atmosphere in the SEEA CF. In the SEEA EA they appear as providing ecosystem services (SEEA CF preface §30 and SEEA EA (draft) table 6.3).

123. The proposal of recording rent as a payment for a service is in line with the view of nature being alike to an economic unit providing ecosystem services, but ignores where the rent actually goes, dealing with it as if it went to nature. The rent, in fact, goes to the economic owner of the service, i.e. the unit who appropriates the service in the first place. This may be the legal owner or not, depending on institutional arrangements. Rent as price for the provision of a service (i.e. not rent anymore) may be fine, but several adjustments would be needed.

124. The service should feature in products' classifications. The sheer possession of nature and possibly its conservation (avoiding destroying it conceived as equivalent of cultivation) should feature in economic activities classifications. The service is provided not by nature, but by its economic owner, carrying out this activity. It constitutes an output for the producing unit and an intermediate consumption for the using unit.[16] But still, the appropriation of the functions of nature, which in the exchange between economic units become a service, is free of charge for the user that is the economic owner of these functions. If these functions are used in production by the owner itself, the rent is embodied in its outputs' value. In order to see the rent as a service, a notional unit should be defined as that part of the economic owner/user unit that appropriates the functions of nature and transforms them into services, separate from the part of the same unit that use the service, and the internal intermediate service flow should be recorded at the rents' value.

125. The distinction between cultivated and non-cultivated biological resources might pose some practical problems in deciding where to draw the line. Since this is a basic distinction in the SNA between human activity that contributes to value added (GDP) and natural processes that have impact on the economic activity but are not part of it, it is of vital importance to keep it as it is, as it means keeping some causes of economic phenomena distinct from their consequences, i.e. from the economic

[16] It is interesting to note the strict analogy with ecosystem services in the SEEA EA. There we also have the case of cultural ecosystem services, where the function directly benefits a member of the household sector (more than a function of nature, it is a spiritual connection between it and people). This is never the case with biological resources, otherwise the picture would be even more complicated, as in those cases there is no rent, neither explicit in payments for the services nor implicit in derived output, and must be literally made up for the accounting. This connects to the improbable identification of the household member as a self-producer own-consumer unit providing.

phenomena themselves. In this case legal ownership plays the role of drawing the line. The owner will care for the resources under ownership but there might be little incentive to care for common resources.

126. In case the owner is allowing another unit to use an uncultivated resource, the payment to the owner cannot be regarded a payment for output. The owner is only granting the resource against a payment without having contributed to it and it is still an uncultivated natural resource. Only the cost of human resources can in this case be regarded the value of a kind of service. The owner has not used any time in creating the resource but maybe some time in negotiating the terms of the rent contract. In relation to the total payment this is only a small part and should not influence the general treatment of these cases. If information is available on the service part of the payment and any taxes related to it these can be recorded in an appropriate way.

127. In a lot of cases, assuming the government acts as if it was the legal owner (as a trustee), the resource is actually let free-of-charge, so the value would be zero even if the resource was cultivated. Ecosystem services, by the way, are provided for free by publicly-owned cultivated ecosystem assets (e.g. city parks): their value is included in public administration costs.

128. Fishing quotas and other quotas are primarily used for the allocation of a resource for which over exploitation is making the existence of the resource being at risk. Quotas transferred between fishermen are redistributions of income usually from high productivity units to units facing some kind of difficulties. The relation of prices for quotas to the value of the stock depends on many factors like output prices, the total amount of fish allocated by quotas and the marginal cost of increasing output by the buyer of quotas. Simply using the unit price of fish evidenced by fishing quotas as the best approximation of the stock value seems biased towards the valuation made by the most productive fishermen. Resource rent is a kind of average of all producers. Maybe a comparison between quotas and the resource rent can put some light on this issue.

WS.11 GN on the Treatment of Renewable Energy Resources as Assets.

Short summary of the GN

129. This GN regards renewable resources used for heating and electricity production. All resources are of flow type and natural (water, wind, solar radiation etc.).

130. The inclusion of renewable energy resources in the SNA is motivated by the fact that there is currently an imbalance between the value of assets in NA and the income measured in the production account. Or, stated differently, part of operating surplus is not correctly related to the relevant assets contributing.

131. The GN recommends the same valuation and economic ownership principles as included in SEEA CF. Consistency in the SNA and SEEA CF information systems respectively

Consistency in the SNA and SEEA CF information systems respectively

132. Regarding the consistency in SNA the inclusion of these resources as separate assets will cause problems. In the case of SNA the definition of assets is not met. First of all, there need to be an object with ownership rights. The object can be intangible but still need to have a legal owner. Without a legal owner economic agents cannot engage in transactions. Secondly, these flows do not have the necessary properties of transforming inputs into output. Actually, they are kind of inputs used mainly to produce electricity. A third problem related to the second is that assets in the SNA can be transferred to future periods but these resources are not possible to store for later use. Finally, they are free to use if the equipment for generating electricity is allowed to be used at the real estate where the economic agent choose to establish the production.

133. That there is an imbalance between assets and income in the current NA due to exclusion of renewable energy resources is not a matter of the accounting framework. Capital formation in the SNA consists of resources created by production or acquired through transactions with other units in the economy. Capital formation means that something has to be given up in order to create or acquire the resource. Resources directly appropriated from nature, regardless of how important they might be for

the economy, are treated as free resources (no ownership). Such resources can after appropriation be sold and appear as assets in the accounts of the buying unit. If the resources cannot be appropriated as such, their derivatives may be. Derivatives appearing as flows can hardly be recorded as assets. Being assets implies that they can be captured, stored and used or transferred in a later period.

134. The imbalance is only there if we want to explain part of operating surplus by some assets that are not accounted for in the balance sheet. There is no intention that the accounting framework should provide an explanation of the causes behind operating surplus. Operating surplus is a residual open to interpretation and for researchers to explain. From the perspective of Marginal Theory there might be an imbalance due to the assumed correspondence between income and different kinds of capital to which the income is attributed in a state of GE.

135. In SEEA there are also issues of consistency. In relation to SNA there is no doubt that these resources shall be included in SEEA, it is more a matter of how. Renewable energy resources can with few exceptions only be used if there is access to land. This means that if these values are recognised by economic agents, land values will include values for these resources as well. Estimating separate values might not be consistent with the values already included in land. Furthermore, it is hard to independently estimate separate values for specific functions of land that also are consistent with observed transaction values.

136. Renewable energy sources, like any other thing, may be the reference for financial assets of the "futures" (bets) kind. Suppose for instance a transferrable right is created, that represents the right to appropriate the value of the extra productivity generated by wind turbines in a particularly windy place, i.e. to reap the rent derived from this specific use of the land (or sea). The transferrable right is an asset for its holder and corresponds to an advance payment of the rent to the landowner, but this does not make the wind a real asset separate from the land or sea area where the turbines are.

Improved coherence of data

137. If the GN is implemented in both SNA and SEEA there will be no issue regarding coherence *between the two systems*. Still, the mix of statistical and theoretical approaches implies, as discussed also for other issues, confusion and inconsistencies *within both systems*, especially serious for the SNA.

WS.7 GN on the Treatment of Emission Trading Schemes

Short summary of the GN

138. This guidance note has not made a strong proposal for a particular recording option. Instead it presents four alternatives to the current recording of an asset that is split in two parts, a prepayment of a tax (financial asset) in combination with a non-produced asset taking care of asset values above the prepaid tax.

139. The four alternatives include two cases (option 1 and 2) with relation to the atmosphere (resource lease and permit for the right to use the atmosphere), a contract (option 3) and finally a pure financial instrument (option 4).

140. Option 1 treats the contract in the same manner as permits to use the Radio Spectrum, a non-produced non-financial asset. The natural resource is not regarded owned by government but still the long-term use is recorded as an asset. Nevertheless, in both cases the government can regulate who will have access to the natural resource and converts this into a permit sold. This recording option is supported by the current SNA.

141. Option 2 treats the emission permit as a payment for using the natural resource as a storage. The advance payment before actual emission is recorded as a financial asset, a forward, and when used as payment for the use of the atmosphere (at the time of emission or surrender of the permit) recorded as a rent payment. It is pointed out that the treatment is similar to fishing quotas, timber and mineral resources.

142. The third option is a simplified version of the current recommendation. In this case the tax is paid at auction and the permit can be used later (at surrender) to evidence the tax payment. In the meantime, when the permit is traded the value can change. In this case the permit is only recorded as a non-financial asset. At surrender the exit of the contract is recorded as other changes in volume. This is symmetrical to its creation except for differences in the value.

143. The last option is to treat the emission permit as a financial asset. The asset is recorded in the accounts of the government issuer as a liability until surrender. The difference in value between issue and surrender is recorded as a revaluation in the accounts of both the government (issuer) and the owner. At the time of surrender the difference between the issue price and the market price is recorded as other changes in volume.

Consistency in the SNA and SEEA CF information systems respectively

144. From the perspective of physical flows of greenhouse gases there is at least three main areas that can absorb these emissions. The atmosphere, the oceans and biota including forests. The idea that emission permits represent the right to use one of these areas in particular is missing the main point with these permits. These are a way of reducing the emissions by imposing quantity restrictions (quota) and at the same time use the market mechanism to allocate the quota among producers. What we actually are witnessing is a case where governments are acting in the interest of the society and not primarily to finance government expenditures. Since the money enters into the government budget a tax is not entirely wrong.

145. The problem with options 1 and 2 is therefore in the first place in the identification of the atmosphere as the asset used, since emissions also end up elsewhere. Forest conservation in particular is used as a justification for the issue of emission permits. Carbon sequestration and storage ecosystem services are often valued based on emission permits' values, as if they were in the same "market" as the use of the atmosphere. Moreover, the atmosphere can be used in a lot of other ways, while here the permit concerns a quite specific consequence of economic activities, a consequence which would in principle be existing even if the atmosphere did not exist. The fact that emission permits are meant to protect the atmosphere does not imply that the atmosphere is an asset used up by emissions, just like discharges into natural water bodies do not use up water.

146. The idea that government provides some kind of storage service is somewhat peculiar since the government does not own the storage facility and in the case of biota in forests and on farmland infringes on other unit's ownership if regarded as a government service. Furthermore, the reference to fishing quotas is only correct for emission permits given for free to producers according to their previous emissions. This might be done to make these producers sustain international competitiveness at the current level of output and only face increased costs for expanding production. The same goes for fishing quotas that are given for free and traded on the secondary market. These are allocation regimes introduced by governments for the use of free resources.

147. The atmosphere as an asset is not included in the SNA due to lack of ownership. Ownership is not a restriction in the SEEA and poses no problem in the treatment of physical flows (i.e. the measurement of quantities of gases dumped in the atmosphere or absorbed by other natural bodies). A further problem with option 1 (sale of a part of an asset) and option 2 (a resource lease) is the possibility to make an economic transaction without having ownership. One major obstacle is the location of the part of the atmosphere that is sold or leased. On a global scale for option 1 it would look like the rich and wealthy countries of the world own most part of the atmosphere so maybe option 2 is the less inaccurate of the two.

148. The recording of emission permits as contracts or financial assets does not impact SEEA. Contracts as a special asset in the NA require that there exists an underlying asset which is hired or leased and that the use of this asset can be transferred to a third party. The lack of an asset in this case should actually prevent us from including this option in the SNA.

149. The last alternative to the current recording is as a financial asset. This comes closest to the way emission permits are used by economic agents prior to surrender. At surrender the emission permits are handed over to the government as evidence of a payments for the reported emissions made earlier.

Emission permits have this double nature as a financial instrument and at some point in time as a tax payment. This is very close to a convertible debenture that is a loan with the possibility to convert it into corporate shares.

Improved coherence of data

150. Option 1 and 2 are referring to the atmosphere as an *implicit asset*. We can understand this as something that has the function of an asset like a storage but, in a strict sense is not included in the asset boundary. The problem with these two options occurs because the recording is made *as if* the atmosphere is included as an asset in the SNA. This raises the issue of coherence since it is clear that the atmosphere is not included in the SEEA asset boundary.

151. Option 3 and 4 are not relevant in the context of SEEA since these values are the same as recorded according to the SNA.

WS.10 GN on Valuation of Mineral and Energy Resources

Short summary of the GN

152. Contrary to the title this GN also includes a proposal for extending the asset boundary of SNA. The aim by this is to make the comparison of values more accurate. It is proposed that SNA should use the same division of mineral and energy resources as in the SEEA. This means to separate the resources into three classes: 'commercially recoverable resources', 'potentially commercially recoverable resources' and 'non-commercial and other known deposits'.

153. Regarding valuation it is proposed that SNA should use the same method and assumptions as recommended in the SEEA CF. The assumptions include in particular the future annual volume of extraction, the development in future resource prices and the discount rate, i.e. the opportunity cost of using the resource.

154. For the estimation of the resource rent it is proposed to take care of volatile output prices by smoothing of historic time series of output prices. This translates into using the trend in output prices and thus avoid the movements around the trend.

155. The calculation of resource values should be done at the lowest possible level of disaggregation, for each deposit at the best, and then be summed up to the total value for the industry and nation respectively.

Consistency in the SNA and SEEA CF information systems respectively

156. Since the GN proposes the same principles as already included in the SEEA CF there is no consistency problem in relation to SEEA. For the SNA the situation is different. Potentially commercial and even less profitable resources is far from what can be included if we regard that what should be included are only the resources that actually are in use. The only reason for including potentially commercial and other resources is if there is a market where these resources are traded (change of legal ownership). In such a case they can be used for saving purposes. The industry can buy and save for later sale or exploitation. Without a regular market it will be impossible to dispose of assets at the time the owner finds appropriate.

157. The valuation of mineral and energy resources including renewable energy resources depends ultimately on the NPV-method. This method is assumed to give accurate values when the economy is in general equilibrium (GE). According to theory and in a state of GE, the capitalised costs are equal to the discounted future net income. If we look on the issue from the other point of view, as a capitalisation of the cost of creating the natural resource things look different. The costs according to SNA corresponds to the use of human resources, so simply stated the value will be zero unless it is a cultivated resource. So, this might be a good estimate of the general equilibrium value. We could also include costs of exploration that should be capitalised paid back including a return to this particular fixed asset out of the future resource rent.

158. Smoothing of the historic resource rent is proposed in the SEEA as a way of reducing the volatility. But this method will also blur the relation between the actual resource rent and the value of the asset. As discussed previously (§§89-90) it is not clear how this should be understood. Another point made is that fixed assets are not valued in the same way as mineral and energy reserves. Productivity gains will only influence the resource rent and the value of the reserves.

159. To the society the resource is a free good and as long as the output prices cover the costs of exploitation and the functional income distribution is acceptable, i.e. the rate of return on produced assets is in line with the rest of the economy, the resource will be exploited. In GE this translates into a resource rent equal or close to zero. So, at the point a natural resource becomes commercially recoverable it has a low value as investment object. If it will be exploited at that time is another matter.

160. When the resource rent increases, the human effort in the extraction activity becomes more rewarding. How this income is allocated between labour and the owner of the resource will determine the potential value of the resource for an investor facing alternative options for the use of money. If the resource can be transferred the potential value can be realised. To the society there is no difference in value it is still a free resource. The resource is used by economic agents to redistribute income.

Improved coherence of data

161. Using the same resource classes and valuation method in the SNA as in SEEA_CF will undoubtedly increase the coherence.

Main conclusions for the ongoing SNA revision's GNs discussed in this paper

162. The following table summarises some features of the proposals included in the GNs discussed in this paper, whose consideration is useful for drawing conclusions about their acceptability. Starting with the current situation and as we have tried to show there is not full consistency in the SNA. This is due to some ad hoc amendments made in the revisions notably the inclusion of Radio spectra as a non-produced asset and also the recommended treatment of emission permits as an asset with a strange double nature, both a financial and a non-produced asset at the same time. The overall consistency of SEEA refers mainly to the physical accounts.

163. The table should be understood in the following way: YES is a positive change and NO is a negative change due to the GN. If the proposed change in the GN already is in place then it is not applicable (n.a.) for the consistency. In case a specific dimension like valuation is not part of the GN this dimension is n.a. as well. Let's take WS.6 as an example. Both split ownership and depletion are already included in the SEEA CF as the recommended recording. If the GN is accepted this will change the recording in SNA but not in SEEA, so it's not changing anything in the SEEA to the better or to the worse. Therefore, SEEA is neutral to the change and we note this with not applicable (n.a.) in the SEEA consistency column. This particular GN adds to the coherence since the definition of assets in the SNA is made to align closer to SEEA. Since the valuation issue of mineral and energy resources is the main issue of GN WS.10 this is not applicable in case of WS.6.

Table 3: The impact of the GN on consistency and coherence of SNA and SEEA (tentative results)

		GN adds internal consistency to		GN adds to the coherence of SNA and SEEA	
GN	Proposals / Options	SNA	SEEA	Definitions / Classification of assets	Valuation method
Current situation		NO	YES	NO	NO

WS.6 Economic Ownership and Depletion of Natural Resources	Split ownership	NO	n.a.	YES	n.a.
	Depletion as production cost	NO	n.a.	YES	n.a.
WS.10 Valuation of Mineral and Energy Resources	Three asset classes	NO	n.a.	YES	n.a.
	SEEA NPV valuation method	NO	n.a.	n.a.	YES
WS.8 Accounting for Biological Resources	All biological resources in the asset boundary incl. oceans	NO	NO	YES	n.a.
	No cultivated / natural resources distinction	NO	YES	YES	n.a.
	Rent as payment for a service instead of income allocation	NO	YES	n.a.	n.a.
	Value of fishing quota as part of the total value of the fish resource	YES	YES	YES	YES
	Natural growth and depletion in the production account	NO	NO	n.a.	n.a.
WS.11 Renewable Energy Resources	Wind, Sun, etc. as assets	NO	NO	NO (creates duplication)	NO
WS.7 Emission Trading Schemes	1: Non-produced non-financial asset	NO	NO	NO (creates duplication)	n.a.
	2: Advance payment as financial asset + surrender as rent payment	NO	NO	NO (creates duplication)	n.a.
	3: Tax paid at auction + permit non-financial asset + surrender as other changes in volume	NO	n.a.	n.a.	n.a.
	4: Emission permit as a financial asset	YES	n.a.	n.a.	n.a.

164. The main conclusion to be drawn from the discussion of GN and as evidenced by the table 3 is that the ambition of creating a higher degree of coherence of the SNA in relation to SEEA is achieved at the cost of reduced consistency in the SNA. The particular feature of assets in the SNA will be confused. As pointed out earlier in the paper it is better to create a separate information system for data that fits the purpose of supplying information into optimisation models like the one used by IPCC and presented in the Dasgupta report. Such an information system could also benefit from the inclusion of the appropriate concepts of output and income that is consistent with the view on assets.

165. The proposals in the GN will to some degree also reduce the consistency of SEEA. The main challenge for SEEA will be the duplication of values for some particular resources.

Concluding remarks

166. As already pointed out, a clear distinction is needed between the role of non-produced assets in production and their role in the distribution of income and wealth. On the one hand, it is certainly useful to determine the exchange value of the right to exploit non-produced assets from the point of view of a country, an institutional sector, an individual unit, as this right is a valuable that can be used for saving purposes. On the other hand, their role in production is not an active one: they do not contribute to value added, their depletion does not enter VA in the first place, so it is not correct to subtract its value to get depletion-adjusted value added. Depletion is a loss of the value that the resource has for its owner (a decrement of the owner's wealth) and must be recorded in its asset account just like the change in volume of other valuables must. So, we are not against valuation of these assets as part of a nation's wealth and of their depletion *in general*, but only against depletion featuring in the production account and of non-produced resources among productive assets.

167. In this paper we discussed some fundamental characteristics of the SNA and the SEEA as statistical frameworks that need be conserved through their ongoing and future update processes, including the coherence needed to sensibly combine information from the two systems. We highlighted some existing deviations from these principles, embodied in *ad hoc* adjustments, and discussed how the adoption of several other similar changes, proposed in the framework of the ongoing SNA revision with the objective to make the monetary aggregates of the systems relevant in terms of measuring welfare and sustainability, would introduce further deviations and inconsistencies. We identified in the adoption of the marginal theory perspective, the common trait of these *ad hoc* changes and proposals, and suggested that it would be sound to maintain and reinforce the characteristics of the SNA and SEEA that make them belong to official statistics, by renouncing to introduce theory-laden measurements in them.

168. While the problem is less serious for the SEEA, since the concerned parts are not organically connected to the rest of the system, the further mixing up of statistical and non-statistical measurements would constitute a serious blow to the SNA's ability to represent economic reality objectively. Theories should be tested by using statistics that are not determined by theories. If statistics are by construction coherent with theories, they are no independent benchmark for research and policy.

169. The most relevant evolution that the SNA can go through in relation to the measurement of welfare and sustainability, as far as the society-nature relationship is concerned, is that it recognises its limits and fully accept that its role is the measurement of human activity only. This means that it needs to be complemented by information in physical terms[17] such as that provided by the SEEA, and that relevance for welfare and sustainability analysis is given by the possibility of combining information from the two systems. In this sense, the two should form an integrated system of systems.

170. Since criticising is never enough, in the following we try and express in positive statements what we see as fundamental tenets for such a system of systems. After that, we summarise the main conclusions as for the ongoing SNA revision's GNs discussed in this paper.

Some tenets for the SNA and SEEA as statistical systems

171. The purpose of the SNA and SEEA as statistical frameworks is not to measure welfare, but economic activity as a human activity (e.g. 2008 SNA, §§1.1, 1.75) and its relationships with the connected but separate physical environment.

[17] Besides of course deepening the classifications used in order made more meaningful as for the description of transactions directly connected to the environment and its protection.

172. *Nature* may be recognised in both the SNA and the SEEA as the seat and source of all *assets* and *natural inputs* in the most general terms[18], comprising every living and non-living natural thing or flow. Two sentences may be sufficient for that in the SNA, clarifying that dealing with physical aspects is one specific purpose of the SEEA.

173. Economic activity is, and must continue to be, strictly and clearly intended as *human* activity, which means that *nature* should never enter the accounts as an economic unit.

174. Nature not being an economic unit means that *transactions* involving *exchange values* are fully recognised as relationships between economic agents, even when the valuable things that are transacted are in their natural state. Indeed, in these cases, transactions concern the *right to use* natural stocks or flows as natural inputs, not the stocks or flows themselves[19].

175. Building on the SEEA, a clear distinction must be drawn between, on the one hand *natural stock and flows, physical flows between nature and economy/society and within the economy* and, on the other hand *economic assets and goods and services and transactions*. Nature is a physical entity, from which *natural inputs* are derived. The economy is the realm of *economic (exchange) values*.

176. While nature is not an actor in the SNA, it must be fully recognised as a contributor to all production and to the very existence of all economic assets *in a physical sense*. Its contribution, however, is never separable from that of human activity, i.e. it does not provide a share in the physical output.

177. Nature is, indeed, the seat and source of all economically relevant stocks and flows and space; it is thanks to its laws that elements combine and recombine, and energy flows; it is thanks to regulating ecosystem services that buildings are not swiped away; it is thanks to photosynthesis that humans can breathe and work and enjoy consumption goods, etc.

178. Production does not escape, but uses, the laws of nature: human action only favours a desired configuration of the material world[20]. Production activities make an *economic use* of nature.

179. The only way to transform any of these material aspects and organisation features of nature (let us call it just "nature") into *economic assets* is to establish *rights to use* them and make them subject, in chunks, to exclusive and transferrable property rights. The existence of these rights to use restricting access for those who do not hold them, we call "appropriation", along with the use itself where there is no explicit restriction (the economic use of nature itself reveals the rights). This appropriation is the basis of the social relationship hinted to above, giving rise to rents of the kind of *resource rents*.

180. A single concept is sufficient for describing the economic aspect of the relationships between humans and nature: "extraction" or – preferably – "appropriation".

181. Not all economically significant uses of nature are significant for the national accounts, no matter how significant it may be for humans and the economy. This is for instance the case of atmospheric oxygen or nitrogen, or of sea water where there is plenty. Significance for the national accounts only arises when restrictions give rise to rents.

182. The existence of rents may be greatly favoured by limitations to access determined by natural restrictions (such as concentration in particular places, including quality differentials of the kind giving rise to Ricardian rents) and by technological constraints (when specific knowledge and machinery are necessary to make a certain economic use of nature), but it always is determined by institutional arrangements, which may even be the exclusive source of restrictions making economically significant

[18] The list of *natural inputs* of table 3.2 in the SEEA CF should be expanded to ecosystem services not already included there (only "provisioning services" are). This would also make clearer the status of such services in the SEEA EA, as there often is confusion between them considered objectively and them considered from the point of view of the exchange value of controlling them (economically appropriating them).

[19] This may indeed seem a subtle distinction, and one that may remain implicit, as long as it is clear that rights to use are and should be dealt with as economic assets of their own, without a need to look for the overall value of the underlying reserves, if these are not actually transacted or up for sale nor offered as a guarantee for liabilities (in which case, the written-down value is what counts).

[20] Quite successfully in many cases, and more and more, but not always!

the use of nature (e.g. emission cap-and-trade schemes make the use of the atmospheric space as a sink economically relevant).

183. The ways in which economies tell apart specific components or aspects of nature and appropriate them, thus transforming them into economic assets (rights to use) does not make reference to any single coherent overall a-priori partition of nature. For instance, the restrictions may concern whole portions of land – including the subsoil, the ecosystems present on the surface, and the air above them – or very specific resources such as for instance metal ores in general, or the very space of an area (e.g. if nothing is allowed to the owner of a park, but levying a fee on entrance). This poses practical problems in assessing ownership and avoiding double counting.

184. In synthesis, it can be said the *right to use* itself is the asset, not the underlying resources. It is the institutional arrangements embodied in the right to use (whether incorporated in a product or a tradable title), that make non-produced "things" valuable in exchange value terms, as they fix the conditions and price of access to them. It is the structure of the market (how imperfect competition for the appropriation of the right to use is) that determines the price.

185. Contrary to the assumptions of the marginal theory, nature's contribution to production is not identifiable as a share *provided by nature* of the exchange value of output. Only the share of the exchange value of output, appropriated by the *economic owners of nature* (the rent), is identifiable. This share crucially depends upon institutional arrangements and market structures concerning the rights to use nature. It only informs about the allocation of income. While the physical results of human production efforts may crucially depend on nature, and their exchange value depends in turn on these results, the SNA is only concerned with the exchange value of the output as a result of human efforts. The SEEA provides all useful elements to take nature's role into account in analysis such as e.g. productivity analysis, in terms appropriate for that kind of assessment, i.e. in physical terms.

186. A clarification is needed about the fact that resource rents do not contribute to added value in general, but only entail income transfers between economic units. A distinction must be drawn between (rights on) nature as economic assets *for their owners*, where the *store of value* aspect prevails, and nature as an asset for society, where the ability to provide repeated benefits aspect prevails (as pre-requite of production and consumption). This asset (or collection of assets) is physical in its nature and its value for society cannot be meaningfully expressed in monetary terms as it is provided free to society as a whole. To the extent it is appropriated, however, it is not free for all economic agents, it just is a valuable and a source of income for its owners. Assuming that the value to the owners is the same as the value to society is not correct in this case.

187. The SNA only deals with *actually existing* exchange values. This excludes hypothetical markets and the valuation as market exchanges of exchanges between nature and economy. Indeed, such valuations always concern the possible extraction of existing *consumer surplus* in the form of rents. These would be paid, under the hypothetical conditions, i.e. under a different *institutional arrangement* than the existing one, by the current economic owners, who use or enjoy them for free, to different economic owners[21].

188. Biological and other natural resources do not underlie economic assets as long as they are not subject to alienable property rights. The existence of alienable property rights is manifest when the owners write their supposed exchange value in the ledger. Biological resources' physical growth increases the quantity of the rights to use held by their owners.

189. Governments are not the owners of all nature that is not privately owned. They are subject to constitutions and laws and could not sell most of what nature consists of, even if they wanted to. They do not represent society at large and even less so mankind. Rather, they are special actors in the economic arena.

[21] As a corollary, in principle, the prices of similar goods, applied in the valuation of own consumption of natural inputs, should be stripped of the resource rent component.

190. Production implies the use of labour and/or machines and results in economic output (when machines are used by humans to get a pure enjoyment result, the human activity involved is not labour). *Nature* does *per se* never provide *economic outputs*. Economic outputs only stems from production.

191. It would not be wise to attempt to put a monetary value on anything that is not in principle alienable, because the SNA should objectively reflect the economic effects of societal choices, void of all judgement about their welfare implications, instead of selecting as measuring rod of all results the meter of that specific institutional arrangement which is the market, i.e. exchange value. No attempt should be made to alter GDP in the direction of measuring a larger concept of "output" through it by including nature's gifts as if they were products.

192. The SEEA must provide, on a par with the SNA, all the information elements about the status and economic use of nature. The *extraction* of *natural resources, renewable energy*, and of some *other natural inputs* is always a production activity, since it takes labour or machines to extract them.

193. The *use* of regulating and cultural ecosystem services may happen in production, but it is not *per se* a production activity. Whatever activities are carried out by humans on biological resources – be it protecting them or cutting them down – they are production activities recorded in the SNA.

194. The regeneration and natural decay of biotas may be influenced by humans in many different ways, in a range that goes – as for the degree of human intervention – from doing nothing, to just protecting them and allowing growth and decay to happen naturally, up to causing, selecting and accelerating growth (through ploughing, seeding, fertilising, using pesticides, weeding, pruning, exposing to artificial light, etc).

195. This range justifies a distinction between cultivated and non-cultivated biological resources only as a convention, while it is necessary to recognise the contribution of cultivation activities (including those instrumental to protection) at one end, as well as the contribution of nature at the other end. As already pointed out, the contributions of nature are not measurable in exchange value terms. In particular, they cannot be identified in the rent, as this only represents an allocation of income (distribution of value added) phenomenon, determined by the ownership claim and not by human activity contributing to production (which is what the SNA wants to measure).

196. A different and more important distinction is between economically used and non-economically used resources. Economically used biological resources, whether cultivated or not, may be available for use as raw material or for other economic uses, i.e. as ecosystems whose services other than provisioning are also up for sale. There is no double accounting risk, as long as actual transactions are the basis for valuation.

197. The purpose of cultivation is not necessarily economic use, e.g. city gardens are cultivated but mostly free for people to enjoy. There is no price, and less so rent, on their use, so one could say that the value of their services coincides with what the municipality decides to spend in cultivation, i.e. with the revenue (output) of the cultivation activity. However, it is more correct to say that city gardens' services are not up for sale (cultivation expenses are paid though taxes, not fees) and since their value is not written down to guarantee the municipality's debt, the purpose of the cultivation activity is not economic use even if it is an economic activity. Some "cultivation" element is present in all biological resources, but clearly the expenditure on the protection of the Amazons should not be taken as a measure of its value or economic importance.

198. The right to exploit renewable energy resources – which in most actual cases is secured through nothing more than putting in place machinery to capture them – may give rise to rents, for example to the extent that better quality locations for wind and solar energy give – *ceteris paribus* – higher physical output. This rent may be captured by any of the economic agents involved: the landowner, if aware of the differential value of the location; the state, if it imposes a tax on the differential; the owner of the machinery, depending on its power on the machinery market; the company running the plant, if nobody cares or has any market power. In principle, unless the State (not the government!) claims property on wind or sunlight, it is however the landlord that appropriates the rent, as climate is a feature of the location. Such issues – whether there is a rent or not and who appropriates it – should be investigated on a case-by-case basis, for the compilation of the allocation of income account.

199. Depletion of natural resources, pollution, environmental degradation, reduced ability of ecosystems to provide "services" are *physical* costs of production. They need be recognised in accounting and indeed they are in the SEEA. Subtraction of these costs from value added as capital costs, and consideration of them as forms of capital more generally, is not consistent with the fact that they are non-produced, i.e. come free for society's economic use in general.

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