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SNA 2008 CONCEPTS RELATED TO PROCESSING AND MERCHANTING AND ITS IMPLICATIONS FOR THE ENVIRONMENTAL ACCOUNTS

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1. Introduction

The new SNA guidelines will lead to changes in the recording of global manufacturing. These changes are the result of revised recommendations regarding the treatment of goods sent abroad for processing and for merchanting. The 1993 SNA stipulated that exports and imports of goods should be recorded at the time in which ownership passes from a resident to a non-resident unit. However it noted 4 possible exceptions to the ownership principle: goods subject of a financial lease; goods shipped to a foreign affiliate; merchanting, and goods sent abroad for processing.[1] With the 2008 SNA these exceptions have been dropped in favour of the application of pure ownership criteria. Therefore the necessity to impute changes of ownership has disappeared.

The 2008 SNA recommendations are to a large extent motivated by the empirical realities of a globalising world in which it becomes increasingly difficult to monitor production processes especially when supply chains are lengthening and the businesses involved are increasingly interconnected across multiple countries. As a result, the 2008 SNA has made the explicit choice to follow more closely business accounting practices where ownership concepts play a key role. In this way economic statistics are more compatible with economic reality and equally important it is easier to collect data which in the end leads to a better quality of economic statistics.

These recommendations regarding merchanting and goods sent abroad for processing not only have major implications for the National Accounts, in particular for the recording of imports and exports but also the recording of production and intermediate use, but a fortiori also call into question how the physical flows underlying these transactions should be recorded in SEEA.

The key issue discussed in this paper is the following:

How should SEEA record physical flows in case of goods sent abroad for processing or goods subject to merchanting?

The outline of this paper is as follows. In section 2 we will briefly describe the 2008 SNA recommendations related to processing and merchanting. Other globalisation issues such as

[1] The rationale for the first two exceptions was that although legal ownership did not change, economic ownership was effectively changed with the transferral of responsibilities and risks. Merchanting was recorded net in order to measure the value of the service the merchant provides. Processing was recorded net or gross depending on the extent in which the identity of the goods sent abroad was changed (with 3-digit CPC as criteria).

'production abroad' are outside the scope of this paper.[2].In section 3 we will discuss the implications of following the 2008 SNA recommendations for various aspects of the environmental accounting system: energy accounts; material flow accounts; air emissions accounts and the ability to perform input-output analysis. In section 4 we will discuss two possible solutions and provide arguments pro and con. In section 5 we will put forward our preferred recommendations and spell out in more detail what this would entail in practice for compilation of the environmental accounts.

2. The 2008 SNA recommendations

2.1 Goods sent abroad for processing

The 1993 SNA stipulated that in case of goods sent abroad for processing (or goods sent to a foreign affiliate)[3] a change of ownership had to be imputed even in case no change in legal ownership occurred. According to the revised 2008 SNA ownership transfer (or a product transaction) is leading without exceptions in determining commodity import and export flows. This implies that goods sent abroad for processing are no longer automatically recorded as imports and exports in the National Accounts. However, they are – at least for now – still recorded in international trade in goods statistics where as a general rule the cross border registration principle is followed. To clarify the issue upfront, let us consider the following realistic example for the Netherlands:

An oil refinery plant (the processor) –resident in the Dutch economic territory - converts 75 million € worth of crude oil into 100 million € worth of petrol. The crude oil is owned by a foreign parent company and shipped in from abroad. The foreign parent sells the petrol abroad. The oil refinery plant is receiving processing fees from the parent company to compensate for operational costs.

The differences between the 1993 SNA and 2008 SNA recording of this economic activity are illustrated in the table below. 1993 SNA demands the imputation of a transfer of ownership. In this way the output of petrol and intermediate consumption of crude oil is explicitly covered in the production account of the oil refinery plant. The new national accounting guidelines do no longer allow this imputation and as a result imports of crude oil and exports of petrol are no longer recorded. Instead exports consist only of industrial services delivered to the owner of all products (crude oil and petrol).

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[2] Production abroad occurs when for example a domestic company outsources its production to a foreign company while still owning the goods produced and the goods used in production. This raises a number of measurement issues. Output and intermediate use are in this case required to be recorded in the domestic economy (ownership is assumed) however whereas production could perhaps be obtained from production statistics, intermediate use would also have to be measured. Second, both the produced goods and intermediate use would not enter the domestic economy and these transactions would therefore not be reflected in international trade statistics of the principal country. As production abroad can be interpreted as a combination of merchanting and goods sent abroad for processing, we will focus on these latter two issues here.

[3] We will focus here on goods sent abroad for processing as goods shipped to foreign affiliates are subject to a similar analysis.

Table 1- Global manufacturing: inward industrial processing

Global manufacturing: inward industrial processing

According to SNA 1993		
Output of petrol	100	
Intermediate use of crude oil		75
Value added		25
Import of crude oil	75	
Exports of petrol		100
According to SNA 2008		
Output of industrial services	25	
Value added		25
Export of industrial services		25

In theory, these new accounting conventions do not lead to different value added numbers or to different trade balance totals[4]. To the contrary, these new accounting conventions do lead to changes in production value numbers. The production value of the activity has been downwardly adjusted due to the new recording conventions.

The mirror situation in which the domestic economy sends good abroad for processing (outward industrial processing) is treated similarly. In this case, the domestic economy imports crude oil (intermediate use) and exports petrol (production) according to 2008 SNA concepts. In reality no cross boundary physical flows of imports and exports will occur and no emissions are emitted in the domestic economy.

2.2 Merchanting

Merchanting occurs when a resident buys goods from a non-resident, and sells these goods to another non-resident without these goods ever entering the economic territory of the resident.

A Dutch merchant buys 100 euro timber in Ghana from a Ghanese company and subsequently sells these for 120 euro to a Chinese company.

The 1993 SNA would record only the margins of the merchanter in our case 20 euro as export of services. The 2008 SNA would record a negative export [NB not an import] of 100 euro of timber and subsequently a positive export of 120 euro of timber. As these physical and monetary flows in general would balance during the accounting no major problems are to be expected.

Although, these physical and monetary flows in general balance during the accounting a shift in type of commodity (from service to wood) will occur. As a result an increase in the amount of exported timber will be observed.

[4] As argued in De Haan and van der Holst different ways of measurement (not based on imputed product flow values) of these activities may nevertheless lead to changes in outcomes.

2.3 Implications for SEEA

One of the main strengths of the SEEA are its hybrid accounts, in which monetary and physical information is juxtaposed in a common framework. Changes in the recording of monetary flows would have to lead to changes in recording of physical flows (and vice versa). This implies that when the 2008 SNA recommendations are followed in the SEEA, the physical flows underlying goods sent abroad for processing would no longer be shown as import and export in the physical flow accounts of the country in which the processor is resident if there is no change in ownership. This would assure consistency with the national accounts.

However, on the other hand such an approach would go against the whole *raison d'etre* of environmental accounting, which is to describe how economies interact physically with the environment as well as with other economies. This is worded quite explicitly in SEEA 2003:

> Physical flow accounts describe amongst other things how one country physically interacts with the rest of the world. These physical flows represent the direct impacts of the economy of one country on the environmental state of another country. These impacts are caused by three different types of cross-border flows, (i) material flows in connection with international trade, that is the import and export of products and residuals and the supply of natural resources and ecosystem inputs to unit residents in another country (ii) economic activity which takes place outside its own environment e.g. international transport and tourism (iii) cross-border transfers of residuals. (Para. 2.46)

The SEEA and many of its accounts attempt to describe the physical requirements of the economy. No longer recording some of the key physical flows (and their possible environmental impacts) would seriously jeopardize this objective. We are therefore facing a difficult choice as two of the key principles that underlie SEEA seem to be in conflict with 2008 SNA recommendations.

It is also important to realize that the issue has consequences for other parts of the system as well. For one, the refinery – even though characterized as an industrial processor - does continue to emit green house gases. It would be problematic to continue recording these emissions without recording consistently the underlying energy flows and their conversion in oil refinery processes.

Before we will be able to sketch pros and cons of possible ways forward, it is important to investigate the implications of following the 2008 SNA recommendations for various aspects of the system. In the next section we will therefore discuss energy accounts; material flow accounts; air emissions accounts and the ability to perform IO analysis.

3. Implications of 2008 SNA recommendations for the environmental accounts

3.1 Energy accounts

The energy accounts monitor supply and use of energy carriers in both physical and monetary terms. We have therefore extended our previous example of the refinery and included also the physical flows for both the 1993 SNA and the situation in which no longer physical flows are recorded (which we will for ease of reference refer to as '2008 SNA' even though the 2008 SNA itself only pertains to monetary transactions and is indecisive to alternate recordings of physical flows in the SEEA).

Table 2- Implications for hybrid indicators

100 percent of oil refineries process oil from abroad into gasoline without transferring ownerhip

Industry account under the 1993 SNA	Processor	
In physical and monetary terms	mln	tj
Gross Output:	**100**	**60**
Gasoline (manufacturing)	100	60
Intermediate inputs		
Crude oil	75	80
All other goods	0	
Processing fees services	0	
All other services	0	
Value added	25	
Indicators		
Energy productivity (mln/kg)		1.3
Energy intensity (kg/mln)		3.2

Industry account under the 2008 SNA	Processor	
In physical and monetary terms	mln	tj
Gross Output:	**25**	**0**
Gasoline	0	0
Industrial services	25	
Intermediate inputs		
Crude oil	0	0
All other goods	0	
Processing fees services	0	
All other services	0	
Value added	25	
Indicators		
Energy productivity (mln/kg)		-
Energy intensity (kg/mln)		0

Suppose the use of energy for the processor in physical terms is equal to 80 TJ and equal to 75 mln euros in monetary terms using the 1993 SNA concepts. Output (or production) is equal to 60 TJ and 100 million euro. Using the 2008 SNA concept, the use of energy for the processor in physical terms is equal to 0 TJ and equal to 0 mln euros in monetary terms. Output is equal to 0 TJ and 25 million euro (no production of energy carriers anymore).

In physical terms, the use (use of energy for combustion) and output of energy carriers has disappeared. In monetary terms, use has disappeared (use of energy for combustion), production of energy carriers has disappeared and total production has decreased (only production of processing services). The changes in recording have consequences for the hybrid energy indicators.

Hybrid indicators like energy-productivity and energy-intensity differ dramatically using the 1993 SNA or the 2008 SNA. Even though the value added remains the same in both scenarios, as use of energy is reduced to 0 under the 2008 SNA recommendations, energy intensity would be 0 and energy productivity undefined.

2. Economy Wide Material flow accounts (EW-MFA)

Economy wide material flow accounts (EW-MFA) record physical flows from and to the economy of a country. Many of the issues that appear in the energy accounts also play a role, on a country scale, in

EW-MFA. In the Dutch EW-MFA physical import-export material flows match the monetary flows of the national accounts, i.e. there is a plausible price relationship between the two.

For those countries subject to ongoing globalisation, maintaining full consistency between the monetary and physical import and export data based on 2008 SNA recommendations has considerable implications for EW-MFA. The individual import and the export flows, and derived indicators (a.o. DMI – Domestic Material Consumption), might change considerably depending on the scale of goods sent for processing. Comparisons over time (pre and post SNA 1993) of indicators like DMI may be seriously disturbed by outsourcing activities. Considering merchanting, the consumption indicator will also be affected as export of physical entities will be added as services change to goods.

Another issue with the 2008 SNA principles is that for MFA a discrepancy in the mass balance might occur. Processors (with no physical in- and outflows) still generate (air) emissions to the environment. As these emissions can not occur out of nothing they should also be omitted from the MFA. This has consequences for MFA indicators, like NAS (Net Additions to Stock)), that include flows from the economy to the environment.

Many countries use data from the international trade statistic directly as input for the EW-MFA. The Eurostat MFA questionnaire also advocates the use of the international trade data directly. Assuming the international trade statistics is not affected by changes in the 2008 SNA regarding goods sent for processing, EW-MFA for countries that use data from the trade statistics do not change. However, the discrepancy between monetary National accounts data and physical trade data, that was already apparent, even becomes bigger.

3.3 Emission accounts

How should (air) emissions that occur during inward and outward processing be recorded? Regardless of the preferred treatment, the chimney of our exemplary refinery will continue to smoke. There appear to be two options:

- Attribute the emissions that occur during refining to the processor: This might be the most logical thing to do as the refinery is resident in the Dutch economic territory. It would however be odd if the processor does emit, but at the same does not require physical inputs of crude oil. This clearly violates material flow principles of mass balancing.
- Attribute emissions to the principal and not to the processor; and consequently to a foreign economy. The argument would go that as the principal is the owner of the primary energy input (crude oil) and of the secondary energy output (oil products), it would therefore also become the 'owner' of the emissions that occur during the process of production. The logic behind this attribution is the following. International transport also crosses boundaries. You could argue that these activities are produced on foreign territory. In other words, production is generated outside domestic territory (i.e. on foreign territory). Still, the emissions are attributed to the Dutch economy in the environmental accounts. Using the same kind of logic, in our example of the refinery, the principal is producing petrol outside its domestic borders (i.e. on foreign territory). By analogy with the treatment of transport activities, these emissions could be attributed to the economy of the principal.

The upshot of the second approach would be that emissions are not attributed based on the residency of the factory where they occur but based on the residency of the company giving the assignment for

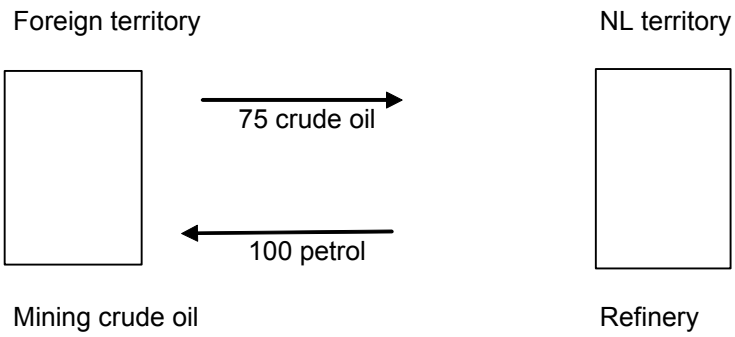
production This would constitute a totally new approach for emission accounting, different from the current emission inventory set-up required under the Kyoto protocol.

It would be therefore difficult to apply in practice. Even if it would be possible to estimate the emissions during inward processing (separate the emissions from processors and non-processors), it would also require to estimate emissions during outward processing which would require all sorts of technical information about the energy efficiencies of industrial processes abroad.

Finally, a mismatch could occur between the emission permits bought and subsequently surrendered by industries and their emissions (that could well be 0). It could therefore undermine the feasibility of SEEA for policy analysis, for instance in assessing the effectiveness of emissions permits schemes. Therefore the first option seems preferable.

3.4 IO analysis

For IO analysis monetary IO tables are combined with (air) emission accounts in order to allocate emissions by residents to final demand categories. The emissions are in first instance in all cases attributed to the producer creating the value added, i.e. the processor. IO tables compiled according to 2008 SNA will differ from previous 1993 SNA type IO tables (in our example there would be lower imports by oil and gas production industry; likewise this industry would record lower exports – services instead of goods). Secondly, as we have seen before, the way in which physical flows are recorded has consequences for the emission intensities and therefore may impact the results of our IO analysis. The example below shows in the first panel the allocation of emissions to final demand categories according to the 1993 SNA. In the second panel we see that using a 2008 SNA IO table in combination with the same air emission intensities reduces the emissions that are allocated to exports. This is to be expected as exports are reduced and subsequently also relative amount of exports in total final demand.



SNA 1993

1) IO table

	NACE 1	NACE 2	Consumption	Export	FD other	Total
NACE 1	0	50	34	163	47	294
NACE 2	60	148	290	94	23	615
Invoer	106	53	35	138	22	354
VA	128	364	31	3	14	540
total	294	615	390	398	106	1803

2) Air emissions 52 8 60

	NACE 1	NACE 2
3) Emission coefficients	0,18	0,01

	Consumption	Export	FD other	Total
4) Air emissions to FD	17	34	10	60

No distinction between production and serive component

SNA 2008

1) IO table

	NACE 1	NACE 2	Consumption	Export	FD other	Total
NACE 1	0	50	34	88	47	219
NACE 2	60	148	290	94	23	615
Invoer	31	53	35	138	22	279
VA	128	364	31	3	14	540
total	219	615	390	323	106	1653

2) Air emissions 52 8 60

	NACE 1	NACE 2
3) Emission coefficients	0,24	0,01

	Consumption	Export	FD other	Total
4) Air emissions to FD	21	26	13	60

Distinction in production and serive component

SNA 2008

1) IO table

	NACE 1a_P	NACE 1b_S	NACE 2	Consumptio	Export	FD oth	Total
NACE 1a_P	0	0	50	34	63	47	194
NACE 1b_S	0	0	0	0	25	0	25
NACE 2	60	0	148	290	94	23	615
Invoer	31	0	53	35	138	22	279
VA	103	25	364	31	3	14	540
total	194	25	615	390	323	106	1653

2) Air emissions 34 18 8 60

	NACE 1a_P	NACE 1b_S	NACE 2
3) Emission coefficients	0,18	0,71	0,01

	Consumption	Export	FD other	Total
4) Air emissions to FD	17	33	10	60

The third panel demonstrates that introducing a split between processors (NACE1a_p) and non-processors (NACE1b_S) yields approximately similar results as the first panel. The emission intensity of the processor is lower than the regular producer as its output is reduced (services instead of goods) while the same amount of emissions are assigned.

The situation could even be more complicated as the following example shows. Suppose now that the petrol after refining on Dutch soil is purchased by Dutch residents. This would be recorded as imports of petrol even though the petrol has remained on Dutch economic territory. How would this be recorded in IO analysis? The implications for IO modelling are discussed in annex A.

As such there appears to be two possible options to assure consistency of results of IO analysis:

- 2008 SNA IO tables are modified by adding monetary imports and exports information regarding processors: in other words, we continue to compile 1993 SNA based IO tables.
- Processors and regular manufacturers are separately identified in the IO table which would therefore obtain an extra row and column; each with their own emission coefficients. As we saw above, all emissions by processors would be correctly attributed to exports. In the case of outward processing we have to add another row and column.

The second option seems preferable as it would not change the total output of all ISIC. In other words, total production in million euro remains consistent with the 2008 SNA production level. On the other hand it does require a somewhat synthetic splitting of industries as well as making specific estimates of emissions caused by processors (resident / non-resident) and non-processors.

4. Evaluation of possible solutions

The picture that emerges from the various consequences that we sketched above is that there are essentially two viable options for recording physical flows related to goods sent abroad for processing and/or merchanting. Either we record physical and monetary flows according to the 2008 SNA; or we stick to SEEA 2003 (SNA'93) principles and continue to record for better or worse the physical flows as they used to be recorded in the past. The latter option would necessitate to either impute monetary flows in a form of shadow bookkeeping (which would obviously be a departure from the 2008 SNA) or severely restrict the hybrid indicators that can meaningfully be derived from the system (restricted to value added indicators).

4.1 Option 1. Record physical flows and monetary flows according to 2008 SNA

Pros:

- *Full consistent set of hybrid indicators* Monitoring physical flows according to 2008 SNA concepts will lead to a consistent set of hybrid indicators. Physical flows and monetary flows are compiled using the same set of conventions. Although consistency is not a problem, the question remains if these consistent indicators really measure what the accounts should monitor (see cons).
- *Just a minor problem in open economies* Processing activities are yet very small compared to the total activities of the economy. It can be argued that these minor inconsistencies are taken for granted and we will opt for a second best solution. However, the Dutch situation shows that industrial processors may in fact be significant polluters and energy users.
- *Material balance principle still ok* When we attribute the emissions to the principal instead of to the processor, no discrepancies will arise between the air emission accounts and the mass balancing principle that underlies MFA. Air emissions accounts need another bridge item to get to Kyoto figures.

Cons:

- *Connection with physical description of economy is lost.* There would be severe problems in monitoring the physical economy behind income generation and production.
- *Indicators dependent on legal situation.* Key hybrid indicators (energy-intensity and energy productivity) are dependent on legal agreements between principal and processor. Changes in legal agreements over time lead to changes in key indicators over time. These changes in key indicators have nothing to do with a potential improvement/worsening of the physical transformation process of a particular industry. More difficult to interpret changes in indicators ('real' or 'legal' changes). The difference in ratio between processing and non-processing between countries makes key indicators non comparable between countries. For example, Norway uses relatively more domestic crude oil and less imports for refinery purposes than the Netherlands does. The changes drawn up in 2008 SNA only apply for import and exports. The ratio 'intermediate energy consumption from domestic (or foreign) supply' is different in between European countries.
- *Material balance principle is lost* When we continue to attribute the emissions to the processors based on their residency, discrepancies will arise between the air emission accounts and the mass balancing principle that underlies MFA.
- *Separately identify processors in IO table* Performing environmental-economic input-output analysis is possible however it does require additional disaggregations of industries in which processing occurs. In addition separate emission intensities for these sub-industries need to be estimated.

4.2 Option 2A. Record physical flows according to SEEA 2003 (thus SNA 1993)

This option entails to continue recording the physical flows according to the SEEA 2003.

Pros:

- *Physical description of economy remains intact* Imports of processors are monitored, output and exports are monitored and intermediate use is also monitored. Using this approach, physical flows are well monitored from an economic-environmental perspective. Especially from a material flow accounts point of view this is very important.
- *Modules of the SEEA are internally consistent.* Air emission accounts and MFA would satisfy the material balance principle.

Cons:

- *Hybrid accounting is undermined* If one chooses to monitor physical flows according to the concepts of SNA 1993, then an inconsistency is born in constructing hybrid indicators. The integration of monetary variables and physical variables becomes more difficult because these variables are not based upon the same set of rules. How consistent is a framework that indeed does monitor the import of materials by processing units in physical terms and does not monitor the import of materials in monetary terms? These two flows cannot be compared with each other.

Option 2B: Record physical flows on the basis of SEEA 2003(thus SNA 1993) and impute (relevant) monetary flows according to 1993 SNA principles.

Pros:

- *We have a system designed for hybrid accounting and analysis that is internally consistent.* Mass balancing principles are satisfied throughout and the system is fully hybrid proof. All relevant types of indicators can be derived.
- *Physical description of economy remains intact* Imports of processors are monitored, output and exports are monitored and intermediate use is also monitored. Using this approach, physical flows which are interesting from an economic-environmental perspective are still well monitored. From a material flow accounts point of view this is very important.
- *Modules of the SEEA are internally consistent.* Air emission accounts and MFA would satisfy the material balance principle when we continue to attribute the emissions to the processors based on residency. There is no need for an extra bridge item to get to Kyoto figures.

Cons:

- *Requirement to produce shadow accounts* The requirement of shadow accounts next to the 2008 SNA accounts leads to extra work for statistical offices. A significant analytical advantage of producing shadow account for goods sent for processing is that supply and use tables will serve as the data source for exports and imports of goods that have been involved in the goods for processing phenomenon. This will help considerably in carrying out input-output analysis.
- *Lower quality.* The recommendations of the 2008 SNA are based partly on empirical necessities as the monetary flows that would have to be imputed (or gathered from international trade statistics) are expected to decline in quality. In carrying out input-output analysis you need detailed information on monetary flows related to processors and non-processors. If the data are not good enough for SNA purposes, why would they be good enough for SEEA in carrying out input-output modelling?
- *Positioning of environmental accounting* The position of environmental accounting is weakened when consistency with national accounting is no longer maintained.

5. Conclusions and recommendations

In our opinion, it is not an option to record physical flows in the new SEEA according to 2008 SNA concepts. This conclusion is defended by 3 main arguments:

1. Recording physical flows according to 2008 SNA concepts leads to hybrid indicators which are very difficult to interpret over time and which are incomparable between countries.
2. Recording physical flows according to 2008 SNA concept leads to a discrepancy for MFA's mass balance. Processors (with no physical in and outflows) still generate (air) emissions to the environment. These emissions can not occur out of nothing. Solving this issue by attributing the emissions to the principal instead of to the processor may cause

serious measurement issues and brings along another bridge item for air emission accounts in order to get to Kyoto figures.

3. The SEEA and many of its accounts attempt to describe the physical requirements of income generation. By recording physical flows according to 2008 SNA, SEEA cannot monitor what it intends to monitor (for example energy-efficiency, material efficiency, energy intensity, material intensity) for the activities that are generating income.

We believe that not recording the physical flows inherent in goods sent abroad for processing would seriously undermine the value added of environmental accounting. We would argue therefore for option 2B.

Choosing for option 2B has implications for the compilation of modules of the environmental accounts when physical flows continue to be recorded as in the 2003 SEEA:

This would have the following implications:

- Energy accounts would require the set-up of monetary shadow accounts consisting of supply and use tables for important energy products (information available in trade statistics as well as energy statistics);
- MFA: these would most likely have to be based on international trade statistics. Important resource productivity indicators would be based upon (most likely) trade statistics, as SNA monetary import and export figures would not be consistent;
- IO: both options are still feasible (1993 SNA IO tables as well as well as 2008 SNA IO tables with extra splits).

Literature

Van der Holst and de Haan 2010, Global Manufacturing and Industrial Processing-Implementation of the new SNA recommendations

Annex-

I-O modelling example

Suppose now that the petrol after refining on Dutch soil is purchased by Dutch residents. This would be recorded as imports of petrol even though the petrol has remained on Dutch economic territory. How would this be recorded in IO analysis?

Intuitively, what happens here is that the refinery emissions are first allocated to exports (to UK in our example) and subsequently allocated to Dutch consumption when they are imported. Obviously the same total emissions that are allocated to exports of refinery services need to be allocated to imports of petrol. This implies that the emissions intensity that would be used for imports would have to be equal to the Dutch refinery plant's emission intensity (i.e. emissions of processors divided by output of petrol).

In case the Netherlands imports both petrol from processors (the refinery on Dutch soil) and non-processors (ordinary UK plant) and the emission-intensities (emission per euro petrol) would differ, the import matrices need to be split in addition to the split that was already introduced above between processors and non-processors. In general the import matrix would have to be split into three (rows and columns):

- Imports of ordinary petrol produced by a non-resident non-processor (UK – import of petrol)
- Imports of petrol produced by a resident processor (NL – import of petrol, inward processing)
- Imports of services produced by a non-resident processor (UK – import of services, outward processing)

The same holds for the general domestic IO table. We need to distinguish between:

- Exports of ordinary petrol produced by a resident non-processor (NL – export of petrol)
- Exports of petrol produced by a non-resident processor (UK – export of petrol, outward processing)
- Exports of services produced by a resident processor (NL – export of services, inward processing)

When we split the 2008 IO table as well as the import matrix for industries subject to processing into two or three (depending on the situation) and estimate corresponding emission intensities, we would arrive at similar (with some marginal differences) results as compared with the 1993 SNA IO table.