LG/15/7

15th Meeting of the London Group on Environmental Accounting
Wiesbaden, 30 November – 4 December 2009

Discussion paper on the valuation of renewable energy resources

Maarten van Rossum and Sjoerd Schenau

Statistics Netherlands

MSP
National Accounts
P.O.Box 24500
2490 HA Den Haag
The Netherlands

Discussion paper on the valuation of renewable energy resources

Discussion paper referring to issue paper:
Renewable energy resources in the SEEA Issue paper London Group (14th Meeting of the London Group on Environmental Accounting)

Maarten van Rossum and Sjoerd Schenau

15th Meeting of the London Group on Environmental Accounting

December 2009

Wiesbaden, Germany

Remarks:
The views expressed in this paper are those of the authors and do not necessarily reflect the policies of Statistics Netherlands.

Project number:
BPA number:
Date: *December 2009*

Introduction

At the 14th Meeting of the London Group on Environmental Accounting (Canberra, 27 – 30 April 2009) the issue paper 'Renewable energy resources in the SEEA' was presented and discussed. The discussion in the London Group put forward four main questions which are addressed in this discussion paper. These four main questions are:

1. *Is the value of renewable energy resources like solar radiation and wind already incorporated into the value of "land"?*
2. *Should we include subsidies in the resource rent or not?*
3. *Is there a problem with the fact that more fixed assets will lead to a higher valuation of renewable energy resources?*
4. *How to deal with other renewable natural resources, for example geothermal energy and tidal stream energy?*

Hereafter these issues will be dealt with in detail. Every question will be discussed in more detail in the next four parts.

1. Are land and renewable resources separate assets?

In the first London Group paper on renewable resources (Renewable energy resources in the SEEA; Maarten van Rossum, Mark de Haan and Sjoerd Schenau, 2009, Statistics Netherlands), it was stated that during energy transition, the creation of surplus income related to renewable energy production is inevitable. The London Group discussed this paper and suggested that although resource rents are created, in particular in the case of wind energy and solar radiation, these rents are already reflected in the valuation of land. In other words, there is no need to create a new asset. The value of land can be decomposed in all kind of determinants who influence the value of land. An energy production possibility is just one factor in the determination of the value of land. In this part two important questions are addressed:

a) Should we include land and renewable energy resources both as assets on the balance in the SEEA?

b) Should the SEEA highlight the energy production opportunities of land in more detail?

1.1 Scarcity of space

<u>Should we include land and renewable energy resources both as assets on the balance in the SEEA?</u>

The price of land is explained by the scarcity of space and the opportunity costs related to the use options of the land under consideration. One could use a piece of land for energy production but also for agricultural purposes. One could use a piece of land under sea for energy production possibilities but also for sea shipping routes. Lastly, one could use a windy spot for energy production but also for settling a new business centre. In optimizing the zoning scheme of a particular piece of land, all these opportunity costs are taken into account before a decision on the final zoning scheme is taken.

A country could decide to exploit the full potential of wind energy and install an endless number of windmills. In reality, countries decide otherwise because they take into account the enormous opportunity costs related to the other use possibilities of the scarce space. Once the decision has been made to exploit renewable energy resources, all opportunity costs related to the use possibilities of the land have been taken into account.

The price of land can be decomposed into a few determinants. This decomposition can be executed by means of the so called Hedonic pricing method. As an example, the price of land can be explained by the following mathematical formulae:

$$f(X) = (X_1, X_2, X_3, X_4, X_5)$$

Where,

$f(X)$: land price of 1 ha

X_1: fertility of land

X_2: distance from market for goods and services

X_3: perception on negative external effects related to windmills

X_4: energy production possibilities

X_5: other important determinants

While wind, solar radiation, geothermal energy are not traded goods, they are attributes which may influence the price of land. Evidence from revealed preferences could suggest that, if others things are equal, a positive relationship exists between the price of land and energy production opportunities. Examination of land prices enables us to impute the value of renewable energy resources. Assuming that data can be collected for all endogenous and exogenous variables, one could estimate the relationship between land rent and all of the attributes relevant to these rents by means of multiple regression analyses. The estimated relationship can be used to quantify the relationship between land rent and energy production possibilities, holding all the other determinants of rent constant.

In theory, the value of land in a windy situation is higher than the value of the land in a wind still situation, since the productivity of land in the windy region is higher than the productivity of the land in the wind still region. Empirical evidence for this theoretical relationship is scarce because it is very difficult to gather statistics on all important variables in such an extensive way. Still, in theory one could state that energy production possibilities are important determinants for the value of land. So, from a theoretical point of view, energy production opportunities created by natural resources like wind, solar radiation and geothermal energy are already reflected in the price of land.

The question whether there are any circumstances in which this position does not hold remains. Are there circumstances in which the resource rent is not incorporated in the value of land and were it is just surplus income which can not be allocated to a typical capital input? This question will be addressed in the next section.

1.2 Information asymmetry and government intervention

The conclusion that the value of renewable energy resources are already reflected in the valuation of land is based upon two fundamental assumptions:

1. Perfect symmetrical information related to expected resource rents
2. No government intervention.

1. Assume an energy producer who is willing to exploit a windmill (or another sustainable energy system) on a particular piece of land which is not the property of the energy producer himself. The piece of land under consideration is property of another private party, namely a landlord. The landlord and the energy producer both acknowledge that there are rents related to the production of renewable energy production. The landlord has less information on this aspect than the energy producer. The landlord and the energy producers will bargain over the price of the land lease. Assume that the outcome of the bargain is a win-win situation in which the resource rent is shared proportionally between the landlord and the energy producer. This information asymmetry leads to the situation that the landlord cannot draw the full resource rent related to the renewable energy production. The landlord does not exactly know how large the resource rents are while the energy producer has full information on this aspect.

The awareness that it is profitable to exploit renewable energy resources leads to a higher land price for the landlord and this is reflected by the cash flow in the form of the land lease. Over time, the gap in knowledge between the landlord and the energy producers will decline due to competition in between energy producers. Competition will lead to a situation where the complete resource rent is reflected by the land lease. No rents will be generated by energy producers. All of the 'rent' is already represented in the land lease. The increase in productivity will go along with an increase in the land price. During energy transition, the information asymmetry will diminish. Surplus income will be generated by energy producers until the moment that information asymmetry exists.

2. Another possibility in which surplus income can be generated by renewable energy producers is government support. In recent years, there is a tendency in supporting private companies to produce renewable energy instead of non-renewable energy. Many governments have nowadays a view on how energy should be produced. This view can go along with supplying licences (e.g. licenses for installing windmills on land of the government) under market price in order to stimulate renewable energy production. This can lead to benefits for the holder of the licence in excess of the price paid to the owner of the natural resource (in this case the land of the government).

How should this generated surplus income be interpreted? The computation of rent is in accordance with the standard neoclassical model. Resource rent related to renewable energy production is determined endogenously. The neoclassical model is based on the twin assumptions of constant returns to scale and perfect competition. These assumptions imply that profit equals zero since all gross output revenue of an enterprise is used to reward the inputs in the production process. The whole operating surplus / mixed income must therefore be allocated to user cost of capital and labour income of the self-employed. Although the usefulness of the neoclassical model is generally recognized, its assumptions seem incompatible with economic reality, especially when there is rapid technological progress (CBS, 2008) and there are changing circumstances (energy transition). To avoid making these assumptions, surplus profits will be allowed. An exogenous approach for estimating capital services of capital is by dropping this assumption feasible. The only exception made here are oil and gas reserves. Capital services generated by this natural capital are determined endogenously. Effects of monopoly power and/or other market failures influence the capital

services and consequently also the valuation of oil and gas reserves. It is extremely difficult to isolate pure resource rent and rent creation due to market failure.

Energy producers generate due to asymmetrical information and government intervention surplus income while landlords make losses. Income is only redistributed. At macro level **no** new asset is created by market failure and government intervention. This does not mean that land value in itself cannot increase due to improved energy production possibilities. It is still possible that the market price of the land at macro level increases due to more strict environmental regulation and/ or scarcity of substitute energy carriers.

1.3 Renewable energy resources are an input in the production function

A broader view on the asset land: 'the tube'

Should the SEEA highlight energy production opportunities of land in more detail?

From an environmental-economic point of view it is interesting to get more insight into the capital services of land used for renewable energy production. It is believed that is useful to decompose the capital services of land into two parts. The capital services related to renewable energy resources should be highlighted because these services represent the energy production possibilities of a country and only these rents can be compared with rents related to other fossil energy reserves. One can interpret these rents as services from nature to the economy, in other words: ecosystem services. From a theoretical point of view one can argue that land rents should be decomposed because renewable energy resources must be seen as a separate input in the production process of renewable energy production.

In this section three examples are described that support the idea that renewable energy resources must be seen as a separate input in the production process of renewable energy production. An important pillar for the arguments made is that the definition of land used here is broader than only the physical part of land. This broader version of land also includes the space surrounding the physical part of land. Space can be seen as a 'tube'. This tube contains the physical land itself but also the atmosphere above this land and the subsoil underneath the physical land[1]. The tube contains all kind of useful inputs to facilitate production possibilities. On the physical land itself one can carry out for example agricultural activities. In the atmosphere above the physical land one can carry out wind energy production and in the space underneath the land one can carry out geothermal energy production.

The physical part of land is only priced by the market. The physical part of land has a market price, because it is institutionalised. These ownership rights are only enforced for the physical part of land. Ownership rights are not enforced for the atmosphere above the physical land.

On the other hand one can argue that the market price of land is not only the result of opportunity costs related to the physical land itself, but is also the result of the opportunity

[1] Indeed, in many countries, ownership rights are enforced for mineral reserves in the underground. The owner of the land situated above the mineral reserves is not necessarily the owner of the mineral reserves underneath his or her land. On the other hand, heat in the underground is very often not owned by another economic agent different from the land owner. This is very much dependend on national legislation and this possibly could change in the future at national level.

costs related to other parts of the tube, i.e. the atmosphere and the underground. Renewable energy resources are effectively owned by land owners. In this paper we want to explore the possibilities to decompose the value of the institutional asset 'land' into a value for the atmosphere, a value for the underground and a value for the physical land itself. This decomposition is not always feasible because there is often no monetary value for land available using the statistical systems of the national accounts. However, it is still very interesting to monitor the rents created by at least one factor, which is the opportunity to generate renewable energy, (partly) determining the value of land. Consequently, it is also interesting to monitor the value of this factor.

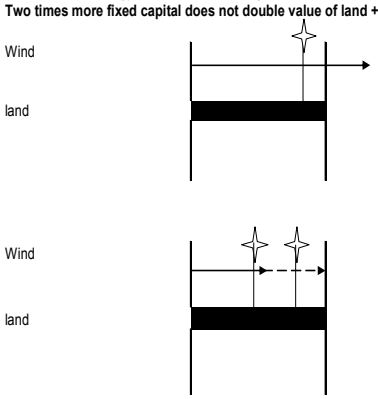
This proposed decomposition of land is desirable because it is argued that renewable energy resources are a separate input in the production process. In other words, these renewable energy resources are distinct from the physical part of land.

The argumentation that renewable resources are indeed separate inputs in the production process is supported by three arguments. First, renewable resources are rival and scarce inputs. Secondly, renewable energy resources differ from in each other in quality and thirdly there are differences in the opportunity costs of land even if energy production opportunities are equal. Hereafter these arguments are discussed in more detail.

1. Renewable resources are rival goods and scarce

1. Renewable energy resources are rival goods

Two times more fixed capital does not double value of land +wind



	2007 value	capital services (discount rate: 5 percent)
land	100	5
wind	100	5
total land+wind	200	10
Resource rent	5	

	2008 value	capital services (discount rate: 5 percent)
land	100	5
wind	150	7.5
total land+wind	250	12.5
Resource rent	7.5	

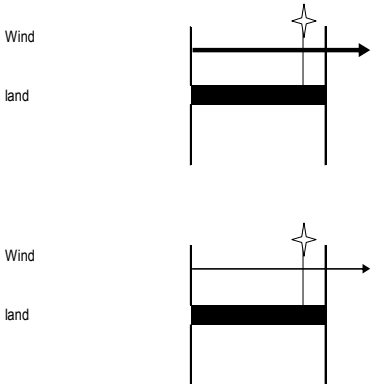
	value		change in value
	2007	2008	
land	100	100	0%
wind	100	150	50%
total land+wind	200	250	25%

Situation 1 is summarized as follows. In 2007, there is only one windmill installed at land piece A. Opportunity costs of land piece A are equal to 5 million euro (all opportunities except the energy production opportunity are taken into account here). The rent related to energy production is also equal to 5 million euro. These two rents are summed up and are the basis for valuation of the tube "land + wind". In 2008, the landlord has permission to build another windmill on land piece A. So in 2008, there are two windmills installed at the same piece of land. The opportunity costs of land piece A are still equal to 5 million euro. The rents related to renewable energy resources are now equal to 7.5 million euro. Rents for renewable energy resources have not doubled because the wind supplied in the tube is scarce. Windmill one absorbs a share of all available renewable energy resources in the tube of land piece A. In other words, the wind in the tube of land piece A is a rival and scarce good. The growth for two 'parts' of the tube, i.e. the land and the wind, show different numbers. Growth of land is

equal to zero and growth of wind is equal to +50 percent. The growth in the value of the tube is equal to 25 percent. In theory, the market price of the land increases with 25 percent.

2. Differences in the quality of renewable energy resources

2. Differences in the quality of renewable energy resources
Two times less wind does not halve value of land+wind



	2007 value	capital services (discount rate: 5 percent)
land	100	5
wind	200	10
total land+wind	300	15
Resource rent	10	

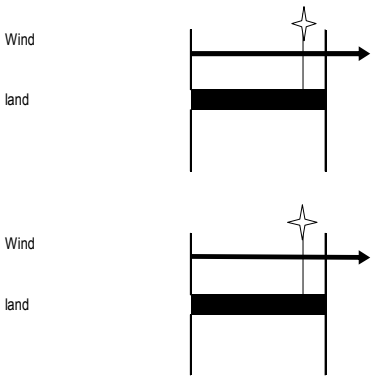
	2008 value	capital services (discount rate: 5 percent)
land	100	5
wind	100	5
total land+wind	200	10
Resource rent	5	

	value		change in value
	2007	2008	
land	100	100	0%
wind	200	100	-50%
total land+wind	300	200	-33%

Situation 2 is summarized as follows. In 2007, the wind flows in the tube of land piece A are twice as large as in 2008. This is caused by the construction of a block of flats at land piece B, which lays next to land piece A. The wind flows reaching the tube of land piece A have halved in 2008. The opportunity costs of land piece A are equal to 5 million euro in 2007 and 2008 (all opportunities except the energy production opportunity are taken into account).The rent related to energy production is equal to 10 million euro in 2007 and equal to 5 million euro in 2008, as a result of reduced wind flows. This results in a value for the tube of 300 million in 2007 and 200 million in 2008. The growth for two 'parts' of the tube, i.e. the land and the wind, show different numbers. Growth of land is equal to zero and growth of wind is equal to -50 percent. The growth in the value of the tube in total is equal to -33 percent. In theory, the market price of the land (in total) decreases with 33 percent.

3. Differences in the opportunity costs of land

3. Differences in the opportunity costs of land
If opportunity costs of land doubles, land+wind will not double in value



	2007 value	capital services (discount rate: 5 percent)
land	100	5
wind	100	5
total land+wind	200	10
Resource rent	5	

	2008 value	capital services (discount rate: 5 percent)
land	200	10
wind	100	5
total land+wind	300	15
Resource rent	5	

	value		change in value
	2007	2008	
land	100	200	100%
wind	100	100	0%
total land+wind	200	300	50%

Situation 3 is summarized as follows. In 2008 new business opportunities have been discovered in the neighbourhood of land piece A. These new opportunities result in an

adjustment of the opportunity costs of land piece A in 2008. These opportunity costs have increased by 5 million euro to 10 million euro. The rent related to energy production remains 5 million euro in 2008. This results in a value for the total tube of 300 million in 2008 and 200 million in 2007. The growth in value related to the two 'parts' of the tube, i.e. the land and the wind, show different numbers. The growth of land is equal to 100 percent while the growth of wind is equal to zero percent. The growth in the value of the tube in total is equal to +50 percent. In theory, the market price of the land (in total) increases with 50 percent.

For all these three situations hold that the individual growths of the parts (wind or land) show different numbers than the growth of the total: the tube. The price of the physical part of the land is institutionalised by the market only. Still this market price represents the value of the complete tube. Because renewable resources can be seen as a separate input in the production process, one could argue to decompose the value of land into a value for renewable resources and a value for the physical part of land.

Resource rent related to renewable energy production is determined endogenously. The creation of surplus income can be the result of not taking into account all capital services of the tube. Not many countries have complete balances for the non-produced capital 'land'. The example discussed in the first issue paper on valuation of renewable energy resources (page 13 of paper 'Renewable energy resources in the SEEA Issue paper') does not take into account the capital services of land in calculating the surplus income related to renewable energy production. In other words, there is a value for an asset that is generating income missing. Sometimes a value for land is missing and sometimes this value for land is underestimated because energy production possibilities are not taken into account in valuing this asset. By means of the calculation method presented in the issue paper 'Renewable energy resources in the SEEA Issue paper', the capital services of land used for renewable energy production can be estimated. These capital services are determined endogenously.

Conclusion and recommendation on the land rent debate

The 'rent' related to energy production by wind, solar radiation, tidal stream and geothermal energy is in theory already incorporated in the value of land. It would be wrong to create a new asset called 'renewable energy resource'. This will inevitably lead to double counting.

Decompose the value of land

In this paper we have investigated if it is useful to decompose the value of the asset 'land' into a value for renewable energy resources and a value for the physical land itself. This decomposition is desired because renewable energy resources are separate inputs in the production process, in other words apart from the physical part of land. Although in the real world only one institutional unit is priced, it is desirable to decompose the value into the individual compartments of the production tube.

Practical issues: Isolating the pure resource rent

There are two cases where the generated surplus income should not be attributed to renewable energy resources; government intervention and information asymmetry. Both cases can lead to surplus income. This surplus income is not the result of a profitable capital input. To the contrary, this surplus income is the result of a principal –agent outcome. This surplus income should not be allocated to the user cost of capital. In theory, only real structural capital services should be accounted for.

Choosing a suboptimal pragmatic solution

It is, however, very difficult to isolate surplus income generated by asymmetrical information, government intervention and the real capital services of the tube. These factors cannot easily be isolated if one uses the endogenous approach for calculating resource rent. Surplus income can be the result of market failure and not taken into account certain capital services of hidden capital assets. Because it is extremely difficult to isolate real resource rent and rent due to market failure, it is proposed to treat all computed rent as resource rent. Here we follow the same line of thinking as has been done in valuating oil and gas reserves.

Recommendation for SEEA

From an economic-environmental point of view it is very interesting to monitor all relevant rents and financial cash flows related to renewable energy production. Still, it is not recommended to include this topic in SEEA volume 1. In this early stage, when methods and concepts have not yet been optimized, it is recommended to include this topic in volume 3. It is recommended to monitor all relevant monetary flows related to renewable energy production. The next variables can give a clear picture on how renewable energy production evolves over time:

- Operating surplus of renewable energy production
- Lease price of land used for renewable energy production
- Capital services of fixed capital
- Depreciation of fixed capital
- Transfers related to implicit subsidies on capital investments
- Subsidies on products
- Investments in renewable fixed capital
- Capital stock of renewable fixed assets
- Value of renewable energy resources

Figure 1 and figure 2 give examples on how the topic of renewable energy can be graphically presented.

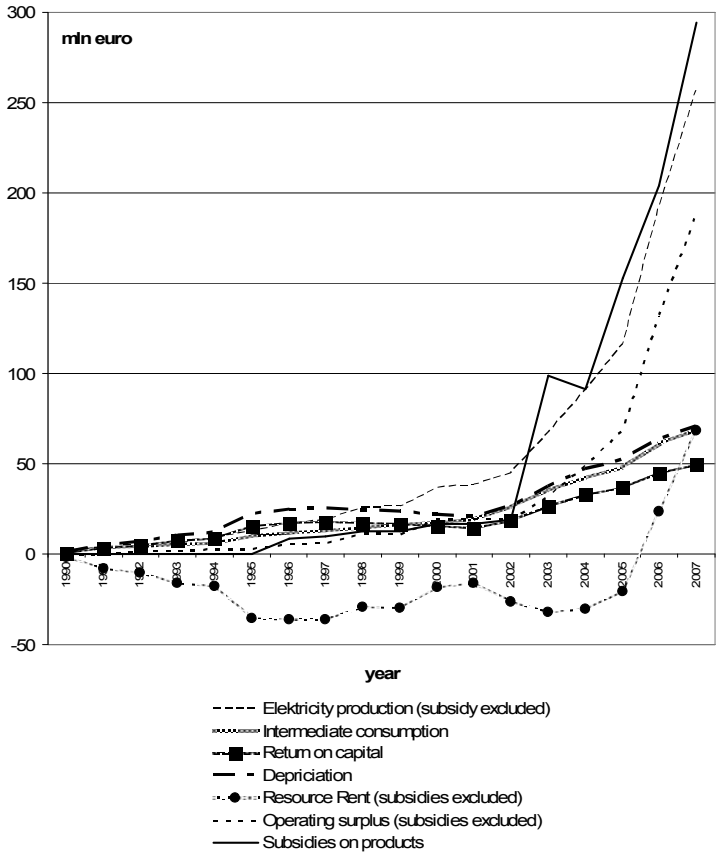


Figure 1- Different variables for renewable energy production

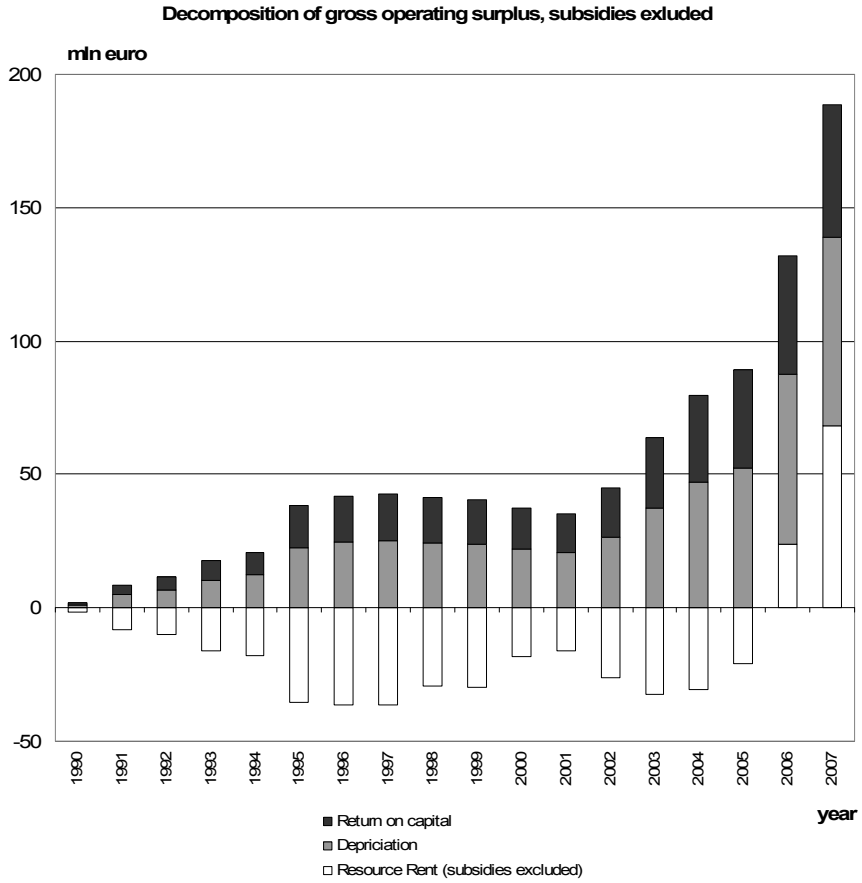


Figure 2- Decomposition of gross operating surplus

2. Subsidies on renewable energy production and resource rent

Subsidies and implicit subsidies (like tax reductions related to renewable energy systems) are important drivers for renewable energy production in many countries. In calculating the resource rent of renewable energy production it has to be decided whether subsidies on renewable energy production have to be taken into account or not.

2.1 Similar treatment of subsidies as in productivity analysis

Productivity measurement requires output to be valued at basic prices; that is, the prices actually obtained by producers. At the same time, inputs must be valued at purchasers' prices. Taxes-less-subsidies on *products* are already included in the costs of the intermediate consumption components. Taxes-less-subsidies on *production* (according to the National Accounts classification), at current prices as well as at constant prices, can be obtained directly from the National Accounts. As far as possible, the components of this expenditure category should be attributed to the various inputs. Some of these taxes-less-subsidies can directly be attributed to a specific input, such that for example wage subsidies can be attributed to labour, and road taxes as well as property taxes to capital (CBS, 2008). It has to be decided to which capital input the subsidies on renewable energy should be attributed.

Subsidies exist on investment in renewable energy equipment as well as on production of renewable energy itself. The subsidies on production of renewable energy are 'subsidies on products'. These subsidies have no effect on gross operating surplus in basic prices. Subsidies on investment in renewable energy systems can be referred to as 'other subsidies on production'. These subsidies indeed do have an effect on gross operating surplus in basic prices. One can decide to attribute these subsidies to different capital inputs.
There are two possibilities: these subsidies can be attributed to the natural capital 'renewable energy resources', or to the fixed capital.

Attribution of subidies on production

	2007	**2008**	**change 2008/2007**
Fixed assets	100	100	0
Renewable energy resources	200	100	-50
of which:Renewable energy resources	100	100	0
of which:Other subsidies on production	100	0	-100
Input renewable energy resources	200	100	-50
	2007	**2008**	**change 2008/2007**
Fixed asset	200	100	-50
of which: Fixed capital renewable energy systems	100	100	0
of which: Other subsidies on production	100	0	-100
Input fixed capital	200	100	-50

If one attributes the subsidies to renewable energy resources, then a decrease in the subsidy assignment (-100 percent) would decrease the input of renewable resources in the production process. This does not seem to be logical because the real input of renewable resources in the production process is not directly linked to the subsidies supplied in year t. Most subsidies are investment subsidies. The subsidies assigned in year t are not directly related to the capital stock of renewable energy resources. These subsidies are more dependent on the level of new investment in renewable energy systems. The subsidies should be attributed to the fixed

capital in place and not to renewable energy resources. Consequently, these subsidies should not be included in the resource rent calculation for renewable energy resources.

Another complexity arises because most *implicit subsidies* on renewable capital investments are not subsidies on production. For example, in the Netherlands there exist a few regulations for renewable energy investments which grant tax reductions in stead of cash transfers from government to producers. These tax reductions are indeed implicit subsidies but are no transfers from government to producers. Only the tax transfers from producers to government are lowered by these regulations. Although these inverse transfers are no subsidies in national accounting, these regulations still play a big role in investment decisions of renewable energy producers.

2.2 Subsidies and emission rights reflect value for cleaner air

Subsidies on products as well as implicit subsidies on production should not be attributed to renewable energy resources and consequently should not be included in the resource rent when using the SNA framework for measuring productivity and calculating resource rent.

In the SEEA, which wants to monitor and measure other phenomena than the SNA, this exclusion is not straightforward. The SEEA has as target to monitor phenomena related to the environment, which cannot be measured by the SNA because the boundaries of the SNA are too tight to monitor phenomena related to the environment. There are two main reasons to reconsider the decision to exclude (implicit) subsidies on products and production in the valuation of renewable energy resources.

Policy measures and the effect on prices and valuation of energy carriers

A subsidy on a particular energy production process inevitable has consequences for the energy prices of different energy carriers. Demand and supply are very much influenced by energy policy measures and political (in) stability in energy supplying countries. A consumer tax on a particular energy carrier, for example diesel, will, holding all other things equal, lead to higher demand for another energy carrier, for example petrol. Moreover, the introduction of subsidies will, in the end, always distort energy markets and thereby influence energy prices of substitute energy carriers. The same holds for emission rights. Emission rights affect prices of non-renewable energy carriers all around the world. Although the instrument 'emission rights' is a market efficient instrument, it is still introduced by the government. The government has a particular view on what kind of energy carriers should be consumed and produced and which not, taking into account external effects related to this production and consumption. Exactly the same is true for subsidies. Indirectly, subsidies on renewable energy production have an effect on the price of natural gas. More subsidies will, holding all other things equal, lead to lower gas prices (decreased demand) and this could in the end lead to a lower valuation of natural gas reserves. The government has the power to decrease or increase the value of typical assets by the introduction of new or stricter regulation. This influence can be direct via subsidies or indirect via price market mechanisms which are triggered by emission rights.

Measuring collective goods and externalities

There is a strong parallel between the valuation of collective goods (like dykes and roads) and the valuation of means to produce less negative external effects (like air emissions). This is related to the so called free rider problem. Individual investment in dykes is often too small to satisfy public demand. This is caused by the fact that nobody can be excluded and there is no rivalry regarding this typical public good. In first instance, the market will not supply this good in a sufficient way, because an individual will not take into account the benefits of other individuals in making an investment decision. There would have been less dykes and roads without government finance. The means to produce these infrastructure services, the roads and railway network are assets on the balance of the country. Without government intervention, these assets would have been much smaller than they are right now.

The above mentioned problem has a strong parallel with renewable energy production. The free rider problem also frustrates sufficient supply of green electricity. In the status quo, public society does not want to pay more for green electricity than for grey electricity. This is caused by the fact that nobody can be excluded and there is no rivalry regarding an important feature of green electricity, which is less emissions. Green electricity goes along with fewer emissions to air; everybody takes the same advantage without paying for this feature. In that way, the free rider problem prevents that marginal benefits for society equal marginal costs to produce green electricity.

Therefore the government decided to act to restore this market failure. The subsidies received by green producers enable green producers to supply green electricity for the same price as grey electricity. In this case the public demand for green electricity is supplied by green producers and the social optimum level is reached. The government has internalised the negative externality of grey electricity production. The market was in first instance not able, due to market failure, to value this feature. Society as a whole in first instance already valued the features of renewable energy production. After internalisation, the market is obliged to value this feature of green production. The market has no other choice than to deal with the new government regulation in making investment decisions. Indeed, after internalization, the market has to value the means to produce this green electricity. This is because the market recognizes the extra benefits, which are the subsidies, received after internalisation.

SNA approach for valuation too narrow to value the environment

For every externality, positive or negative, holds that the SNA approach for valuation is too narrow. Fixed capital producing grey electricity is valued equally as fixed capital producing green electricity (assuming the same costs, etcetera). SNA simply does not recognize the value of clean air because clean air is no asset in the SNA. The SEEA should value the means to produce more environmental friendly goods and services since the boundaries of the SEEA are broader than that of the SNA. Indeed, in theory, the SEEA should value a capital input that is capable of producing the same goods and services in a more environmental friendly way.

Many aspects of the environment are interrelated with externalities which are a by-product of economic production. Exactly these externalities are not valued by private market parties, but these are valued by the society as a whole. Exactly these externalities are solved by government policies, like taxes and subsidies. It might be possible to divert from the SNA

approach regarding resource rent calculation. The SEEA wants to value the means to produce less externalities, like air emissions, because it also intends to value the asset atmosphere.

At the macro level, *after* redistribution of taxes and subsidies, the market values green products more than grey products. Society as a whole was before redistribution of taxes and subsidies already capable to value green products more than grey products. Consequently, society as a whole also values the means to produce these green products more than the means to produce grey products. The fact that the government has here a distribution of income function does mean that society as a whole has a certain preference for a particular production method. Indeed, the government is the only party in place to restore the inefficient market equilibrium. If we want to value clean air, than we have to value the means to produce this clean air. The existences of subsidies for renewable energy production is evidence for the fact that society as a whole has a certain preference for a certain production method. This should be reflected in valuation of the necessary capital input.

Conclusions and recommendation on the subsidies debate

Subsidies on products as well as implicit subsidies on investment should not be attributed to renewable energy resources and consequently are not included in the resource rent when using the SNA framework for measuring productivity and calculating resource rent.

For the SEEA, which wants to monitor and measure other phenomena than the SNA, it is advocated to monitor subsidies on products as well as other implicit subsidies (tax reductions related to investments) related to renewable energy production. This is because subsidies are an important financing item for renewable energy projects.

There are also other reasons to give (implicit) subsidies on renewable energy more attention. There is a strong parallel between valuation of collective goods (like dykes and roads) and the valuation of less negative external effects (like air emissions). In both cases the free rider problem is solved by governmental interventions. At the macro level, *after* redistribution of taxes and subsidies, the market values green products more than grey products. Society as a whole was before redistribution of taxes and subsidies already capable to value these green products more than grey products. The fact that the government has here a distribution of income function does mean that society as a whole has a certain preference for a particular production method. Reason two for highlighting subsidies is that subsidies on green electricity production have an indirect effect on the price of other energy carriers, like for example natural gas. Subsidies have indirectly an effect on the valuation of natural gas reserves. It seems not logical to take into account an indirect effect of green subsidies on non renewable natural resources and not to take into account the direct effect of the subsidies on renewable natural resources. Energy markets enable that renewable natural resources and non-renewable natural resources are interrelating assets.

It remains a question if these two reasons allow the SEEA to divert from the SNA approach for valuation. If one sticks to the valuation rules of the SNA, then the reduction in externalities, which is expressed in the valuation of means to produce goods and services, are underestimated. If one diverts from SNA rules, and indeed takes into account subsidies, then the reduction in externalities will be expressed in the valuation of the means to produce goods and services and this valuation is closer to the social preferences regarding energy production.

3. More fixed assets will lead to a higher valuation of renewable energy resources.

There is a strong link between the fixed assets and the renewable asset. This link was doubted by some LG members. This link can be interpreted as a reflection of the proper market reaction of the producers. The producers react to better market conditions by investing more in for example windmills. In other words, they are investing more in order to pick up more of the resource rents created by favourable market conditions. This is a specific characteristic of this asset. It emerges when benefits are present and it disappears when benefits vanish. There is a strong parallel with oil- and gas reserves. In the case of oil- and gas reserves assets shrink too if oil prices go down because some gas wells do not render enough profits. Assets grow if oil prices go up because some gas wells become economically profitable and thereby recoverable. When new mining technology develops, investment in this new mining technology will lead to more fixed assets. Here also holds that due to these new investments more gas wells become economically recoverable and this leads to a higher valuation of fossil reserves.

Conclusions and recommendation on the fixed asset debate

It is not a problem that more fixed assets lead to more resource rent and thereby to a higher valuation of renewable resources. In mining, growth in fixed assets also goes along with growth in natural reserves.

4. Similar treatment for tidal stream and geothermal energy

Resource rent related to tidal stream and geothermal energy is treated in the same way as resource rent related to wind energy and solar radiation. Energy production by geothermal energy and tidal stream does not seem to lead to ownership of these energy resources or the prevention of other use options. It does not affect future consumption options in the way the consumption of fossil resources does. For both tidal stream and geothermal energy holds that the characteristics of the landscape and its surroundings are essential in creating the potential resource rents. The characteristics of the landscape are already valued and incorporated into the value of land.

5. Questions to the LG related to discussion paper on renewable energy resources in the SEEA

The price of land is explained by the scarcity of space and the opportunity costs related to the use options of the land under consideration. In optimizing the zoning scheme of a particular piece of land, all opportunity costs will be taken into consideration before a decision on the final zoning scheme is taken. So, in theory, the surplus income related to renewable energy production is already incorporated into the value of land.

1. Does the LG agree that in theory the rent related to renewable energy production (except water) is already incorporated into the value of land?

It is advocated to report data on at least one factor that is generating land value. In other words, from an environmental-economic point of view it is very informative to report data on the rent creation of all renewable energy resources.

2. Does the LG agree that 'rent' generated by renewable energy production, although already incorporated in land, should be highlighted?

It is not recommended to include the topic of rents and valuation related to renewable energy production in SEEA volume 1. In this early stage, when methods and concepts are not optimized, it is recommended to include this topic in volume 3.

3. Does the LG agree that the topic of resource rent related to renewable energy production and its corresponding valuation issues should be included in SEEA volume 3?

Using standard SNA rules, subsidies on renewable production should be attributed to fixed capital in stead of renewable energy resources. As a consequence, these subsidies should not be included in the resource rent calculation for renewable energy resources.

The distribution of income function of the government indicates that society as a whole has a certain preference for a particular production method. Another reason for highlighting subsidies is that subsidies on green electricity production have an indirect effect on the price of other energy carriers. To take into account an indirect effect of green subsidies and not the direct effect seems not logical. It remains the question if these reasons allow us to divert from the SNA approach for valuation.

4. Does the LG group (dis)agree that subsidies on renewable energy should not be taken into account in calculating the resource rent and valuing renewable energy resources?

5. Does the LG group (dis)agree that the arguments 'redistribution of income' and 'interrelating assets' are reasons to divert from the standard approach for valuation?

It is not a problem that more fixed assets lead to more resource rent and thereby to a higher valuation of renewable resources. In mining, growth in fixed assets also can go along with growth in natural reserves.

6. Does the LG group agree that it is no problem that more fixed assets eventually can lead too more resource rent and thereby too a higher valuation of renewable resources?

For tidal stream and geothermal energy the characteristics of the landscape and its surroundings are essential in creating the potential resource rent. The characteristics of the landscape are in theory already valued and incorporated into the value of land.

7. Does the LG group agree that tidal stream and geothermal energy should be handled the same as solar radiation and wind energy?

References:

CBS (2008), Productivity measurement at Statistics Netherlands, Working paper.

System of Environmental and Economic Accounting for Energy, SEEA-E, Draft Chapter 4 Monetary Asset Accounts, United Nations Statistics Division DESA, May 2008

United Nations (2008), System of National Accounts 2008 (draft), CEC-Eurostat, IMF, OECD, UNO, World Bank, Brussels/Luxembourg, New York, Paris, Washington D.C.

Renewable energy resources in the SEEA (Maarten van Rossum, Mark de Haan and Sjoerd Schenau, Statistics Netherlands). Available at: http://unstats.un.org/unsd/envaccounting/londongroup/meeting14/LG14_7a.pdf