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INTRODUCTION TO THE THEORY OF eSNI, A MACRO INDICATOR FOR SUSTAINABLE DEVELOPMENT.

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Environmentally sustainable national income (eSNI) is defined as the maximal attainable production level by which vital environmental functions remain available for ever, based on the technology available at the time. Thus the eSNI provides information about the distance between the current and a sustainable situation. In combination with the standard national income (NI), the eSNI indicates whether or not the part of the production that is not based on sustainable use of the environment, is becoming smaller or greater. Because of the precautionary principle, future technological progress is not anticipated in the calculation of eSNI. When constructing a time series of eSNI's, technological progress is measured after the event on the basis of the development of the distance between the eSNI and standard NI over the course of time. When this distance increases, society is drifting farther away from environmental sustainability, if this distance decreases, society is approaching environmental sustainability.

A first rough estimate of the eSNI for the world in 1991 by Tinbergen and Hueting arrives at fifty percent of the production level of the world: the world income [1)] . Estimates for The Netherlands by a cooperation of Statistics Netherlands, the Institute of Environmental Studies and the Netherlands Environmental Assessment Agency also arrived at about fifty percent of the production level or national income of The Netherlands [2)] . In the period 1990-2000 the distance between NI and eSNI increased by thirteen billion euro.

The environment is defined as the non-human-made physical surroundings, or elements thereof, on which humanity is entirely dependent whether producing, consuming, breathing or recreating. Producing is defined, in accordance with standard economic theory, as the adding of value. *This value is added to the elements of our physical surroundings (the environment), so the non-human-made physical surroundings falls outside the standard NI.* This is logical, for water, air, soil, plant and animal species and the life support systems of our planet are not produced by humans.

In our physical surroundings, a great number of possible uses can be distinguished, which are essential for production, consumption, breathing, et cetera, and thus for human existence. These are called environmental functions, or in short: functions. As long as the use of a function does not hamper the use of an other or the same function, so as long as environmental functions are not scarce, an insufficiency of labour, that is intellect or technology, is the sole factor limiting production growth, as measured in standard NI. As soon as one use of a function is at the expense of another or the same function (by excessive use), though, or threatens to be so in the future, a second limiting factor is introduced. Competing functions are by definition scarce and consequently economic goods, indeed the most fundamental economic goods humanity disposes of. In the situation of severe competition between functions, in which we live today, production not only adds value (viz. goods for consumption) but also nullifies value (by damaging environmental functions).

As a result, the shadow price of environmental functions rises, and with it their value, defined as price times quantity, from zero to an ever-higher positive value. *This rise in value reflects a rise in costs*. To determine the extent of the loss of function, we must know the value of the function. Therefore supply and demand curves have to be constructed.

The estimated costs of measures necessary to restore functions, that rise progressively per unit of function restored, can be seen as a supply curve. Except in the case of irreparable damage, this curve can always be constructed. For several reasons it is not possible to construct a complete demand curve. Consequently, shadow prices for environmental functions remain unknown. This means that the *correct prices for the human-made goods* that are produced and consumed at the expense of environmental functions remain *equally unknowable*. From this it follows that *both the eSNI and the standard NI are fictitious* in the context of what is at issue in economic theory and statistics, namely to provide indicators of the effect of our actions on our welfare.

However, to provide the necessary information, assumptions can be made about the relative preferences for environmental functions and produced goods. *One* of the possible assumptions is that the economic agents, individuals and institutions, have a dominant preference for an environmentally sustainable development, as is the case with eSNI. This assumption is legitimate since governments and institutions all over the world have stated support for this.

When assuming absolute preferences for sustainability, the unknown demand curves must be replaced by physical standards for sustainable use of the environment. The standards are scientifically estimated using environmental models and are in this sense objective. They must, of course, be distinguished clearly from the subjective preferences for whether or not they should be attained. From an economic perspective, sustainability standards approximate demand curves that are vertical in the relevant area of a diagram that has the availability of functions measured in physical units on the *x*-axis and the demand for functions and their opportunity costs on the *y*-axis.

The shadow price for environmental functions based upon the assumed preferences for sustainability then follows from the intersection of the vertical line and the marginal cost-effectiveness curve. In this manner the distance to sustainability, denoted in physical units on the *x*-axis, is translated into monetary units. See Figure 1. This monetary distance is equal to the distance between the national income figures belonging to the current path *b* and the sustainable path *s* in Figure 2. This is the distance to sustainability the country in question has to bridge in terms of the required opportunity costs, c.q. factor costs. For a correct approximation, such calculations have been done with the aid of a general equilibrium model, which also generates the shadow prices for produced goods in a sustainable economy, with robust changes in the price ratio's between environment burdening and less burdening products. From this, the level of sustainable national income follows.