System of Accounts for Global Entropy Production, (SAGE-P) and the 'Integration Problem' of the Natural and Social Sciences.

The central concept of SAGE-P is that Production, Consumption and Capital Accumulation in both Nature, and Society, are reducible to a set-theoretic structure of well-defined boundary conditions of the entropic process. This universal measure of qualitative state, and change of state, of material production systems was first, and brilliantly, expounded in Georgescu-Roegen's "Entropy Law and the Economic Process." The Clausius formulation of the Second Law of thermodynamics could, in his view, be applied to any macro-material system denoted as a function of time's arrow:

> *The Entropy Law itself emerges as the most economic of all natural laws. It is in the primary science of matter that the fundamental nonmechanistic nature of the economic process fully reveals itself.* (Georgescu-Roegon, 1971:3)

The seminar will explore the the entropic process described in G-R Flow-Fund Model. This is constructed from well-defined *flows* of: (i) objects, (ii) functions and (iii) values which are mapped on a hierarchically-structured topological domain spaces (TDS) representing the *stock* of the *Low Entropy* FUND unique to the

(A) ECONOSPHERE: where object values are conserved-in-exchange, (i.e., markets);
(B) SOCIOSPHERE: where object values are conserved-in-use, (i.e., participation) and;
(C) ECOSPHERE: where object values are conserved-in-themselves, (i.e., intrinsic to the object observed).

The object identities of the **A, B,** and **C** categories are integrated by the common denominator of entropy production, where *neg-entropy* defines the production function, *entropy* defines the consumption function and the difference between entropy production and neg-entropy production defines the capital accumulation function. This can be written as a time-delayed feedback loops: **Production**(t) - **Consumption**(t+1) = **Capital Accumulation**(t+1). The Categories are hierarchically nested structure of 'causes' in the form: **A →[B →(C)]** and a parallel set of ordered values: **exchange →[use →(intrinsic)]**.

The contention of the authors of SAGE-P is that this method of accounting offers policy analysts direct, as opposed to indirect, measures of the rate of disorder in any well-constructed system of economic, social and environmental accounts. The common denominator which cuts across all domains, is the rate of entropy production per unit of consumption. This is an attractive measure of the mirror image of GDP, and is readily adaptable, through algorithmic methods, to construct, *inter alia*, compelling indices, (i.e., ordinal valuations) of the: (i) ecological footprint, (ii) sustainable development and the (iii) human welfare function.

The focus of the discussion is on the 'integration problem' identified with complex, adaptive, systems which, so far, has eluded the best minds in the social sciences. The proposition that SAGE-P be developed as the accounting framework for the Rio Declaration and the Agenda 21^{+20} will be the subject of a Panel Discussion in the forthcoming ISEE Biannual Conference on "Challenges and Contributions for a Green Economy" (Rio de Janeiro, 16-19 June, 2012).

Reference:

Georgescu-Roegen, N. 1971. The Entropy Law and the Economic Process. Boston, Harvard University Press

This extract from Wikipedia may be useful to those who wish to attend the seminar, but are unfamiliar with the concept of "entropy."

Entropy is a thermodynamic property that can be used to determine the energy not available for work in a thermodynamic process, such as in energy conversion devices, engines, or machines. Such devices can only be driven by convertible energy, and have a theoretical maximum efficiency when converting energy to work. During this work, entropy accumulates in the system, which then dissipates in the form of waste heat.
In classical thermodynamics, the concept of entropy is defined phenomenologically by the second law of thermodynamics, which states that the entropy of an isolated system always increases or remains constant. Thus, entropy is also a measure of the tendency of a process, such as a chemical reaction, to be *entropically favored*, or to proceed in a particular direction. It determines that thermal energy always flows spontaneously from regions of higher temperature to regions of lower temperature, in the form of heat. These processes reduce the state of order of the initial systems, and therefore entropy is an expression of disorder or randomness. This picture is the basis of the modern microscopic interpretation of entropy in statistical mechanics, where entropy is defined as the amount of additional information needed to specify the exact physical state of a system, given its thermodynamic specification. The second law is then a consequence of this definition and the fundamental postulate of statistical mechanics.

Thermodynamic entropy has the dimension of energy divided by temperature, and a unit of joules per kelvin (J/K) in the International System of Units.

The term *entropy* was coined in 1865 by Rudolf Clausius based on the Greek εντροπία [entropía], *a turning toward*, from εν- [en-] (in) and τροπή [tropē] (turn, conversion).[2][note 2]