DEFINING A STANDARD MEASURE FOR WHOLE SYSTEM EROI COMBINING ECONOMIC “TOP-DOWN” AND LCA “BOTTOM-UP” ACCOUNTING

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ABSTRACT

Business investments rely on creating a whole system of different parts, technologies, field and business operations, management, land, financing and commerce using a network of other services. Using the example of a wind farm development, a typical life cycle assessment (LCA) focuses upon the primary technology inputs and their countable embodied direct impacts. What LCA omits are the direct and indirect impacts of the rest of the business system that operates the primary technology, the labor, commerce and other technology employed. A total environmental assessment (TEA) would include the physical costs to the environment of the labor, commerce and other technology too.

Here a simplified "system energy assessment" (SEA) is used to combine a “top-down” method of measuring implied indirect business impacts using econometric methods, with a “bottom-up" method of adding up the identifiable direct impact parts. The top-down technique gives an inclusive but rough measure. The bottom-up technique gives a precise accounting for the directly identifiable individual parts that is highly incomplete. SEA allows these two kinds of measures to be combined for a significantly improved understanding of the whole business system and its impacts, combining the high and low precision measures indentified by each method.

The key is exhaustively accounting for energy uses within the natural boundary of a whole business system as a way of calibrating the measure. That allows defining a standardized measure of complex distributed system energy flows and their energy returns on invested energy resources (EROI). The method is demonstrated for a generic business operation. Starting from the easily accountable inputs and outputs, SEA successively uses larger natural system boundaries to discover a way of finding the limiting value of EROI after all parts of the whole are included. Some business choices and a net present value model of cash flow for the 20 year project help illustrate the related financial issues. The business model used shows that the EROI of a generic "Texas Wind Farm" is 31 when accounting for direct and indirect fuels only, but decreases to 4-6 after accounting for the economic energy consumed by all necessary business units and services.

Keywords: energy return, internal rate of return, net energy, energy economics, system boundaries