This definition doesn't claim to speak for everyone who is interested in this new field; rather, it's my current best attempt at summing it up, with an explanation.

Biophysical economics: The study of the biological and geological resources that sustain economies and the individual and social choices that determine the use of those resources to meet felt needs

It's probably my economics brainwashing coming through, but I think it's important to keep the idea of "choice" explicitly in the game.[1] Of course we also need to know about the flows of resources that make our choices possible, but I would call that study on its own "human ecology."

My rationale for that limitation is that there was a series of decisions that had to happen in order for those flows to be available in the forms we currently see, and another set of choices to use that availability for particular current purposes. If you focus on the resource flows without asking what choices influence their current availability and use, then you're doing human ecology. If you focus on the choices without considering the ways that resources have shaped and limited them, you're doing conventional economics. When you integrate human ecology's understanding of our relationship to resources with economics' insights into how individuals and societies make choices about the exploitation and application of resources, you're doing **biophysical economics**.

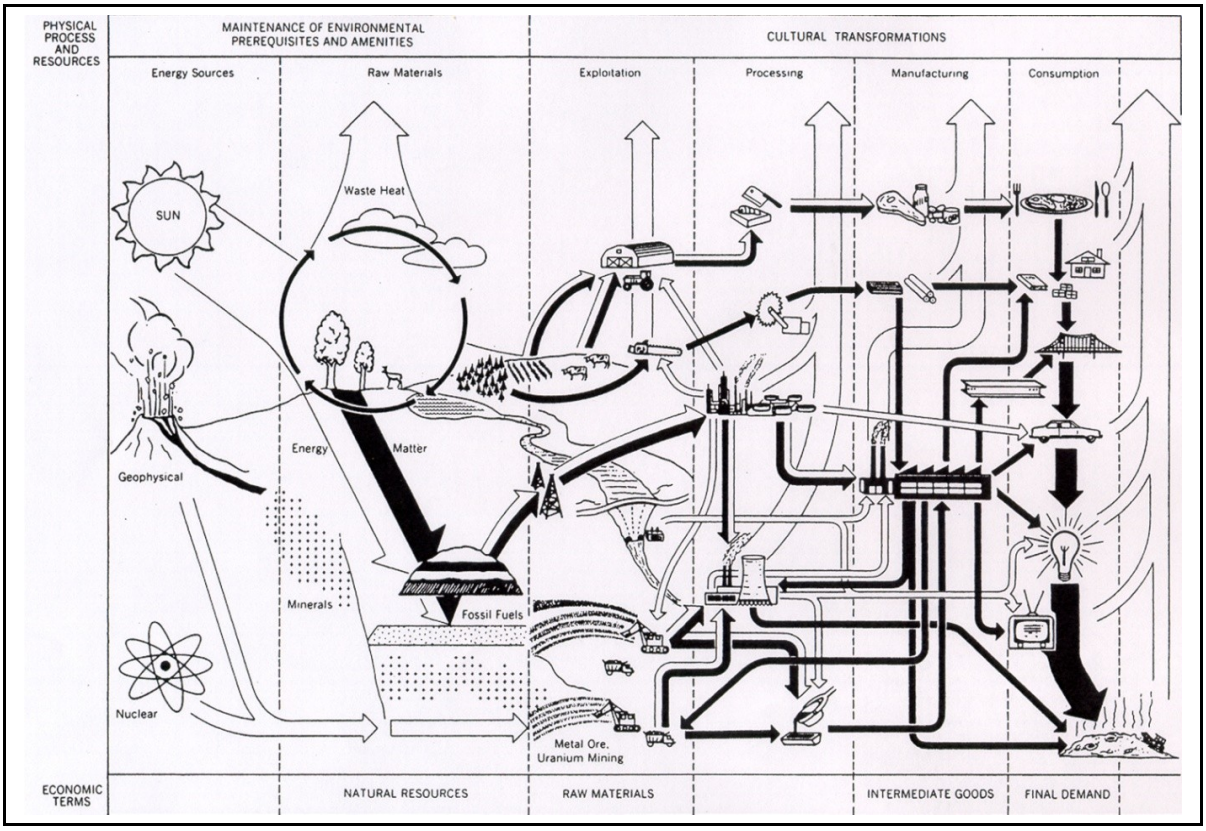
Let the winter strawberry illustrate. It's now commonplace to see plump strawberries neatly packaged in any decent size grocery store in any month of the year. The economist looks at the cost of the investment in farm equipment, packing facilities, packaging materials, shipping, and storage, and compares those things with the subjective value expressed by the shoppers who puts the strawberries in their carts and pay for them. The cost may be accounted in terms of dollars, but if we're true to what we say we do, we really mean cost in terms of other things foregone. We grew strawberries instead of lettuce (or instead of having non-agricultural land there); we shipped strawberries instead of shipping more computers. And those choices are justified by the grocery shoppers' subjective preference for the strawberries. They're willing to pay $4 a pint, which sufficiently rewards everyone on up the supply chain so that they're willing to keep providing the strawberries. In this analysis the use of physical resources is only of interest insofar as someone has to have a reason to use those resources for strawberry production rather than something else.

The student of human ecology focuses on the physical resources that economics takes for granted. For a New Yorker to buy a pint of strawberries in January for $4, there has to be industrial agriculture with cheap energy (and cheap labor) in order for the production cost at the farm to stay down. For that industrial agriculture to exist in California's Central Valley, there have to be the oil wells to provide the diesel, the iron ore mines and steel mills to make the farm implements, the abundant freshwater in northern California's rivers to water the crop, and the energy to build and operate the state's massive water system that moves the water from northern California up the Central Valley. To get the strawberries from there to here requires a vast network of roads, built with tremendous quantities of resources, and a

[1] As a professor of mine put it, if you don't have choice, you don't have economics; if someone points a gun at you and says, "Give me your money or I'll shoot you," you don't have a very interesting choice and economics doesn't have much to say about your actions at that moment. (It might have a lot to say about why the mugger made the choices that led him to his action, or why you looked like a good target, but it doesn't have much to say about your response to the assault itself.)

fleet of refrigerated trucks to drive over those roads carrying the precious fruit. There also has to be the cheap feedstock for the plastic containers so that we can ship the berries thousands of miles and still have them look good at the end. To complete the human ecology perspective, there are the landscape alterations to have the farm, the water system, and the highways; there's the atmospheric pollution from driving the trucks and from generating the electricity to pump the water; and there's the disposal of the plastic container, so cheap to make that we blithely toss it away when the strawberries are gone.

To do biophysical economics, you take the findings of human ecologists as your starting point. If their description of the resource flows is correct, you can't disregard it and still sensibly analyze how we humans provision ourselves. But you also need a model of how humans make choices, because the strawberries weren't made inevitable by the mere physical possibility of them appearing in your grocery store. People had to decide to build the California water projects that allowed them to be grown (as well as having access to the water and the energy to move the water). People had to decide to build the roads to carry the trucks (as well as having access to the energy to build the roads). And for the roads to be worth it, there had to be a lot of potential cars and trucks to use them (and therefore access to a lot of energy to move them around). And while the energy to do all that is available through sources that we understand, it does not automatically offer itself. 300 years ago, the coal, oil, and uranium that power industrial society were there, but we didn't know how to use them. Figuring that out and building the capital that makes them useful is an inherently economic process—these are the famous siblings "innovation and investment." In conventional economic analysis these two forces do *all* the work of progress, leaving crumbs for their enabler, resources. Biophysical economics rebalances the relationship, with potential resources making innovation and investment rewarding, and innovation and investment turning potential resources into things that are actually available to the economy.



From Charles A.S. Hall, “Biophysical economics: definitions and applications”

Another way of illustrating the concept is with the diagram Charlie showed in the morning session of the meeting (see above, pasted in from his 2005(?) paper, “Biophysical economics: definitions and applications”). In the terms I’m using here, the entire diagram is human ecology, particularly if you take the waste streams and bring them back into the diagram to show their potential effects on ecosystems or directly on humans. The diagram organizes its six stages into two groups: the left two panels constitute “Maintenance of environmental prerequisites and amenities” while the right two thirds are “Cultural transformations.” The division highlights a crucial fact, the distinction between our deepest inheritance from the natural realm, and what we make of that inheritance. My only suggested addition would be to note that all of those “cultural transformations” are the result of **choices**. Those choices have to be feasible, or they’re just fantasy (this is where conventional economics goes off the rails, implicitly assuming that we can choose indefinite growth without thinking about the resource use that would entail). But there are in principle lots of ways of arranging the cultural transformation of resources. Biophysical economics takes geology and biology as its fundamental constraints (the left third of the diagram, plus the scientific principles that govern how we are potentially capable of transforming what we exploit). It then asks **why** we’ve chosen to build the cultural transformations the way we have and **how** they could be built differently to improve human lives. If we understand those two questions, we may be able to intelligently say **what policies** would help us move from where we are to a feasible alternative.