*From “*[*Draft Email to David Packer*](https://docs.google.com/document/d/1pb2EuWVv73PMKg0SKsKJ1SLviMu1wZgXGca9xtExvV4/edit)*:”*

*Objective for the book*: To develop a dynamic model that (a) has the potential to describe structural transformations of the economy and (b) provides a framework for improved economic and environmental accounting.

1. Prologue: The IEESA story. Put in a different font. See for example: <http://www.nytimes.com/1994/04/20/business/environmental-factors-to-be-calculated-in-gdp.html?action=click&module=Search&region=searchResults%230&version=&url=http%3A%2F%2Fquery.nytimes.com%2Fsearch%2Fsitesearch%2F%3Faction%3Dclick%26region%3DMasthead%26pgtype%3DHomepage%26module%3DSearchSubmit%26contentCollection%3DHomepage%26t%3Dqry733%23%2Fieesa>
2. Burning question: How can you maintain a system of national accounts without accounting for natural assets? Unpack later to mean flows between the economy and the biosphere!
3. **Problem**: We're not counting materials, energy, and economic value in a way that allows society to (a) understand the connections between energy and the economy and (b) plan for a future in which energy transitions/transformations will occur. Why is this important?
   1. The world is facing energy transformations.
   2. Either the transformations will *happen to* us, or we will *plan for* them. We believe that planning is preferred.
   3. To plan for the coming transformation, we need to know the existing materials and energy structure of our economy. And, we need to know where materials and embodied energy accumulate in economic sectors and infrastructure. In short, we need to understand the connections between energy and the economy.
   4. However, we (as a society) are not accounting the necessary things to help us *plan for* the economic challenges that will accompany the impending energy transformation. In fact, Congress is preventing the BEA from doing this! (See Prologue.)
   5. Relative vs. absolute scarcity and depletion!
4. **Solution**: Our book provides a dynamic model that shows (a) what should be accounted and (b) how to analyze the data. This is a step along the path of solving the stated problem.
5. Why is our collective imagination stuck on a view of the economy as isolated from the biosphere?
   1. The isolated machine metaphor for the economy tells us that structural transformations will occur smoothly.
   2. The isolated machine metaphor leads to some incorrect assumptions:
      1. No connection between the economy and the biosphere
      2. Resources are always available.  If a particular resource is becomes scarce, substitute.
      3. Infinite assimilative capacity for wastes
      4. Economic forces (through prices and the market mechanism) will smoothly guide transition processes to good and just outcomes
      5. The machine can and will carry on
   3. However, energy transformations have been rocky to this point. (eg. 1973, 2008)
   4. Why? Perhaps our economic models are wrong.
   5. But, economic models are informed by metaphors. Perhaps our metaphors are wrong.
   6. Discussion of importance of metaphors.
6. Requirements for an apt metaphor for the economy: see first column of table below.
7. Perhaps a better metaphor for the economy is a metabolism (Greek root means "change").
   1. Metabolisms have the aspects of economies in the first column of the table below.
   2. How can we fill in the metabolism metaphor? There are ideas “lying around” that can address these important aspects of economies. (See middle column of table.) However, ideas 1–5 above create snapshots of flows. None (except 6) provides structural information. In other words, 1–5 talk about the blood, not the bones. We need to understand flows (blood) and structure (stocks, bones). 6 helps with that.
   3. Furthermore, an apt metaphor should inform models that are verifiable against historical data. We need a way to collect and categorize the information. The SNA is supposed to do that. But, the BEA doesn’t include important information (material flows and accumulation, for example) in the SNA. These facts bring us back to
      1. our burning question (How can you maintain a system of national accounts without accounting for natural assets?) and
      2. stated problem (We're not counting materials, energy, and economic value in a way that allows society to (a) understand the connections between energy and the economy and (b) plan for a future in which energy transitions/transformations will occur.)

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|  | **Aspects of economies that should be addressed by an apt metaphor** | **Ideas**  **“Lying Around”** | **Significance** |
| 1 | Intakes material and energy from the biosphere | MFA, EW-MFA | Stresses importance of material intake |
| 2 | Exchanges materials and information internally | I-O method | Highlights importance of internal exchanges |
| 3 | Discharges wastes to the biosphere | LCA, EIOLCA | Focuses attention on otherwise-neglected wastes |
| 4 | Affected by scarcity (non-linearity) in the face of low-substitutability (and uncertainty) | EROI | Predicts that energy resource scarcity reduces EROI and increases prices |
| 5 | Affected by energetic costs | EI-O method | Gives prominence to energetic costs for internal flows |
| 6 | Exhibits non-linear dynamics with the potential for structural transformation. Embodies energy in capital stock of economic sectors. | Thermodynamic control volume modeling | Describes transient behavior and transformations. Provides “accounting” equations. |

1. **Restate the Problem**: We’re not counting materials, energy, and value in a way that allows society to
   1. understand the connections between energy and the economy
   2. plan for a future in which energy transitions/transformations will occur.
2. **Need**: A modeling approach that
   1. brings together the ideas “lying around,”
   2. has the potential to describe structural transformations of the economy, and
   3. provides a framework for improved economic and environmental accounting.
3. **Approach**: Our approach to meet the need is to develop a dynamic model by applying rigorous thermodynamics to economies, informed by the ideas lying around and the metabolic metaphor, in a manner that is verifiable against the existing (or expanded) System of National Accounts (SNA).
   1. Where and how should we apply rigorous thermodynamics to develop our dynamic model? What accounting must be done well to understand the dynamics of economies?
      1. Materials (Chapter 2)
      2. Energy (Chapter 3)
      3. Embodied energy (Chapter 4)
      4. Economic value (already done very well by the System of National Accounts, Chapter 5)
      5. Key metrics that arise from this dynamic model: energy intensity and EROI (Chapter 6)
   2. The list above provides the outline for the center of the book. The rest of the outline is:
      1. Implications from the dynamic model (Chapter 7)
      2. Unfinished business (Chapter 8)
      3. Summary (Chapter 9)