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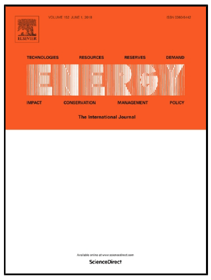

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# Proposed 2nd Law of Thermodynamics: An Assertive Statement

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**ABSTRACT**. Generally, the 2nd Law is stated in *negative,* passive terms, in a way that says what cannot happen, or what the best possible outcome could be, or what is an inevitable (e.g., inopportune) consequence. Granted, there has been productive usage of the exergy concept, to do '2nd Law *Analysis'.* Granted, there are statements saying that a *consequence* of every process is the generation of entropy. And there have been many efforts aiming to use an entropy statement to do '2nd Law *Modeling*' – to predict the *path* of processes. While there have been *specific* successes, there are issues. For example, in some instances a success depends upon an extremization that maximizes the entropy generation (or the rate thereof), while in other instances, minimization. Though there may be criteria for determining whether maximization or minimization is appropriate in a particular application, the need for such a criterion points out a weakness. Proposed here is this: *Every* process is a consequence of a *cause*, and to assertively predict the path of a process is to determine consequences of a *cause*. Entropy production is *not* a cause but *only* a consequence. The 2nd Law statement to be proposed herein employs *a* common measure of cause, namely Gibbs' available energy, *and* how the expenditure of that cause ensues in a process. Therein lies an underlying *principle* for modeling the process path (whether macro, nano, bio or micro).

Three *rudimentary* examples of the application of this '2nd Law principle' for modeling processes are presented in this paper; one for a transient 'heat transfer' process, one for a 'mechanical' process, and a third for a combined thermal and pneumatic process. It is shown how available energy a key to modeling processes of different 'types' – heat transfer, mechanics, pneumatics. Heretofore each type required distinct 'principles' (and courses of study). To show the authenticity of the results obtained with this '2nd Law modeling', they are compared with results obtained with the 'traditional' models.

## *1 INTRODUCTION.*

A process involves interactions between systems and/or spontaneous changes within them, and results from a cause. Interactions are a consequence of disequilibrium between systems, and spontaneous changes result from disequilibrium within a system. The cause of processes, then, is disequilibrium. The modeling (prediction) of the path of a process seeks to determine the consequences of the cause. Consider that every productive process seeks to utilize a 'fuel' to impel it – where, here, a 'fuel' is a condition with inherent disequilibrium and, therefore, the 'potency to cause change'. A 'productive' process is one that, taking advantage of one disequilibrium condition, achieves and/or maintains another. Gibbs proposed a common measure of disequilibrium, which he called the 'available energy'of the 'body' [1; see also 2]. (His development was for the case where energy transports (to or from or within) the body are associated only with exchanges of volume (V) or entropy (S). Besides available energy he presented 'available vacuum' and 'capacity for entropy' as alternative measures of disequilibrium.)

***1.1 The First Law.*** Pertinent to interactions is the 1st Law. The following statement is adopted here: