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Editorial

Type-B Energetic Processes: Introduction and Invitation to Special Issue of *Energies*

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Currently, there is substantial scientific evidence for the existence of Type-B energetic processes on Earth, such as the naturally occurring transmembrane-electrostatically localized protons (TELP) thermotrophic properties in life [1]. A number of groundbreaking human-made Type-B energetic processes, including (but not limited to) "asymmetric function-gated isothermal electricity production" [2], "epicatalysis generating a temperature difference between catalysis-asymmetric filaments" [3], "artificially made asymmetric membrane concentration cell" [4,5], "Fu's experiment on heat–electric conversion using surface electron emission under a static magnetic field" [6], and the "dynamic processes in superconductors indicating Type-B energetic process" [7–9] have been invented and/or experimentally demonstrated. The innovative efforts of Type-B processes to enable the isothermal utilization of endless environmental heat energy could help to liberate all people from their dependence on fossil fuel energy, thus helping to reduce greenhouse gas CO_2 emissions and control climate change towards a sustainable future for the humanity on Earth. However, almost the entire scientific community and the public are currently "still in sleeping with all the Type-A energetic processes taught in textbooks"; only a quite limited number of scientists now understand and appreciate the Type-B energetic processes. Therefore, in addition to the need for further research and development, better messaging and education on Type-B energetic processes are also highly needed to achieve the mission.

One of the criteria to qualify for a Type-B energetic process is its required asymmetric structure and/or function that makes it possible to isothermally utilize environmental heat energy to conduct useful work, such as producing electricity without being constrained by the second law. In contrast, the classical heat engines and many of the known chemical, electrical, and mechanical processes belong to the classification of Type-A energetic processes, which commonly have freedom in 3D spaces and, thus, follow the second law of thermodynamics well.

That is, an asymmetric structure and/or function is a necessary requirement to enable for a Type-B energetic process. There is a well-known adage in particle physics [10]: *Break a symmetry, make a boson*. This has been applied to great effect in predicting new subatomic particles and in understanding quantum forces and fields, perhaps most famously in explaining the vast differences in masses between the various hadrons and leptons. The remedy to this broken mass symmetry is the Higgs boson. We now understand that a similar adage applies in thermodynamics: *Break a spatial–thermodynamic symmetry, extract some work*. This principle lies at the heart of energy and entropy production across the universe. For example, spatial temperature (pressure) asymmetries power heat (pressure) engines, and asymmetries in chemical potentials between reactants and products drive chemical reactions. Even the direction of time itself is guided by differences in entropy between the past and future. In short, asymmetries make the world go round.

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This Special Issue of *Energies* explores the nature and ramifications of a new and special class of processes driven by spatial–thermodynamic asymmetries. Everyday thermodynamic processes, like those driving heat engines, batteries, and biochemistry, are classified as Type-A energetic processes. These fully conform to the first and second laws of thermodynamics and are generally well understood. In contradistinction, Type-B energetic processes adhere fully only to the first law, while redefining the second.

First enunciated by Carnot during the age of steam engines, the second law has served the physical sciences and engineering well for 200 years. Over the last 30 years, however, several dozen Type-B processes have been advanced theoretically, and many of these have received strong experimental support [11]. Not surprisingly, they have been the center of considerable discussion and controversy. In this Special Issue, these systems and their controversies are tackled head-on.

We now begin to understand Type-B energetic processes and their implications [12]. More in-depth studies are needed to better understand Type-B energetic processes and their applications. For example, more efforts are needed to investigate potential applications in quantum computing and nanotechnology and to develop theoretical frameworks integrating asymmetric functions and thermodynamics. There is also a need to conduct experimental validations across various scales and conditions and analyze implications for existing thermodynamic models and laws.

In this Special Issue, we, the guest editors, welcome submissions of full-length articles, short communications, perspective reviews, and educational articles pertinent to the theme of Type-B energetic processes, whether theoretical, experimental, or numerical. More broadly, we invite the wider scientific community to view the thermodynamic landscape with new and imaginative eyes, to see beyond old preconceptions and realize that, just as the second law has been the thermodynamic touchstone for change, now, in the face of new ideas and evidence, our understanding of this venerable law must itself also change.

Conflicts of Interest: The authors declare no conflicts of interest.

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