EDITORIAL

Planet Habitability under Energy Balance and Resource Carrying Capacity

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Abstract

Against the backdrop of the in-depth advancement of the global energy transition, the sustained development and utilization of resources, and the escalating risks to Earth's habitability, ensuring energy and resource security as well as environmental sustainability for our planetary home—and laying the foundation for humanity's future interstellar migration and the exploration of habitable planets—the *Journal of Energy and Resources* (*JER*) is launched with a focus on building a high-end academic platform for the interdisciplinary field of "Energy-Resources-Habitable Planets". The journal centers on energy, resources, and Earth sciences, while also emphasizing frontier interdisciplinary research areas, including geological AI computing, data science, planetary exploration technology, and sustainable development. Our goal is to establish a high-level academic exchange platform, pool the wisdom of top scholars worldwide, and jointly explore approaches to achieving the safe, efficient, and green development of energy and resources through scientific and technological innovation—ultimately serving the grand vision of "habitable planets": whether in safeguarding Earth, our current home, or pioneering potential new habitats such as Mars and the Moon. The journal is founded to document and advance this remarkable journey spanning planetary scales.

Keywords: energy, resources, artificial intelligence, environmental sustainability, planetary exploration, habitable planet.

1 Introduction

Energy and resources are the lifelines sustaining the operation of human society, ecological communities, and even the entire Earth system. From coal in the Industrial Revolution to electricity in the artificial intelligence era, every leap in civilization has been accompanied by profound transformations in the ways energy and resources are utilized. However, under the dual pressures of population growth and economic development, the depletion crisis of traditional fossil fuels, the environmental costs of resource extraction, and the global threats posed by climate change have

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forced us to address a core question: How can we develop and utilize energy and resources safely and efficiently while ensuring the balance and security of Earth's ecosystems? This proposition runs through multiple core research fields focused on by this journal, including energy and resource engineering, Earth sciences, and sustainable development.

We are in a "new era" driven by data. The rapid development of artificial intelligence, machine learning, and big data analytics is reshaping the landscape of the energy and resources industry with unprecedented momentum. Ranging from the accurate characterization of geological models and intelligent prediction of oil and gas reservoirs to the automation of mine operations and smart dispatching of power grids, data science is transforming the traditional experience-driven model into a data-driven scientific decision-making model, significantly improving exploration success rates, operational efficiency, and production safety.

At the same time, humanity's vision has expanded from the deep Earth and deep seas to deep space. The "Habitable Planet" initiative is no longer merely a science fiction theme but a scientific goal actively pursued by global aerospace agencies and commercial companies. Whether celestial bodies such as Mars and the Moon have the potential to become humanity's "second home" hinges on the ability to acquire and utilize essential resources (e.g., water, minerals, energy) in these extraterrestrial environments. As the most cutting-edge frontier in this industry, planetary resource and energy exploration technology is a key direction that this journal actively embraces and encourages for publication, aiming to provide technical solutions to address the long-term survival and development of humanity.

2 Energy and Resource Security & Environmental Sustainable Development

Ensuring the stable supply of energy and resources is the cornerstone of achieving economic prosperity and social stability. Nevertheless, this goal must never be achieved at the expense of the environment. The research focused on in this section is committed to finding the optimal balance between "security" and "sustainability".

In the field of energy engineering, we focus not only on technologies for the clean and efficient utilization of traditional fossil fuels (e.g., carbon capture, utilization, and storage (CCUS)) but also vigorously promote technological innovation and large-scale deployment of renewable energy (e.g., solar energy, wind energy, hydrogen energy, and geothermal energy). Furthermore, as a key to addressing the intermittency of renewable energy, advanced energy storage technologies (e.g., next-generation batteries, pumped hydro storage, and underground energy storage) are prioritized in research.

In terms of resource engineering, the research focus lies in innovative resource development and green mining technologies. This includes the development of low-energy-consumption and low-waste-emission resource extraction processes, the promotion of waste-free mining and mine restoration technologies, and the realization of circular utilization of mineral resources. Meanwhile, interdisciplinary research integrating artificial intelligence with geology, geophysics, and rock mechanics serves as the scientific foundation for improving resource exploration accuracy, assessing geological disaster risks, and ensuring efficient resource extraction.

Ultimately, all technical pathways must undergo scrutiny through environmental impact assessments. This journal encourages the publication of research findings on life cycle assessment (LCA), ecosystem restoration, mining land reclamation, and the coordination between resource development and biodiversity conservation, aiming to build a resource development and utilization system with minimal environmental footprint.

3 AI + Energy and Resources

The integration of artificial intelligence has triggered a profound paradigm shift in the energy and resources field. This section aims to demonstrate how data intelligence empowers the entire industrial chain.

In the energy sector, AI-driven smart grids can achieve dynamic balance between supply and demand through real-time data analysis, optimize energy balance, and effectively accommodate high proportions of renewable energy. Additionally, AI has shown great potential in energy demand forecasting, optimization of market trading strategies, and carbon footprint tracking. We encourage submissions of research on the innovative application of new AI algorithms (e.g., deep learning, reinforcement learning) in the energy and resources field, promoting the development of this field toward greater intelligence and precision.

In the resource sector, AI algorithms can integrate

satellite remote sensing, multi-source geophysical, geochemical, and geological data to construct high-precision 3D geological models, significantly improving the prediction success rates of oil, gas, and mineral resources. In production and operation, machine learning-based predictive maintenance can anticipate equipment failures and reduce unplanned downtime; intelligent robots and autonomous driving systems are enabling unmanned and automated mine operations, greatly enhancing work safety.

4 Exploration of Habitable Planets

Turning our gaze to extraterrestrial space, the development and utilization of planetary resources are prerequisites for humanity to achieve long-term extraterrestrial survival and activities, as well as the material foundation of the "Habitable Planet" initiative. This section focuses on the cutting edge of planetary science and exploration technology.

Research content includes, but is not limited to: technologies for the detection and extraction of water ice on the surfaces of the Moon and Mars—these water resources can not only support life but also be converted into hydrogen-oxygen fuel through electrolysis; the use of in-situ resource utilization (ISRU) technology to transform planetary surface regolith (e.g., lunar soil, Martian soil) into construction materials, oxygen, and even raw materials usable for 3D printing; and the development of energy systems adapted to extraterrestrial environments (high vacuum, microgravity, extreme temperatures), such as high-efficiency solar arrays and small-scale nuclear reactors (e.g., kilowatt-level fission systems).

This journal actively accepts research on planetary probes, drilling robots, resource processing experimental devices, and extraterrestrial habitat construction technologies. These explorations not only serve the distant dream of interstellar migration but also their derived technologies will inevitably feed back to Earth, providing new ideas and tools to address the resource and environmental challenges we face on Earth.

5 Publication Norms and Academic Standards

The *Journal of Energy and Resources* (*JER*) strictly adheres to the publication norms and academic standards of the International Center for Computing and Knowledge (ICCK). We uphold rigorous, transparent, and ethical publishing principles. All submitted manuscripts will undergo a double-blind peer review process to ensure that the published academic results are innovative, scientific, and reliable. We firmly oppose all forms of academic misconduct, including plagiarism, data falsification, and duplicate submission. For detailed author guidelines, manuscript formatting requirements, and ethical standards, please refer to the instructions on the journal's official website.

6 Call for Submissions and Acknowledgments

This journal sincerely invites scholars, engineers, and researchers engaged in relevant fields worldwide to submit their work enthusiastically. Your cutting-edge research will contribute valuable knowledge to our joint efforts in addressing energy and resource challenges and exploring the future destiny of humanity.

Finally, the editorial department would like to extend our most sincere gratitude to the leaders of the academic societies who provided guidance for the establishment of this journal, the experts and scholars who dedicated their efforts to the peer review work, and all colleagues who have paid attention to and supported the development of this journal. Let us move forward hand in hand to jointly record and advance this scientific and technological journey that concerns the destiny of humanity.

Yours sincerely,

Founding Editors-in-Chief

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Conflicts of Interest

Liang Liu is an employee of The Eighth Geological Brigade, Hebei Bureau of Geology and Mineral Resources Exploration, Qinhuangdao 066001, China.

Ethical Approval and Consent to Participate

Not applicable.

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