

# ENERGIZING NEW ENERGY RESEARCH

A conversation with **JIAOFENG PAN**, Professor, President, Institutes of Science and Development, Chinese Academy of Sciences (CASISD)



The use of fossil fuels is a primary source of greenhouse gas emissions, and considered a culprit for global warming. Aiming for carbon neutrality — achieving a balance between emitting and absorbing carbon, many countries are looking into new energy solutions to cut carbon emissions. With increasing demands for low-carbon technologies, what are the global patterns of research growth in new energy? And what are some promising technologies? A collaborative report seeks to explore into these questions using bibliometric analysis. Here, Jiaofeng Pan, who leads the project, shares his insights.

### Why do you focus on new energy technologies?

From wind and solar to biomass and geothermal energy, renewable energy resources offer solutions to the global climate change crisis. They also facilitate sustainable economic development, and bring benefits to human and environmental health. Therefore, ensuring access to affordable and clean energy is high on the agenda of United Nations' Sustainable Development Goals. Considered the driving force for the energy revolution, new energy research is growing. We want to review the progress of new energy technology research in China and the world, and examine the connections between scientific publications and patents. We hope our analysis will provide a reference for academia and industry for their new energy research and technology deployment in future.

### Who are the main contributors to this report?

The project is a joint effort by CASISD, CAS's Wuhan Documentation and Information Centre and Guangzhou Institute of Energy Conversion, along with Springer Nature. We used the Dimensions data from Digital Science for bibliometric and patent analysis to highlight the strengths and weaknesses of China's new energy technology research, and also conducted interviews with experts in

key technology areas for their insights into opportunities and challenges for developing these new energy technologies.

### What are some key findings on new energy research?

By assessing scientific publications in renewable energy, including solar, wind, biomass and geothermal energy, as well as new energy system technologies, such as advanced nuclear energy, hydrogen, energy storage and energy internet, we see accelerated growth of new energy research in the recent decade. Particularly, among the eight new energy fields analyzed, solar energy, energy storage and hydrogen have the largest research output in the period of 2015-2019, demonstrating the focus on these fields. For fields with more than 10,000 publications in the past five years, research on energy storage, hydrogen and energy internet sees the fastest growth.

### How does China perform in new energy research?

Committed to achieving net-zero carbon emission by 2060, China is an active player in new energy research. It is the largest contributor to new energy research, accounting for more than a quarter of the global publications in the last five years. Particularly, it is a key contributor to the world's top three new energy fields, with

outstanding performance in energy storage, solar energy and hydrogen research by volume of publications. And similar with the global trends, China grows fastest in energy internet, hydrogen, and energy storage research output for major new energy fields 2015-2019. But average citation of China's new energy research output is relatively low compared with some developed countries, suggesting the need to improve the global impact of its research.

### Outline some findings about promising new energy technologies?

We have explored 20 subtype technologies under the eight new energy fields, and define promising new energy technologies as those with a considerable amount of total research output, fast growth, and a sizable volume of top 1% papers by average citation. Here, battery storage, solar photovoltaic, solar fuel, hydrogen production, and energy internet architecture and core equipment technologies are identified as the top five promising new energy technologies.

Energy storage is a key component of the modern energy system, and contributes significantly to the development of novel power batteries, which have attracted growing research attention with the rise of

the electric vehicle industry. Also a promising battery technology, hydrogen fuel cell provides an alternative option for transforming the traditional transportation systems and reducing carbon emission. New electro-catalytic approaches have promoted breakthroughs in solar fuel technologies, which are promising for reducing fossil fuel dependence. Energy internet technologies, key to the infrastructure of modern energy systems, need more applied research for improved implementation.

### What are the challenges for developing new energy technologies?

Translation of new energy research results into applicable technologies remains a global issue. Bringing these new energy technologies from lab to market requires close collaboration between academia and industry, and governments also play an important supporting role.

China can play an important role in this energy revolution, and needs to improve research efficiency, focus more on high-quality research with social impacts, and encourage industry to participate in the technological innovation process.



# NEW ENERGY TECHNOLOGY RESEARCH: OPPORTUNITIES AND CHALLENGES

Ensuring access to affordable, reliable, sustainable and modern energy for all is one of United Nations' Sustainable Development Goals. Such a new energy system is vital for sustainable economic development, as well as for addressing global climate challenges. Many countries are seeking to accelerate the transition to such a new energy system by investing in renewable energy resources and developing or adopting new energy technologies. A collaborative report led by three institutes under the Chinese Academy of Sciences (CAS) reviews the landscape of new energy research, attempting to identify opportunities and challenges.



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Contributed to planning the study, setting the report outline, guiding the analysis and writing the report.



**JIANFENG GUO**  
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Designed the study, set the report outline, provided data analysis strategies and wrote the report.



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Classified new energy technologies, conducted the analysis and wrote relevant sections of the report.



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Contributed to designing the report outline, conducting the analysis, reviewing and revising drafts of the report.



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Organized expert interviews and summarized main points, supported analysis of hotspots of new energy technologies and future development trends.



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Revised report drafts, and provided advice on the analysis.

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