

Moving Forward with Solar Cooking: Closing Knowledge Gaps in Technical, Environmental and Food Quality Aspects

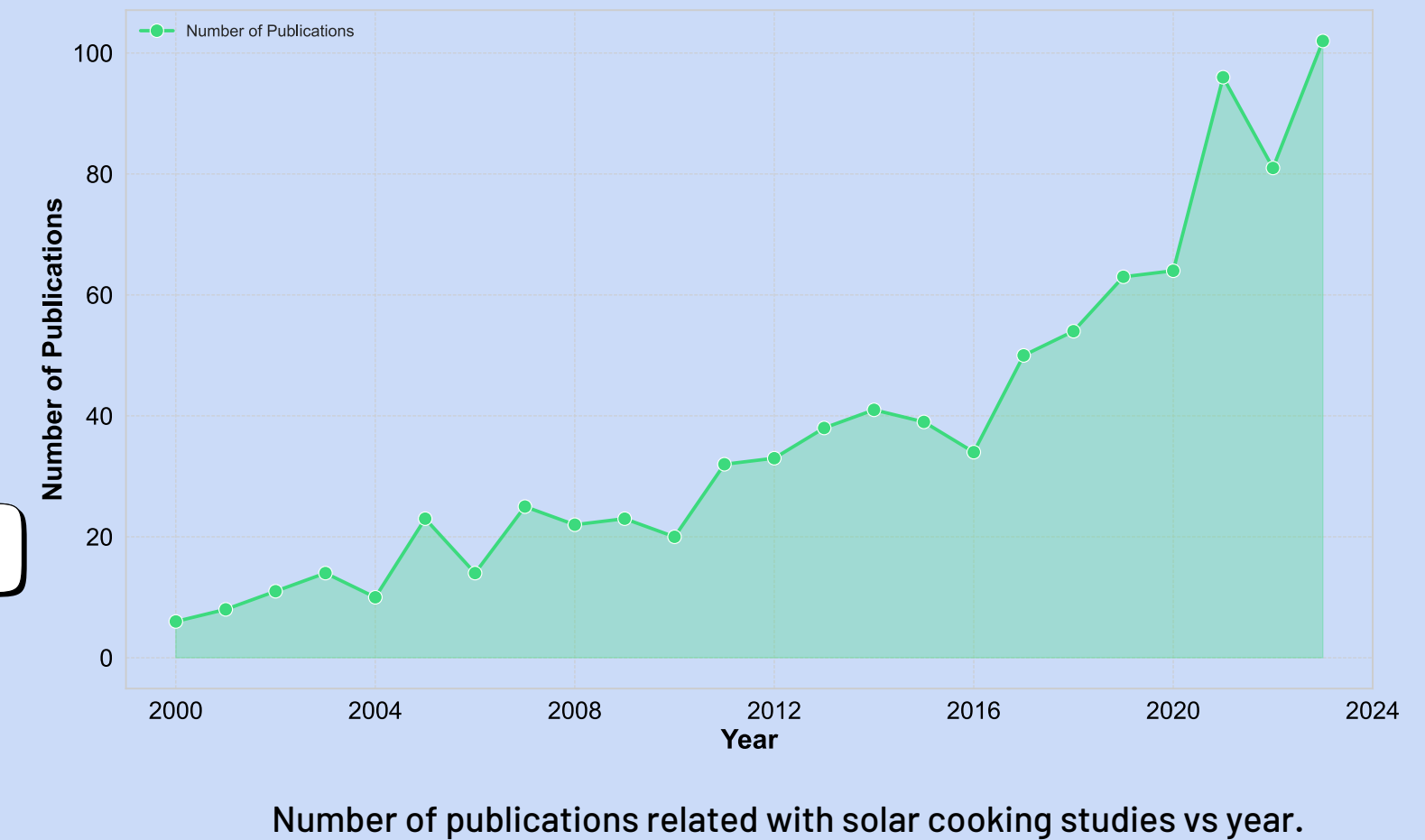
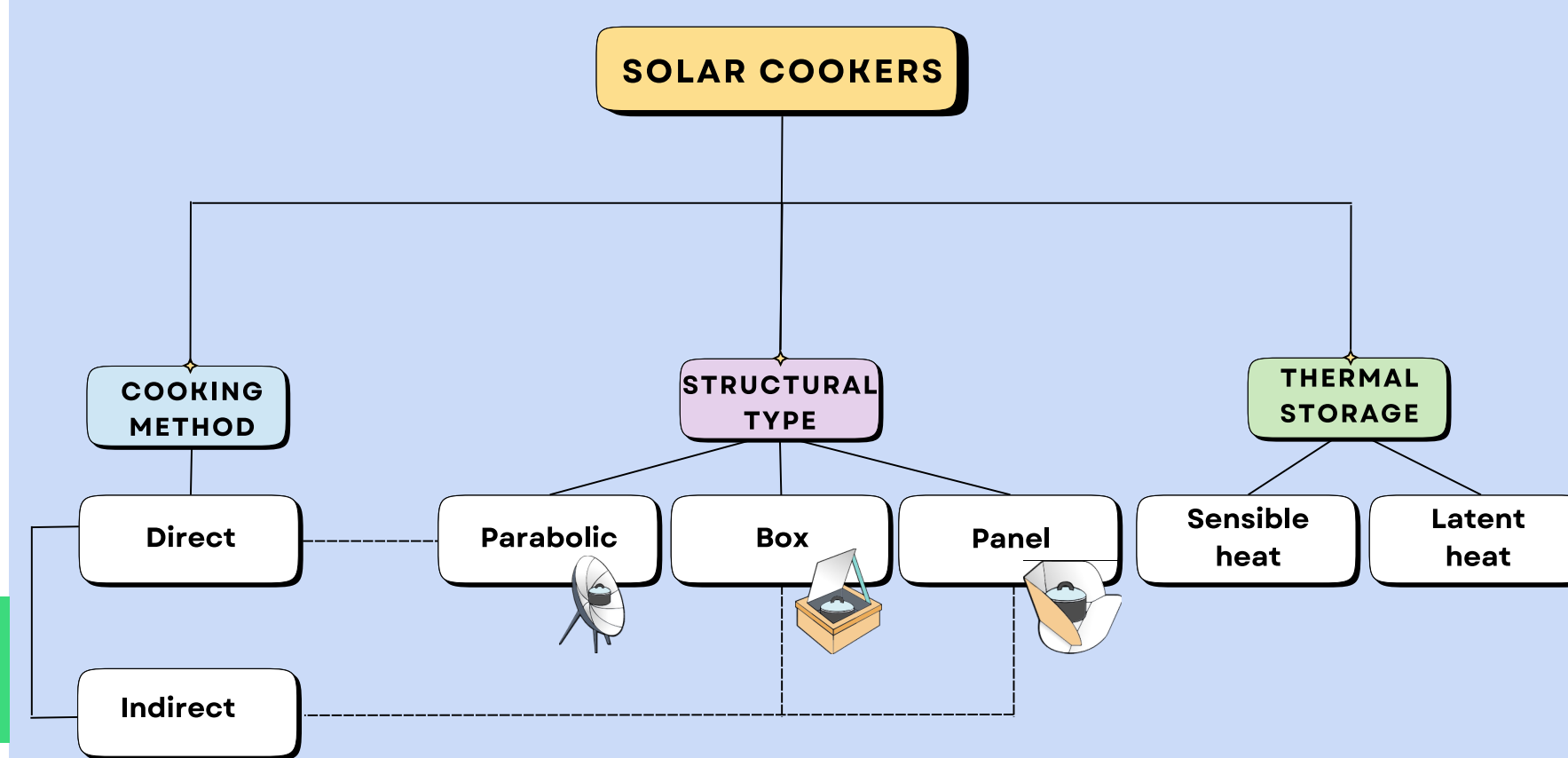
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Solar cooking

uses the sun's energy to cook food, offering a sustainable alternative to traditional methods that depend on non-renewable energy sources. This environmentally friendly approach helps reduce greenhouse gas emissions and preserves natural resources.¹ Despite these benefits, significant knowledge gaps remain regarding the technical complexities, sustainability implications, and impact on food nutritional quality.

Solar cookers have different types and shapes, demonstrating the diverse approaches to utilizing solar energy for cooking. Since 2000, there has been a significant increase in research interest, driven by the growing recognition of solar cooking's potential for sustainable and **environmentally friendly** food preparation.²



Beneficial Application

Household

Large scale

Depends ON

Cost Energy

Technical factors: Price, Design

Economical factors

Political factors

Health

Environment

Customer needs

Successful implementation

Right Now

4M units

6 tonnes of CO₂

Solar cooking research and application vary widely globally, with significant contributions from countries like India, the United States, and Mexico. Solar cooking can be used effectively in both homes and large-scale settings, offering a **sustainable and cost-effective** solution. Successful implementation depends on several factors, including technical advancements, health benefits from reduced air pollution, and significant environmental impacts. Solar cooking also offers substantial cost savings, though barriers to widespread adoption remain.³ Political support and regulatory frameworks are crucial, as is addressing user needs.

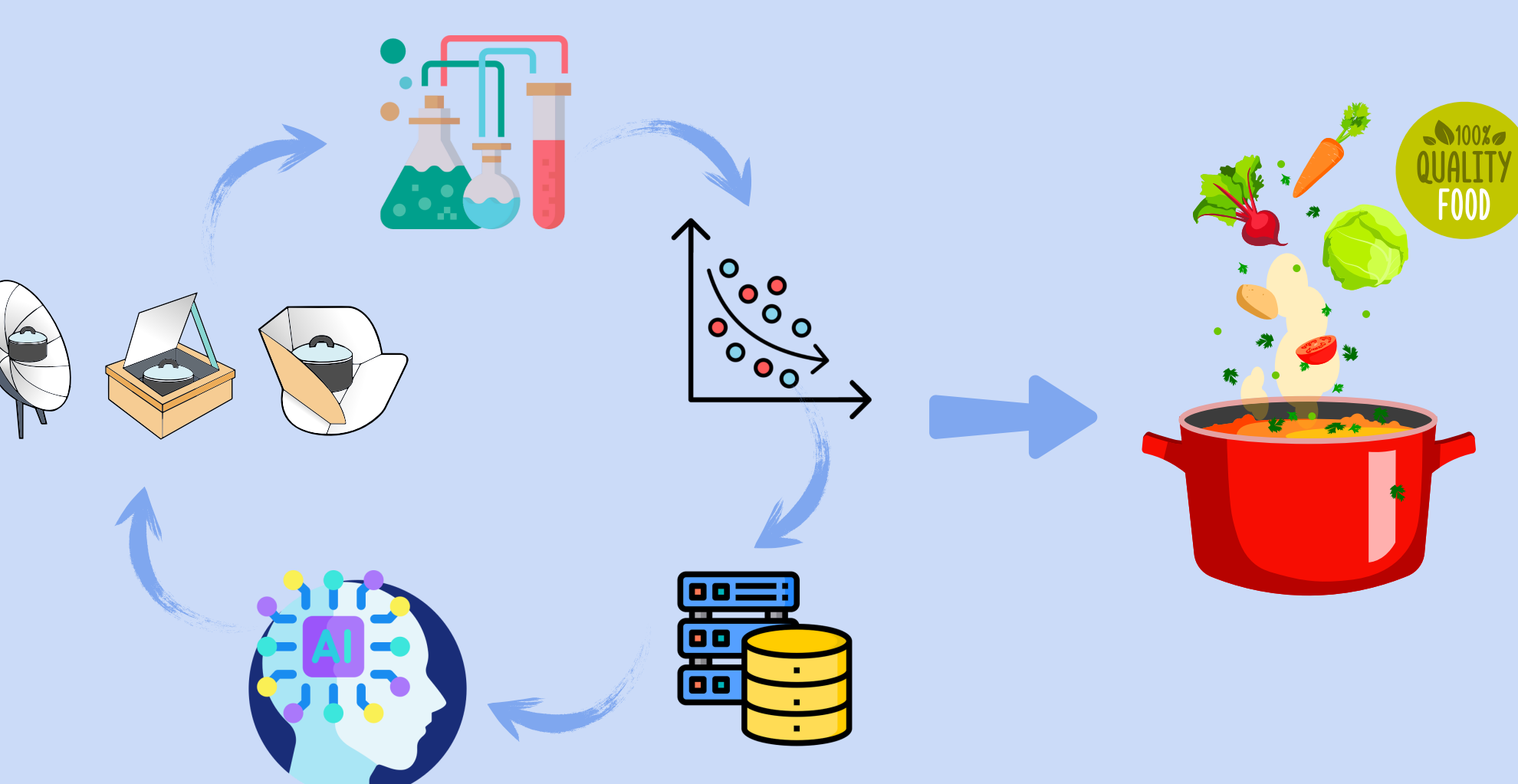
What has been done?

Recent advancements in solar cooking focus on improving thermal performance, design efficiency, and integrating innovative materials. Research highlights theoretical modeling and experimental validation to optimize heat transfer and predict performance. Innovations include phase change materials for better heat retention, sun-tracking mechanisms, and optimized geometries. Solar cookers can reach high temperatures quickly and are effective in various climates. Comparative studies and prediction models enhance understanding of food quality impacts and design improvements.⁴ These efforts highlight solar cooking's environmental and economic benefits, promoting its adoption as a sustainable solution.



What should be done?

Future research should integrate interdisciplinary approaches, combining machine learning, dynamic modeling, and sustainability assessments, to advance solar cooking technologies. Understanding the impact on food quality, developing reliable prediction models, and conducting thermal performance studies with degradation kinetics modeling are essential.⁵ By testing and incorporating these studies, researchers can continuously enhance solar cooker designs and performance, creating a circular system of ongoing improvements that make solar cookers more user-friendly and efficient.



References:

- Battocchio, C., Bruni, F., Di Nicola, G., Gasperi, T., Iucci, G., Tofani, D., Varesano, A., & Venditti, I. (2021). Solar cookers and dryers: Environmental sustainability and nutraceutical content in food processing. In *Foods* (Vol. 10, Issue 10). MDPI. <https://doi.org/10.3390/foods10102326>
- Panwar, N. L., Kaushik, S. C., & Kothari, S. (2012). State of the art of solar cooking: An overview. In *Renewable and Sustainable Energy Reviews* (Vol. 16, Issue 6, pp. 3776–3785). <https://doi.org/10.1016/j.rser.2012.03.026>
- Zubi, G., Fracastoro, G. V., Lujano-Rojas, J. M., El Bakari, K., & Andrews, D. (2019). The unlocked potential of solar home systems: an effective way to overcome domestic energy poverty in developing regions. *Renewable Energy*, 132, 1425–1435. <https://doi.org/10.1016/j.renene.2018.08.093>
- Gorjian, A., Rahmati, E., Gorjian, S., Anand, A., & Jathar, L. D. (2022). A comprehensive study of research and development in concentrating solar cookers (CSCs): Design considerations, recent advancements, and economics. *Solar Energy*, 245, 80–107. <https://doi.org/10.1016/j.solener.2022.08.066>
- Pereira, S., Abreu, E. F. M., Iakunin, M., Cavaco, A., Salgado, R., & Canhoto, P. (2022). Method for solar resource assessment using numerical weather prediction and artificial neural network models based on typical meteorological data: Application to the south of Portugal. *Solar Energy*, 236, 225–238. <https://doi.org/10.1016/j.solener.2022.03.003>