



Sustainable Energy Future: Navigating Challenges through Perovskite

Duangmanee Wongratanaphisan, Ph.D.

Email: duangmanee.wong@cmu.ac.th

Affiliation:

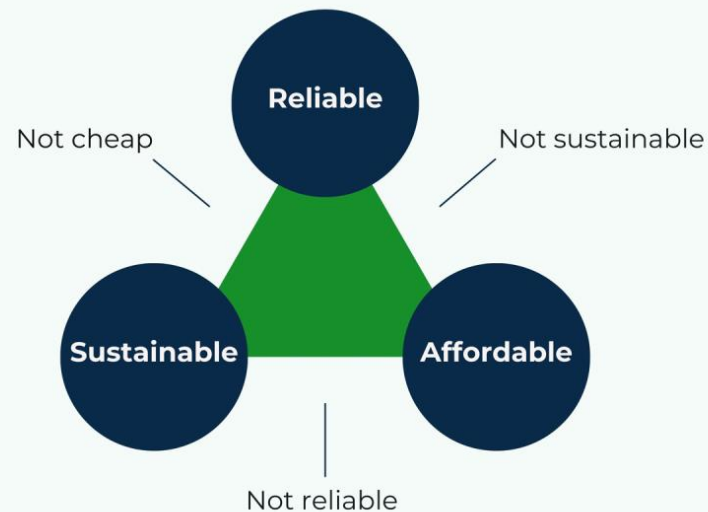
Thailand Center of Excellence in Physics (ThEP Center)
Ministry of Higher Education, Science, Research and Innovation
Bangkok 10400, Thailand
Department of Physics and Materials Science, Faculty of Science
Chiang Mai University, Thailand



17 January 2024

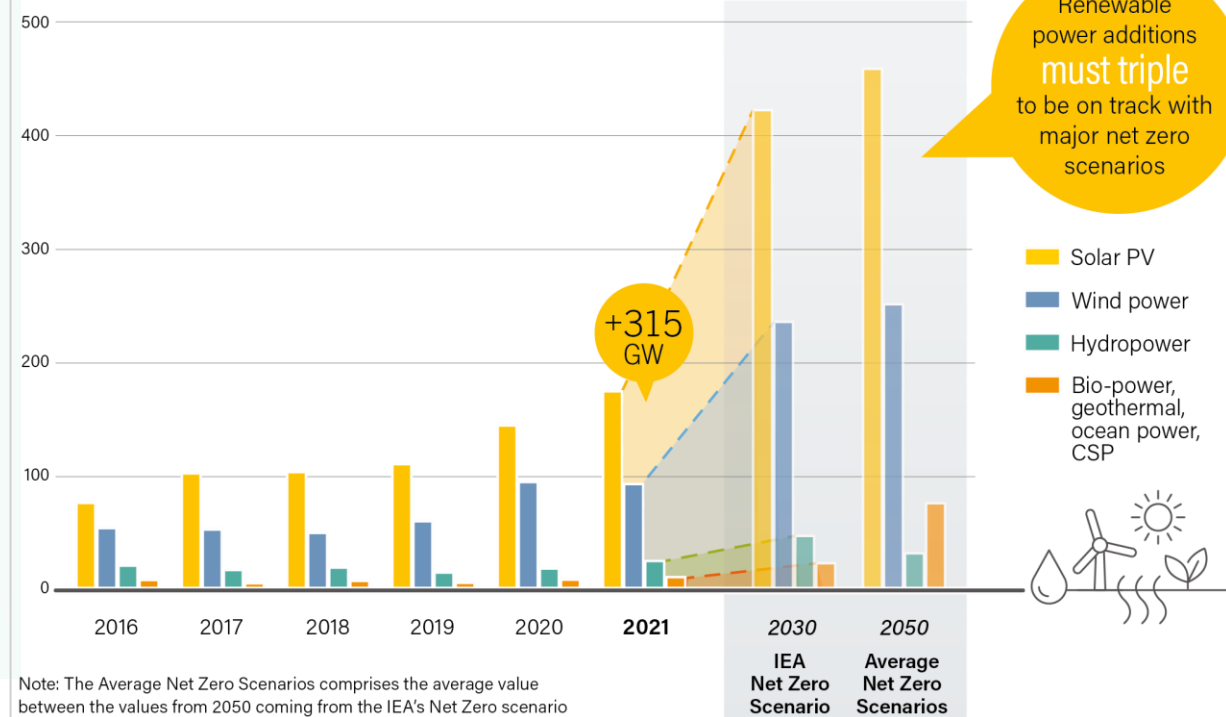
Navigating the Energy Trilemma: Moving from Demand Response to Responsive Demand

The Energy Trilemma



Annual Additions of Renewable Power Capacity, by Technology and Total, 2016-2021, and to Achieve Net Zero Scenarios for 2030 and 2050

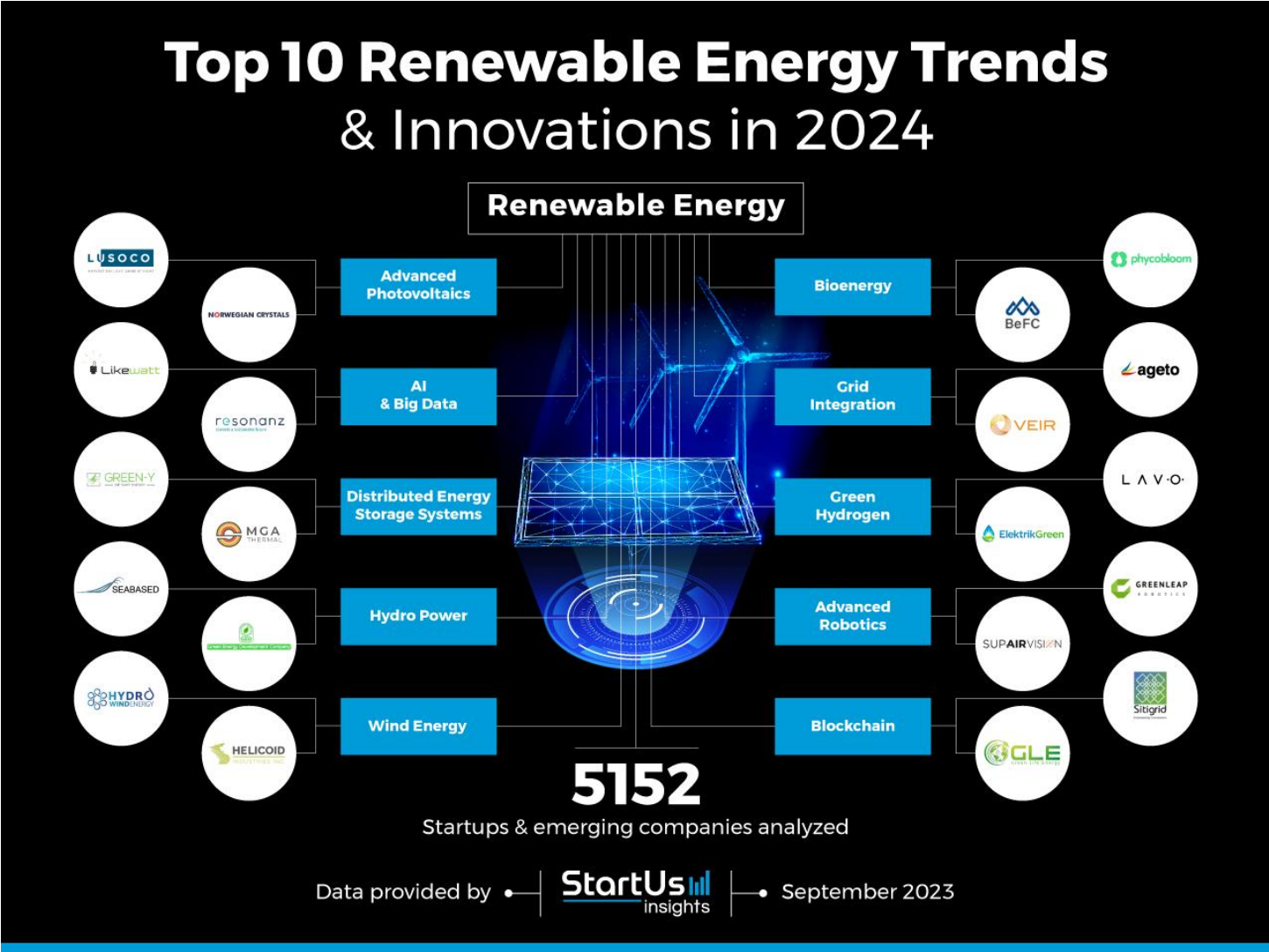
Additions by technology (Gigawatts)



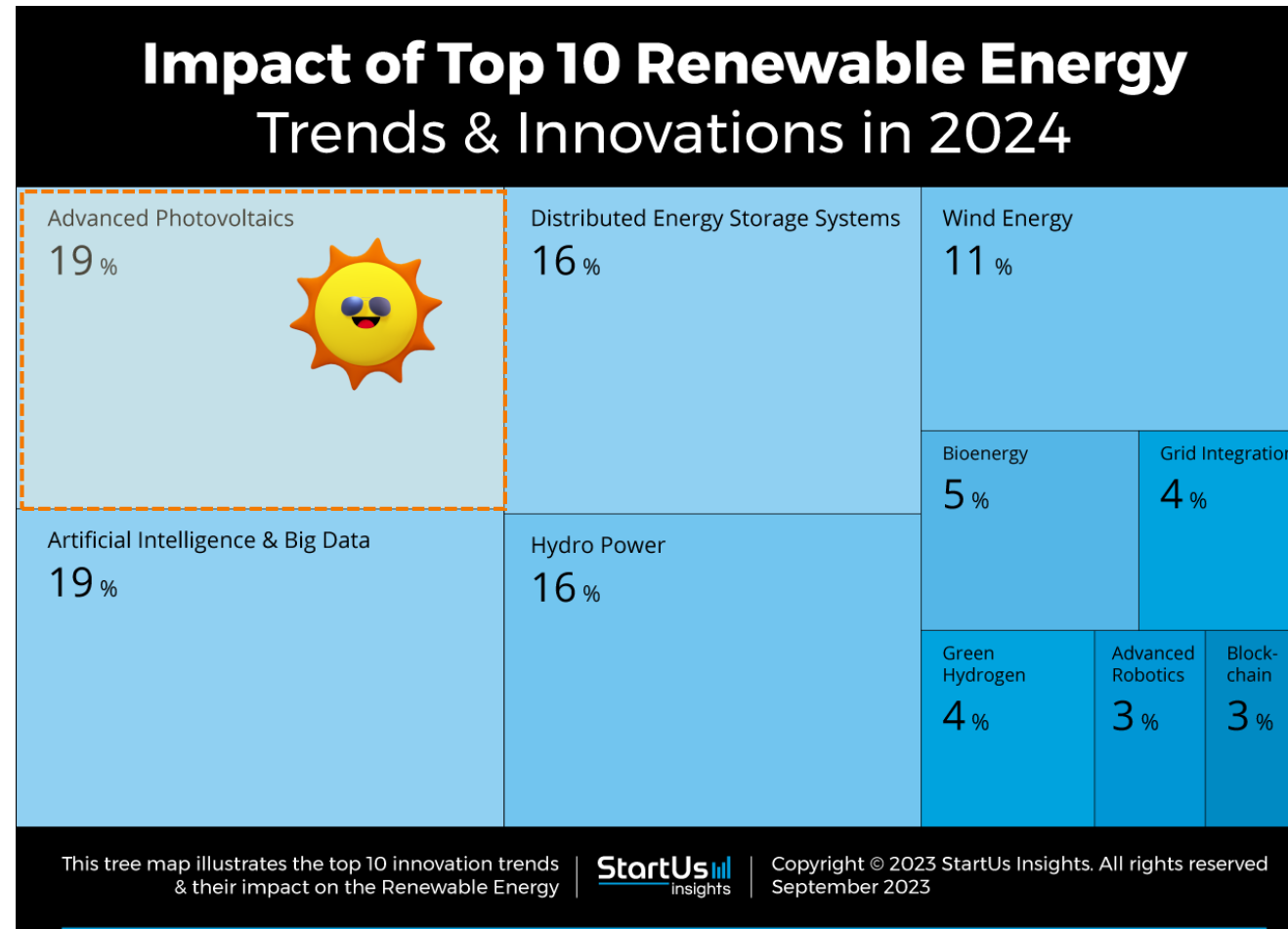
REN21 RENEWABLES 2022 GLOBAL STATUS REPORT



Top 10 Renewable Energy Trends in 2024



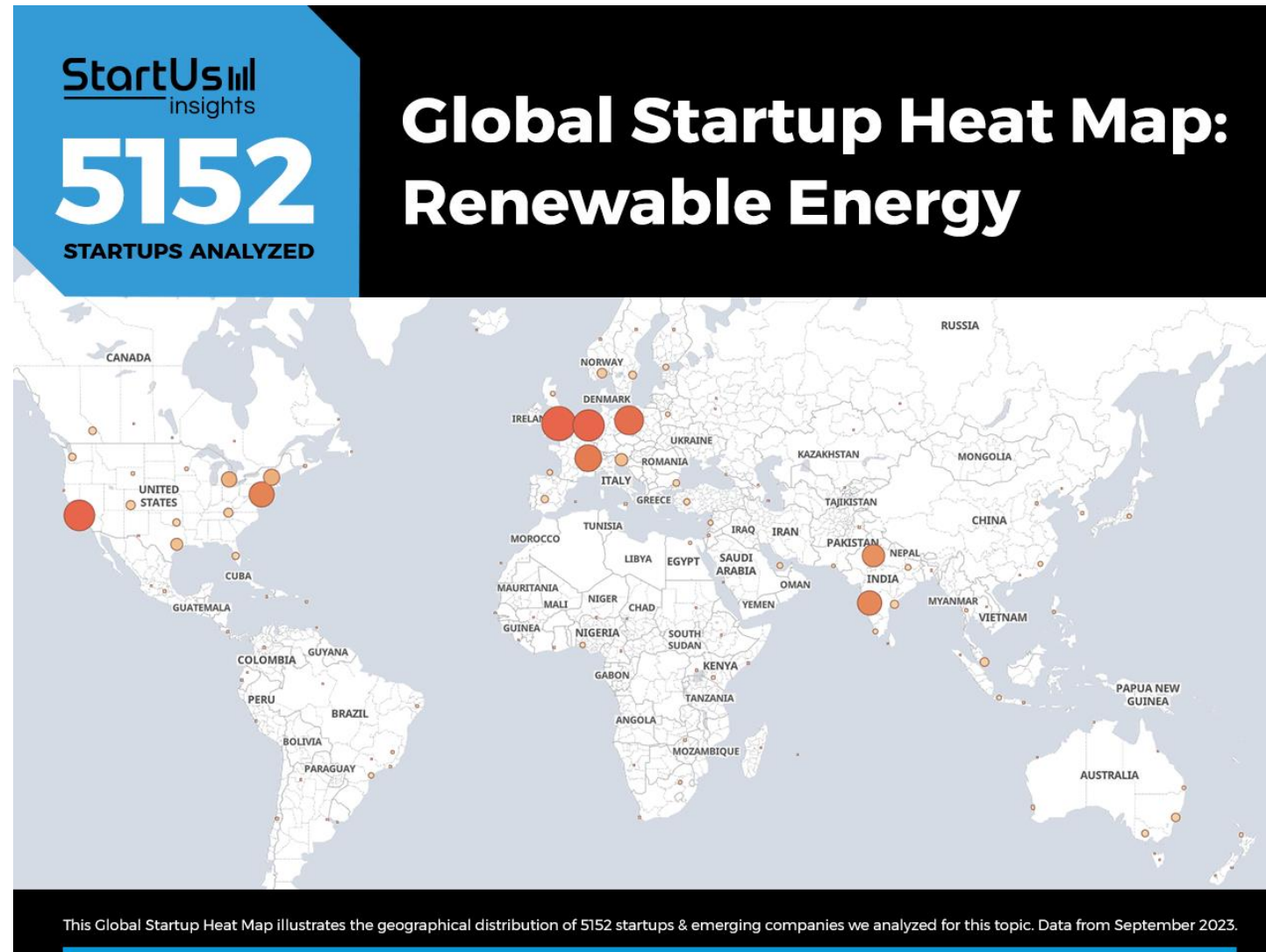
Impact of Top 10 Renewable Energy Trends in 2024



"Advancing PV: Perovskite Innovation Amplifies Solar Power Performance."



Global Startup Heat Map: Renewable Energy



Perovskite solar cells: Paving the way for eco-commercialization

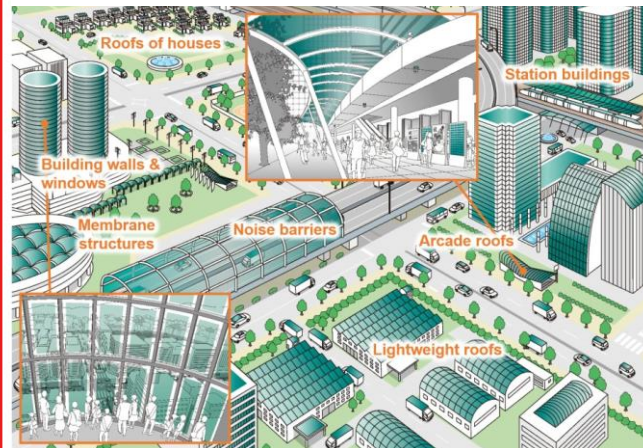
Perovskite technology: Shining the spotlight on the future of affordable solar power

"Solar power has disrupted the future of renewable energy. As photovoltaic technology blazes a trail to cheaper, cleaner electricity, the UK now has the potential to power 100 million LED bulbs at once," writes Professor Joe Briscoe, Professor of Energy Materials and Devices.



Toshiba Paving the Way for a Solar Future with Perovskite Photovoltaic Modules

SINGAPORE, March 30, 2022 /PRNewswire/ -- Solar power is the one of the most effective and important solutions of clean energy. Thin, light and flexible perovskite solar cells are a powerful option. Toshiba has developed the world's most efficient large scale film-based perovskite solar cell and in doing so, will contribute to a society where we can all enjoy a cleaner, safer and more sustainable future.



pv magazine

No.1 SUNGROW

Indoor perovskite PV solar cells with 32.0% efficiency

Scientists in Thailand built an indoor perovskite solar cell with low-cost carbon electrode architecture. The manufacturing process is based on antisolvent deposition and vacuum thermal annealing (VTA) and reportedly results in higher perovskite film quality.

JULY 7, 2023 EMILIANO BELLINI

MODULES & UPSTREAM MANUFACTURING TECHNOLOGY AND R&D THAILAND



Carbon electrode Perovskite solar cells on track to eco-commercialization

≡ pv magazine



No.1 THE WORLD'S MOST BANKABLE INVERTER BRAND Source: BloombergNEF

Carbon electrode perovskite solar cells on track to commercialization

Carbon electrode back-contacts for perovskite solar cells promise simpler, less energy-intensive manufacturing, but low power conversion efficiency has held back adoption. However, this may change now, as researchers are overcoming the barriers to commercialization.

SEPTEMBER 27, 2023 VALERIE THOMPSON

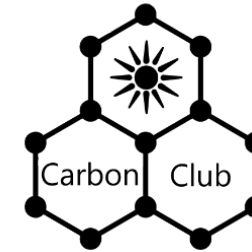
TECHNOLOGY AND R&D

EUROPE

WORLD

First International Conference on Carbon Electrode-based Perovskite Solar Cells

Carbon electrode-based perovskite solar cells have established themselves as highly promising device architectures for the next generation of photovoltaics. Unprecedented device stabilities have been achieved. Efficiencies are exceeding 21%. The fully printable design enables rapid upscaling. Materials and processes allow for the most sustainable manufacturing. In the past decade, researchers all over the world have pushed the boundaries. Now it is time to bring them all together in one conference.



13

Invited Speakers

25

Contributed Talks

2

Days

SESSION 7 - STABILITY

MODERATED BY MAHBUBE HADADIAN, UNIVERSITY OF TURKU

10:25 CET	Yaoguang Rong, Wuhan University of Technology
INVITED TALK	"Carbon-based perovskite solar cells: efficiency, stability, and upscaling"
CHINA	
10:45 CET	Chinnatip Hammanasvate, Chulalongkorn University
CONTRIBUTED TALK	"Impact of carbon black selection on performance of Carbon-Based Perovskite Solar Cells"
THAILAND	
11:00 CET	Marta Pereira, University of Porto
CONTRIBUTED TALK	"Hermetic encapsulation for an extended lifetime of printable perovskite solar devices"
PORTUGAL	
11:15 CET	Romain Lavoipierre, University Grenoble Alpes
CONTRIBUTED TALK	"Electrodeposition of perovskite films for carbon-based perovskite solar cells application: Impact of 5-AVAI on the traditional MAPbI3 perovskite"
FRANCE	
11:30 CET	Takaya Shioh, University of Hyogo
CONTRIBUTED TALK	"SrTiO3 Electron Transport Layer for Enhancing the UV-Stability of Carbon-based Multi-Porous-Layered-Electrode Perovskite Solar Cells"
JAPAN	

DIAMOND

MODERATED BY JAN CHRISTOPH GOLDSCHMIDT, UNIVERSITY OF MARBURG

10:40 CET	Andreas Hinsch, Fraunhofer ISE
INVITED TALK	"A brief guideline on how to overcome challenges in the development of sustainable perovskite solar cells based on carbon counter electrodes"
GERMANY	
11:00 CET	Elena Akulenko, University of Turku
EXTENDED TALK	"Revival of Carbon-Based Perovskite Solar Cells Using Green Solvents: An Approach Towards Sustainable Renewable Energy"
FINLAND	
11:20 CET	Woraprom Passatorntaschakorn, Chiang Mai University
CONTRIBUTED TALK	"Surface Passivated Carbon Electrodes for Efficient and Stable Flexible Perovskite Solar Cells"
THAILAND	
11:35 CET	Fabian Schmitz, Justus Liebig University Giessen
CONTRIBUTED TALK	"Enhancing Stability and Band Alignment in Cs2AgBiBr6-based HTM Free Solar Cells by Applying a 2D Surface Modification"
GERMANY	

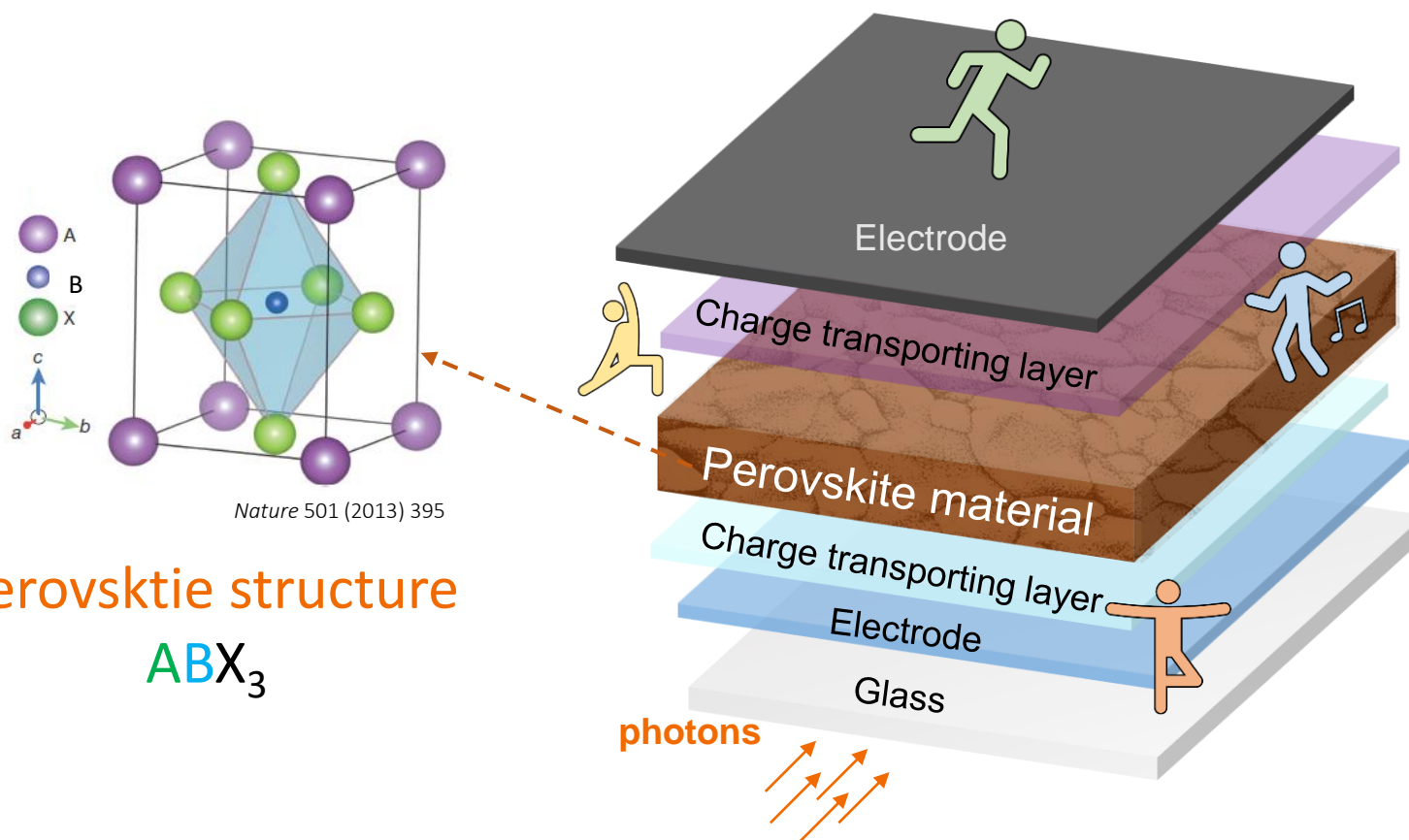


What is “Perovskite Solar Cell (PSC)”?

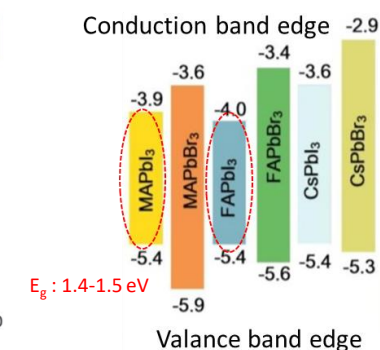
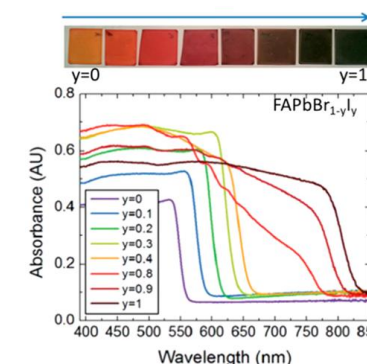
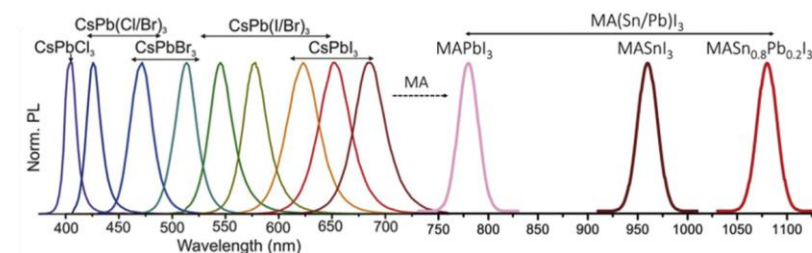


A solar cell with **perovskite** material as a photo-absorber

Each layer in the device has a significant impact on the device performance. – *Let's Play It Now!*



Tunable band gap



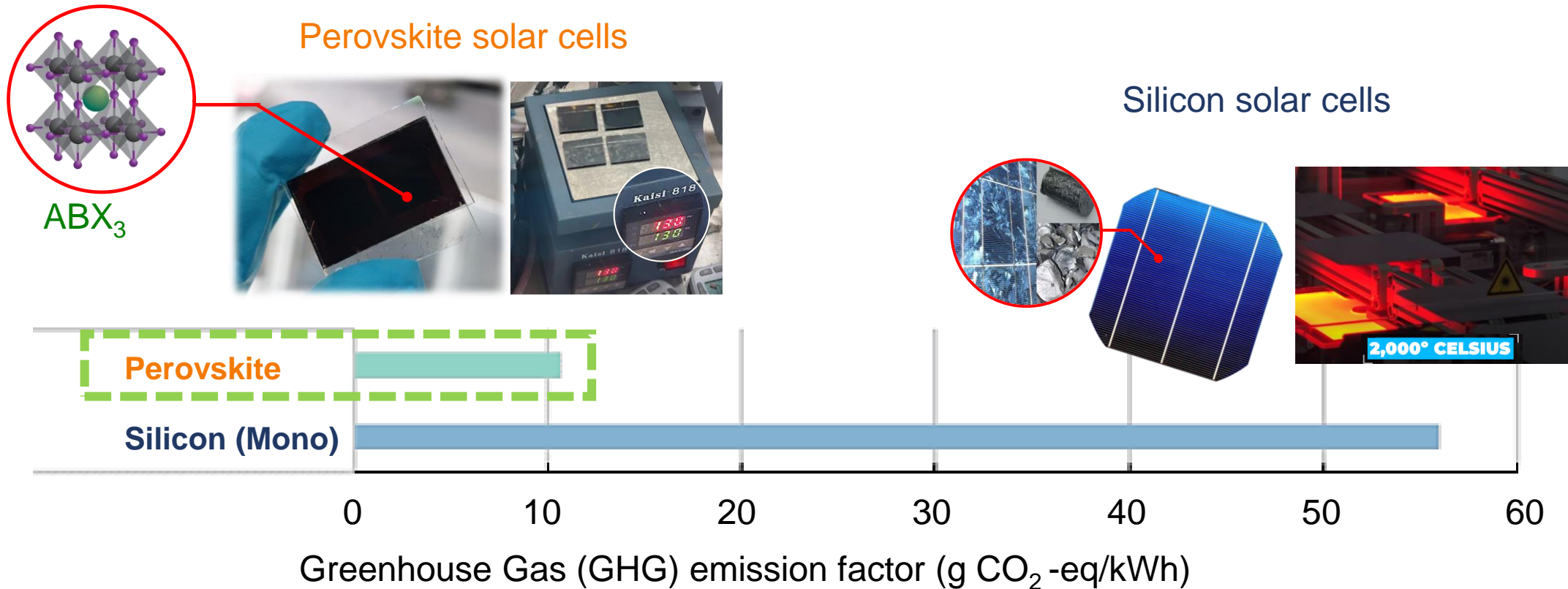
Nature 501 (2013) 395



"Why Choose Perovskite Solar Cells?"



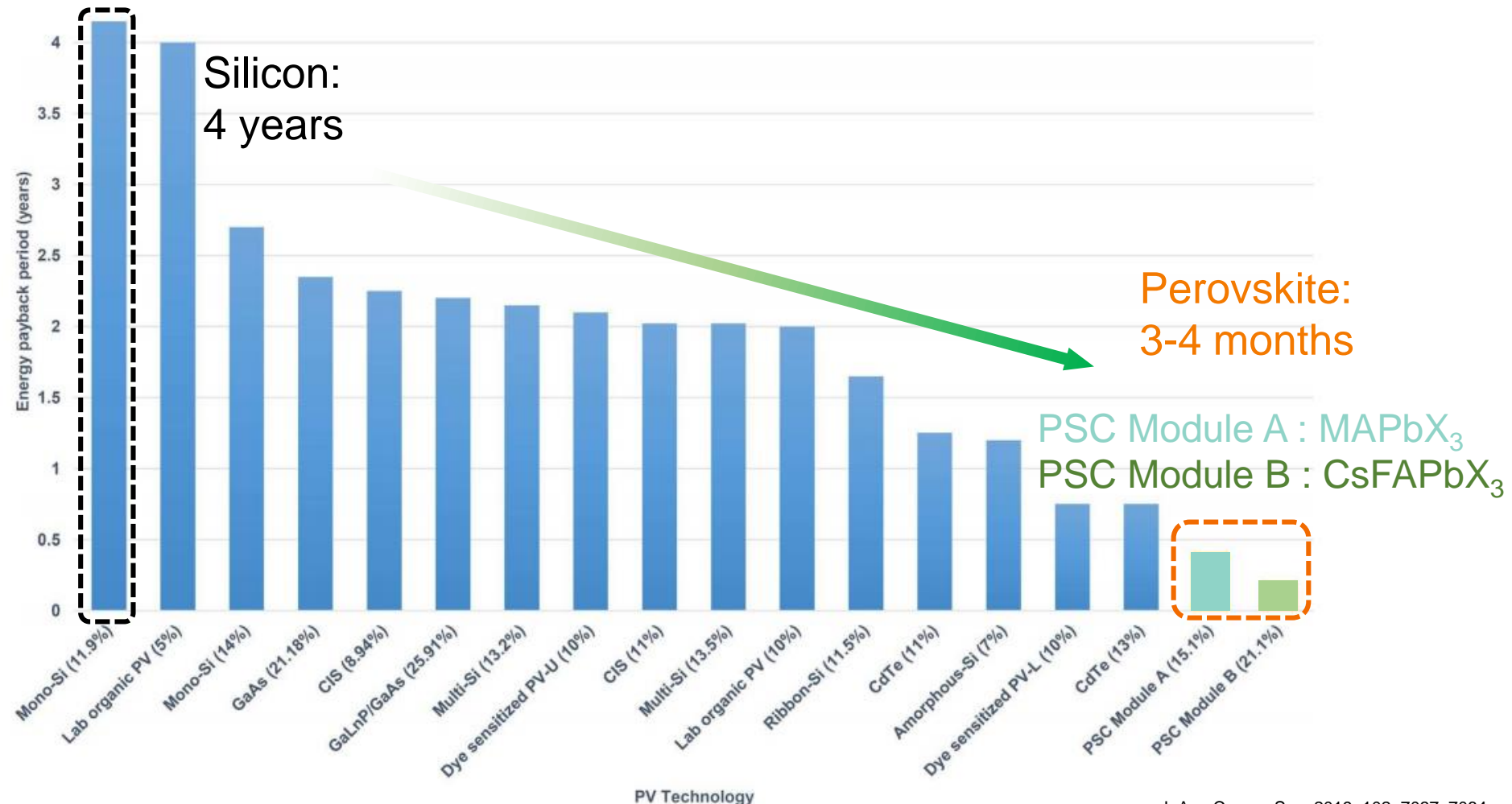
Perovskite solar cells have lower carbon footprints than Silicon solar cells.



[Ref: Nature Mater. 2014, 13, 838–842. Wikimedia Commons. (May 3, 2018). Silicon solar cell (PERC) front and back [Online]. <https://www.engineering.com/story/perovskite-solar-cells-are-greener-than-silicon>, <https://www.youtube.com/watch?v=aIQFVKYLwT0>]



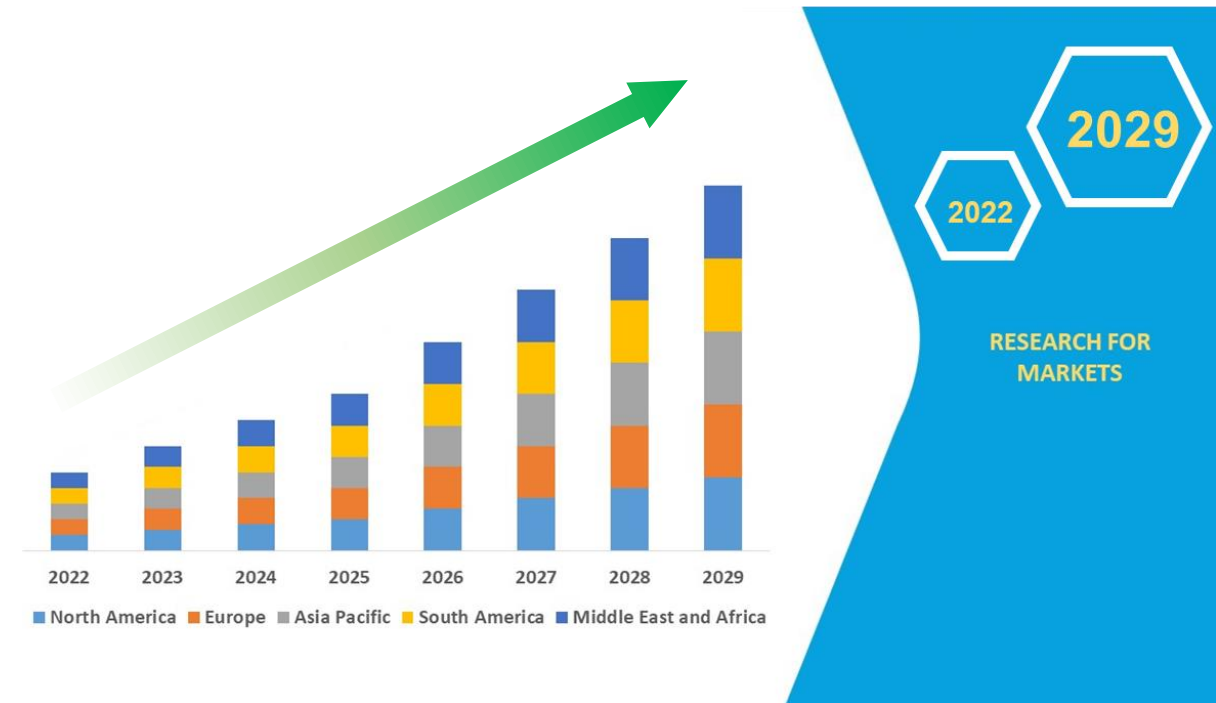
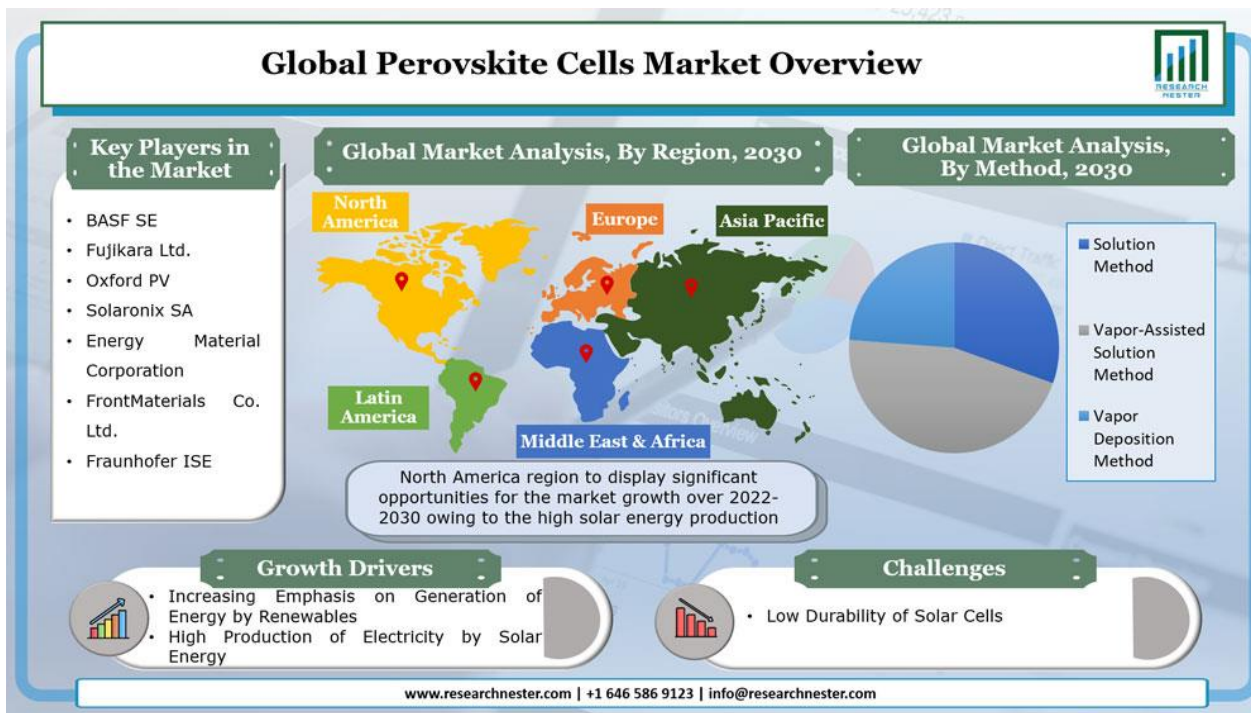
Perovskite solar cells have shorter energy payback periods than Silicon solar cells .



J. Am. Ceram. Soc. 2019, 102, 7037–7064.



Global Perovskite solar cells Market is Expected to Account for \$6.29 Billion by 2029

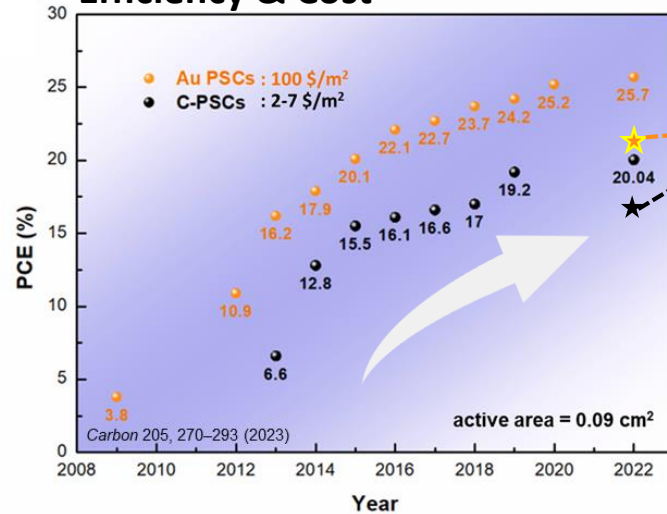


[Ref: <https://www.databridgemarketresearch.com/reports/global-perovskite-solar-cell-market>.]



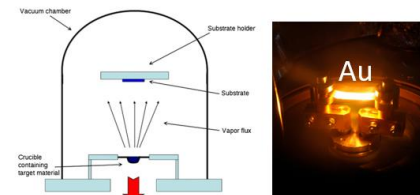
Current status and trends of Perovskite solar cells

Efficiency & Cost



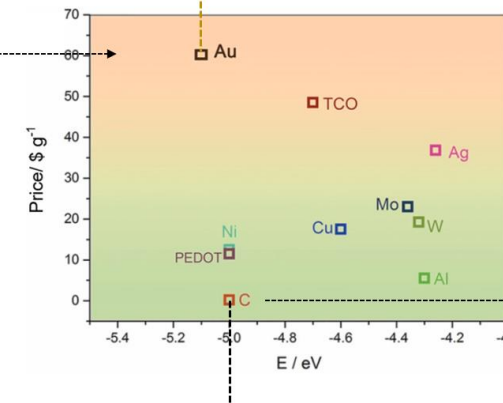
Gold

75% of the total cost in assembling PSC devices



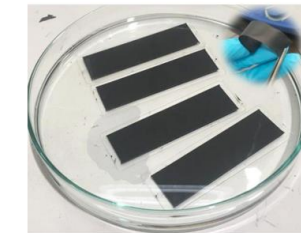
- high-energy consumption evaporation methods
- not feasible for large-scale

Work function of Au = 5.1 eV



Work function of C = 5.0 eV

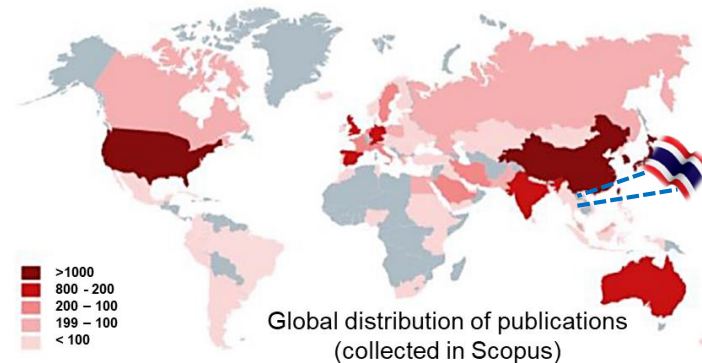
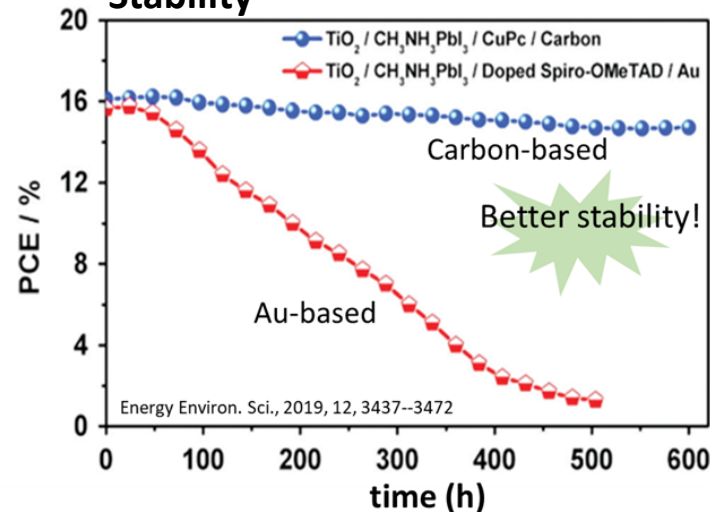
Carbon



the lowest price

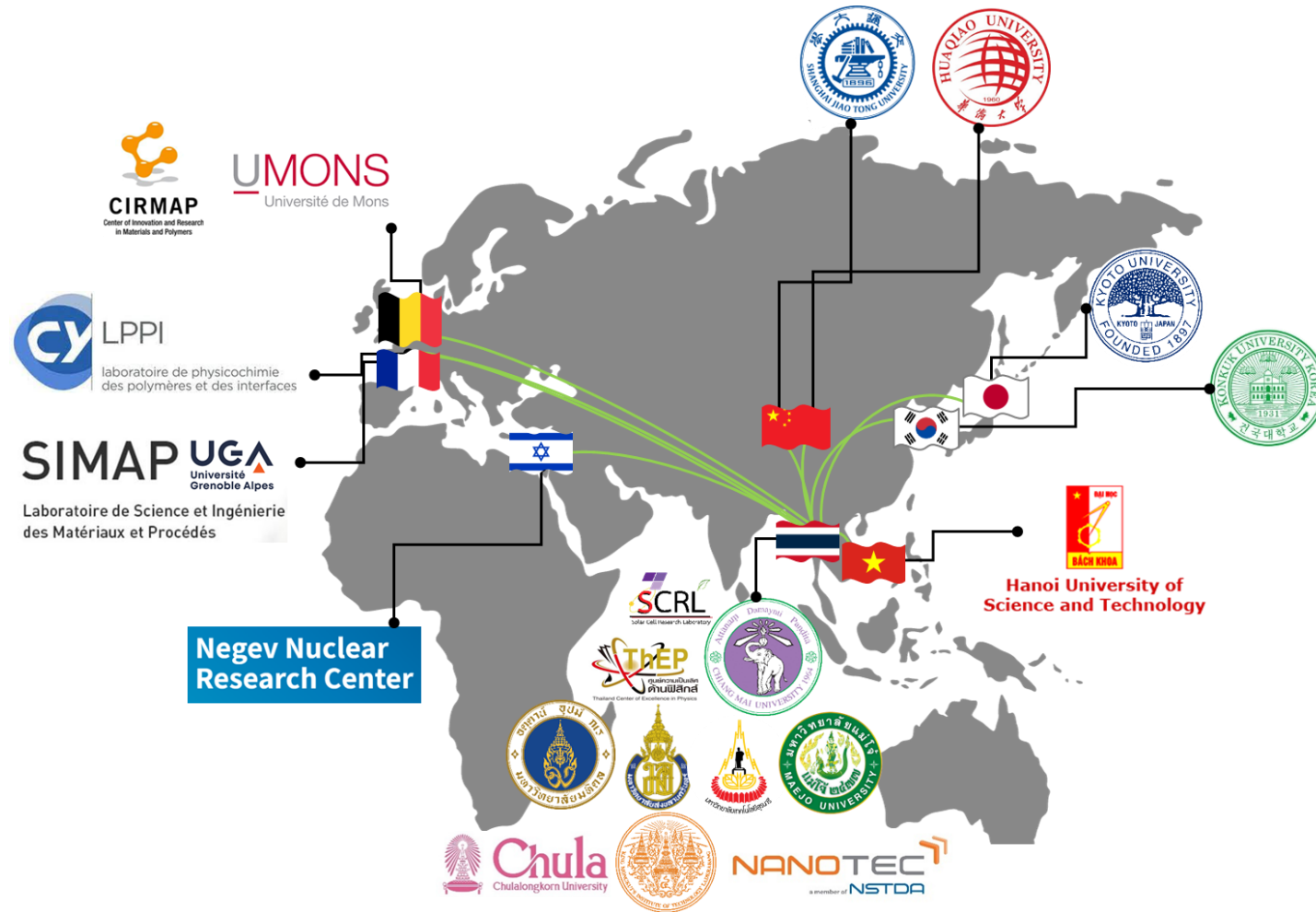
- simple processes
- suitable for up-scaling
- abundance, safety, low cost, and simple fabrication

Stability



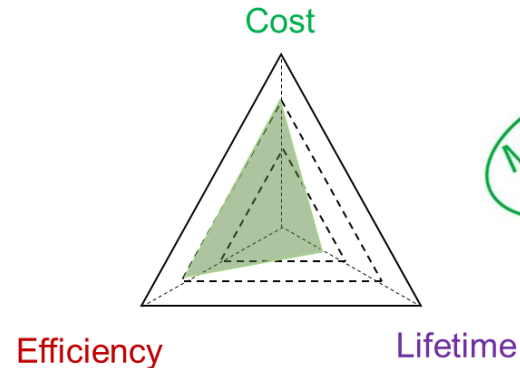
J. Energy Chem 68, 222-246 (2022)

Domestic & International Collaborations



Perovskite: Advancing Eco-Commercialization for Sustainable Energy

Solar Cell Performances Golden triangle



eScience 2.6 (2022): 567-572



Thank you for your attention

Further information please feel free to contact us

