碳中和研討會系列 – 與國家氣候變化專家探討
如何應對碳中和及制定減碳戰略

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科學和工程在實現碳中和擔當重要角色

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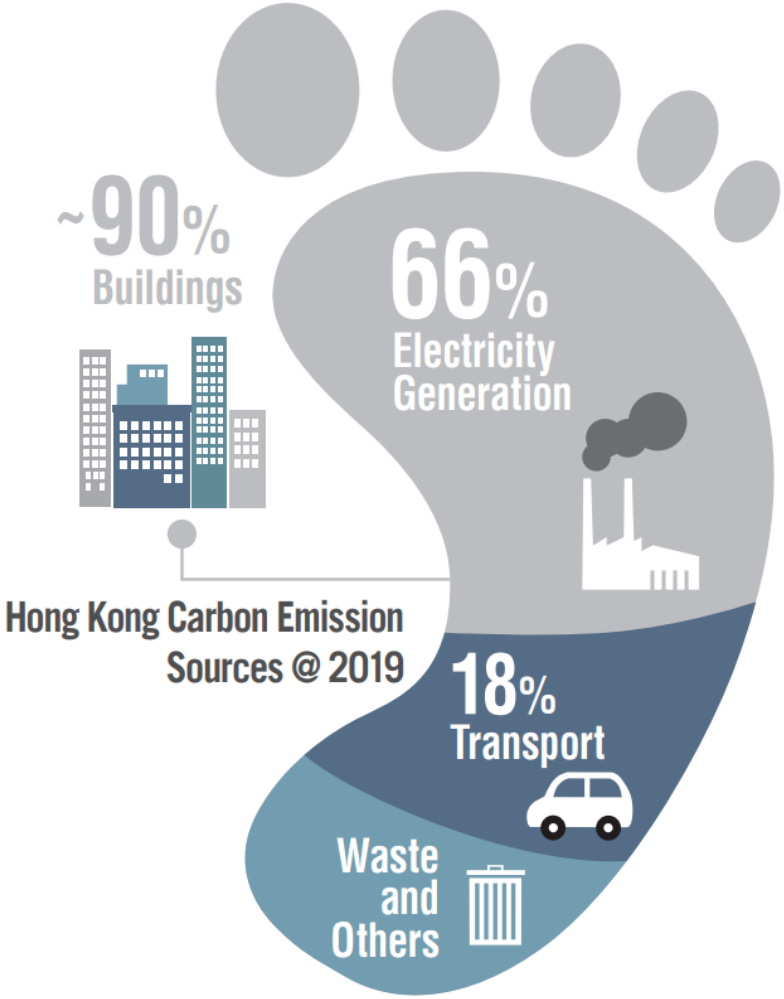
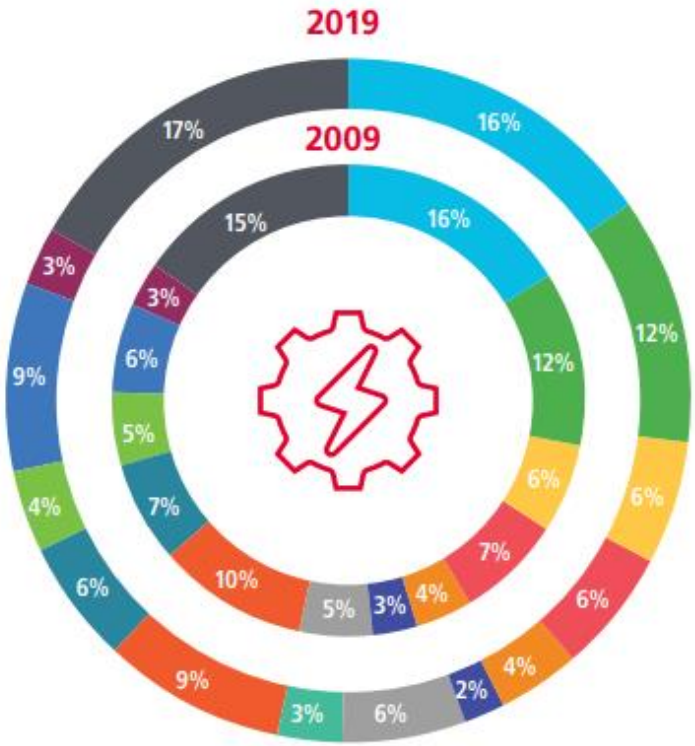


Total GHG emissions in 2020:
33.8 million tonnes of $CO_{2\text{-}e}$

圖表 Chart 18

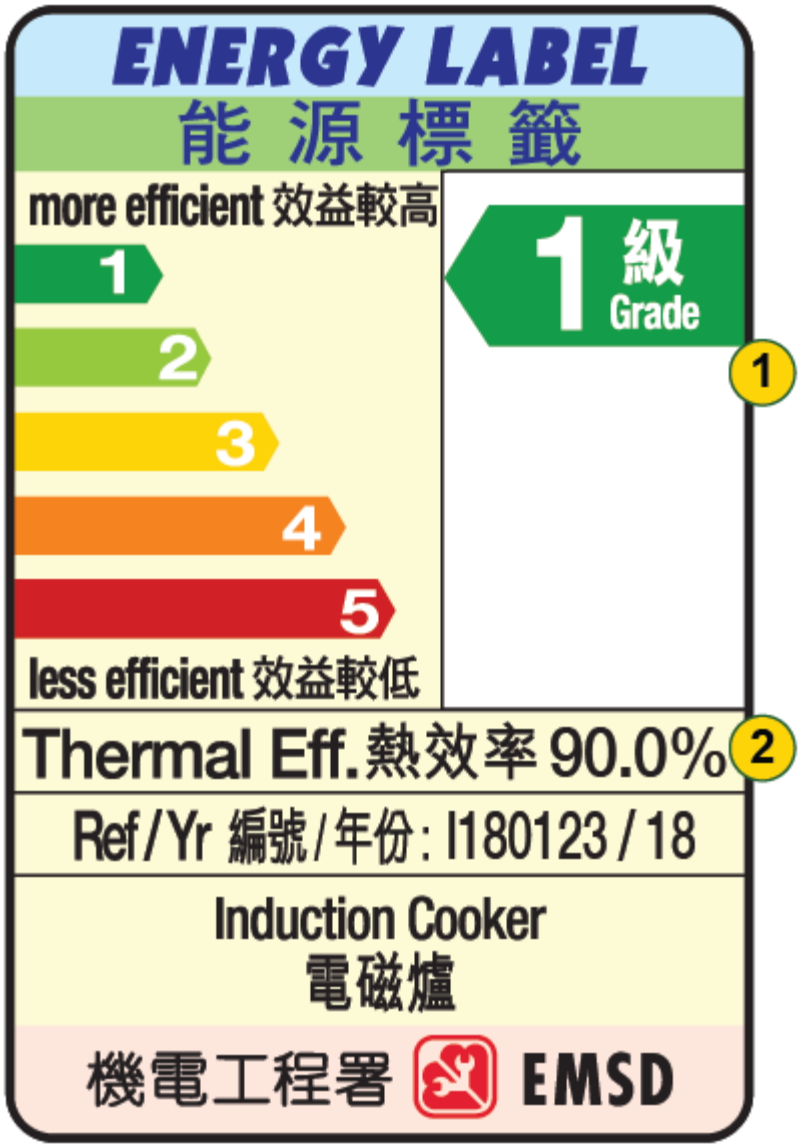
所有能源使用按最終用途劃分
Total Energy Consumption by End-use

參考表格 Refer Table 11



空氣調節 Air Conditioning
煮食 Cooking
工業生產 / 設備 Industrial Process/ Equipment
照明 Lighting
辦公室設備 Office Equipment
冷凍 Refrigeration
熱水 Hot Water
垂直運輸 Vertical Transport
貨車 Goods Vehicle
巴士 Bus
的士 Taxi
汽車 Car
船隻 Marine
其他 Others

Energy Labels 能源標籤



Product List

Air-Conditioners

Refrigerators

Washing Machines

Dehumidifers

Televisions

Water Heaters

Induction Cookers

More….

Retro-Commissioning 重新校驗

Retro-commissioning (RCx) is a systematic process to periodically check an existing building's performance to identify operational improvements that can save energy and thus lower energy bills and improve indoor environment.

Water-Cooled Chillers 水冷式冷水機

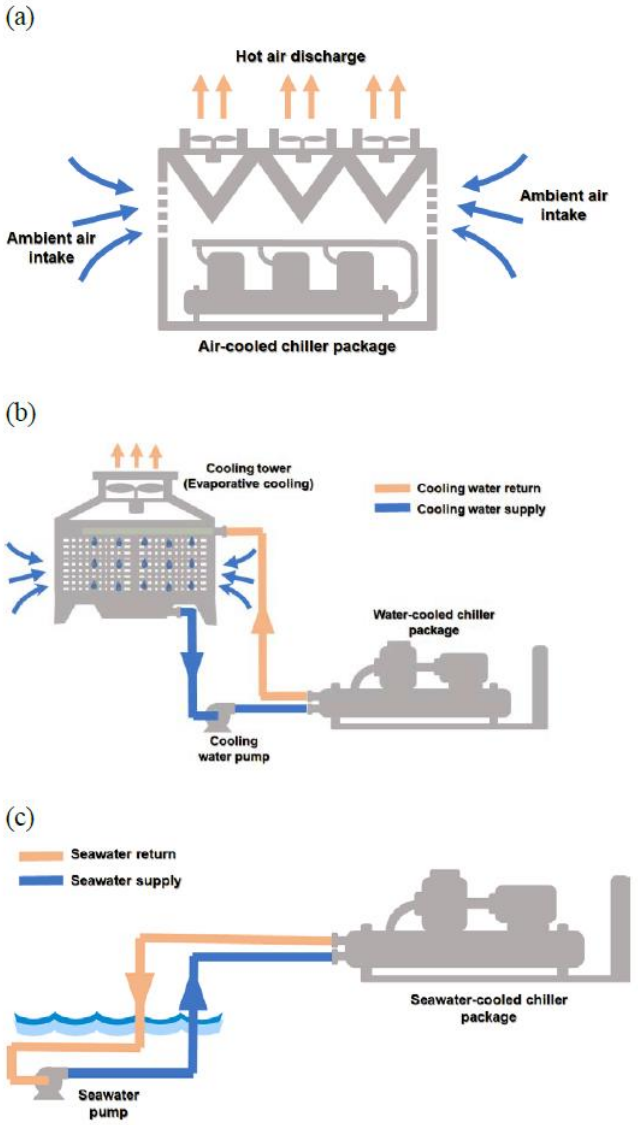


Figure 4. Chillers using different condenser types: (a) air-cooled condenser; (b) water-cooled condenser; and (c) seawater-cooled condenser.

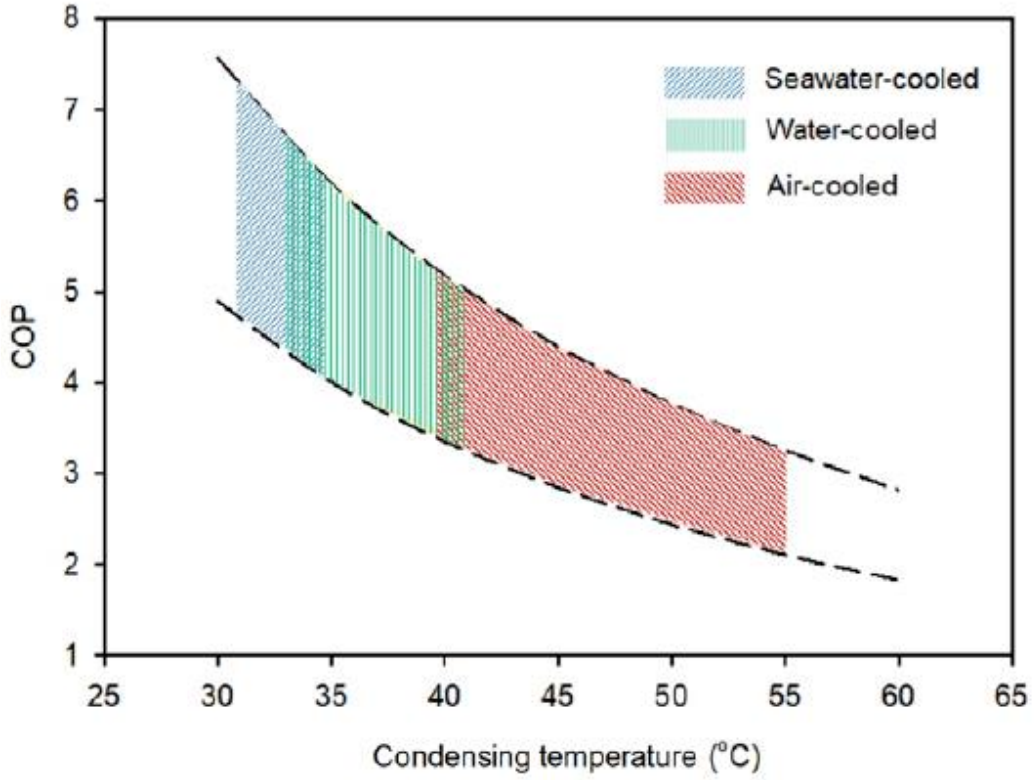
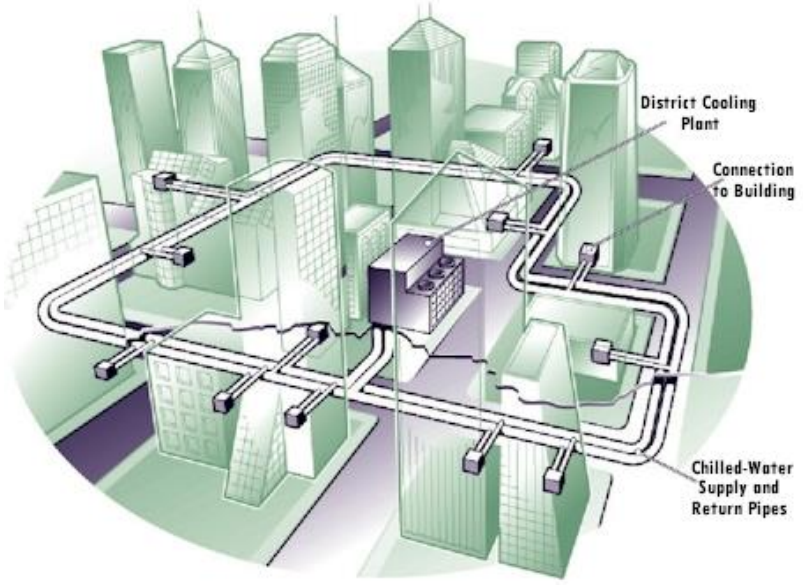


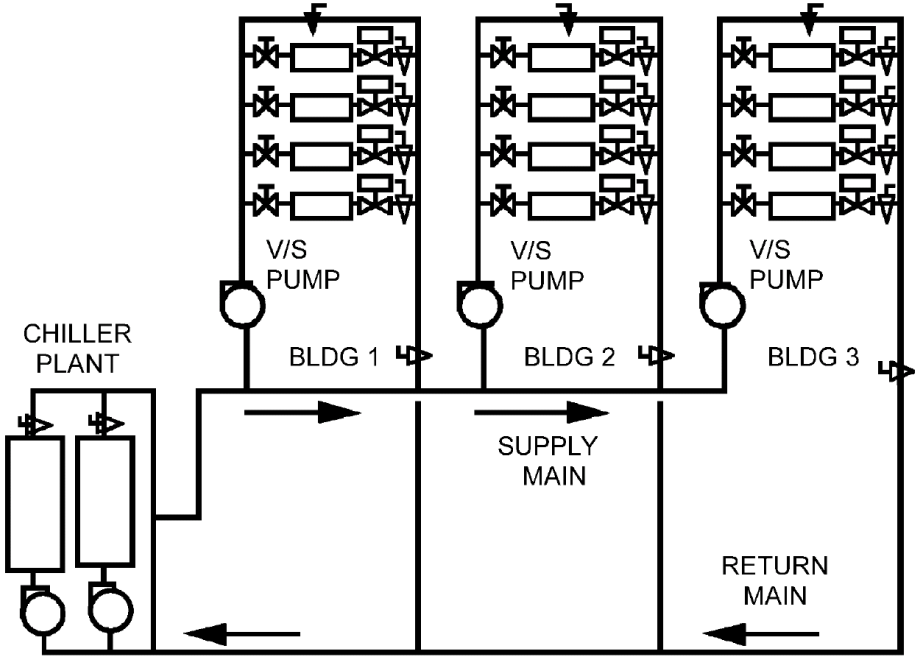
Figure 5. Typical COP of air-cooled, water-cooled and seawater-cooled chillers.

Ref.: Leung, M. K. H., Tso, C. Y., Wu, W., Zheng, Z. & Cao, J., Chillers of air-conditioning systems: An overview, 2020, HKIE Transactions, Hong Kong Institution of Engineers. 27, 3, p. 113-127.

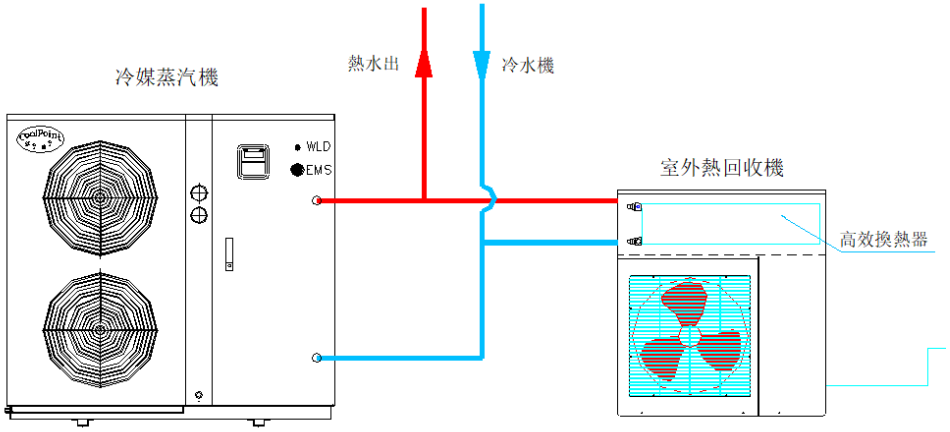
District Cooling 區域供冷

- District Cooling System (DCS) - centralised air-conditioning system on a mega scale.
- DCS provides cooling by distributing chilled water via a supply network to multiple buildings within a district.
- It eliminates the requirement of installing chiller plants for each individual building.





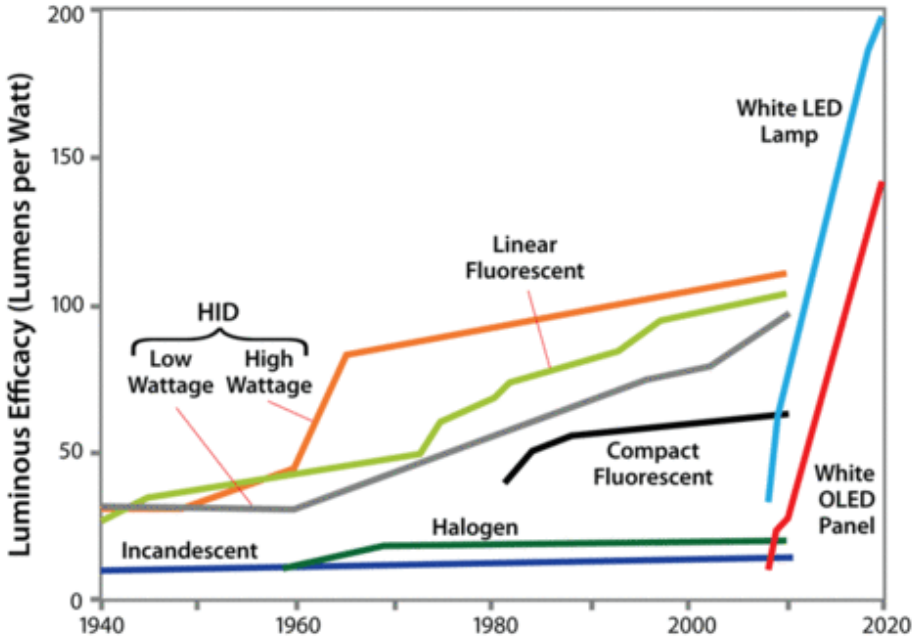
Heat Pump Water Heater 熱泵熱水器



Features:

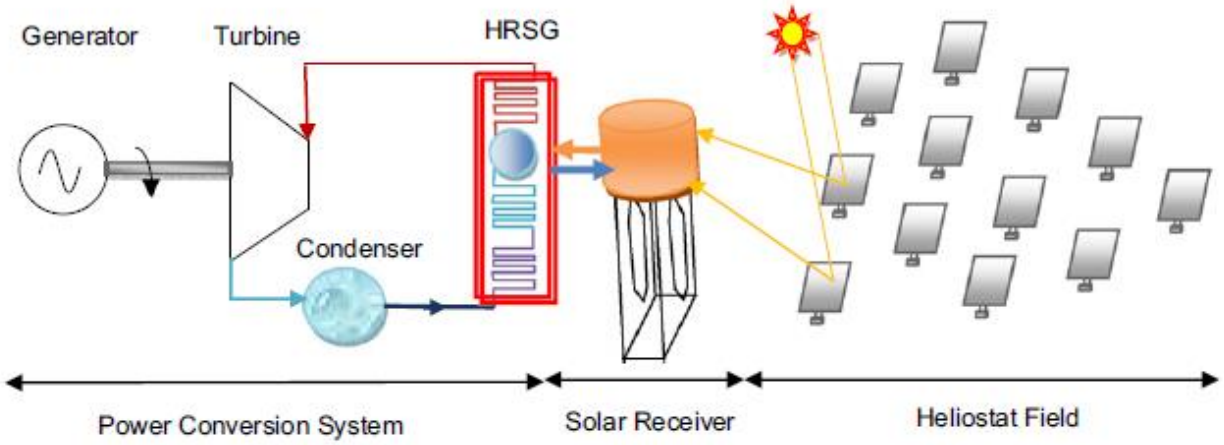
1. Compact in size => Tankless, direct heat design
2. Double-wall heat exchanger with high heat transfer coefficient
3. Rapid response to dynamic heating load (hot water) and cooling load (air-conditioning)

Lighting 照明


Luminous Efficacy (Lumens per Watt)
200
150
100
50
0
1940
1960
1980
2000
2020
White LED Lamp
Linear Fluorescent
HID
Low Wattage
High Wattage
Compact Fluorescent
White OLED Panel
Halogen
Incandescent

Electric Vehicles and Fuel Cell Cars
電動汽車和燃料電池汽車

Heliostat Solar Power Plant 定日鏡太陽能發電



Solar Photovoltaics (PV) 太陽能光伏

Poly-Crystalline
Solar Cell

Mono-Crystalline
Solar Cell

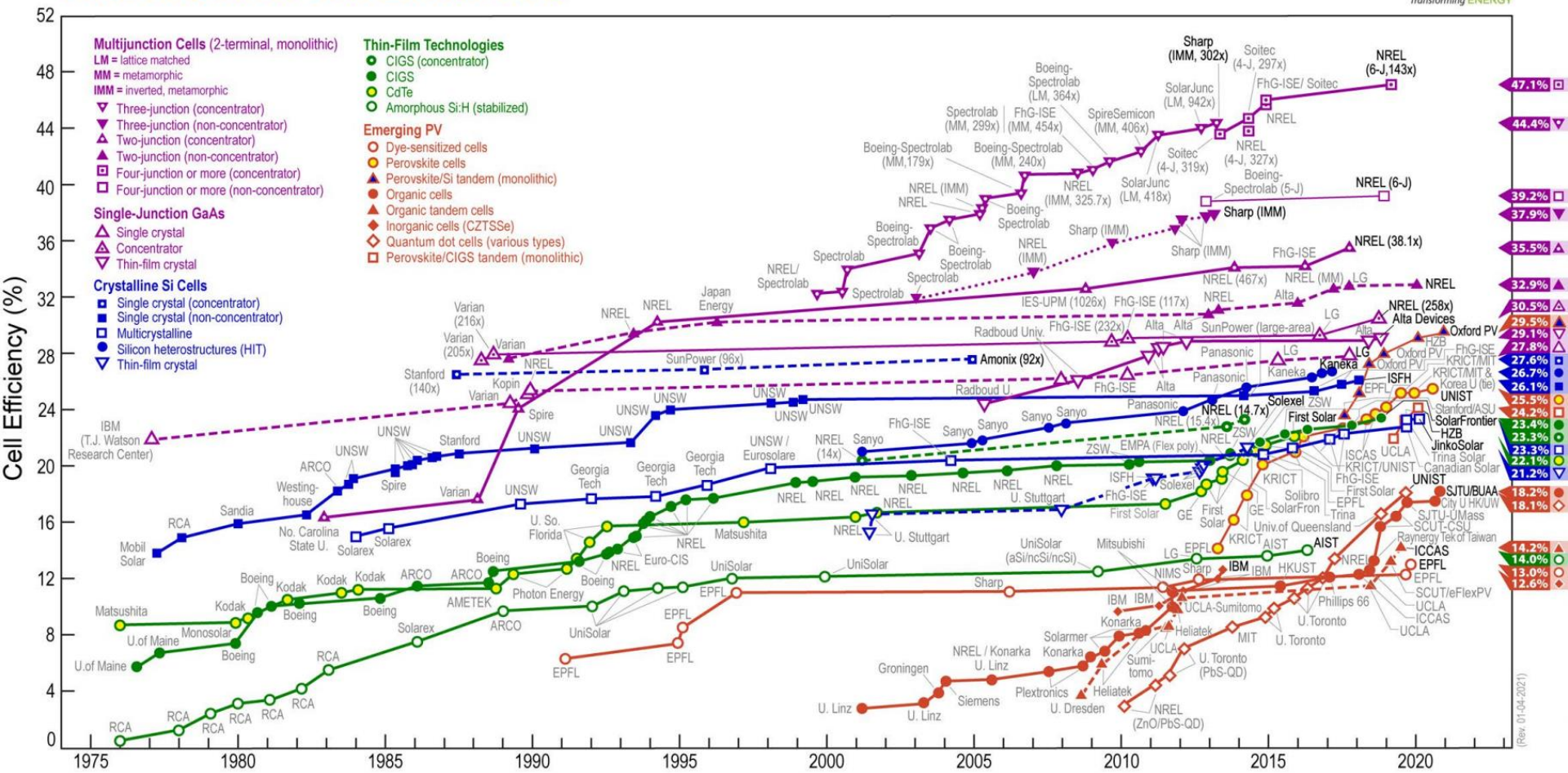
Rooftop PV

Thin Film CIGS

DSSC

Building Integrated Photovoltaics (BIPV)

Best Research-Cell Efficiencies

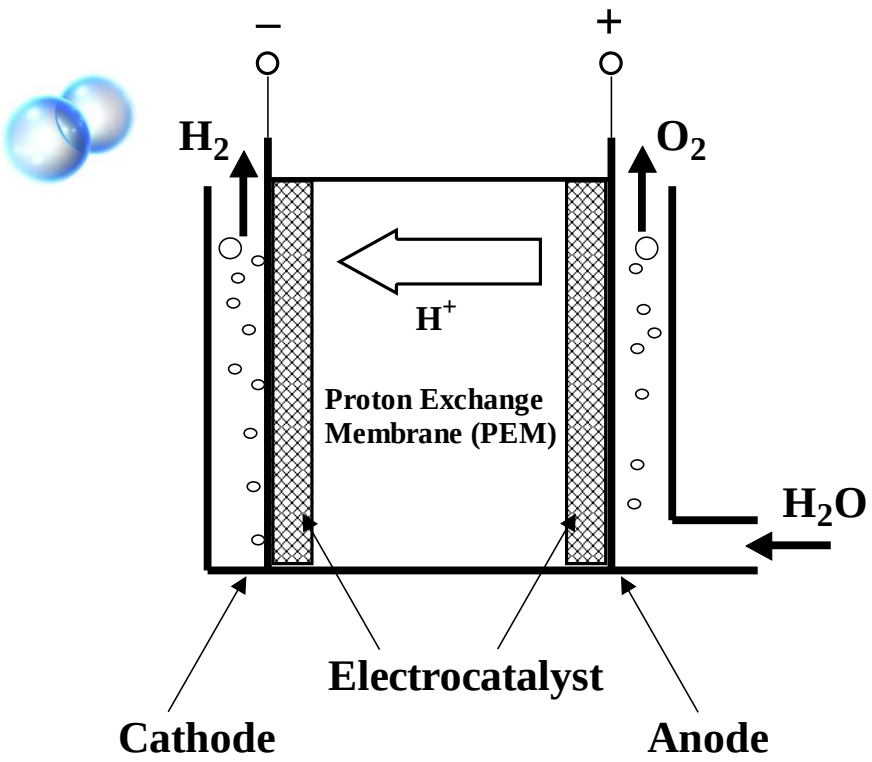


Offshore Wind Turbines 離岸風力發電

- Offshore wind is stronger and steadier. Thus, offshore wind turbines generally produce more power output than onshore wind turbines.
- Offshore wind is less turbulent.
- Sea has less resistance to airflow. Offshore wind turbines can be installed at a lower altitude.
- More environmentally friendly as noise problems are less disturbing.
- Adverse visual impact is less as offshore wind turbines are farther away from the community.

Hydrogen Power 氫能

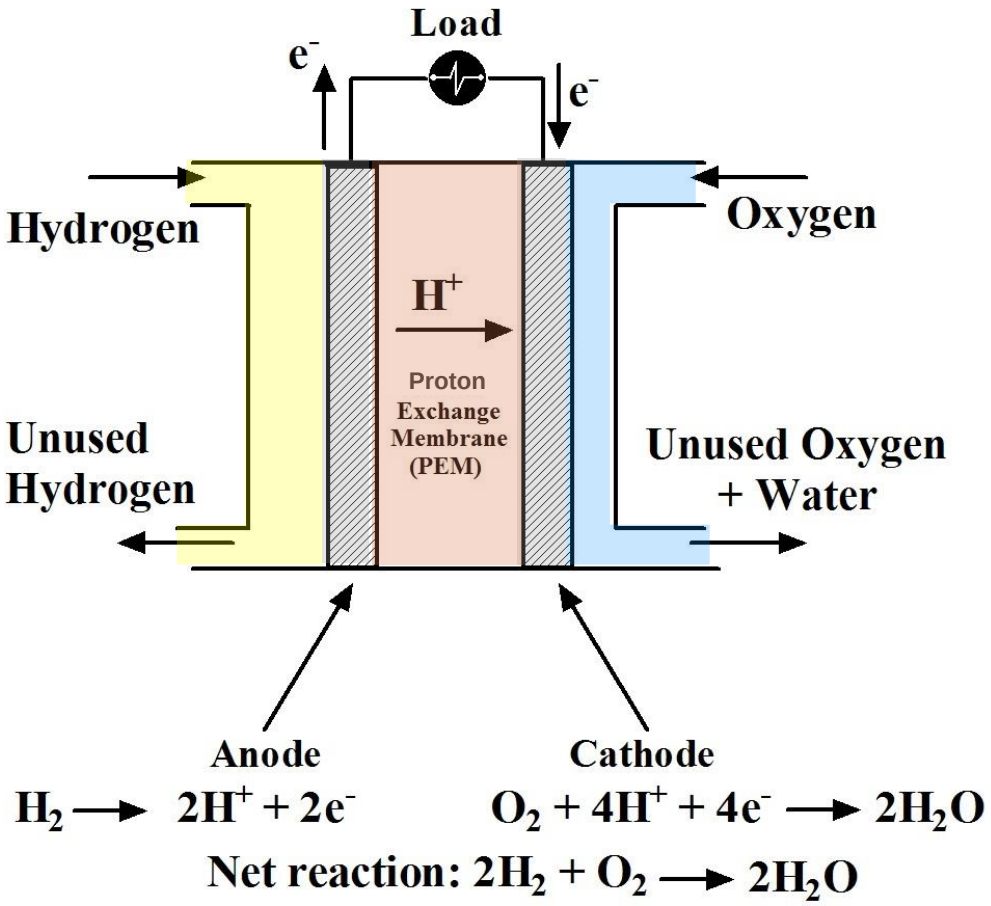
Water electrolysis for hydrogen production



Electrolyzer

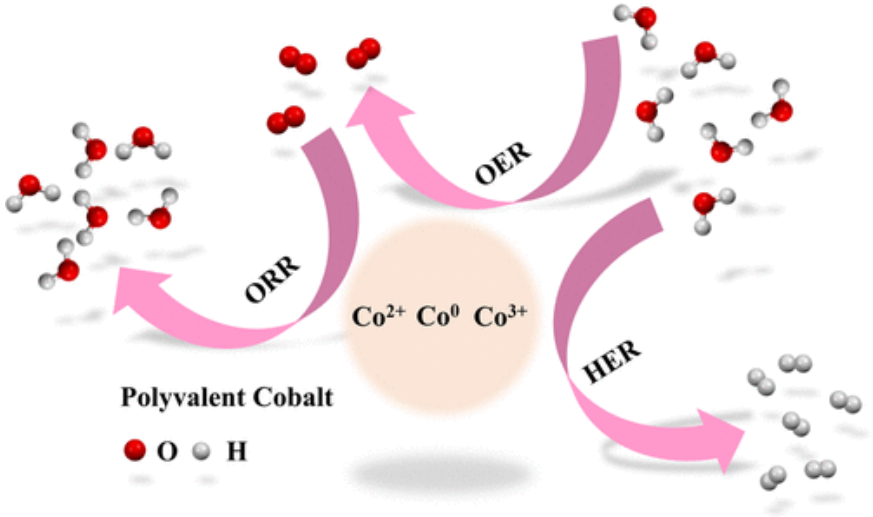
Fuel Cell 燃料電池

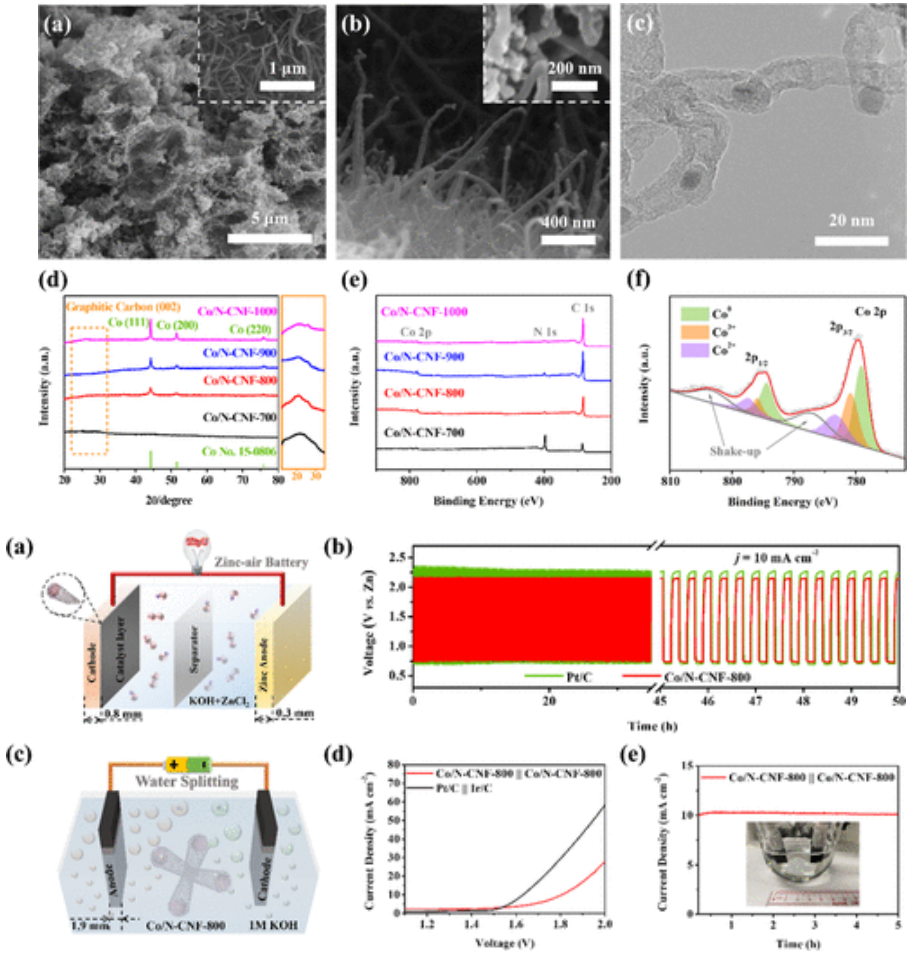
Fuel cell converts hydrogen into electricity by electrochemical reactions. Water and heat are byproducts.



Electrochemical Production of Green Hydrogen

綠色氫氣的電化學生產

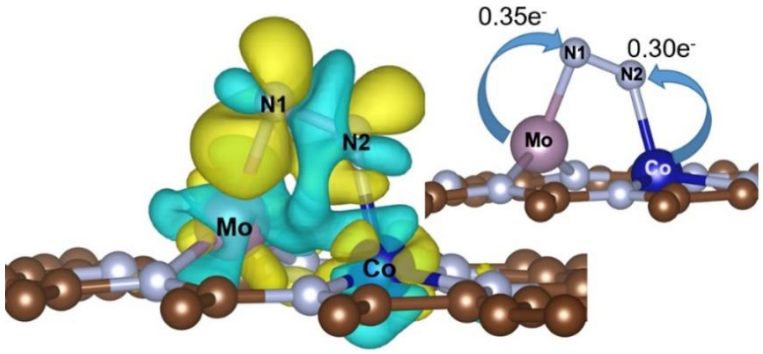


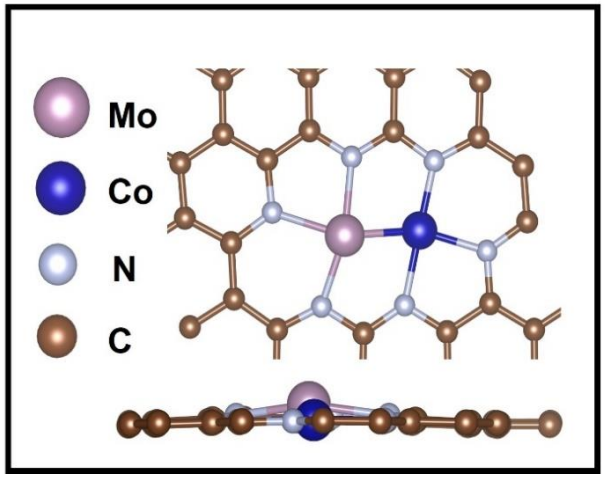


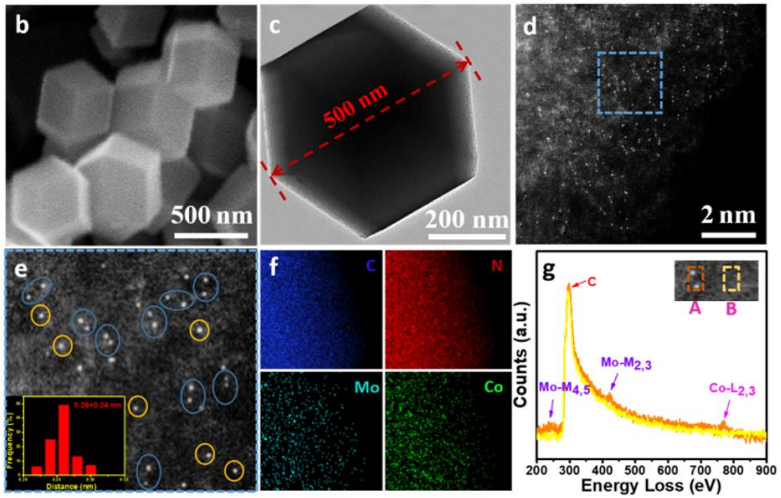
Ref.: Jin Liu, Jinsong Zhou, **Michael K. H. Leung**, Valence Engineering of Polyvalent Cobalt Encapsulated in a Carbon Nanofiber as an Efficient Trifunctional Electrocatalyst for the Zn−Air Battery and Overall Water Splitting, 2022, ACS Appl. Mater. Interfaces, 14, 4399−4408.

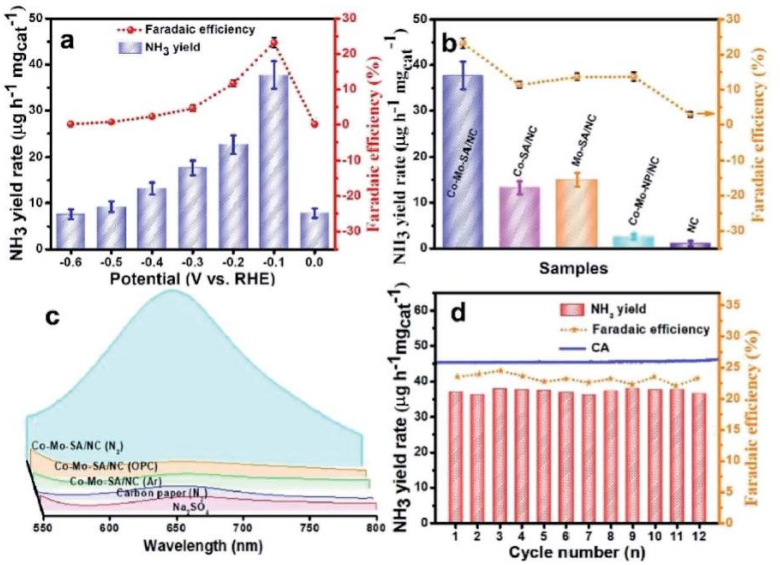
Solar Driven Electrochemical Ammonia Production

太陽能電化氨生產



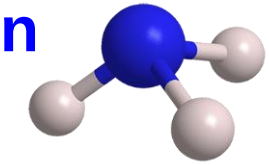




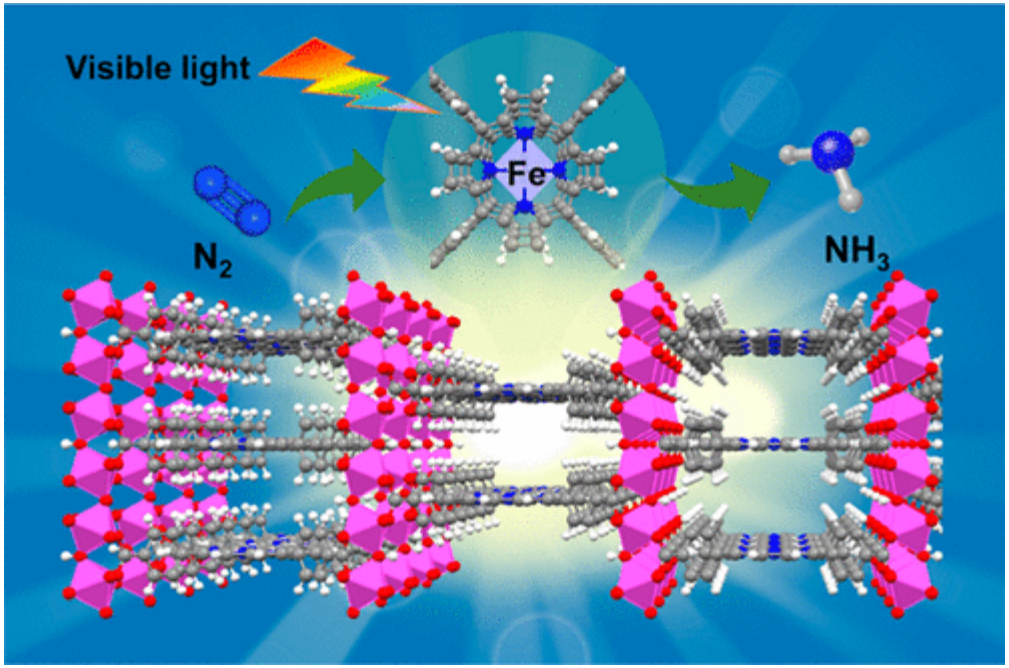


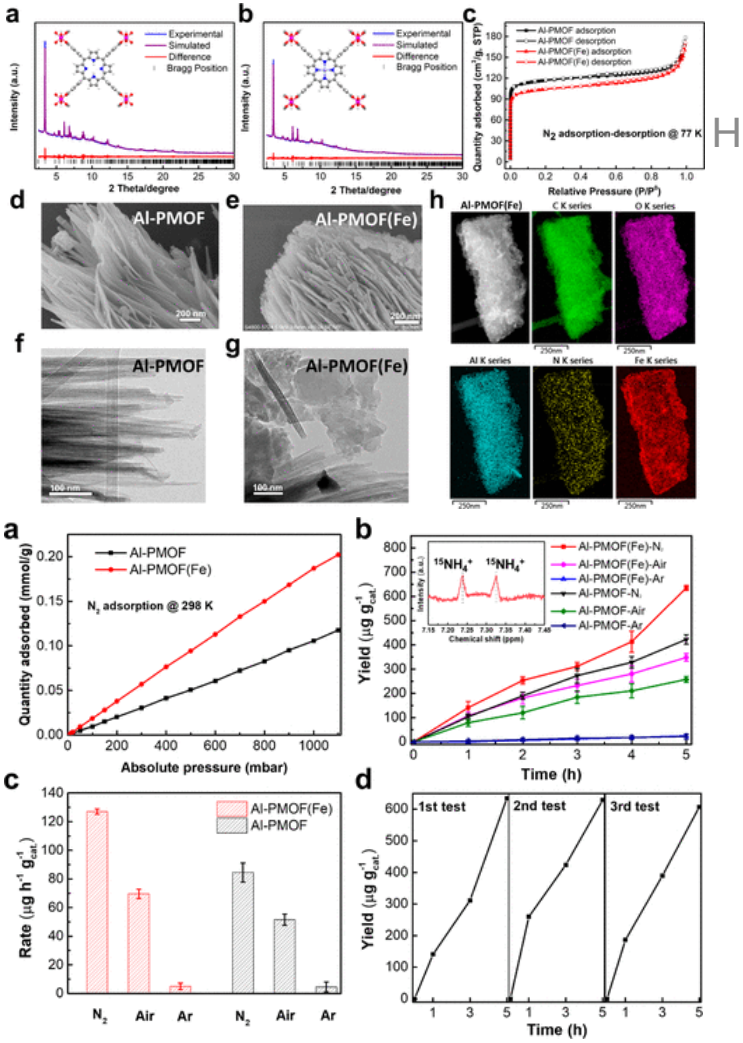
Ref.: Li, Xin; Liu, Jin; Zhang, Yizhen; **Leung, K.H. Michael**, Changing charge transfer mode with cobalt-molybdenum bimetallic atomic pairs for enhanced nitrogen fixation, 2022, Journal of Materials Chemistry A, Vol. 10, No. 29, p. 15595-15604.

Solar Photocatalytic Ammonia Fuel Production



太陽能光催化氨燃料生產





Ref.: Shang, S., Xiong, W., Yang, C., Johannessen, B., Liu, R., Hsu, H., Gu, Q., **Leung, M. K. H.** & Shang, J., Atomically Dispersed Iron Metal Site in a Porphyrin-Based Metal−Organic Framework for Photocatalytic Nitrogen Fixation, 2021, ACS Nano. 15, 6, p. 9670–9678.

Imported Renewable Energy
進口可再生能源

NH_3

Conclusion

Advanced science and engineering are essential to develop the green technologies that expedite our journey towards the carbon neutrality target.

謝謝