

Brief Introduction to SMRs

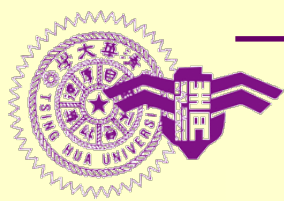
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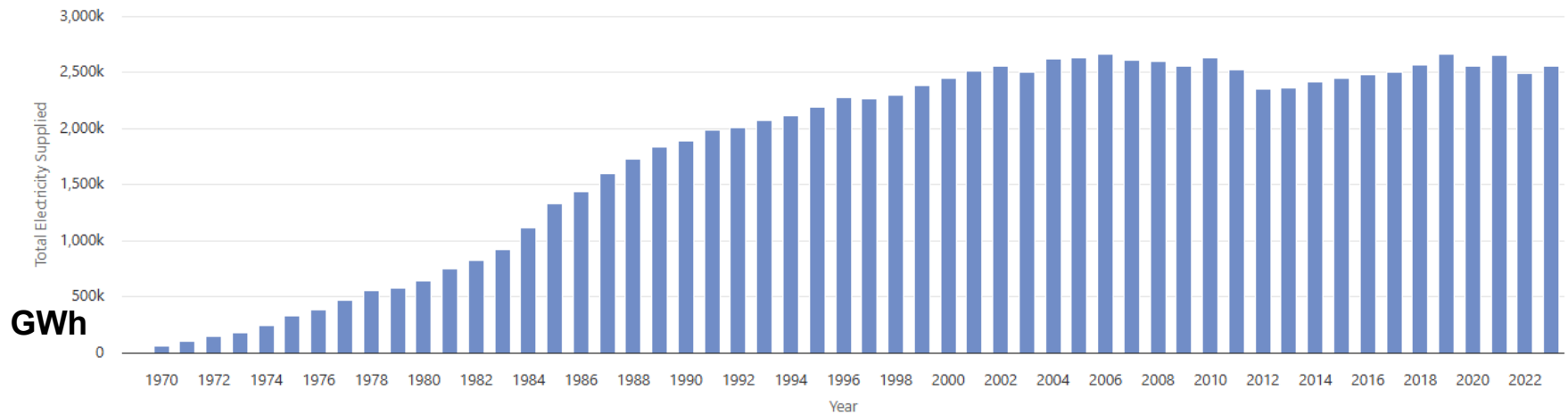
Presented at
SMR International Forum
Taipei, Taiwan

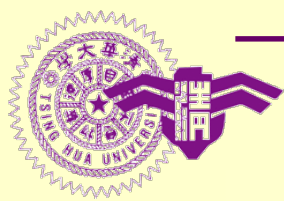
December 16th, 2024



1970-2023年 全球核能發電量 (GWh)

GLOBAL NUCLEAR GENERATION BY YEAR





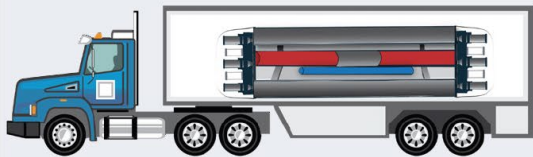
微小型反應器-SMR&MMR (1/4)

◆ 反應器分類

Micro Reactors

Range: 1 MW to 20 MW

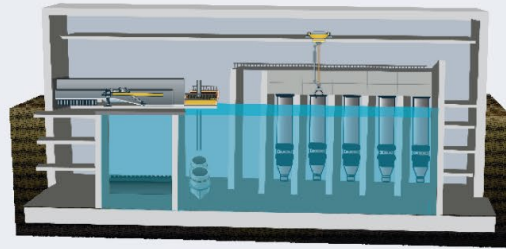
Can fit on a flatbed truck, and are mobile and deployable.



Small Modular Reactors

Range: 20 MW to 300 MW

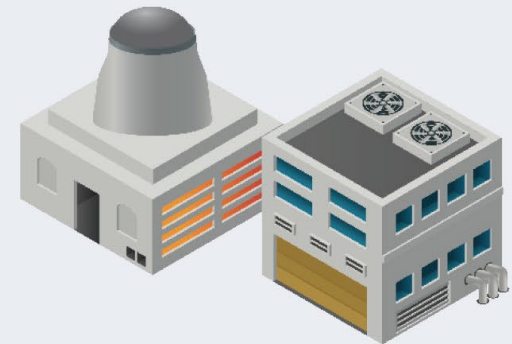
Can be scaled up or down by adding more units.



Full-Size Reactors

Range: 300 MW to 1,000+MW

Can provide reliable, emissions-free baseload power.

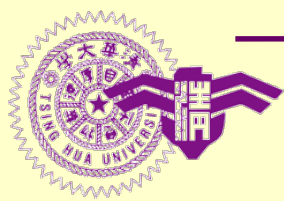


<https://www.energy.gov/sites/prod/files/2020/01/f70/011620%20Advanced%20Reactor%20Types%20Factsheet.pdf>

供電吃緊時就會奉命上線支援的小機組

核電廠內一部緊急用氣渦輪輕油發電機裝置容量：40 MW

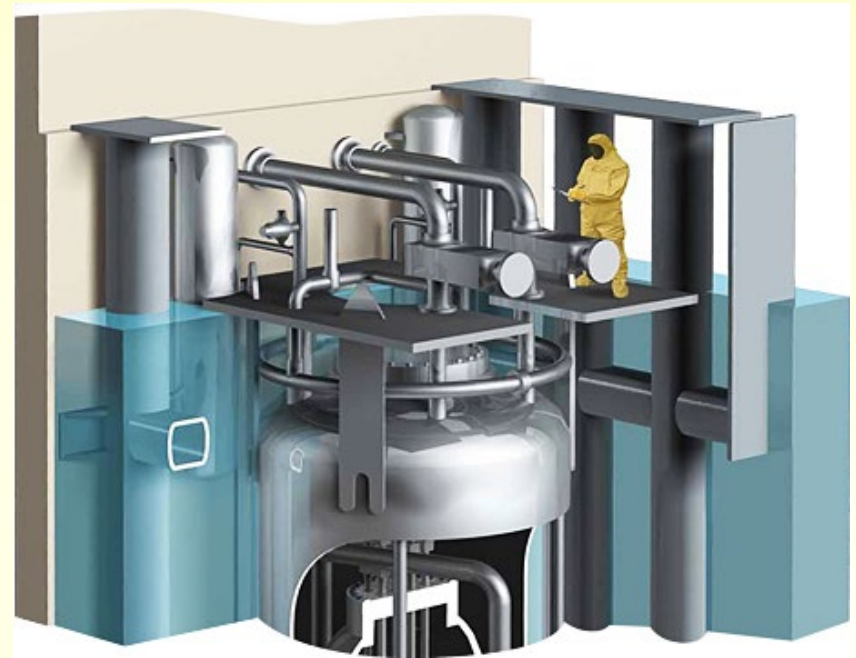
4口之家用電量：5 kW (0.005 MW)



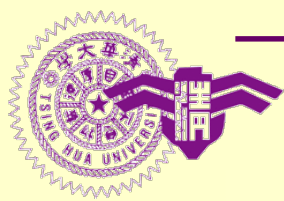
微小型反應器-SMR&MMR (2/4)

◆ SMR特點

- 價格便宜
- 低環境衝擊
- 本質性安全
- 較高民眾接受度
- 小區域及偏鄉供電
- 模組建置
- 工程耗時短
- 管制機關審查時間短



<https://www.energy.gov/ne/advanced-small-modular-reactors-smrs>



微小型反應器-SMR&MMR (3/4)

◆ MMR 特點

- 工廠製造後現地安裝
- 運送與移除簡單快速
- 物理定律下的高安全性
- 可靠富彈性的供電模式
- 運轉相對容易
- 數年不須裝填新燃料
- 符合各種型態的用電需求
- 可與其他供電設施整合

Microreactors have 3 main features:

FACTORY-FABRICATED
工廠製造

TRANSPORTABLE
可運輸

SELF-ADJUSTING
自我調整

What are the benefits of microreactors?

小且可移動
Fits on the back of a semi-truck and can be deployed to remote locations and military bases for reliable heat and power.

設計簡單
Fail-safe and self-adjusting designs that require fewer components, maintenance and operators.

快速現地組裝
Can be connected and generating power within months of arriving on-site. Some, possibly within weeks.

<https://www.energy.gov/ne/downloads/infographic-what-nuclear-microreactor-0>

微小型反應器-SMR&MMR (4/4)

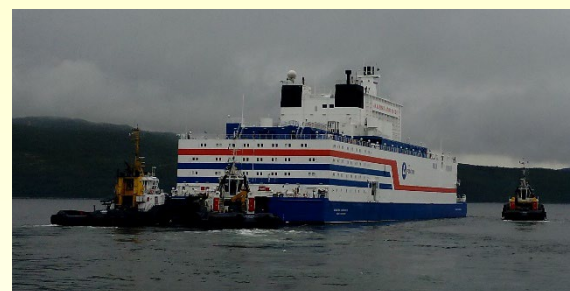
◆ SMR應用實例

山東石島灣核電站 (210 MWe)



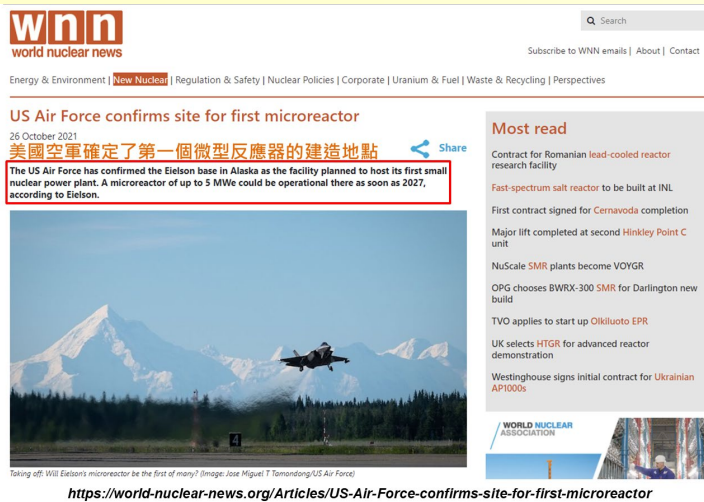
<https://baike.baidu.hk/item/石島灣核電站/1407051>

俄羅斯浮動式核電站 (100 MWe)



https://en.wikipedia.org/wiki/Floating_nuclear_power_plant

◆ MMR應用實例



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US Air Force confirms site for first microreactor
26 October 2021
美國空軍確定了第一個微型反應器的建造地點

The US Air Force has confirmed the Eielson base in Alaska as the facility planned to host its first small nuclear power plant. A microreactor of up to 5 MWe could be operational there as soon as 2027, according to Eielson.

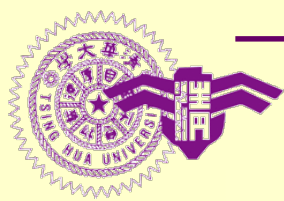
Most read

- Contract for Romanian lead-cooled reactor research facility
- Fast-spectrum salt reactor to be built at INL
- First contract signed for Cernavoda completion
- Major lift completed at second Hinkley Point C unit
- NuScale SMR plants become VOYGR
- OPG chooses BWRX-300 SMR for Darlington new build
- TVO applies to start up Olkiluoto EPR
- UK selects HTGR for advanced reactor demonstration
- Westinghouse signs initial contract for Ukrainian AP1000s

<https://world-nuclear-news.org/Articles/US-Air-Force-confirms-site-for-first-microreactor>



<https://www.epa.gov/>



比爾蓋茲泰拉能源的小型反應器

Natrium反應器

ADVANCED NUCLEAR TECHNOLOGY

Generation IV non-light water reactors offer many advantages, including potentially better economics, improved fuel utilization, higher operating temperatures for industrial process heat applications and integrated energy storage systems, and the ability to close the fuel cycle. Sodium-cooled fast reactors have the highest technology readiness levels of any advanced non-light water reactor that enables the technology to be commercialized fast enough to have an impact on decarbonization.

The Natrium reactor builds on existing nuclear energy plant technology on a number of fronts. It offers safety enhancements, reduces even further the risk of weapons proliferation, minimizes waste production, uses uranium fuel more efficiently and lowers costs.

