International Energy Agency

Nuclear Energy in the Age of Electricity

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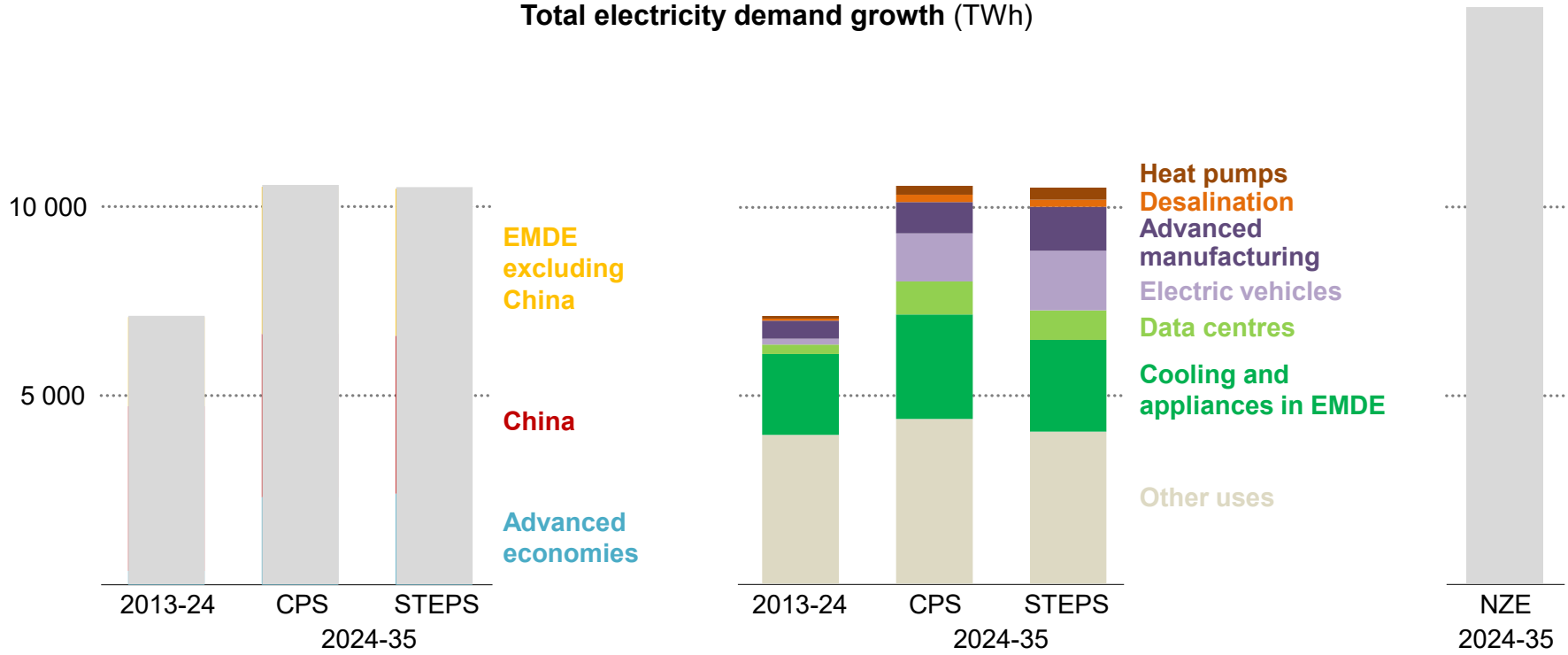
CET 2026

29 September 2026

The Age of Electricity is here



Electricity demand accelerates in all scenarios as growth resumes in advanced economies and strengthens across emerging markets. Electricity is key to major growth areas for the economy such as advanced manufacturing & AI.

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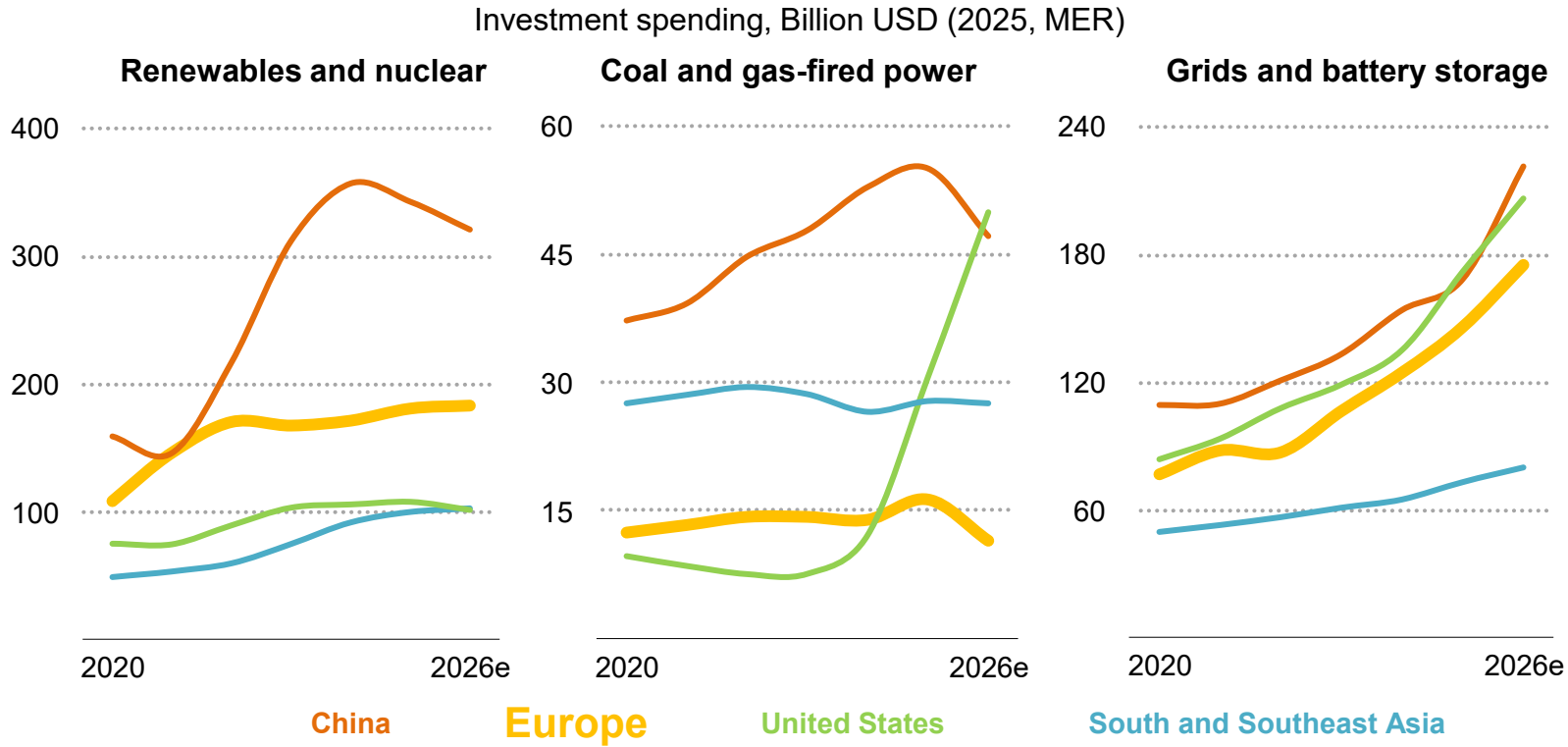
The future power system is not one technology



Renewables spending has dipped recently, largely because of China, but still makes up 70% of total power generation investment, while nuclear is making a comeback and spending on grids and storage is on the rise almost everywhere

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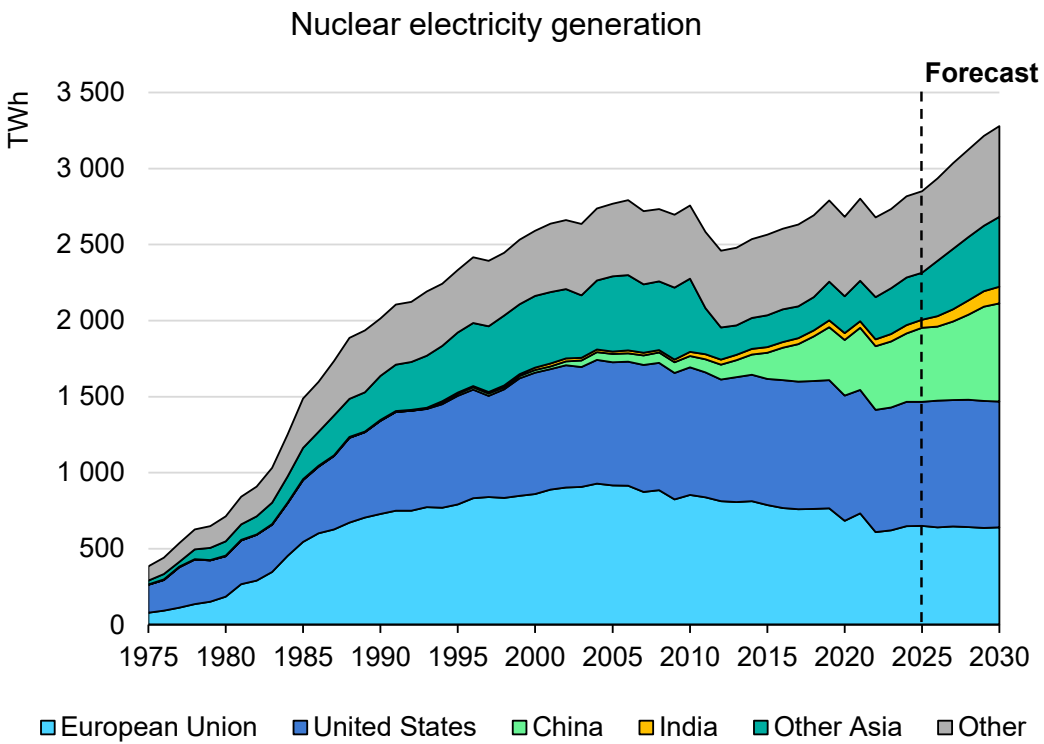
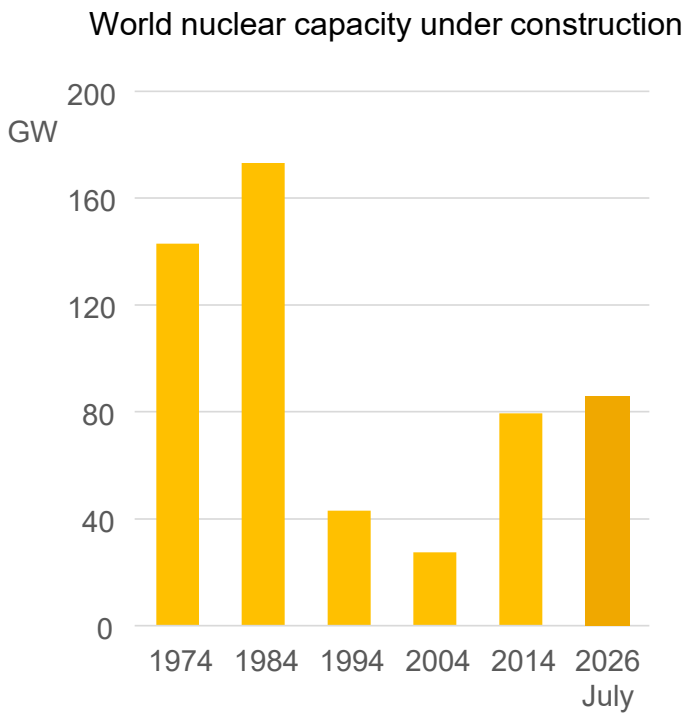
Nuclear energy is making a strong comeback





There are several reasons for optimism about the future of nuclear energy: record high output, robust construction, technology innovation for large and small reactors, and plans to expand the role of nuclear in over 40 countries

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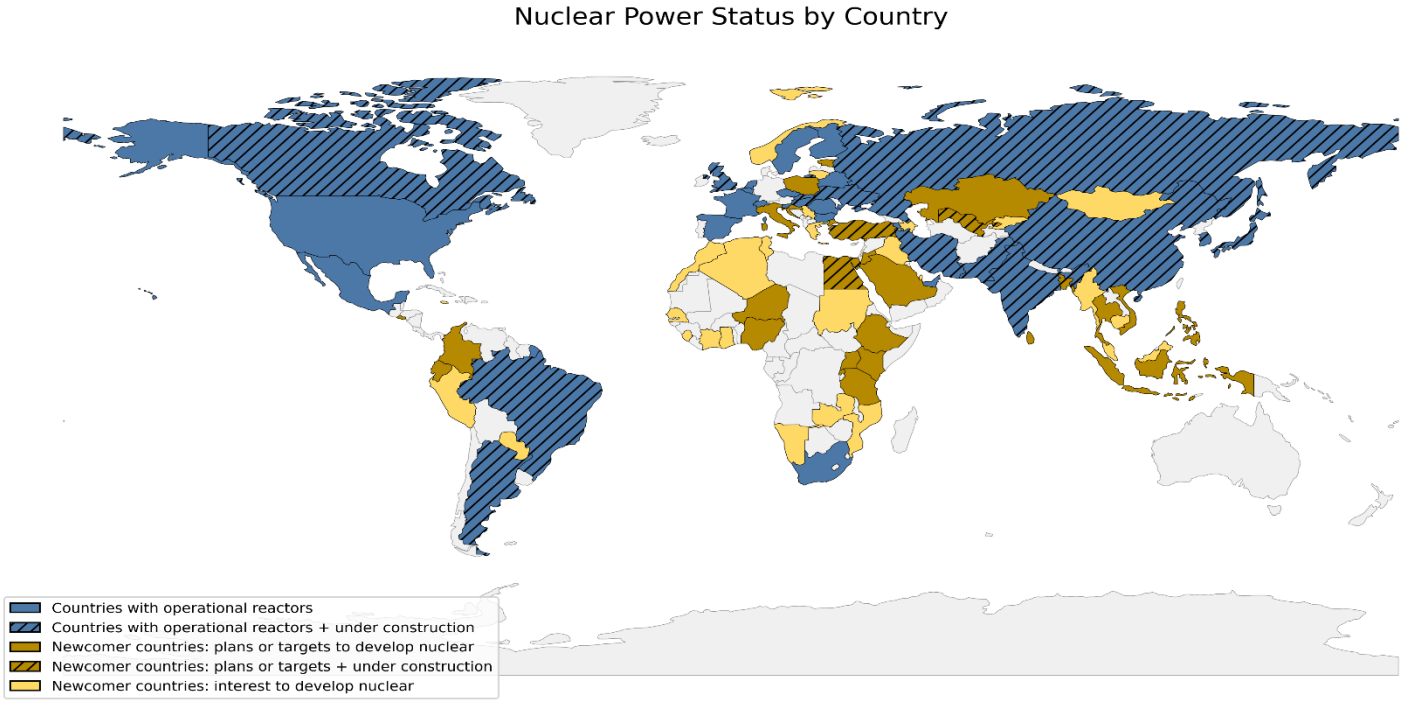
The new geography of nuclear

Current status of nuclear programmes worldwide



There are over 30 countries with operating reactors and over 50 countries that have plans, targets or interest to add nuclear to help strengthen and diversify their energy systems

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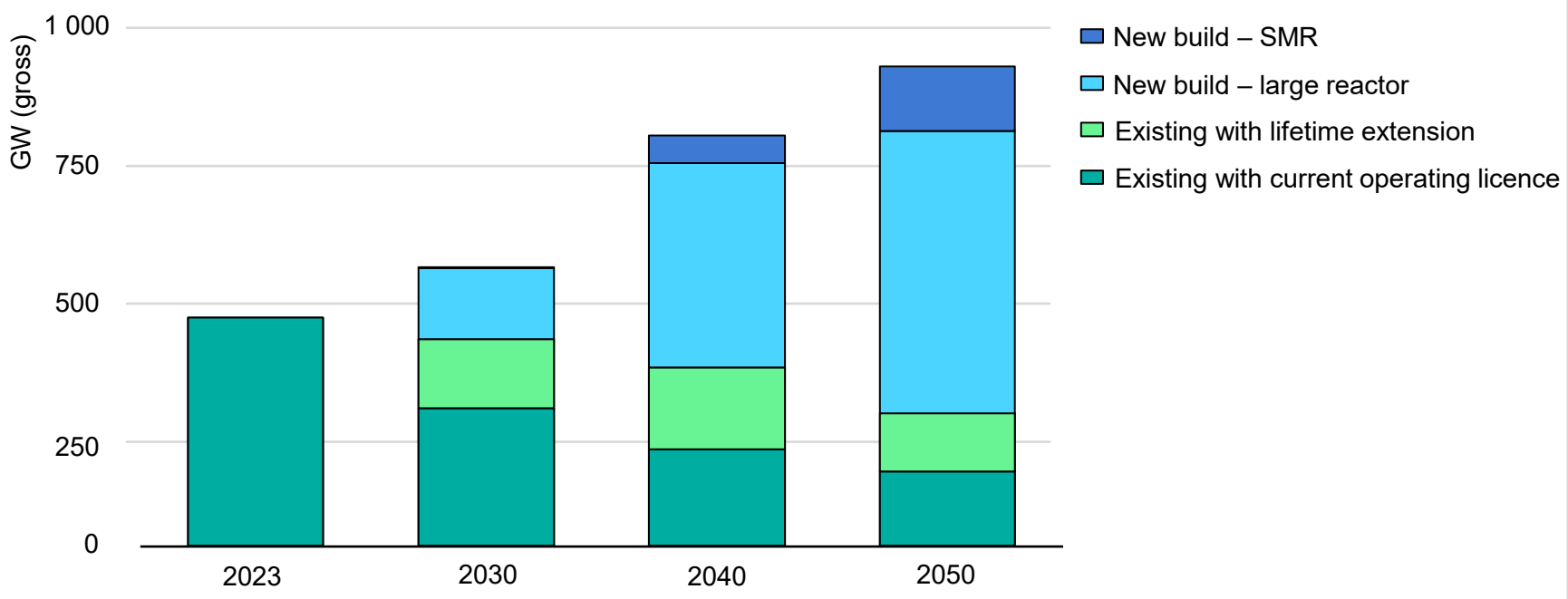
A more diverse nuclear industry is emerging



Fulfilling country plans and targets would lead to global nuclear capacity doubling by 2050.
Most growth comes from China and developing economies, and large reactors remain the majority of the fleet.

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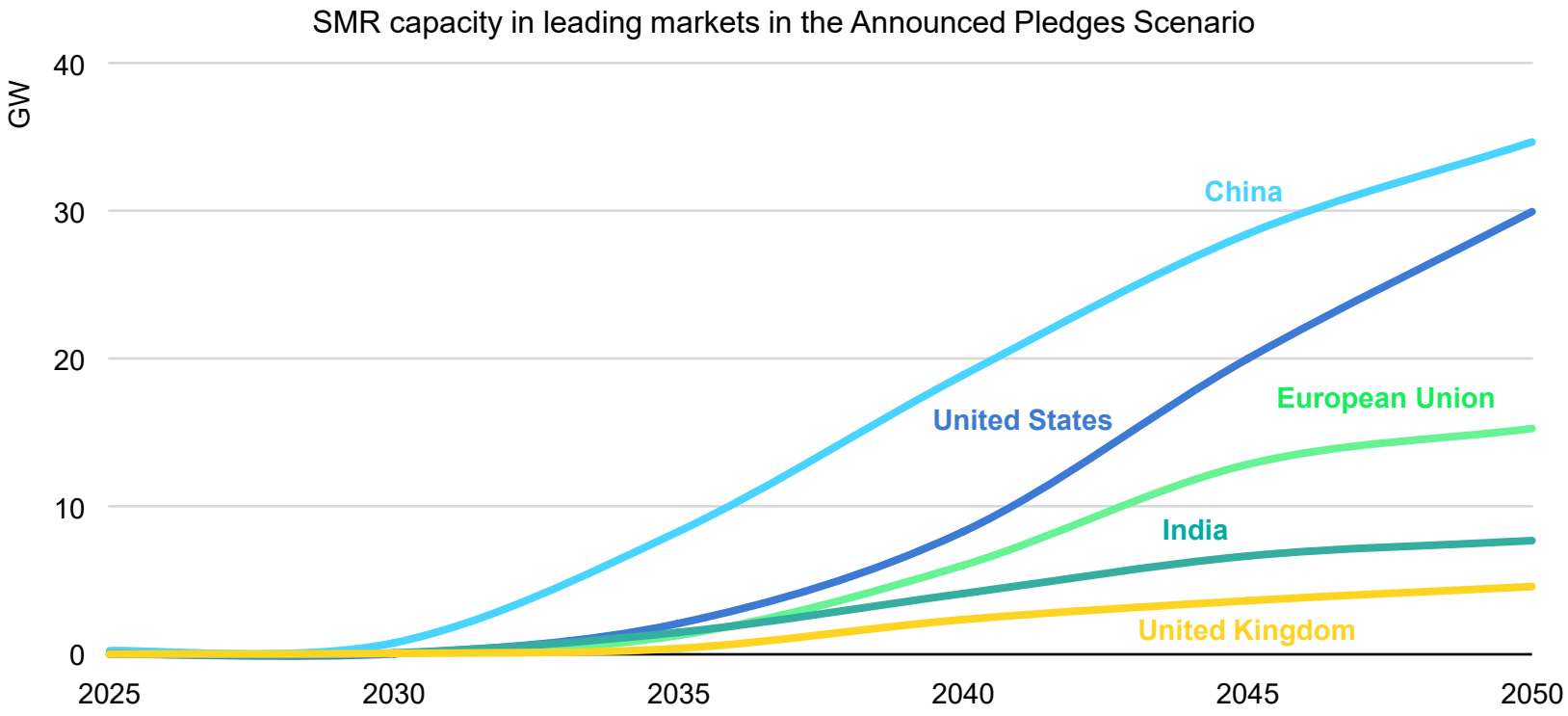
Technology in focus: SMRs are getting ready to take off



Innovation, government support and new business models can open a new era for nuclear energy, with potentially over 1 000 SMRs totalling 120 GW by 2050, and cumulative investment of USD 670 billion.

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Future electricity systems need more than energy

Electricity security depends on four complementary system needs across different timescales

MONTHS TO YEARS AHEAD

Adequacy

Is there enough capacity to meet demand under most conditions?

Key contribution

Firm and dependable capacity

SEASONS TO HOURS AND MINUTES

Flexibility

Can supply and demand adjust as conditions change?

Key contribution

Ramping, storage and demand response

SECONDS OR LESS

Stability

Can the system remain secure through disturbances?

Key contribution

Frequency, voltage and system services

LONG-TERM CHANGE

Resilience

Can the system absorb shocks and recover?

Key contribution

Diversity, robust networks and preparedness

System value increasingly comes from sources that contribute to power system adequacy, flexibility, stability and resilience

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Conclusions

- The world will need much more electricity to support modern economies
- Nuclear is growing again, but in a different way than in previous decades
- The most secure, affordable and sustainable electricity systems will combine:
  - Nuclear, renewables and other sources
  - Robust, modern and digital grids
  - Strong system flexibility including demand response and storage

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