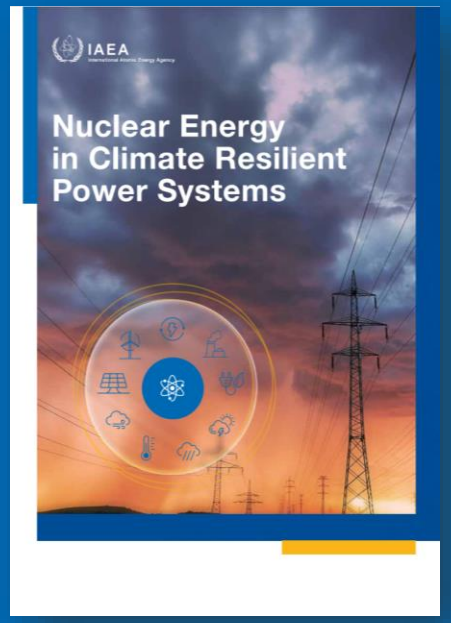


Impacts of Extreme Weather Events on Electricity Generation – case of nuclear

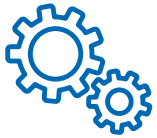
Dr. Henri Paillere,

Head, Planning and Economic Studies Section, IAEA

Deep Dive Workshop: Resilient energy systems against extreme weather events

4 June 2025

Planning and Economic Studies Section



Planning and Capacity Building

- Development of technology-neutral energy system analysis tools
- Capacity building for energy systems analysis and planning, taking into account nexus Climate-Land-Energy-Water (CLEW)
- Technical assistance in elaboration of sustainable energy strategies

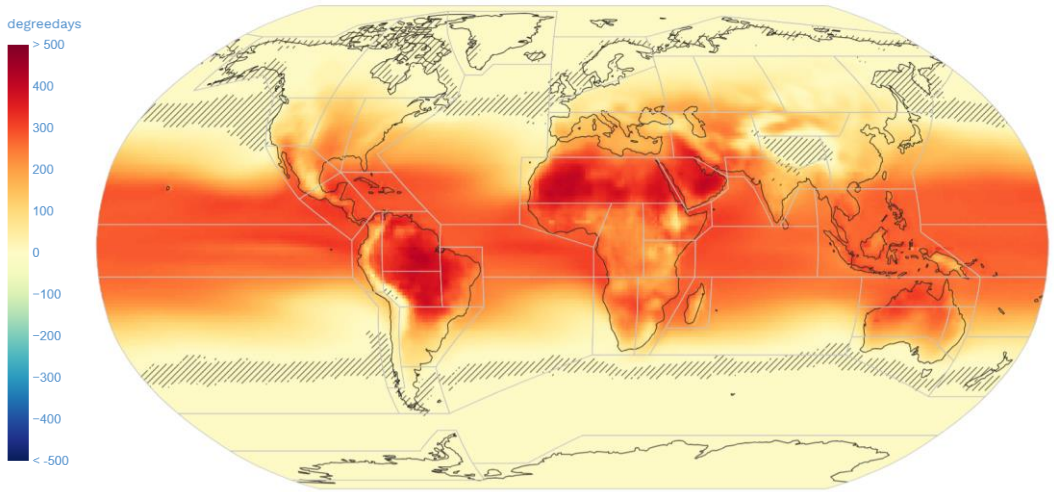
Energy, Economics and Environment Analysis

- Economics & financing clean energy transitions
- Contribution of nuclear energy to SDG and climate goals
- Climate resilience of energy systems (IAEA PRIS database)
- Information references of energy and economic data

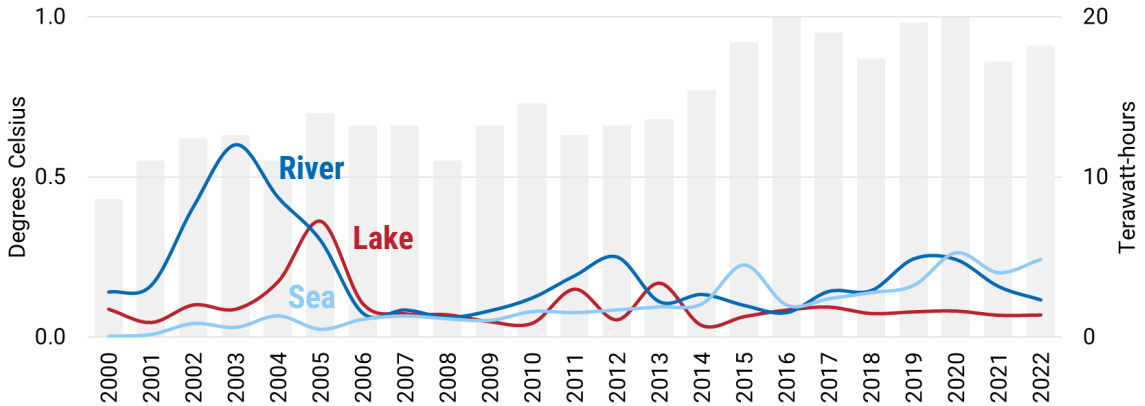
Impact of climate change on the energy sector

- Increased frequency and severity of extreme weather events (e.g., heat waves, storms, droughts) disrupting energy infrastructure
  - Rising temperatures affecting cooling processes in thermal power plants, hydropower potential and efficiency of transmission infrastructure
  - Sea level rise threatening coastal energy facilities
  - Slight decrease in wind power potential
  - Vulnerability to climate impacts on energy infrastructure are highly location-specific

IPCC SSP3 scenario mean annual temperature in degrees Celsius (2021-2040)

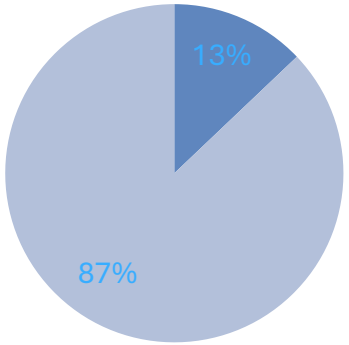


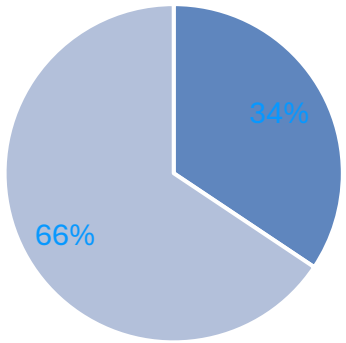
Global temperature anomalies and weather-related nuclear energy losses, 2000-2022

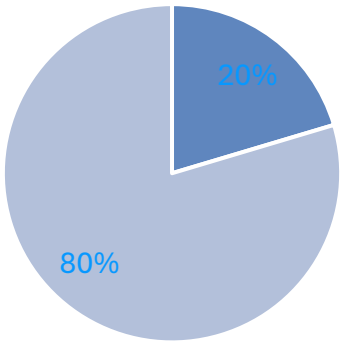


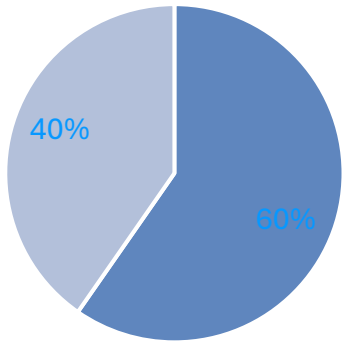
Energy security perspectives on nuclear energy

In the world	31 operating countries	32 newcomer countries	417 reactors in operation	62 reactors under construction
ADB member countries	**4 operating countries**	**11 newcomer countries**	**85 reactors in operation**	**37 reactors under construction**





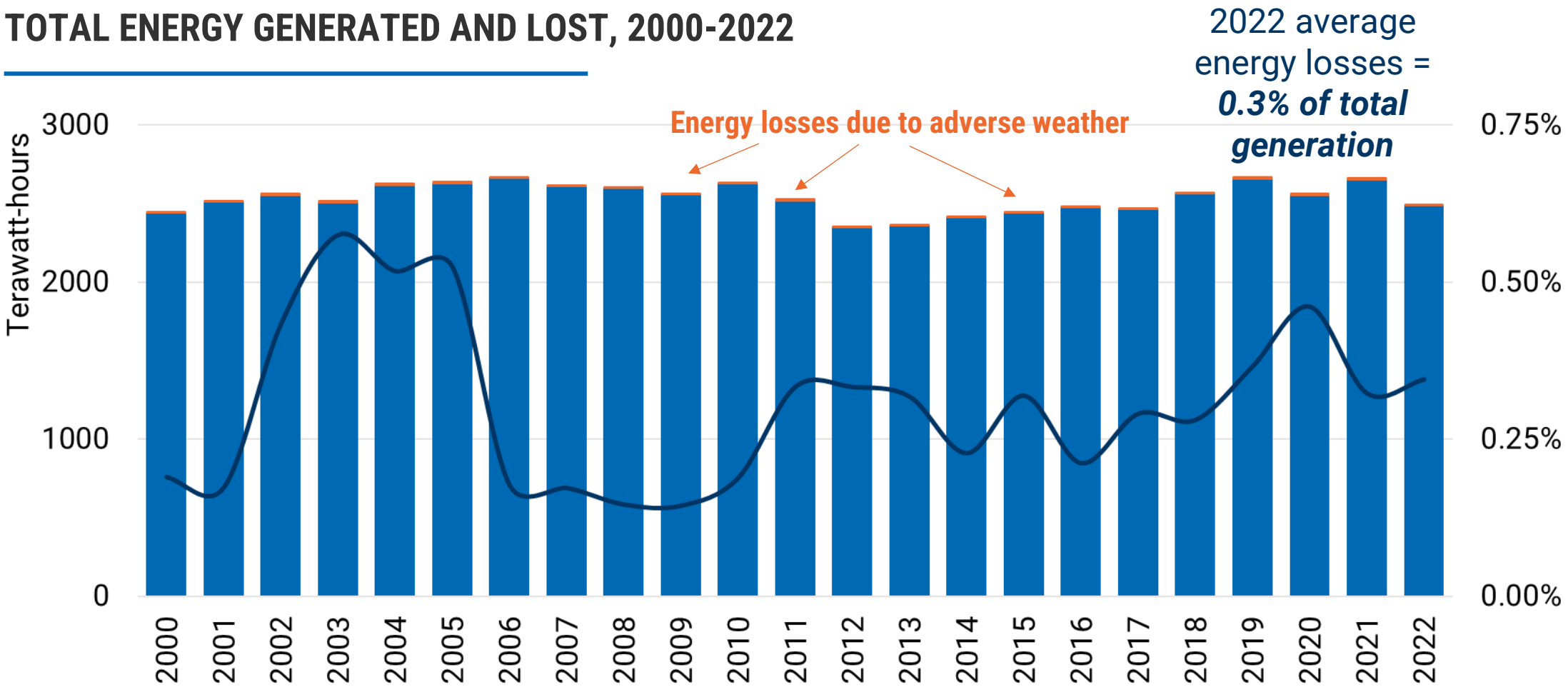




Source: IAEA Power Reactor Information System (PRIS)

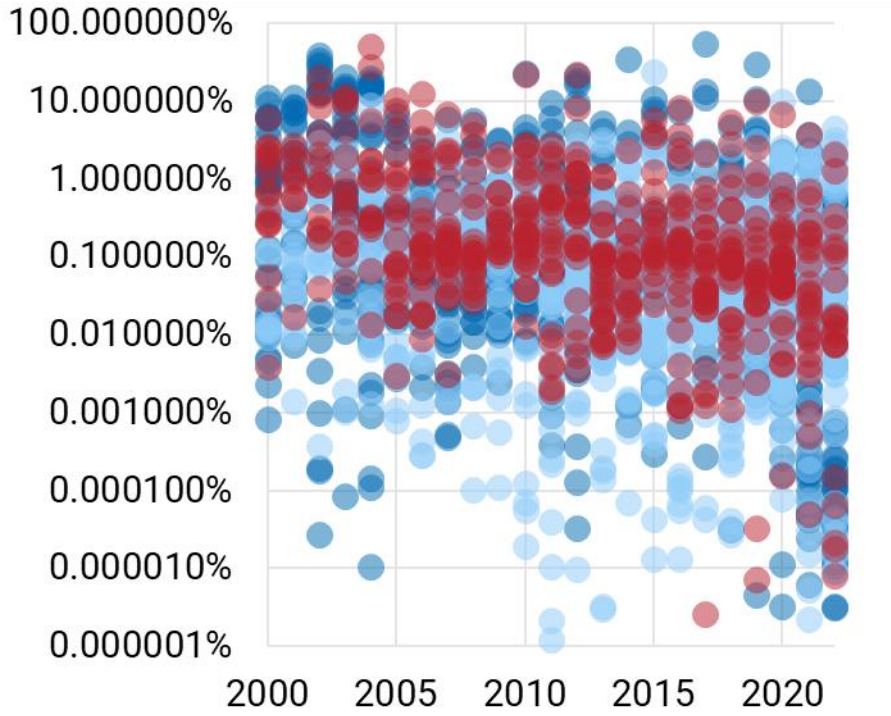
Nuclear operation during extreme weather conditions

TOTAL ENERGY GENERATED AND LOST, 2000-2022

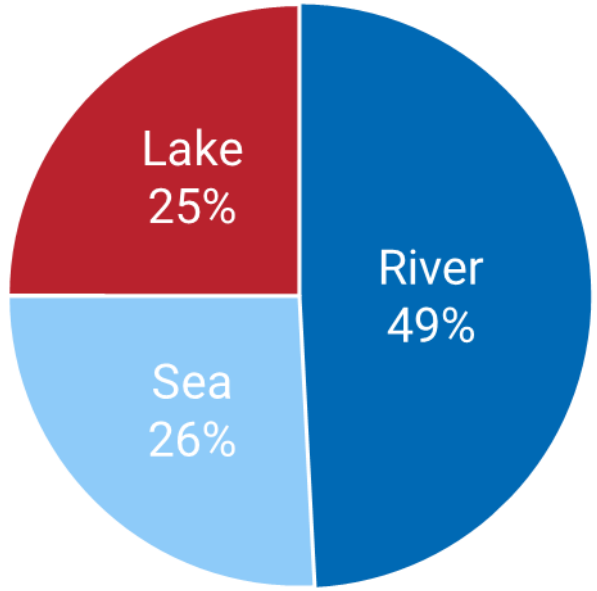


Weather-related nuclear energy losses

AS A SHARE OF REACTOR GENERATION



BY COOLING WATER TYPE, AVERAGE 2000-2022

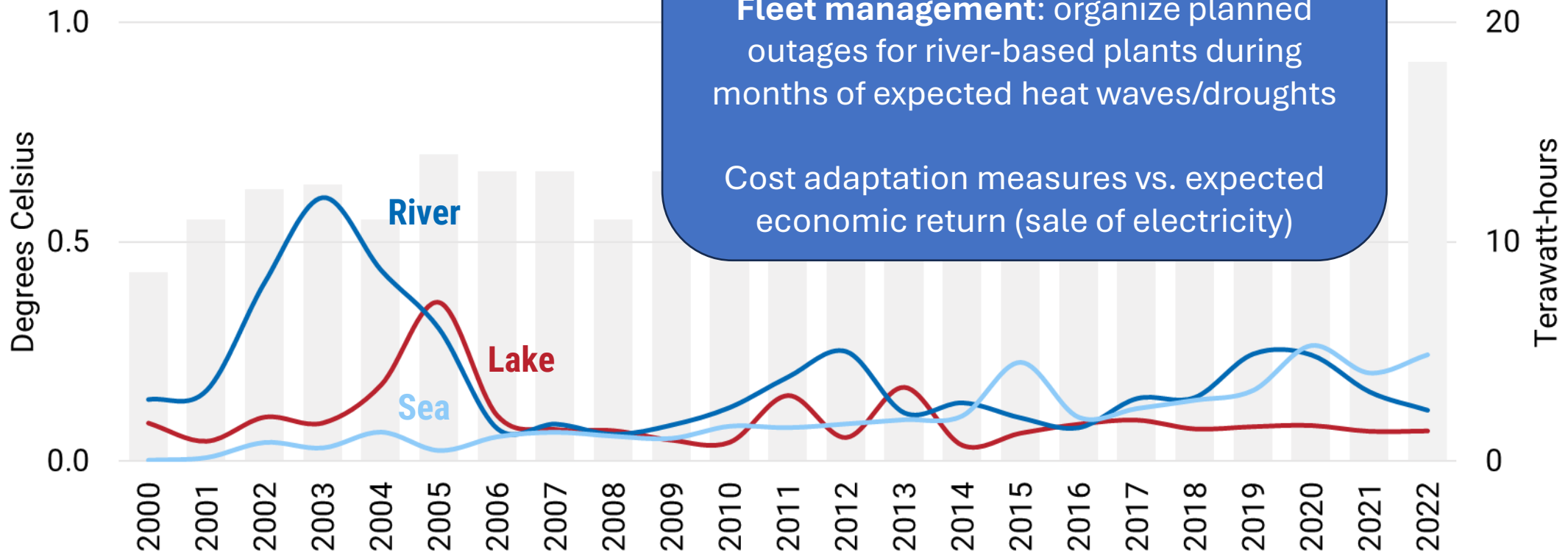


Evidence of adaptation in the nuclear energy sector

GLOBAL TEMPERATURE ANOMALIES AND WEATHER-RELATED NUCLEAR ENERGY LOSSES, 2000-2022

Examples of adaptation measures:
Technical: water withdrawal systems, heat exchangers and other cooling systems
Fleet management: organize planned outages for river-based plants during months of expected heat waves/droughts

Cost adaptation measures vs. expected economic return (sale of electricity)



Building climate resilient energy systems

Climate change will impact every aspect of the energy sector: the output of each energy generating technology, the volume of energy demanded and the combined physical and nonphysical infrastructure that ensures safe and reliable operations during extreme weather events.

Technical strategies

Accelerating the adoption of clean energy technologies

- **Diversified energy mix**: to minimize overall system cost, increase energy security and decarbonize
- **Enabling infrastructure**: establishing tech-neutral infrastructure for diversified energy systems
- **Harmonization**: non-tangible (policy and regulatory) and tangible (electrical grid, procurement) frameworks

Financial strategies

Unlocking investment through innovative financing

- **Pooled finance**: financial frameworks to unlock private sector investment in climate resilient infrastructure
- **More than just capital**: Multilateral financial institutions can provide expertise and oversight
- **Knowledge sharing**: leverage climate data and regional cooperation

Importance of data to analyze impact of extreme weather events and develop cost-efficient adaptation /resilience strategies

Thank you!

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