

Water Data and Water Security

Great Lakes Water Conference, University of Toledo College of Law & Legal Institute of the Great Lakes

Rhett Larson

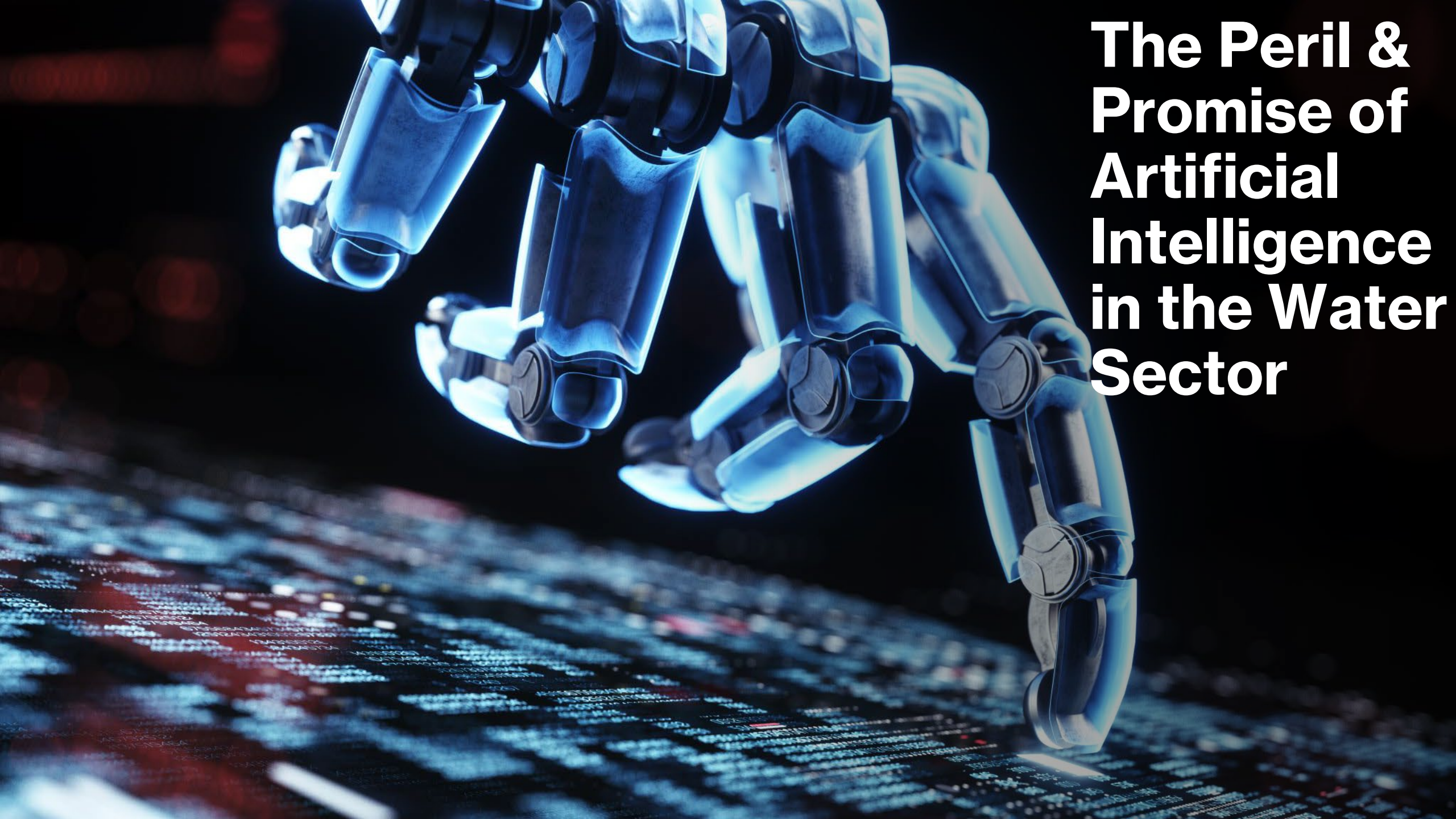
Richard Morrison Professor of Water Law

Arizona State University

Sandra Day O'Connor College of Law

Senior Research Fellow

Kyl Center for Water Policy



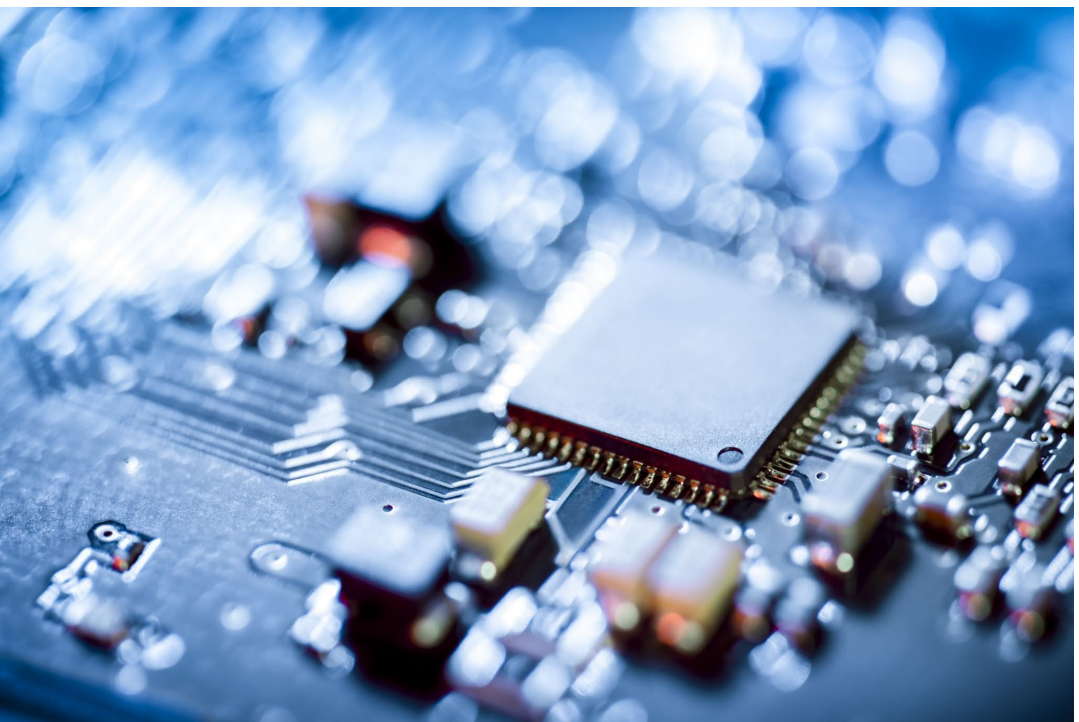
The Peril & Promise of Artificial Intelligence in the Water Sector

Water & Energy Demands of Data Centers

- When people are angry about data centers, what are they angry about?
- Data center generate tens of thousands of megawatts (over 34 billion BTU/h) of heat. They generally will not function well without a stable temperature at or below 80˚F. This requires cooling, which is typically energy and/or water intensive.
- A large data center consumes about 20x the energy of the average US household (or as much as around 100,000 homes).
- Data centers make up around 5% of all energy consumption in the U.S., or about 180 terawatt hours per year (about the amount of 17 million homes).
- Cooling makes up about 30% of all data center energy expenses each year. Data centers are commonly cooled by:
  - Air: more common in more temperate climates, requires compressors and fans which are energy intensive. Very little direct water use, but as much as 40 MWh/day of energy (about the same as 1,300 homes in the US each day).
  - Evaporation: in dry climates, more energy efficient, but very water-intensive. 1.5-5 million gallons per day (between 600 million to more than 1.5 billion gallons over a year, or as much water as New York City uses in a day).
  - Mechanical Refrigeration: chilled water that is energy-intensive, with heat rejected through cooling towers (water-intensive) or dry towers (water efficient). 40 MWh/day and around 300 million gallons of water each year.
  - These numbers are impacted by whether facilities have closed-loop systems or rely on other water recycling technologies. Higher energy uses to reduce direct water consumption may lead to more indirect water consumption from water used in energy generation. Additionally, even closed loop systems will having flushing requirements with periodic high amounts of direct water use.
  - There are other less-common cooling technologies with other costs, risks, and benefits, like liquid cooling using water or dielectric fluid flows directly on CPUs/GPUs, immersion in dielectric fluid, or micro-blade cooling.





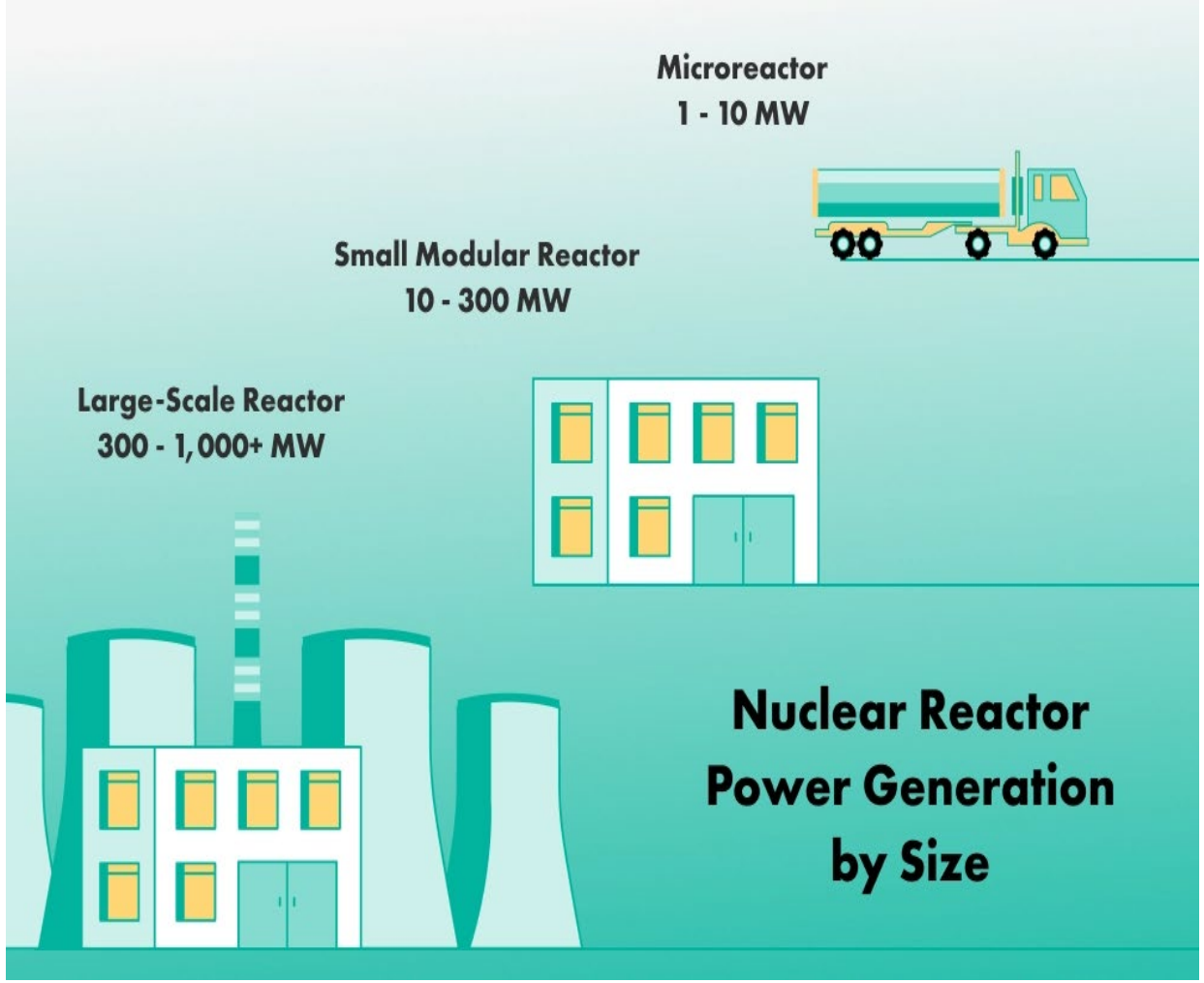


Water & Energy Demands of Semiconductors

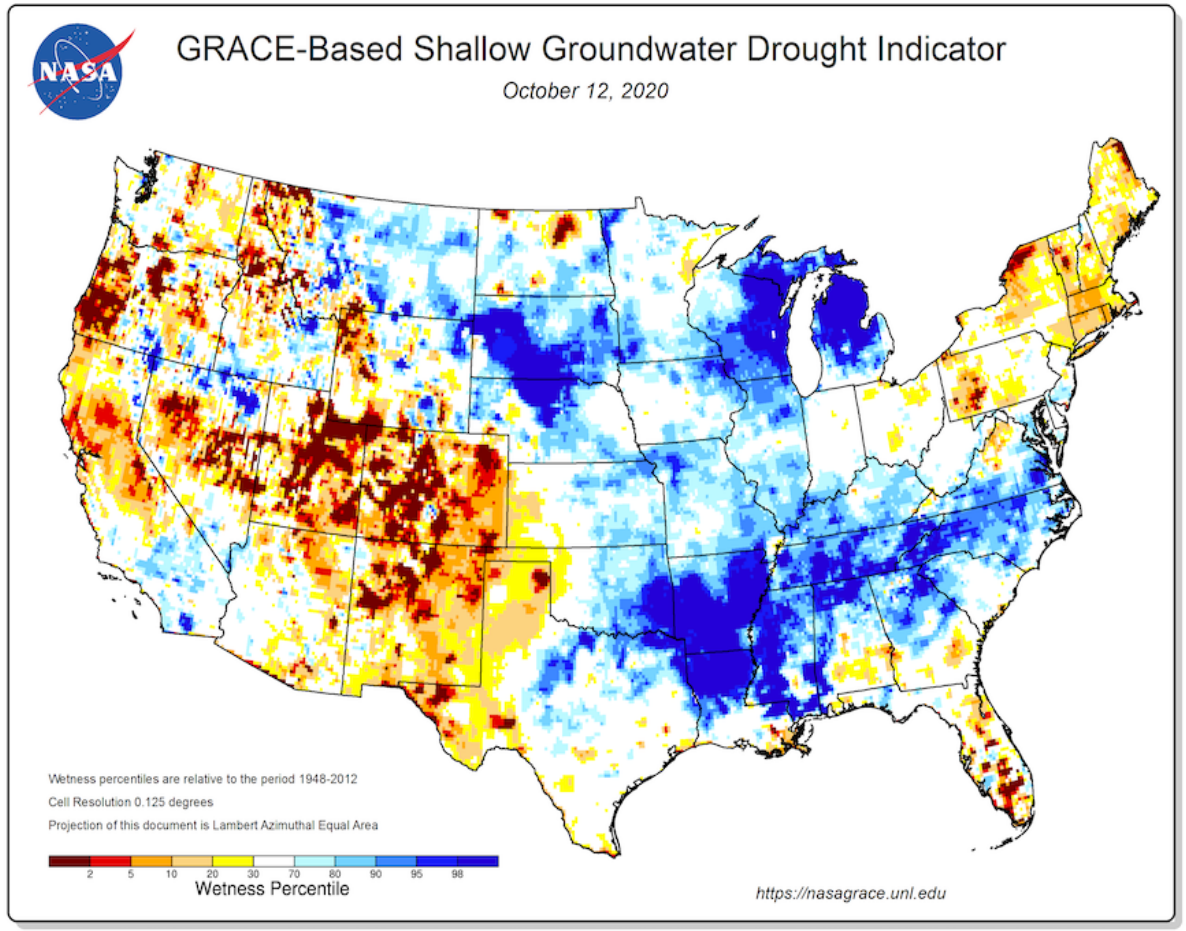
- A chip factory consumes 2-10 million gallons of ultrapure water (UPW) per year, It takes 1.5 gallons of tap water to produce 1 gallon of UPW – about the equivalent of 33,000 U.S. homes.
- Globally, the industry consumes about 317 billion gallons of water annually.
- Most major fabricators recycle more than 85% of their water.
- About 40% of energy consumption is for processing, 25% for cooling, 10% for air purification.
- Some larger companies (TSMC, Intel, Samsung) consume around 9 billion KWh/year (a little less than Seattle or Denver).

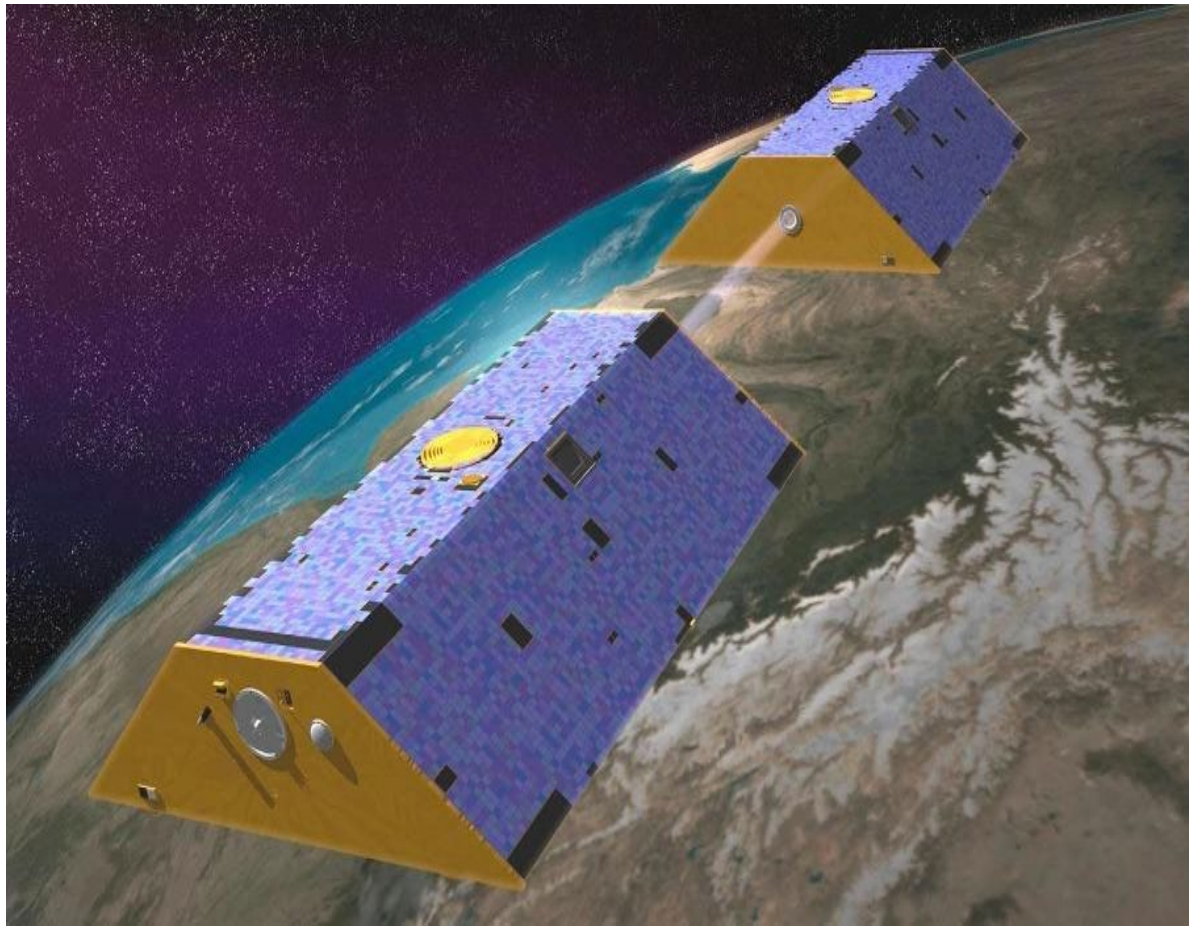
The “Nuclear” Option

- Increased energy demand from AI could be addressed with Small Modular Reactor (SMRs).
- Relatively low carbon and low cost (compared to other options) but would require around 12 million gallons per day (depending on size).
- Waste disposal and security challenges
- The potential for innovation and scaling in cooling technology.
- Increasing demand on effluent.



Water Data from Space





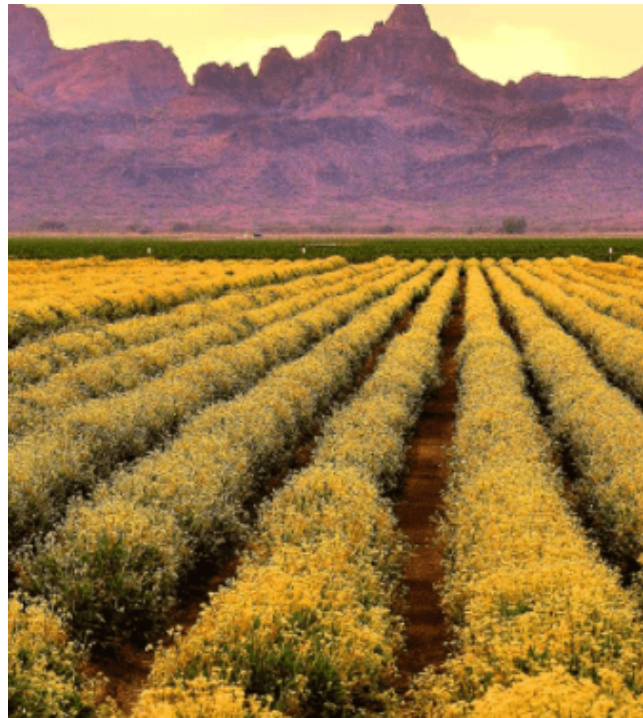
AI, Data, & Water Conservation

- Precision Agriculture
- Reduction in Non-Revenue Water
- Industrial Optimization

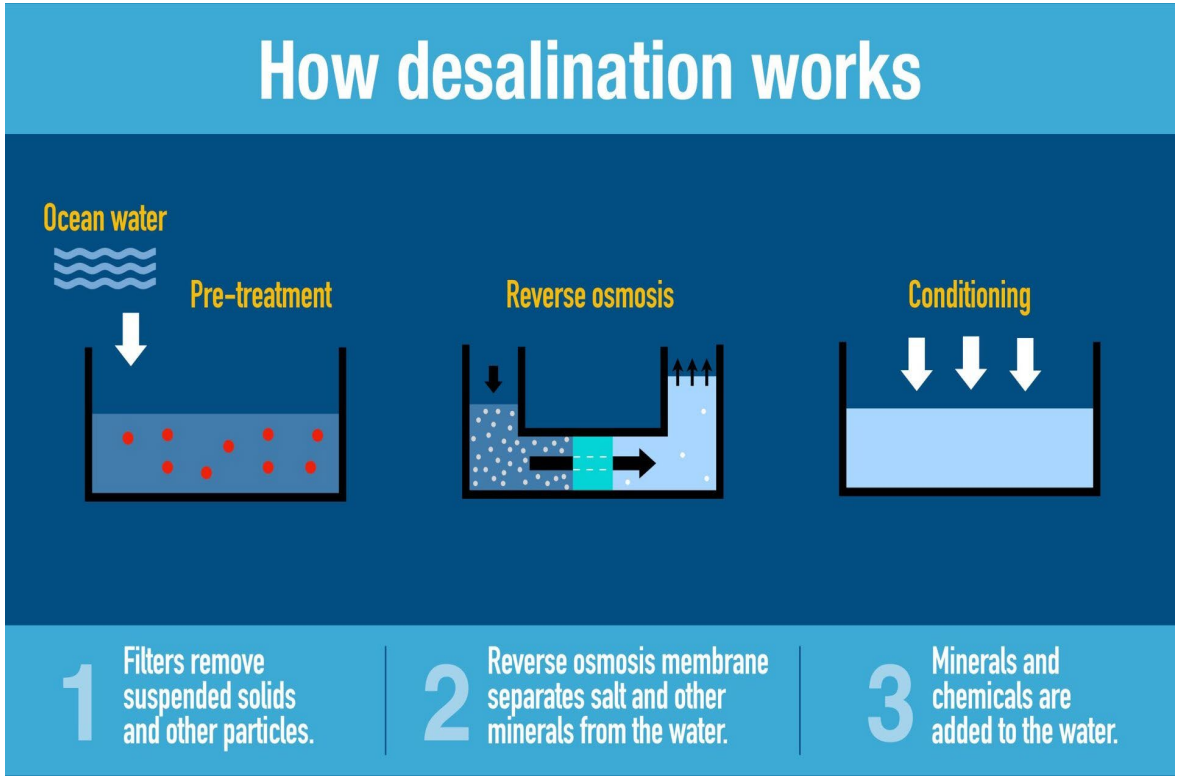


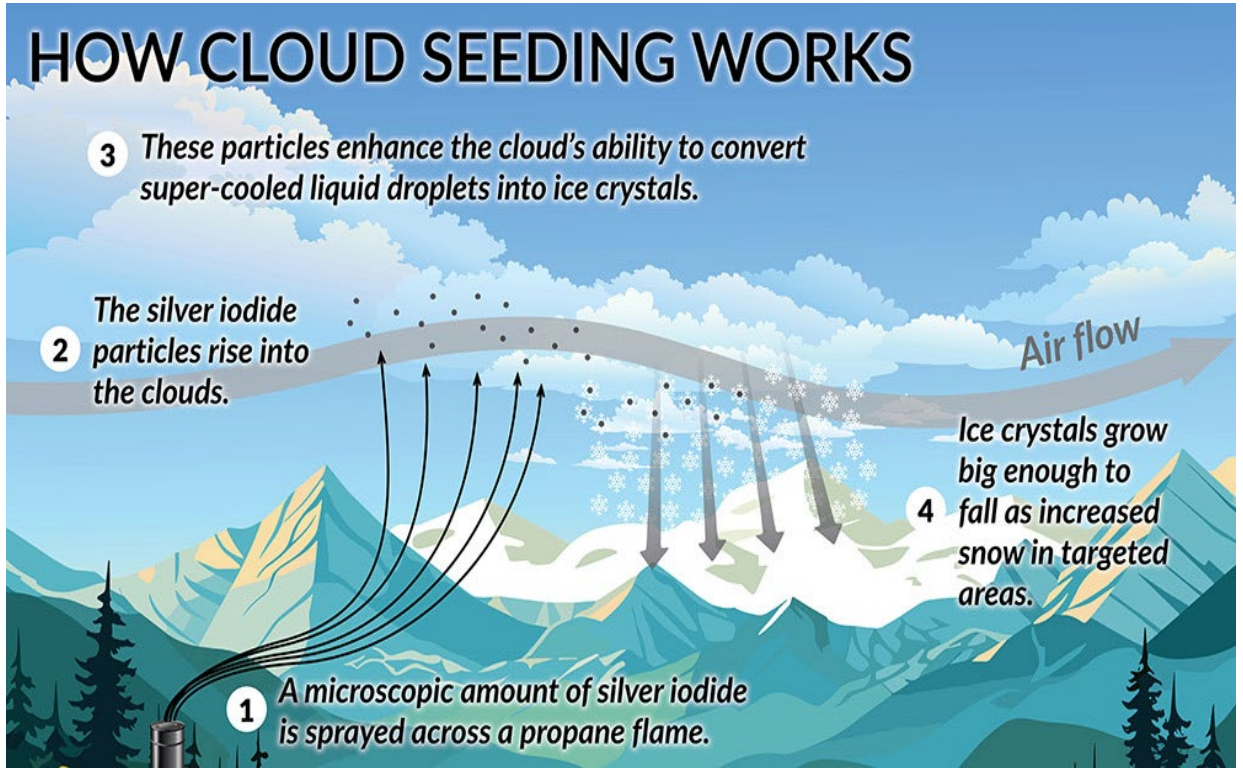






AI, Energy, and Water Augmentation







AI, Data, & Water Cybersecurity



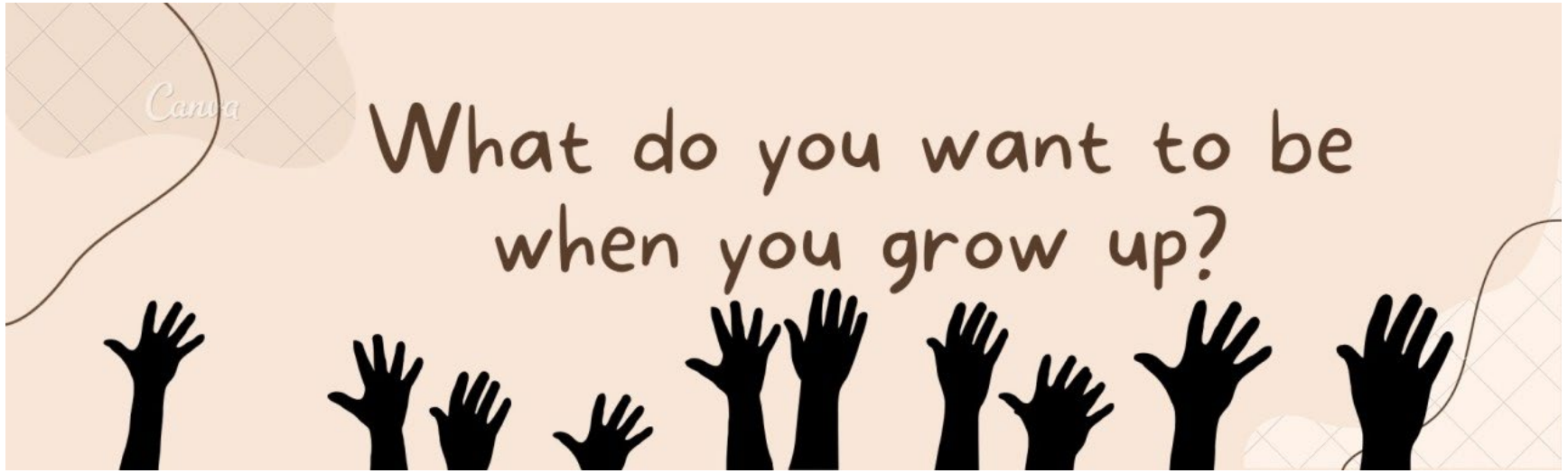




Nudging



AI, Models, and Water Data



Life isn’t about having all of your dreams come true. It’s about having the most important ones come true.