A look into the future of Energy Efficiencies

We won't let history define our future. Our actions will speak for us. Our determination will turn doubters into believers.
Future Power Considerations

- **Triboelectricity**
  - Enables production of an electrical charge from friction caused by two different materials coming into contact

- **Optical rectenna**
  - Electromagnetic waves into direct current electricity

- **Flexible generator**
  - Solid-state devices that directly convert heat to electricity without moving parts

- **Enhanced controls**
  - Plant control systems and computer controls all inclusive

- **Sodium Ion batteries**
  - Could be a replacement for Lithium

- **U Beam batteries**
  - Uses ultrasound to transmit electricity
Future Cooling Considerations

- **Energy reuse** – Capture waste heat and repurpose
- *New Chemical solution* – Emerging chemical solution that will enhance heat transfer
- **Submerge cooling** – Utilizing an immersive solution for infrastructure and at compute level
- **Enhanced controls** – Plant control systems and compute controls all inclusive
What could this mean to existing infrastructure

• Resiliency – Right condition and right controls - know your environment
• Energy efficiencies – Need to be more energy efficient will be the driver
• More efficient designs – Thinking outside of the box
• Long range planning/flexibility – Must be a visionary to develop a sustainable over arching plan that includes strategies for both power/cooling & connectivity to the site
• Closely coupled/integrated control systems are a must – Algorithms based on compute demand/power availability/environmental all meeting the most optimum curve in the respective design
• New team members (e.g., chemical engineers, high voltage engineers)
• Collaboration of efforts – Can’t do it alone
Alternative sources of power

- Fuel cells
- Wind/solar
- Geo thermal
- Nuclear fusion
Future Cooling Considerations

- Thermosyphon
- Hyperbolic Cooling Tower
- Plate Frame Heat Exchangers
- Absorption Machines
Completing the Puzzle

**Smart Grid / Micro Grid**

- All inclusive in one arena
- Self sustaining system
- Utilization of the grid as back up power
- Low impact to the community
- No impact to the aging outside infrastructure (e.g., transmission lines and piping)

*Distributed generation (localized) in micro grids and part of a larger smart grid*
Life is all about choices...