

# HPC User Forum - Tucson

Disruptive Technologies Panel

# Problem Statement



## Power and TCO

- Power is a major design constraint for vendors
- Greatest power consumption is in data movement
- Total Cost of Ownership is a major constraint for users
- Operating costs include everything from power to software licensing

## Concurrency

- Key to all HPC problems today
- Need to exploit *all* available parallelism from compute to data movement
- Exposing parallelism can be especially difficult for complex multi-scale, multi-physics codes

## Programming Difficulty

- Concurrency, co-processors and memory hierarchies significantly complicate applications software
- Programming challenges have the potential to disrupt scientific progress
- Need to hide this complexity from the users

**No hardware based “technological wizardry” is on the horizon to address challenges at application level**

**Middleware will play increasingly critical role in energy management, performance management and resiliency management.**

# Potential Disruptive Technology – Application Auto-Tuning for Performance and Power Optimization

- A programming environment, including compilers, libraries, and tools, that allow for optimizing the power consumption of an application in addition to the current focus of optimizing its performance:
  - Understand energy to solution and time to solution.
  - Scoping and parallelization tools to “hybridize” applications to leverage all levels of concurrency (MPI, UPC, Coarray, OpenMP, vectorization,...)
  - Support for and developing asynchronous programming models will become increasingly unavoidable.
  - Provide control of the power consumption of certain components of a node, including core processor, memory controller, and processor interface (eg:PCIe).
- **Benefits:**
  - Address many of the most severe issues facing users today
  - Minimize disruption to science, engineering and analytics
  - Enable rapid adoption of new architectures and accelerate implementation of new algorithms and models
  - Would revolutionize usage of HPC across diverse communities