

How to **demonstrate economy of scale** for a Geosciences high performance computing (HPC) enterprise?

- Definition: Realize economy of scale by producing more “output” for lower marginal costs.
 - Implement a new product/system when you reach the low point of the curve (delta marginal cost = 0).
- “End-to-end” cost includes not just the hardware, but also the management structure around it.
- Address the learning curve.
 - Application requirements are different for different architectures.
- Time value of information is also important to product delivery
- “Best” Demonstration of EoS -- Develop common tools to address common problems.

How to design HPC to **provide capability** to support both **emerging opportunities** and **“hero” computing**?

- Demand a big machine and partition appropriately (and with flexibility) for large and small scale and real-time.
- Have a ‘spinning’ reserve to respond to new discoveries, or events with limited life span.
- Support ‘hero’ codes so they will evolve with future technology.
- Important to keep balance.

How to **be fair allocating computing**, given **available resources** and **required science**?

- Know what the resources are.
- Procedures, policies and rules should be well defined and recognized by all parties
- Implement two-part process
 - Facility certifies the code and estimates time allocation.
 - NSF reviews the science.
- Restrict based on funding? Reciprocity with other funding agencies?

How to **improve collaboration** in **education, outreach, training, and workforce development**?

- Provide 3-D simulation software that allows students & public to change parameters and view impact.
- Engage students at the middle and high school levels.
 - Communicate with teachers to determine tools they could use.
 - Get storylines to which children can respond.
- Include computer training in traditional science programs at universities.
- Train researchers on how to develop codes for Petascale systems
 - Training center staff
 - Community provide
- NSF programs addressing education curriculum