AllScale is an innovative programming approach for ExaScale, decoupling program specification parallelism from management tasks during runtime. The parallel programming model is based on nested recursive parallelism, focusing on the following developments:

- Automated C++ applications porting from small- to extreme scale architectures
- Flexible tuning of program execution to fulfill trade-offs among execution time, energy and resource usage.
- Efficient management of hardware resources and associated parameters (e.g., clock speed).
- Seamless integration of resilience management measures to compensate for isolated hardware failures.
- Online performance monitoring and analysis.

AllScale is expected to boost the parallel applications development productivity, their portability, and runtime efficiency. It will reduce energy needs, thus improving the resource efficiency utilization of small to extreme scale parallel systems. The achieved outcomes are validated with applications from fluid dynamics, environmental hazard and space weather simulations, provided from SME, industry and academic consortium partners.

AllScale enables developers to be productive and to port applications to any scale of system.

Proposed AllScale Technology for EsD

- AllScale API (TRL 4)
- AllScale source to source C++ compiler (TRL 3)
- AllScale runtime system (TRL 5-6)

Using the AllScale Technology for an EsD

- AllScale API based on C++ templates
- User API
  - high-level abstractions (grids, meshes, stencils, parallel for loops, map-reduce)
- Core API
  - template for recursive parallelism, recursive data structures, control- and data flow primitives
- AllScale API implementations
  - Standard Toolchain: pure C++ based implementation compilable by any C++14 conform toolchain
  - AllScale Toolchain: based on the AllScale Compiler and Runtime System for distributed memory parallel architectures
- Adjust the AllScale Runtime System to be used for other toolchains
- Existing codes to be parallelized must be re-implemented using the AllScale API

Pre- or co-requisite items

- The existence of a functional complete application implementation exhibiting sufficient potential for large scale parallel architectures.
- Existing codes to be parallelized must be re-implemented using the AllScale API.
- Online performance monitoring for performance debugging at scale.

Additional work to be done to make AllScale technology ready for EsD

- AllScale toolchain requires substantial engineering and stabilization work to reach TRL 7 by the end of an EsD
- AllScale API and AllScale compiler: 72 PMs
- AllScale runtime system needs to be restructured to be usable without a compiler: 36 PMs

Information/actions needed to prepare for EsD projects

- information on codes to be parallelized
- information on target architectures
- time frame for stabilization/engineering work available during project duration