NREL
NATIONAL RENEWABLE ENERGY LABORATORY

ENERGY SYSTEMS INTEGRATION

ESI optimizes the design and performance of electrical, thermal, fuel, and water pathways at all scales.

PARTNERSHIPS

NREL + HEWLETT-PACKARD

NREL and Hewlett-Packard (HP) collaborated to design a highly efficient supercomputer that uses warm water for cooling. The cooling process results in hot water coming from the supercomputer, which is captured and used for space heating. This design strategy avoids the need for expensive, energy-consuming chillers and allows the heat captured from the supercomputer to provide all the heating needs for the ESIF, including heating outside walkways in the winter for snow melt. During the summer, the unused heat can be rejected via low-cost, efficient evaporative cooling towers.

R&D STRATEGY

HP was in the process of designing a warm-water-cooled supercomputer when NREL released a request for proposals on the same topic, so the partnership was an ideal fit. NREL served as a test bed for the supercomputer, a role that was essential in finding the best approach for installing the liquid cooling system and in maintaining computer uptime during maintenance. NREL also integrated the supercomputer into the ESIF's energy systems for waste heat capture and re-use in office and laboratory space, making the ESIF itself a prime example of energy systems integration.

IMPACT

NREL's first supercomputer, named Peregrine, is a model of efficiency for the high-performance computing industry, and an example of how the energy normally wasted when cooling supercomputers can instead be captured and used for beneficial purposes. HP launched its warm-water-cooled design as the HP Apollo 8000 System in June 2014. As the supercomputer industry aims to achieve exascale performance levels—a billion billion calculations per second, or roughly 1,000 times faster than Peregrine—such energy-efficient approaches are essential to keep the electrical demands for the computers and the cooling systems that support them within practical limits.

The Peregrine supercomputer, capable of 1.19 million billion calculations per second, is cooled with warm water to provide efficient cooling while meeting all the heating needs of the ESIF. The total energy used for cooling is only 3% more than the energy needed to cool the computing components. *Photo by Dennis Schroeder, NREL 31716*

Partner with NREL at the ESIF

User facility access to the ESIF is awarded through the review and approval of user proposals, depending on the scientific merit, suitability of the user facilities, and the appropriateness of the work to DOE objectives, and includes a signed user agreement for the facility.

For more information, please visit:
www.nrel.gov/esi/working_with.html
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The Energy Systems Integration Facility (ESIF) at the National Renewable Energy Laboratory (NREL) provides the R&D capabilities needed for private industry, academia, government, and public entities to collaborate on utility-scale solutions for integrating renewable energy and other efficiency technologies into our energy systems.

To learn more about the ESIF, visit: ***www.nrel.gov/esif***.

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