Hewlett Packard Enterprise

Case study

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AMAZING EFFICIENCY

Keith Foston and the team at Siemens PLM Software develop the simulation software critical to the design of clean, greenhouse gas-reducing turbines.

Reducing greenhouse gas emissions is a truly global issue. In some way it involves every individual, nation, and industry on the planet—whether they're part of the problem or part of the solution.

Keith Foston and Siemens PLM Software are hard at work on the solution side.

Siemens Digital Industries is an innovation and technology leader in industrial automation and digitalization, and Keith Foston is the technical product manager of cloud and high-performance computing for Simcenter STAR-CCM+.

STAR-CCM+ is Siemens' champion in the fight against greenhouse gas emissions. The multiphysics simulation tool is critical to many manufacturing processes—everything from glass bottles to rockets to cleaner, more efficient natural gas turbines.

Research shows natural gas consumption is increasing more than 40% between 2018 and 2050.[1] Compared to coal-fired power, natural gas power plants emit half as much CO_2 per kilowatt hour. And they have the potential to do even better.

[1] eia.gov/todayinenergy/detail.php?id=41433#

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Siemens PLM Software

Industry
Energy

"The efficiency improvement and reduced emissions from gas turbines are making a meaningful difference in the global fight against climate change."

Siemens PLM Software
Siemens PLM Software is a world-leading provider of product lifecycle management and manufacturing operations management software.

High-Performance Computing Center Stuttgart
The High-Performance Computing Center Stuttgart supports researchers from science and industry. Their Cray XC system is one of the most powerful HPC systems in the world.

System details
- Cray XC supercomputer
- 7.42 PF peak performance
- 41 cabinets
- 7,712 compute nodes

"Today, combined cycle natural gas power plants achieve over 60% efficiency," says Foston. "But a performance improvement of just 0.1% would equate to a $15 million reduction in fuel costs over the life of a single gas turbine."

In this case, lower fuel costs mean less greenhouse gas released into the atmosphere. It also means gas turbine manufacturers are racing to increase their products' efficiency.

To do so, they need to do high-fidelity modeling of turbulent combustion with a focus on turbulence-chemistry interaction. Foston says this type of simulation is **very demanding**, because the chemical reactions can range in scale from less than a millimeter to 0.1 kilometer. Correspondingly, timescales range from nanoseconds to minutes. But done well, these simulations equip engineers with the insight to improve turbine performance and, ultimately, drive down emissions.

Enter Siemens PLM and STAR-CCM+.

"We're dedicated to providing the best tools for engineers doing this important work," says Foston. "And we're continuing to make advances in complex chemistry and transient large eddy simulation capabilities in STAR-CCM+."

Those advances rely heavily on making efficient use of ever-growing compute power—and scalability is the key. "Scalability enables combustion engineers to run very high fidelity simulations in a practical amount of time," says Foston. "Not just for turbulent 'cold flow' but for the entire 'hot flow' process which is essential to improving combustion efficiency and providing accurate predictions of emissions."

In their effort to improve the scalability of STAR-CCM+, the Siemens PLM team partnered with the High- Performance Computing Center Stuttgart (HLRS) to demonstrate the software's capability on the center's Cray XC supercomputing system. They successfully ran a high-fidelity gas turbine combustion simulation using over 50,000 compute cores.

Their run showed almost perfect speedup, or 100% parallel efficiency.

"Making efficient use of such a large amount of computing power is key," says Foston. "A simulation that may have taken weeks to complete can now provide insight to the engineer overnight."

With globally agreed-to goals and deadlines looming for greenhouse gas reductions, time truly is of the essence. But there's already much reason for optimism. Foston says: "The efficiency improvement and reduced emissions from gas turbines are making a meaningful difference in the global fight against climate change."

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