General Motors

Clean Combustion Engines Advanced with Predictive Simulation Tools

Sandia National Laboratories (SNL) has been working with General Motors (GM) for over 30 years. In the last few years, this partnership has become a Strategic Alliance, which includes a Cooperative Research and Development Agreement (CRADA), making it easier for the partners to work together.

The Alliance has broken new ground in how the national laboratories work with industry leaders. There's a dedicated SNL liaison to GM and a GM liaison to SNL. The liaisons create continuity and provide a person dedicated to facilitating communication between appropriate individuals in the two large and complex organizations. This model expedites collaborations on key technologies and systems analysis to address the most critical issues including working to strengthen U.S. positions in energy efficiency, energy security, technology innovation, and global competitiveness.

Research areas being focused on include systems modeling for energy, infrastructure, and future generation vehicles; energy storage-advanced batteries and hydrogen storage; clean advanced combustion; and future generation vehicle networks and sustainable communities. Combustion is an area that GM and SNL have worked on extensively over the years. Currently, GM and SNL are addressing clean advanced combustion using many technologies and may include the Predictive Simulation of Internal Combustion Engines (PreSICE) in the future.

Because of their relatively low cost, high performance, and ability to utilize renewable fuels, internal combustion engines—including those in hybrid vehicles—will continue to be critical to our transportation infrastructure for decades. Achievable advances in engine technology can improve the fuel economy of automobiles by over 50% and trucks by over 30%.

The use of predictive simulation tools for enhancing combustion engine performance will result in direct economic benefit through reduced time-to-market and reduced development costs. Dramatic increases in fuel efficiency will increase the nation's energy security and simultaneously reduce greenhouse emissions.

A PreSICE workshop with participants from industry, including GM, the national laboratories, including SNL, and universities was held in March 2011 to identify research needs. While workshop participants agreed enhanced efficiency is achievable, they also agreed that dramatic increases in engine efficiency can only be reached by developing new design tools that fully leverage the computational simulation capabilities of the nation.

The final appropriation for the DOE Office of Science in 2012 included $10 million for this effort. The GM-SNL Strategic Alliance will be a key partnership helping to achieve the PreSICE program goals.

Daniel Dedrick, an SNL researcher, handles a complex metal hydride within an inert production and storage environment.

GM and Sandia have a rich history of significant collaboration. The result is cleaner, more efficient combustion engines on the road today than would have otherwise been possible.

Dr. Gary Smyth
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