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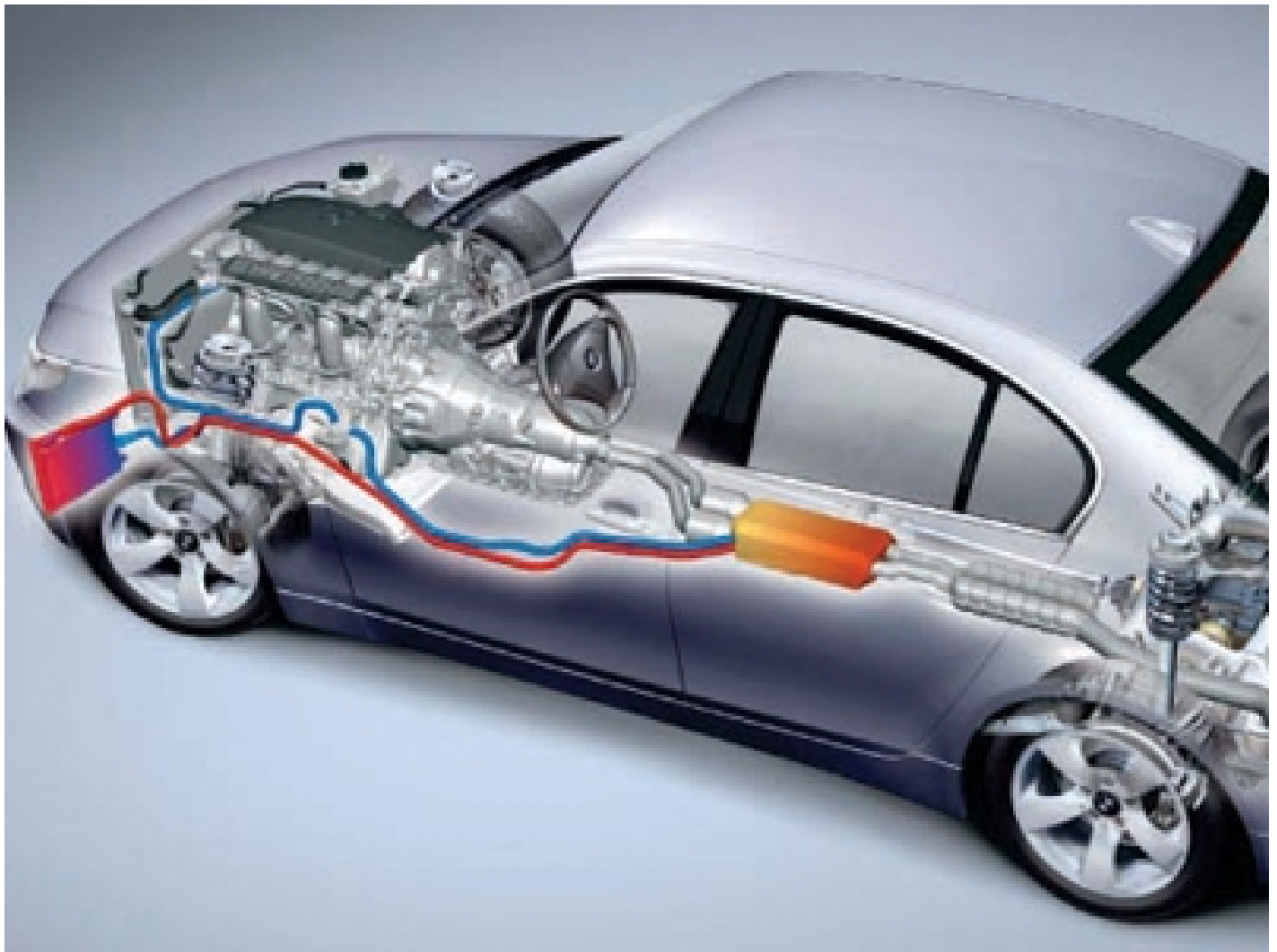
Department of Energy

# Could TEG Improve Your Car's Efficiency?

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This image shows how a thermoelectric generator would be placed in a passenger car. | Photo courtesy of BMW

More than half of the gas we buy -- and the money we spend on it -- is wasted.

Even the most efficient drivers are at the mercy of their vehicles' internal combustion engines, which lose an average of 60 percent of their energy as heat from the tailpipe and radiator.

John LaGrandeur has been working on this since 2004. He and his team want to recapture that heat -- something he says will benefit automakers as well as drivers. And TEG -- a thermoelectric generator -- that converts the engine's heat to electricity is the solution, according to LaGrandeur.

"Vehicle designers are looking at the need for higher electrification. They need more power," says LaGrandeur, who is director of automotive programs for Irwindale, Calif.-

based BSST. "At the same time, [they're] seeing pressure by governments to reduce emissions. Burn more gas but [create] more fuel economy: that's tough to do."

Come this October, LaGrandeur, and the team, will test the TEG they created. That TEG will first be attached to a BMW engine and put through simulated drive cycles in a lab at the National Renewable Energy Laboratory in Golden, Colo. Then, in February of 2011, the devices will be placed in a Ford Fusion sedan and a BMW X6 roadster for test drives.

## **Something old is new again**

Thus far, LaGrandeur says, the system converts four to five percent of the escaping heat to 500-750 watts of electricity. This increases fuel economy by one to five percent, by reducing the amount of fuel burned to power the car's electrical components, like the headlights, and in turn, reduces emissions.

Scientists have understood the technology behind TEGs for several hundred years, but recent concerns about emissions have motivated research into how it might be used in cars. In addition, LaGrandeur says, the increasing electrification of vehicles coupled with increasing regulatory pressure on tailpipe emissions both help to make this project worthwhile.

BSST was building on its parent company Amerigon's existing expertise and principal product -- a [heated and cooled seat system](#) for the automotive market that works on thermoelectric principles. LaGrandeur says BSST's automaker partners, BMW and Ford, handled a good part of the project by developing vehicle exhaust systems to work with a TEG, and modeling how the entire system would work under real-world conditions.

## **Defining TEG**

Automotive Thermoelectric Generators (ATEG) recover heat that escapes from a vehicle powered by an internal combustion engine, and generate electricity with the heat.

"Their model looks at everything from tire traction to extra weight to drag on front of car," he says. "It's very holistic, it's very comprehensive and they can use it to predict fuel economy."

## **Practical applications**

In the beginning, LaGrandeur doesn't think drivers will notice changes in their cars more than they'd notice any other slight improvement in the powertrain. But in the long term, he says, TEGs could increase fuel efficiency by as much as 10 percent, and replace the alternator (a car's electrical generator) entirely in vehicles with internal combustion engines.

In addition, LaGrandeur says, the technology could add to the energy efficiency of hybrid vehicles. Currently, a hybrid such as a Prius recaptures some energy from braking, which helps recharge its batteries - but this applies mostly in city driving. On a long road trip, opportunities for this regenerative braking are minimal. Installing a TEG could provide a counterpoint to regenerative braking, he says, improving fuel economy by five percent during highway driving, when more exhaust gas thermal power is available.

Introduction into the market is scheduled for 2012 in Europe, where strict EU emissions standards have made automakers eager to adopt fuel efficiency technologies. TEGs will be introduced more widely around 2018.

LaGrandeur adds that U.S. research in this area is vital, because the country that comes up with the best emissions reduction technology is the country that's likely to capture the market for selling it - and the jobs producing it.

The research is funded in part by the U.S. Department of Energy's Vehicle Technologies Program. As of the summer of 2010, DOE has provided about \$7.15 million, and the partners have contributed another \$2.385 million.

"What you have to consider is that the winners in this area will develop products creating jobs that don't exist today," he says. "The DOE investment is very important because the funding is early-stage, pre-competitive, and it's enabling us companies to gain a position in this market, to capture part of the market and jobs."

What are the key facts?

A Thermoelectric Generator (TEG) recaptures lost vehicle heat for better efficiency. This project is funded in part with \$7.15 million federal Vehicle Technologies Program grant.

This is targeted for the U.S. market in 2018 models.

## LORELEI LAIRD

Lorelei Laird is a writer with Energy Empowers.

### MORE BY THIS AUTHOR

1000 Independence Ave. SW

Washington DC 20585

202-586-5000

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