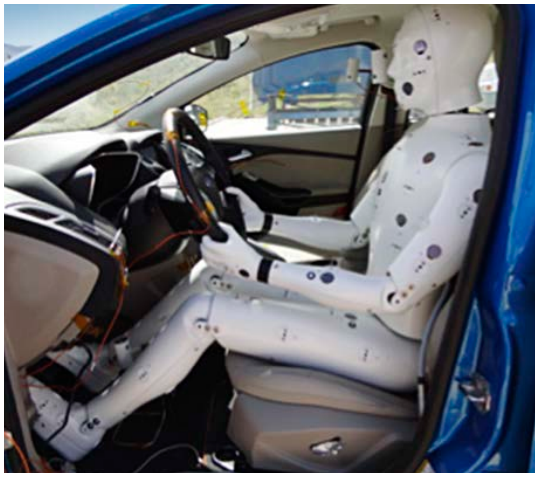
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

NREL Reduces Climate Control Loads in Electric Vehicles

Highlights in Research & Development

NREL demonstrates that zonal climate control can reduce air conditioning power and improve range while maintaining driver thermal sensation.

When the climate control system in an electric-drive vehicle (EDV) is operating, the energy consumed has a significant impact on range. Researchers at the National Renewable Energy Laboratory (NREL) are seeking to increase in-use EDV range by minimizing climate control energy requirements. The goal is to increase EDV range by 10% during operation of the climate control system through improved thermal management while maintaining or improving occupant thermal comfort. The research results indicate the opportunity to reduce energy consumption and improve thermal sensation with a zonal climate control approach.



A thermal manikin was used to assess the zonal concepts.
Photo by Matt Jeffers, NREL

Currently, conventional vehicles heat cabins with engine waste heat, but because EDVs do not have an engine, automobile manufacturers are presented with new climate control challenges. Using the battery for cabin electrical resistance heating takes valuable energy away from propulsion. Therefore, it is critical to minimize climate control loads in EDVs to maximize vehicle range. The research team is working with the automotive industry to develop strategies to reduce climate control loads and evaluate their effectiveness. New strategies for thermal comfort evaluation are being investigated.

As part of a cooperative research and development agreement (CRADA) project with Ford Motor Company, NREL researchers completed summer thermal load reduction testing on two Ford Focus Electrics. Temperature and power measurements as well as a thermal manikin were used to assess three zonal climate control configurations and six thermal load reduction configurations. At the same HVAC air-flow rate as the established baseline, the zonal vent configurations demonstrated up to a 16.7% reduction in climate control energy compared to the baseline HVAC system. Reducing the total airflow rate increased the energy savings up to 50% without sacrificing driver comfort.

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Key Research Results

Achievement

As an outcome of the research, EDV climate control energy was reduced up to 16.7% with equivalent HVAC airflow and 41.3% with reduced airflow through zonal vent configurations while maintaining or improving occupant thermal comfort.

Key Result

Vehicle simulations in city and highway drive cycles showed that a zonal air conditioning system has the potential to increase vehicle range by 7%–15% during A/C operation in high temperature and solar load environments.

Potential Impact

The results indicate the opportunity to reduce energy consumption and improve thermal sensation with a zonal climate control approach.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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