



National Renewable Energy Laboratory

A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy

Innovation for Our Energy Future

Evaluating Ultracapacitors for the Saturn Vue Mild Hybrid Platform

Cooperative Research and Development Final Report

CRADA Number: CRD-08-00276

NREL Technical Contact: Ahmad A. Pesaran

CRADA Report
NREL/TP-7A1-48420
August 2010

NREL is operated for DOE by the Alliance for Sustainable Energy, LLC

Contract No. DE-AC36-08-GO28308



NOTICE

This report was prepared as an account of work sponsored by an agency of the United States government. Neither the United States government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or any agency thereof.

Available electronically at <http://www.osti.gov/bridge>

Available for a processing fee to U.S. Department of Energy
and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
phone: 865.576.8401
fax: 865.576.5728
email: <mailto:reports@adonis.osti.gov>

Available for sale to the public, in paper, from:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
phone: 800.553.6847
fax: 703.605.6900
email: orders@ntis.fedworld.gov
online ordering: <http://www.ntis.gov/ordering.htm>



Printed on paper containing at least 50% wastepaper, including 20% postconsumer waste

Cooperative Research and Development Final Report

In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

CRADA number: CRD-08-00276

CRADA Title: Evaluating Ultracapacitors for the Saturn Vue Mild Hybrid Platform

Parties to the Agreement: General Motors + NREL

Abstract of CRADA work:

Recent analysis conducted by NREL for the USABC and the Electrochemical Energy Storage Technical Team indicated that HEVs utilizing smaller energy windows from the on-board storage system can achieve much of the fuel economy benefit realized by larger energy window HEVs. The simulations showed that nearly all hybridization fuel savings are realized with energy windows of 150 Wh or less. Dynamometer testing of a variety of production HEVs (both mild and full hybrid) has confirmed battery window use less than 200 Wh on standard drive cycles. These findings suggest a cost-saving opportunity from using either smaller batteries or ultracapacitors (which have lower projected long-term costs and superior cold-temperature performance) in order to still achieve a sizeable hybridization benefit. An additional limitation for batteries is that even a small in-use energy window requires a much larger nominal energy level in order for the battery to last the life of the vehicle. Ultracapacitors on the other hand possess excellent cycle life capability, so they require a much smaller size margin (even if they are frequently cycled over a smaller in-use energy window). With specific respect to the production Saturn Vue Green Line BAS Hybrid, NREL's dynamometer test data analysis has indicated that the vehicle already uses energy windows no greater than roughly 50 Wh on each of the standard test cycles examined. This tentatively suggests that an ultracapacitor with approximately 75 Wh of usable energy could be used to achieve most if not all of the current configuration's fuel savings—much smaller than the 600 Whr battery used in the current Vue hybrid.

Summary of Research Results:

- Accomplishments – Converted and tested HEV with three energy storage configurations
 - NiMH (stock)
 - 1 and 2 Ultracapacitor modules
- Findings – The HEV performed equal or better with one Ultracapacitor module relative to the stock NiMH HEV configuration
- Significance – Ultracapacitors could increase HEV market penetration (thus increasing fuel savings)
 - Ultracapacitors possess excellent life and low-temperature performance, and have low long-term projected costs

See attached publicly-presented summary for further details
(Gonder_HEVUcapBatteryTesting_2010SAEHEVSymposium_FINAL.ppt).

Subject Inventions listing: None

Report Date: 4/19/10

Responsible Technical Contact at Alliance/NREL: Pesaran, Ahmad A.

This document contains NO confidential, protectable, or proprietary information.