12 Volt Auxiliary Load:

Fuel Economy Sensitivity Study and Advanced Alternator Evaluation

www.inl.gov

Idaho National Laboratory

Barney Carlson
Idaho National Laboratory
Energy Storage & Transportation Systems
Advanced Vehicle Testing Activity (AVTA)

Aymeric Rousseau
Argonne National Laboratory
Autonomie team

INL/MIS-15-36956

Introduction

- Investigate and quantify the impact of auxiliary load on vehicle fuel economy
  - Dynamometer testing
    - Artificially Elevate and Reduce auxiliary load
      - External DC loads and power supplies
      - Remove / disconnect alternator entirely to quantify sensitivity bounds
  - Map the efficiency performance of state of the art alternator technologies (speed vs. torque)
  - Benchmark advanced alternator technology
    - Test and compare Mazda 3 i-ELOOP to standard Mazda 3
  - Combine the above results with U.S. national fleet driving and climate data to quantify national petroleum displacement impact

Measure Auxiliary Load Impact on Fuel Economy

- Test one or more AVTE vehicles (from present 12V Aux. evaluation)
  - Baseline: prior APRF testing
  - Elevated auxiliary load
    - external DC load
    - Additional accessories ON
  - Reduced auxiliary load
    - External DC power supply to offset auxiliary load
    - Remove and/or disconnect the alternator to determine minimum bound

Mazda 3: i-ELOOP vs. standard alternator

- Evaluate standard Mazda 3 and compare to Mazda 3 i-ELOOP

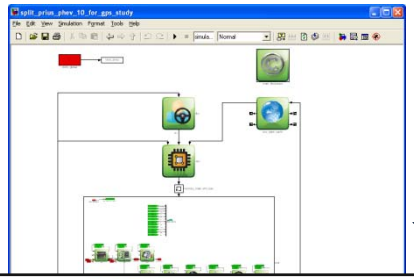
- Acquire one or more used 2014 Mazda 3 with standard alternator
- Testing and evaluation
  - Dynamometer testing
    - Standard suite of drive cycle testing across 3 temperatures
  - Baseline / track testing

  - On-road operation
    - Operate both vehicles on-road, concurrently (side by side)
      - Operate same accessories concurrently

Autonomie will be used to evaluate Advanced Alternator Benefits to Multiple Drive Cycles and Multiple Powertrain Technologies

Accessory Load Characterization;
Accessory load utilization information

Sample Vehicles,
Multiple Driving Scenarios



AUTONOMIE

Advanced Alternator Characterization,
Accessory load characterization

Sample Vehicles,
Sample Driving Scenarios,
Detailed Instrumentation

Impact of advanced alternator technology & accessory load reduction on FE benefits for
- A large set of real world driving scenarios.
- Advances in engine technology.

Background info: Several RWDC drive Cycles from NREL TSDC database have been previously used in Autonomie

Kansas City

California Household Travel Survey 2012

Chicago Metropolitan Agency

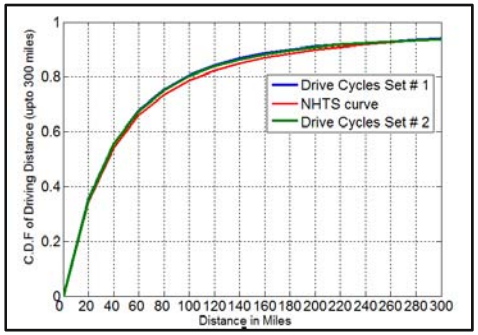
Information per Vehicle

Attributes:
trips per day,
Trip start time,
End Time,
Vehicle ID, Day ID, etc.
Along with time stamped data.

Additional information also provided

AUTONOMIE READY!!!

Real World Drive Cycles
OR
Sets of Daily Driving Schedules to match NHTS



Summary

- This study will investigate and quantify the impact of auxiliary load on vehicle fuel economy
  - Artificially Elevate and Reduce auxiliary load
  - Map the efficiency of state of the art alternator
  - Benchmark advanced alternator technology in a production vehicle platform
  - Combine the above results with U.S. national fleet driving and climate data to quantify national petroleum displacement impact