

12 Volt Auxiliary Load On-road Analysis

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

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Timeline

FY15

- Add sensors into vehicles
- Characterize individual auxiliary loads
- Collect and analyze data from on-road operation
- Publish quarterly reports of findings

Budget

- FY15: \$ 150k

Barriers

- Lack of the availability of real world, on-road driving data detailing
 - 12V auxiliary loads
 - driving characteristics

Partners

- Intertek CECET, Phoenix AZ
- Argonne's APRF (dynamometer testing)
- OEMs
 - Chrysler
 - Ford
 - GM

Objective / Relevance

- Quantify the real world, on-road auxiliary loads and driving characteristics from multiple non-electrified vehicle models
 - To support OEMs request for real world data to support advanced technology systems with respect to off-cycle fuel economy credit
 - “Off-Table” Alternative EPA-Approved Methodology
- This on-road data collection and published results
 - Can be used by OEMs / Suppliers for possible off-cycle credits for advanced technologies
 - Gain understanding of variation of auxiliary loads due to temperature, driving condition, and driving style

Milestones

- Data collection commenced after current and voltage sensors were added
 - May 2014
 - 2012 Honda Civic CNG
 - 2013 Volkswagen Jetta TDI
 - August 2014
 - 2014 Chevrolet Cruze Diesel
 - 2014 Mazda 3 i-ELOOP
- Individual auxiliary loads characterized during steady state operation
 - Examples: lights, fans, heated seats, elec. power steering, etc.
- Benchmark over standard dynamometer drive cycles (Argonne's APRF)
- Published Fact Sheets
 - Summer 2014, Autumn 2014, Winter 2015, Project to Date
 - 2012 Honda Civic CNG
 - 2013 VW Jetta TDI
 - Autumn 2014, Winter 2015
 - 2014 Chevrolet Cruze Diesel
 - 2014 Mazda 3 i-eLoop
- Duration: Data collection is on-going for 12 months for each vehicle model

Approach:

- Leverage vehicles operating in the AVTE fleet
- Add sensors (current and voltage) to measure auxiliary loads
- Testing and Evaluation
 - Characterize each individual auxiliary load (steady state) for each vehicle model
 - Example: headlights, interior fan, heated seat, etc.
 - Benchmark auxiliary loads over standardized drive cycles
 - Argonne APRF dynamometer test facility
 - Collect on-road data during all driving conditions
 - Process and organize data into SQL database
 - Analyze data for auxiliary load and interdependence with external factors and utilization
 - Publish results
 - Quarterly basis (for seasonal comparison)
 - Summarized results

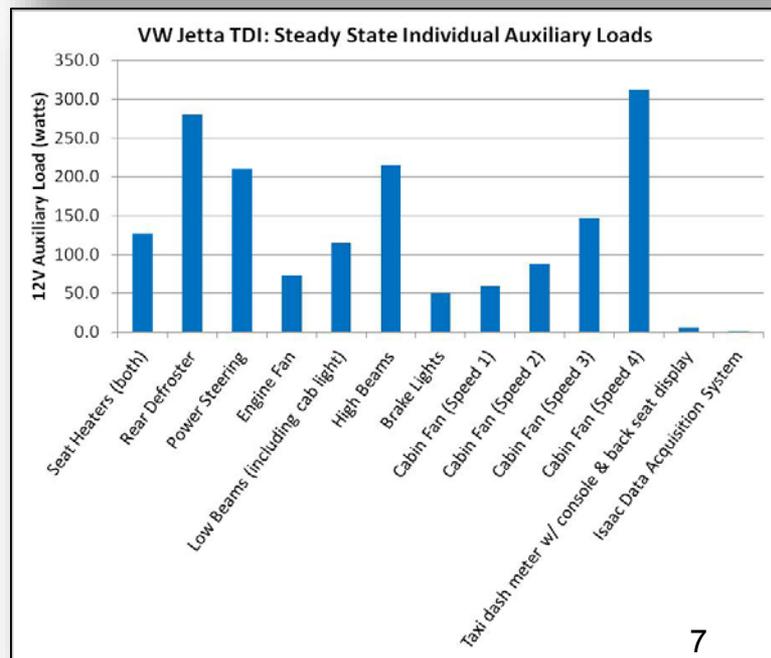
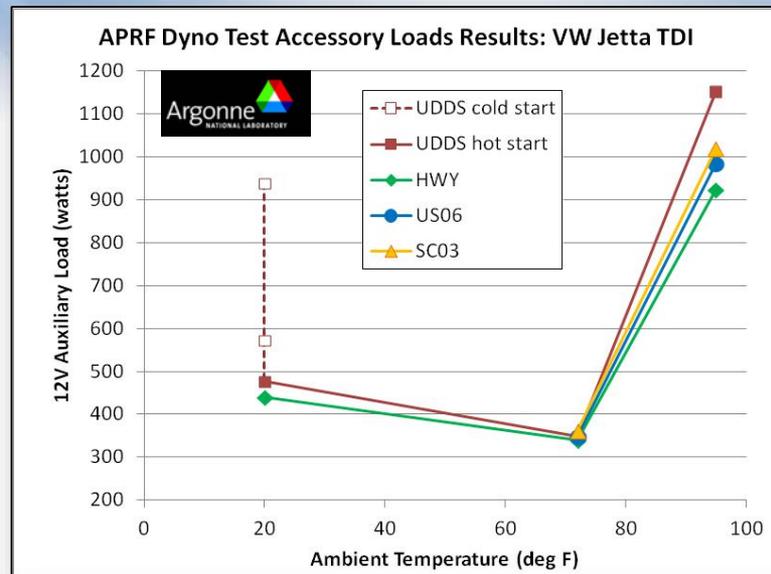
Approach: Vehicles Evaluated

- 4 of each model
 - 2012 Honda Civic CNG
 - 2013 Volkswagen Jetta TDI
 - 2014 Chevrolet Cruze Diesel
 - 2014 Mazda 3 i-ELOOP



Accomplishments:

- Characterize auxiliary loads
 - Loads are characterized from standardized dynamometer testing
 - Auto climate control set to 72°F for all tests
 - Significant A/C operation during 95°F tests
 - Significant heater operation during 20°F tests
 - Individual loads are operated in steady state condition
 - Figures shows example results of each load increase over base load from VW Jetta TDI
 - Base load with engine running and all accessories off
 - 258 watts

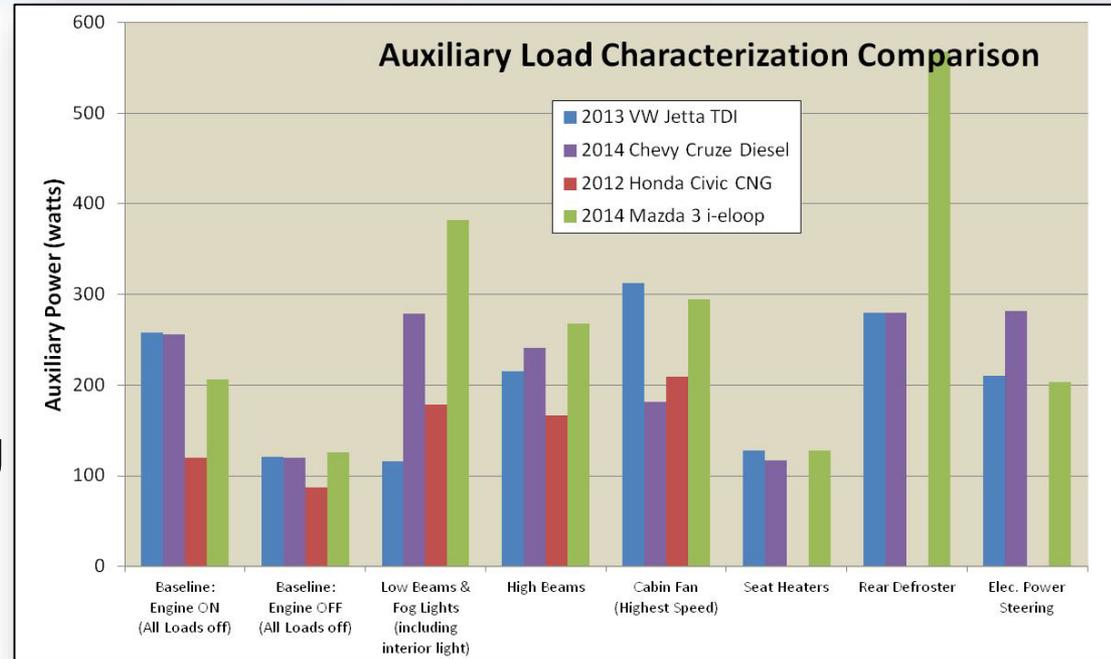


Accomplishments:

- Comparison of vehicle models

Notable attributes:

- Honda Civic CNG
 - No fuel pump
 - No seat heaters
 - No rear defroster
 - Hydraulic power steering
- Mazda 3
 - Fog lights

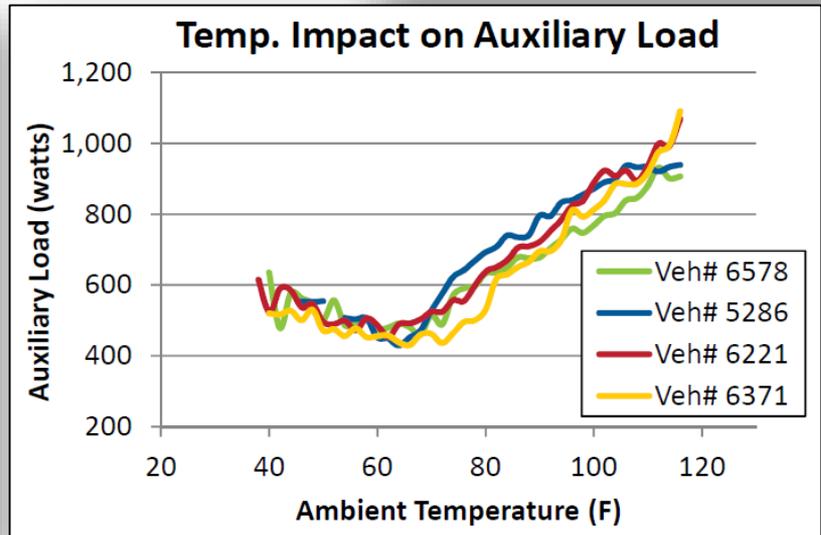
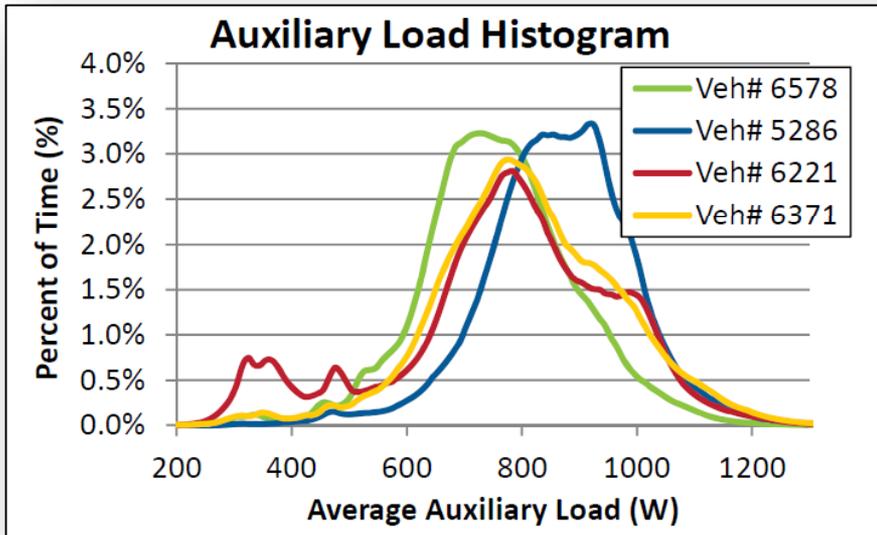
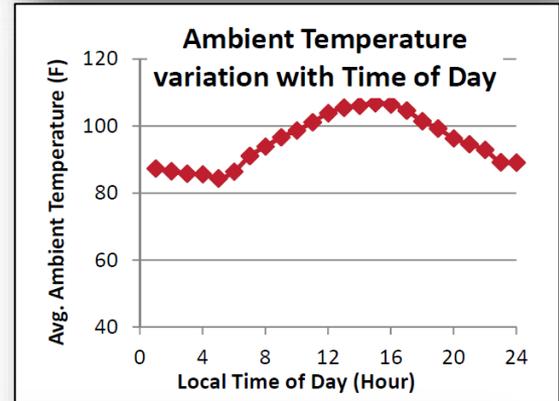
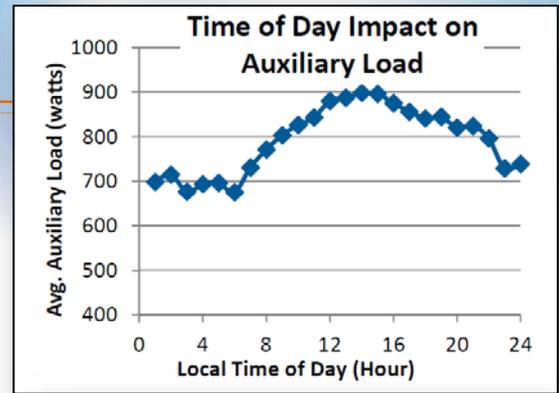


	VW Jetta TDI	Chevy Cruze Diesel	Honda Civic CNG	Mazda 3
Summer 2014	796 watts	N/A	338 watts	N/A
Autumn 2014	657 watts	555 watts	297 watts	405 watts
Winter 2015	491 watts	570 watts	293 watts	441 watts
Overall Avg.	667 watts	562 watts	308 watts	425 watts

Accomplishments:

On-road auxiliary loads results

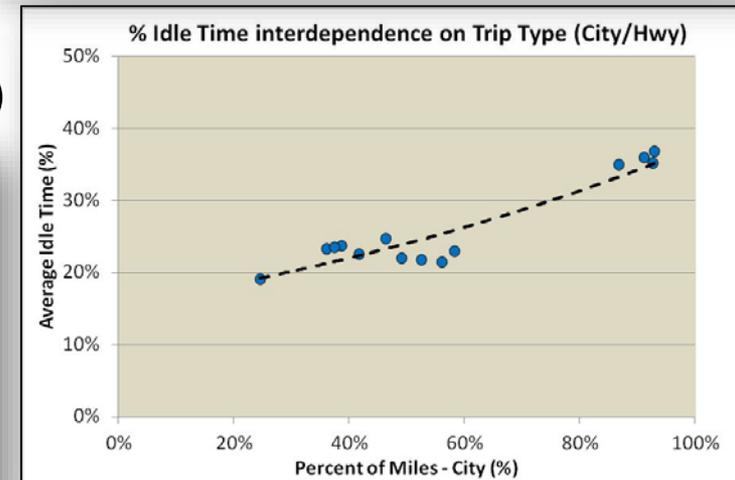
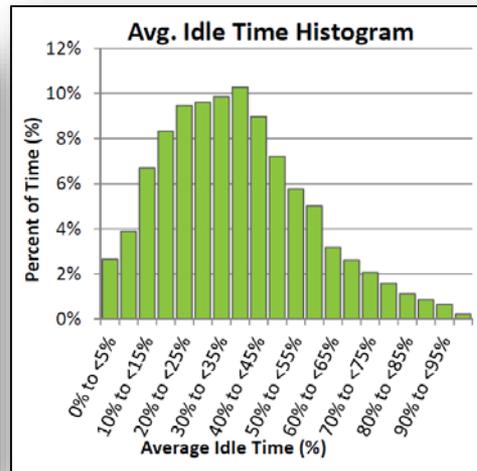
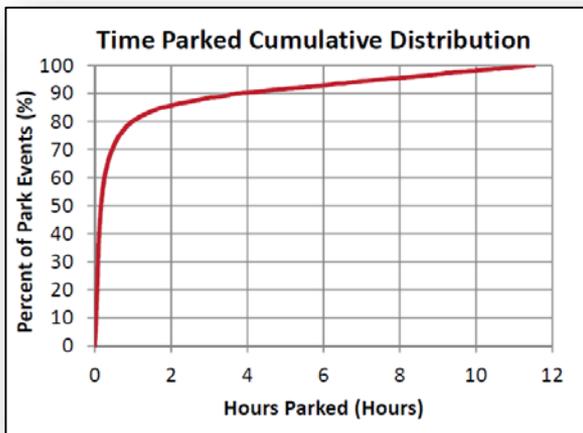
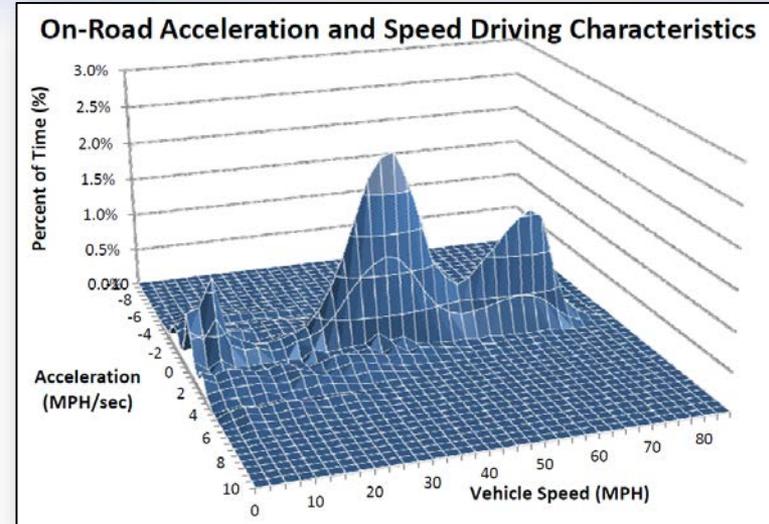
- Example:
- Impact to avg. Auxiliary Load from change in Ambient Temperature
 - JettaTDI: 425 to 1,100 watts
- Impact due to vehicle lighting (evening)
 - JettaTDI: avg. of 150 watts between 19:00 and 5:00



Accomplishments:

On-road driving characteristics results

- Calculated for each vehicle model
 - Average percent Idle Time
 - Time Parked (between drives)
 - Distribution of vehicle speed and acceleration
- Example from varying vehicle utilization:
 - 36.9 % Idle time
 - Mostly city driving (92.9% mi in city)
 - 19.1% Idle time
 - Mostly Hwy driving (24.6 % mi in city)



Accomplishments: Example Fact Sheet

Advanced Vehicle Testing Activity

Auxiliary Loads: 2013 VW Jetta TDI
5/13/2014 through 3/1/2015

Number of Vehicles: 4
Location of on-road operation: Arizona
Description of use: Taxi service



Description / Specifications
Engine Displacement: 2.0 L
Engine and Fuel Type: Turbo Diesel
Alternator max current rating: 140 A

Summary of On-Road Results

Vehicle Number (#)	6578	5286	6221	6371	All
Distance Driven (miles)	23,713	34,245	36,502	31,404	125,863
Average Auxiliary Load (watts)	639.3	729.0	648.7	631.9	666.9
Average Ambient Temp. (F)	87.2	91.7	81.7	75.9	84.2

Auxiliary Load Histogram

Time of Day Impact on Auxiliary Load

Temp. Impact on Auxiliary Load

Ambient Temperature variation with Time of Day

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Summary of On-Road Driving Characteristics

Vehicle Number (#)	6578	5286	6221	6371	All
Percent of Driving: City (%)	90.4%	92.9%	96.9%	83.1%	91.1%
Percent of Driving: Highway (%)	9.6%	7.1%	3.1%	16.9%	8.9%
Average Idle Time (%)	33.3%	37.6%	39.5%	31.5%	36.0%

On-Road Acceleration and Speed Driving Characteristics

Avg. Idle Time Histogram

Time Parked Cumulative Distribution

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Response to Previous Year Reviewer Comments

- This project is new for this year.

Future Work:

- Continue data collection on the 4 models through a minimum of one year of data collection and analysis
- Continue to publish:
 - Quarterly fact sheets
 - Project to Date fact sheets
- Publish white paper on results and findings
 - On-road results
 - Dynamometer testing results
- Evaluate additional vehicles (non-electrified) as available through AVTE

Summary / Comments:

- **Completed:**
- Data collection commenced
 - May 2014 and August 2014 for the respective models
- Individual auxiliary loads characterized during steady state operation
 - Examples: lights, fans, heated seats, elec. power steering, etc.
- Benchmarked auxiliary loads over standard dynamometer drive cycles
 - Argonne's APRF dynamometer test facility
- Published Fact Sheets
 - Quarterly
 - Project to Date (current summary of results)
- Duration: Data collection is on-going for minimum of 12 months for each vehicle model

- These results provide a referenceable and publically available source of auxiliary load and driving characteristic data

Acknowledgement

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EERE Vehicle Technologies Office**

More Information

<http://avt.inl.gov>