

Bleeding Edge EnSys, LLC.

Army Expeditionary Technology Search (xTechSearch) Competition

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Technology Focus Area:

Next Generation Combat Vehicles

Design / Advanced Power Generation

Advanced Thermo-Aerodynamic Diesel/Electric Upgrade

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Proven Operating Principals

- Up to 10% fuel savings/lower emissions
- 65+ restored horsepower
- Improved engine environment
- 50% lower under-hood temp/thermal signature
- 50dB lower under-hood sound/acoustic signature
- Improved drag-coefficient
- Reduced heat-related failures
- Reduced maintenance cost/intervals

Next Generation Combat Vehicle Technology Starts with Optimized Cooling and Airflow

Heavy-duty vehicles are challenged with high-performance demands and high under-hood temperatures. Military vehicles must optimize armor weight/insulation. Heavy trucks experience near constant heat-related component failures. Even new EV/HEVs (Electric Vehicle/Hybrid Electric Vehicles) face similar challenges with reliable/efficient cooling of electrical components, especially with high-voltage/rapid-charging.

There is a critical/overlooked problem in heavy-duty vehicle airflow/cooling design and maintenance/operation that brings hot air into an already hot engine compartment. Our technology is a fundamental shift in vehicle cooling system design. The globally patented advanced thermo-aerodynamic AMS (Air Management System) optimizes internal combustion engines (ICE) dramatically improving airflow/cooling/engine power/air-resistance/vehicle drag by reconfiguring this airflow. This innovative solution allows for low-cost yet substantial ROI

The AMS accelerates and redirects hot radiator air to outside the vehicle reducing under-hood temperatures up to 50%. High-performance electric fans restore 65+ horsepower to the engine by removing parasitic loads of the original belt/gear-driven fan assembly. Custom internal/external ducting separates radiator air from the engine compartment. All incoming air is efficiently diverted through the plenum/hood eliminating “dead-heading” and improving drag-coefficient. The engine and compartment then split cool ram-air through a full-width cowl-induction scoop. Heated compartment air exits through pressurized side ducting. The AMS creates fuel savings with minimal engine/body modifications just by replacing the fan system, restoring horsepower and reducing drag-coefficient. The TMC/SAE J1321 Fuel Economy Test conducted by Claude Travis & Associates resulted in 7.47% average fuel savings on a fully loaded Class 8. Ryder Systems tested 2 on-road trucks. New modifications are estimated to increase savings to 10%. Jacobs Engineering at Ford Motor Company wind tunnel revealed 130°F reduction in under-hood temperature. The system weight/cost is similar to the replaced OEM fan assembly. A version of the AMS has been tested on a military Humvee in simulated environments and our current Class 8 truck is a 3rd generation prototype with the production model in development. The AMS also has potential to cool motors/batteries/brakes.

In addition to the AMS, a synergistic set of proprietary cooling system cleaner/inhibitor filters are used to fully clean/restore scaled-out cooling systems and keep them clean with non-acidic chemistry that doesn't damage aluminum/copper, while driving. Direct benefits realized in a nine-year extensive independent study confirm dramatic decrease in maintenance costs and failures/replacements of radiators, water pumps, defroster cores, oil coolers, and 100% reduction of clog-related overheats.

This total air/liquid cooling system protection removes all radiant/conductive under-hood heat-related risks.

Optimizing thermodynamics by using natural air pressure differentials and advanced controls we redesigned the entire under-hood airflow. Vehicles will see immediate temperature reduction, increased available horsepower, fuel savings and drivability improvement from less fan noise. The AMS is suitable for any ICE/EV/HEV experiencing

high-demand workloads and/or long idling, especially heavy military vehicles in hotter climates. We are currently developing advanced telematics that collects all critical vehicle system data and directly verifies efficiency/operational claims. Fleets/drivers will gain features like predictive maintenance alerts, dynamic routing, driver coaching and fleet management tools.

The next development is building an advanced diesel/electric hybrid module integrated into the AMS to further optimize performance. The AMS will benefit HEVs with cooling and restored horsepower, allowing a lower HP engine to be used in an HEV design while maintaining the same output/MPG.

This regenerative electric upgrade for heavy vehicles allows full EV low-speed driving, seamless EV-to-Diesel transition and back, fast-charging while driving and increased range with lower fuel consumption. The HEV concept electrifies all accessories, serving as an advanced APU for the ICE allowing full EV-idle, increased horsepower, less maintenance/downtime and increased vehicle life. We anticipate the new design to provide a high-torque/full EV operation with zero-emissions/fuel for low-speed driving and seamlessly transition to an optimized ICE for highway cruising/recharging. Additional benefits include redundant propulsion and fewer engine failures/recovery costs. The HEV module is estimated to create 30%+ fuel savings with the combined AMS/HEV system close to 40%+ savings. Restoring HP allows for down-speeding the ICE or spec'ing lower horsepower. This can result in significant light-weighting, and smaller fuel tanks while maintaining or increasing MPG/range.

Commercial/military vehicles need proven/rugged/reliable equipment with lower operational costs. The AMS Thermo-Aerodynamic Package is TRL 7. The AMS finalized commercial ready system will be completed early 2019. The Cooling System Cleaner Filter is TRL 9, commercially available, and proven with a nine-year independent case study. The HEV System is TRL 2/3 though all its independent parts are TRL 9 and commercially available. We are currently in R&D phase 1 with a leading electric vehicle controls company and seeking additional funding to build an HEV around the AMS. The Hybrid Prototype is on our road map in less than 2 years through rapid development and testing.

Core Team Members & Primary Experience

- **George Sturmon**, Inventor/Owner/Engineer, founder of ATRO, a leading manufacturer of high-performance polymers for high-wear, high-heat, shock/vibration-mitigation. Published works in thermodynamics/gaseous fuels, worked on Gemini reentry issues, has 50+ global patents.
- **Edward Murray**, Vehicle Technician, co-inventor and military technician on AMS for early Humvee trials.
- **Susan Schmidt**, Vice President/Manufacturing/Purchasing, vast knowledge of purchasing/sourcing manufacturing processes, taking product R&D to market/starting new companies.
- **Mark O'Hare**, Business and Technical Advisor, 18-year CEO experience and retired USN CAPTAIN (PEO) with numerous successful government/commercial production and product deployments in hardware, software, IT and Cyber Security products, has run multi-million/billion-dollar businesses, is technically astute with 300+ global patents issued or applied for.
- **Joshua Medling**, Creative Director/R&D, research/product dev and strategic marketing, won 1st Place Award for the AMS submission to NASA/SAE Tech Briefs Create the Future Design Contest 2017.
- **Glenn Harris**, Plant & Quality Manager, uses ISO9000/Mil-Spec procedures for quality-control, extensive manufacturing/machining/automation/inspection knowledge.
- **Jason Harmon**, Heavy Truck Mechanic/Technical Advisor, successful truck-shop owner, has extensive knowledge of truck subsystems/industry.