



Transit



## Air-Steam Hybrid Engine: An Alternative to Internal Combustion

### Background

The premise behind the binary recovery, air steam hybrid (BRASH) engine technology is that the combination of air and water in an external combustion (EC) engine provides much higher fuel efficiency than a conventional steam or internal combustion (IC) engine. More significantly, the BRASH engine can provide more power with lower emissions from a wider range of fuels than an IC engine and should be particularly well-suited to powering large vehicles. In addition, integration of modern control circuitry with external combustion brings a level of performance, operational simplicity, and safety heretofore unavailable. In this Small Business Innovation Research (SBIR) Phase 1 project, an energy-efficient air-steam propulsion system was developed, patented, and evaluated for performance.

### Objectives

After making necessary mechanical and electronic modifications to a Smart™ sized test vehicle, two experiments were performed to validate the air-steam propulsion system operation and determine key baseline performance parameters. The first test run was to establish minimum fuel and propellant flow rates for sustained operation at low speed (air-rich mode), and the second to establish reasonable upper limits of fuel and propellant flow at higher engine speeds (steam-rich mode).

### Findings and Conclusions

The results of this Phase I project collectively demonstrate the technical feasibility and commercial potential of the BRASH air-steam hybrid engine technology. Key performance attributes of the patented energy-efficient air-steam propulsion system have been demonstrated to be superior to those of internal combustion engines. A mixed air-steam propellant system can provide immediate power without a boiler, and that power can be varied simply by modifying the ratio of water and air in the propellant mix. Next steps for this innovation include more detailed performance verification and an analysis of scaling this promising technology for mass transit use.

## Benefits

Successful validation of the BRASH technology through more detailed performance evaluation could lead to a vehicle retrofit of a smaller, lighter, more fuel-efficient engine to propel buses and trains for mass transit use. That engine could operate on a variety of fuels other than refined petroleum. These goals are consistent with the SBIR subtopic narrative regarding “economical and durable technologies and devices for improving safety for riders and transit agency employees, reducing noise and energy consumption, or improving the rider experience. The innovations must be adaptable to existing bus and rail transit vehicles and systems.”

## Project Information

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