

**State of Michigan
Senate Committee on Transportation**

***RTA Transit Bus Fleet:
Improving Operating Efficiencies***

November 27, 2012

*Michigan Senate – Committee on Transportation
November 27, 2012*

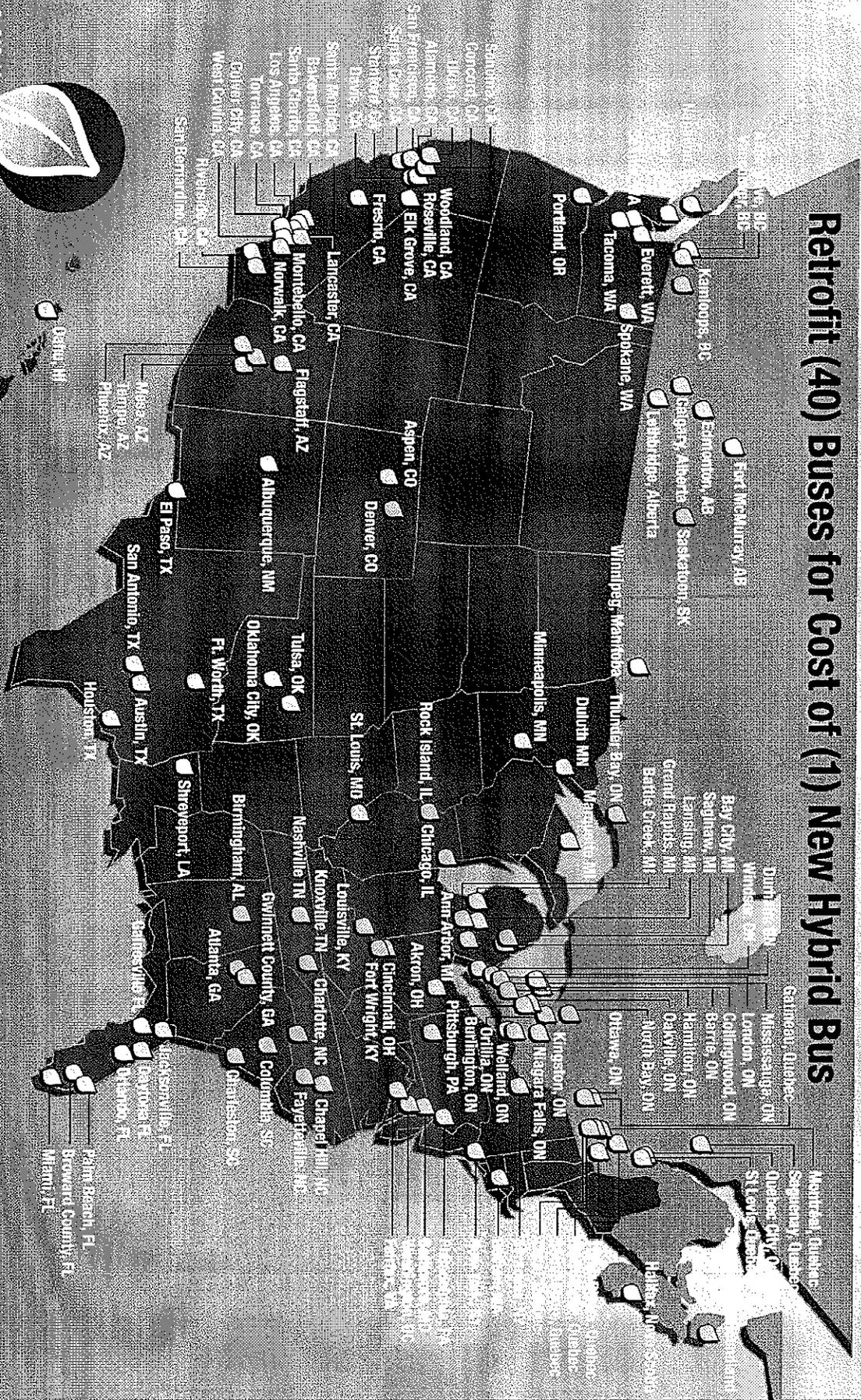


Improving Operational Efficiencies for RTA Legacy Fleet:

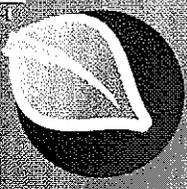
- Michigan Jobs – Retaining & Creating
- Michigan ‘Green’ Technologies
- Michigan Companies
- Benefits & \$\$ Savings to RTA
- CATA Testimonial
- Q&A

EMP Mini-Hybrid™ for Transit Buses

Retrofit (40) Buses for Cost of (1) New Hybrid Bus



MINI-HYBRID™

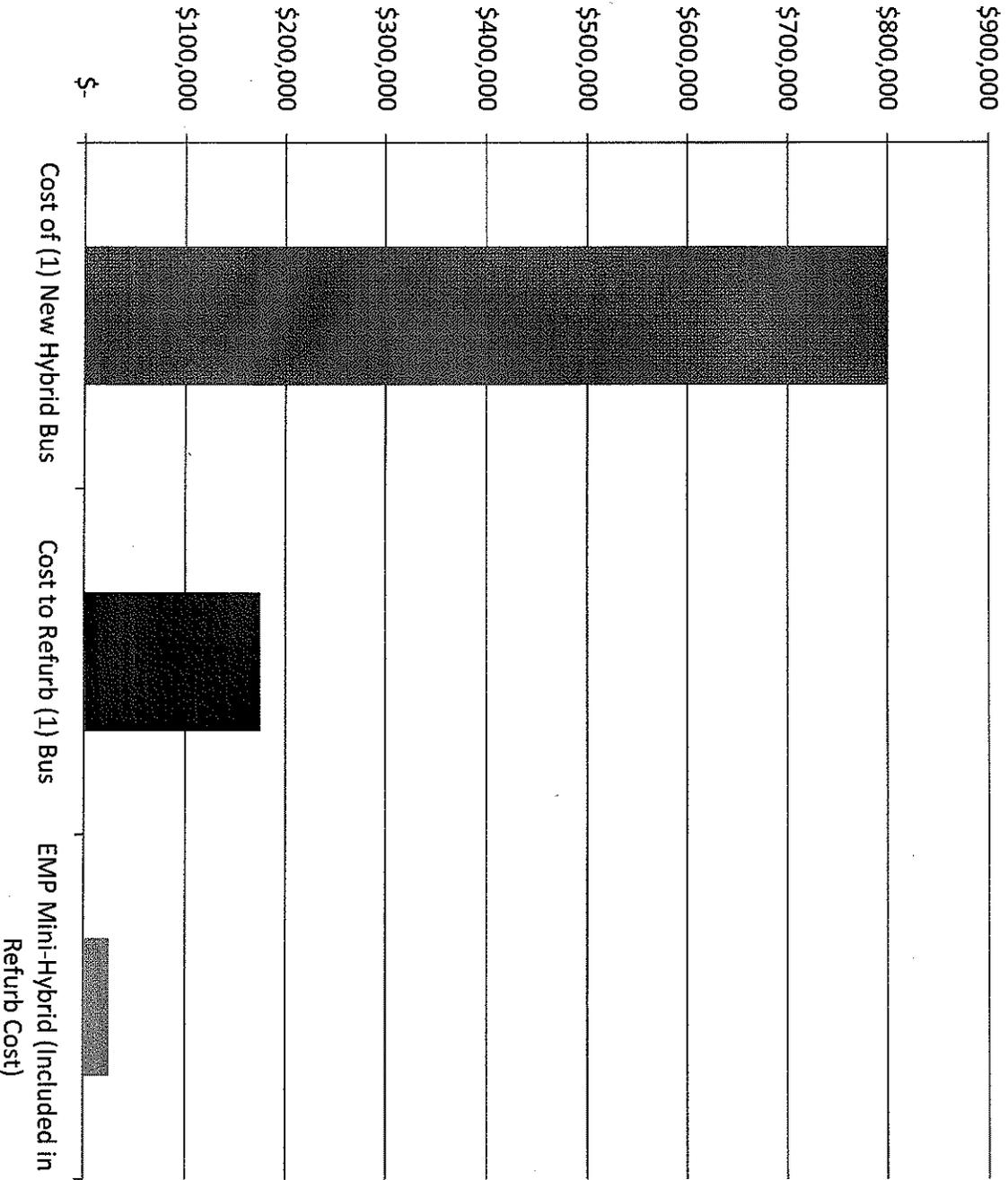


Millions and Millions of In-Service Miles Logged

EMP
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Price of New Hybrid Bus vs.

Cost to Refurb an Existing Transit Bus



- EMP Mini-Hybrid
- Cost to Refurb (1) Bus
- Cost of (1) New Hybrid Bus



Transit Bus Fuel Savings Calculator



Transit Bus Fuel Savings Calculator



Buses in Your Fleet

Average Annual Miles Per Bus
 Average Annual Kilometers Per Bus

Average Fuel Price Per Gallon
 Average Fuel Price Per Liter

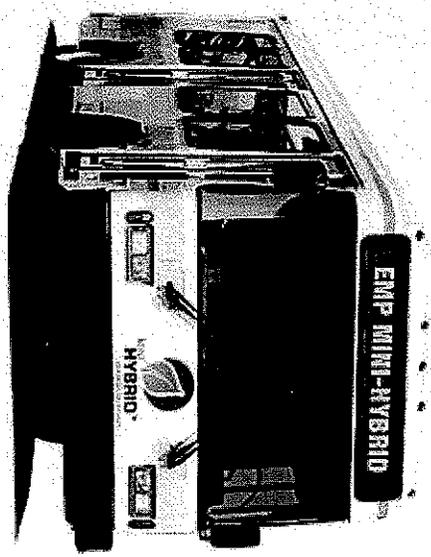
Applicable
 Not Applicable

CALCULATE*



Your Fleet MPG
 Your Fleet L/100km

CUSTOMIZE
 MPG/L/100km



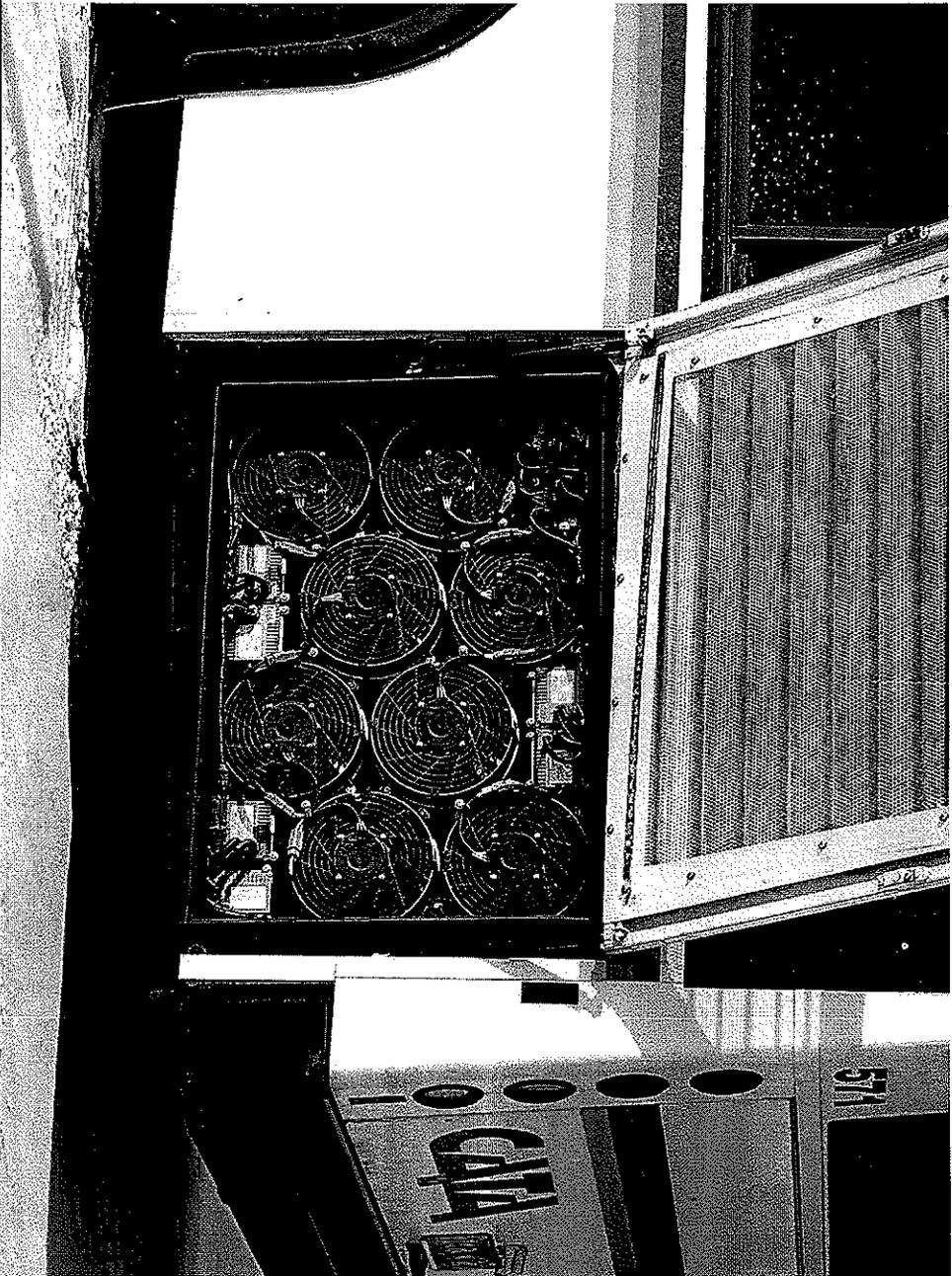
Projected Annual Fleet Fuel Savings **401,014**
 WITH EMMP MINI-HYBRID

This example is representative of 9.5% average fuel savings with EMMP Mini-Hybrid. Actual results may be much higher.

Year 1	Year 3	Year 5
ROI	ROI	ROI
-63%	8%	81%

< RESET CALCULATOR PLOT ROI GRAPH >

* Fuel costs calculated from MPG, L/100km performance data provided by typical city bus fleet and may be different in your application.



Fuel Economy Improvement – 5% to 14% per bus.
Annual Fuel Savings per Bus – \$2,200 - \$6,000.
More Efficient / Less Maintenance / Curbside Quiet.



EMP
POWERING THE FUTURE
MINI-
HYBRID™
THERMAL SYSTEMS
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Capital Area Transportation Authority

Patricia K. Munshaw, Board Chair

Sandra L. Draggoo, CEO/Executive Director



April 1, 2008

Mr. Ralph Bedogne
Engineered Machine Products, Inc.
2701 North 30th Street
Escanaba, MI 49829

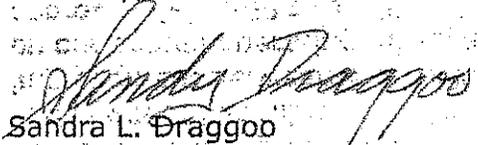
Dear Ralph:

I wanted to express how pleased CATA is to be working with Engineered Machine Products, Inc. on the Mini-Hybrid Fan Project. We have experienced the benefits from this project that will reduce costs, emissions and noise in our operating community. With seventeen buses currently in the program, we are excited to see the fuel economy gains made. There is no doubt that with today's fuel prices, it becomes a challenge to manage these expenses. The result of installing the mini-hybrid system has produced fuel economy improvement between 3 to 14% among the various engines involved. Based on our annual operating mileage, this will produce a fuel savings of approximately 300 to 1,400 gallons per bus annually. With the present fuel costs this annual savings per bus equates to approximately \$1,000 to \$4,900.

In addition to the fuel savings, the kits have demonstrated a reduction in ambient operating noise emitted from these buses during the summer months when engine cooling requires optimum performance. The fans are very quiet yet very efficient. The maintenance required to the cooling systems has been reduced as well. The debris normally collected in the radiators has been significantly reduced with the mini-hybrid system.

We look forward to the continued success of this project and to working with your staff. Thank you for being such a great partner!

Sincerely,


Sandra L. Draggoo

CEO/Executive Director



EMP Mini-Hybrid™ Talking Points

EMP's investment in the transit bus market is paramount and demonstrates our commitment to be the world class thermal management system provider to the transit and motorcoach industry.

First, we do not sell an electric fan device --- We market a fully integrated thermal management system capability, backed by a complete enterprise that is committed to quality and customer satisfaction. Throughout the entire life cycle, we are supported by a dedicated support team including sales, customer service, training, design, validation, system and application engineering.

EMP's Mini-Hybrid™ Thermal System is produced in the USA, is military grade and proven worldwide.

EMP's fully dedicated Enterprise Team includes:

- Regional sales managers
- Training and system support available online or on site
- Mechanical design engineering
- Electrical design engineering
- Applications engineering and support
- Component engineering
- System engineering
- Software engineering
- Testing
- Prototype fabrication
- Vehicle integration
- Low and high volume manufacturing facilities
- ISO Certified
- Continuous improvement focused
- Web based service tool and diagnostic software

The Numbers

7000+	Number of Mini-Hybrid™ Thermal Systems in the field at 11/2012
2007	First to market with Mini-Hybrid™ Thermal System capability
125+	Number of Transit organizations using Mini-Hybrid™ Thermal System technology
100%	Aftermarket make, model, engine and fuel kit availability
96%	North American bus OEM Production approved
31	Number of degreed engineers supporting the Mini-Hybrid™ technology
30	Number of dedicated support staff for the Mini-Hybrid™
13	Number of months on average for a ROI on the Mini-Hybrid™
120,000,000+	Number of documented pilot test miles
7%-18%	Fuel savings documented by end customers
60,000+	Number of EMP fans shipped at 11/2012
0.005%	Fan failures to date
10,000	Heat Exchanger JW/CAC shipped
≤ 0.001%	Heat Exchanger Failures to date



High Performance — Commercial Grade

MINI-HYBRID™
TOMORROW'S FUEL EFFICIENCY... TODAY!

MINI-HYBRID™

Ideal Retrofit for Municipal Transits
OEM & Aftermarket

EMP's MINI-HYBRID™ Thermal System

HAVING PROBLEMS WITH TRANSIT BUSES?

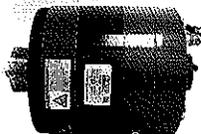
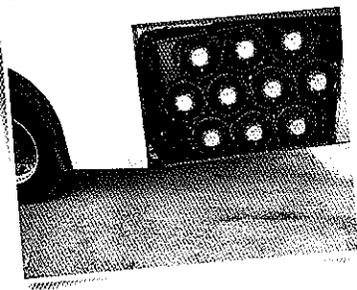
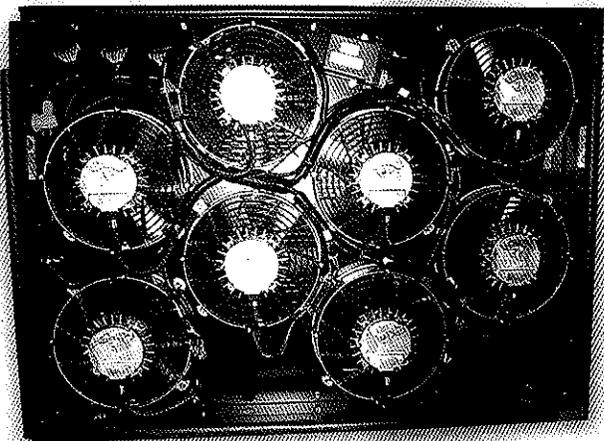
- Hydraulic Leaks/Fires
- Poor Fuel Economy
- Engine Overheating
- High Maintenance Costs
- Noise

MINI-HYBRID™ IS YOUR TRANSIT SOLUTION:

- Electric Fans Eliminate Hydraulic Fan Drive System
- Reversible Fans Clean Debris from Radiator
- Powered by 450 Amp 24 Volt Alternator (*included*)
- CAC and Water Jacket Heat Exchanger (*included*)
- Designed for Full Load Cooling Requirements
- Variable Speed Control
- Diagnostic Maintenance Software Available
- Application/Technical Support

MINI-HYBRID™ BENEFITS:

- Fuel Economy Improvement up to 10%
- Greenhouse Gas Emissions Reduced up to 10%
- Safety Increased by Elimination of Hydraulic Fluid
- Reduced Maintenance Leads to Increased Uptime
- Curbside Noise Abatement Feature
- Designed for Diesel, CNG, LNG Applications



*Air intake tube not to scale

Improves Fuel Economy and Delivers More Power to the Wheels!



EMP
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COOLING SOLUTIONS
FOR TODAY & TOMORROW

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906.789.7497

SPECIFICATIONS

MINI-HYBRID™

BASE KIT INCLUDES:

- (1) Thermal Management Controller
- EMP FIL-11 24 Volt Pusher Fans With Integrated Controllers
- (1) Radiator
- (1) Charge Air Cooler
- (1) Powdercoated Steel Frame & Fan Shroud
- Jacket Water & Charge Air Temperature Sensors
- Wiring Harness
- Adjustable Door Seal

STANDARD INSTALLATION KIT:

- Power Cables, CAN Interface Cable, Ignition Signal Wire
- Power Distribution Center with Main Fuse & Cable Tie-downs
- Power Steering Reservoir, Fittings & Brackets
- Kit Mounting Brackets & Isolation Grommets
- Fan Reversal & Diagnostics LED Panel

CHARGING SYSTEM KIT:

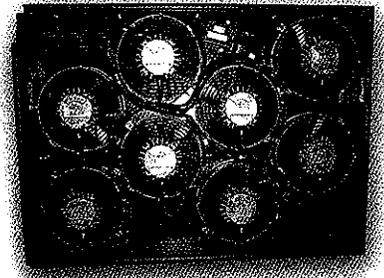
- Brushless Alternator - 450 Amp 24V DC
- Cooling Air Duct / Air Filter & Mounting Bracket
- Voltage Regulator
- Voltage Regulator Harness (if required)
- Oil Port Block-off Kit (if required)

PRODUCT APPLICATIONS:

- Most New Flyer, Gillig, NABI, NOVA, ORION & Neoplan
 - o Engines: Cummins, DDC, John Deere, Doosan
 - o Fuels: Diesel, CNG, LNG

WEIGHT OF BASE KIT:

- 350 - 450 lbs.



AVAILABLE KITS:

- MH8-5034DE - Engine and Hybrid Cooling
- Nova T-Drive
- MH9-4836
- MH10-5536
- MH9-Xcelsior St'd
- MH9-Xcelsior/MCP
- NABI OEM
- New Flyer OEM
- Gillig OEM
- Orion OEM

BASE KIT FEATURES:

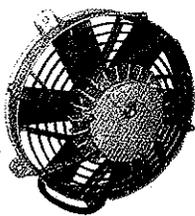
- Reduced Power Consumption
- Powered by 28 VDC Alternator
- Increased Efficiency; Improved Packaging
- Reversible Fans Clean Debris from Radiator
- Long Life, Brushless, Sensorless Motors
- Corrosion and Water Resistant
- Robust Design
- CAN Capable
- Curb-Side Quiet Mode
- Mounts in Stock Location
- Electronic Control of Coolant and CAC Temperature
- Onboard Diagnostics
- Standard Service Tool Software

POWER DRAW:

- Draws 40 Amps OR LESS, 90% Of The Time

MINI-HYBRID™ COMPONENTS*

**Please request individual component specifications by email at productinfo@emp-corp.com*



FIL-11 Electric Fans



Optimized Radiator and CAC



Power 450 Alternator



MINI-HYBRID Thermal Management Controller

Engineering, Manufacturing and Assembly
Leaders in Thermal & Oil Management
Technologies

emp-corp.com

productinfo@emp-corp.com

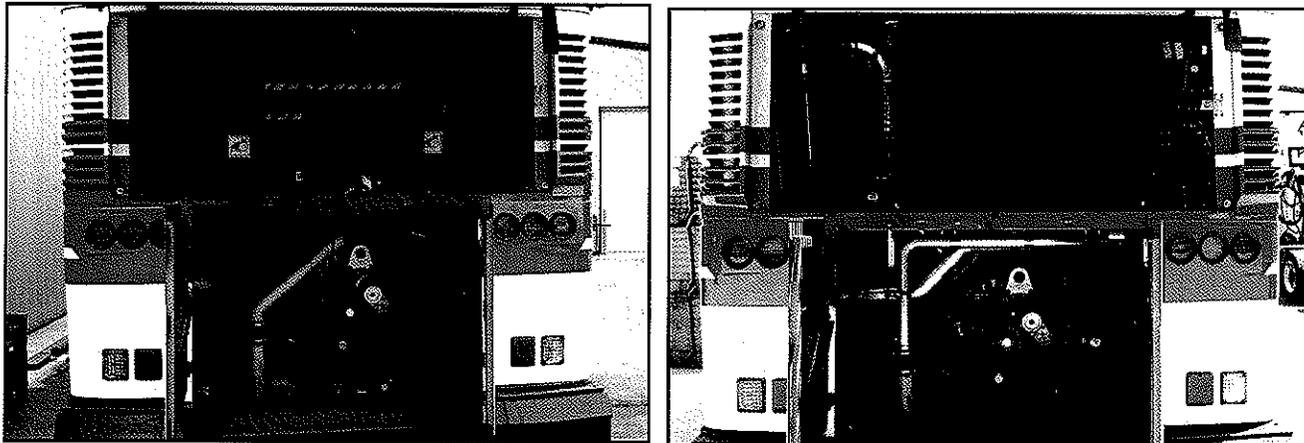
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(906) 789-7497

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POWERING THE FUTURE™

TECHNOLOGY of clean AIR

HYBRID APPROACH TO BETTER FUEL ECONOMY

Pilot test demonstrates how EMP's Mini-Hybrid Thermal System can boost commuter bus efficiency



The EMP Mini-Hybrid Thermal System was recently installed in a Potomac and Rappahannock Transportation Commission (PRTC) commuter bus. The retrofitted vehicle, a 45 ft. model year 2002 MCI D-series bus, showed a 15% improvement in fuel efficiency during the test run. At left is the vehicle's engine compartment before the installation, with the completed retrofit shown at right.

BY JACK BURKE

Since 2006, EMP has carved out a niche in the transit bus market, as more than 7500 transit vehicles have been retrofitted with the company's seen its Mini-Hybrid Thermal System. That market has proved to be fertile ground for the Mini-Hybrid system, since the transit bus duty cycle is mostly made up of relatively low speeds and frequent stops.

More recently, the Escanaba, Mich., manufacturer completed a pilot test with a commuter bus that spent much of its time on high-occupancy vehicle (HOV) lanes outside of Washington, D.C. The vehicle belonged to the Potomac and Rappahannock Transportation Commission (PRTC), which provides commuter and local bus services as well as ride-share services in the Prince William County area of Northern Virginia.

EMP's Mini-Hybrid radiator-cooling system had never been tested in such an environment, said Ralph Bedogne, vice president of corporate accounts for EMP.

"The core technology works, every-

one understands that," Bedogne said. "But we've never done it on an attic mount and we needed to test it to see that it works and it does work."

And the test result indicated it worked well for PRTC. The retrofitted bus is a 45 ft., 2002 MCI D-series powered by a Detroit Diesel Series 60 engine rated at 400 hp at that drives an Allison B500 six-speed automatic transmission. The bus showed a 15% improvement in fuel efficiency, said Eric Marx, director of planning and operations for PRTC. The commission is retrofitting 29 more buses in the fleet, all 40 to 45 ft. MCI buses from model years 2002, 2004, 2005 and 2006, which are also powered by Series 60 Detroit Diesel engines.

The EMP Mini-Hybrid Thermal System is an eight-fan kit that replaces the mechanically driven cooling system. It consists of a high-output, belt-driven 450 Amp, 24 V brushless alternator combined with an electrically driven thermal management package.

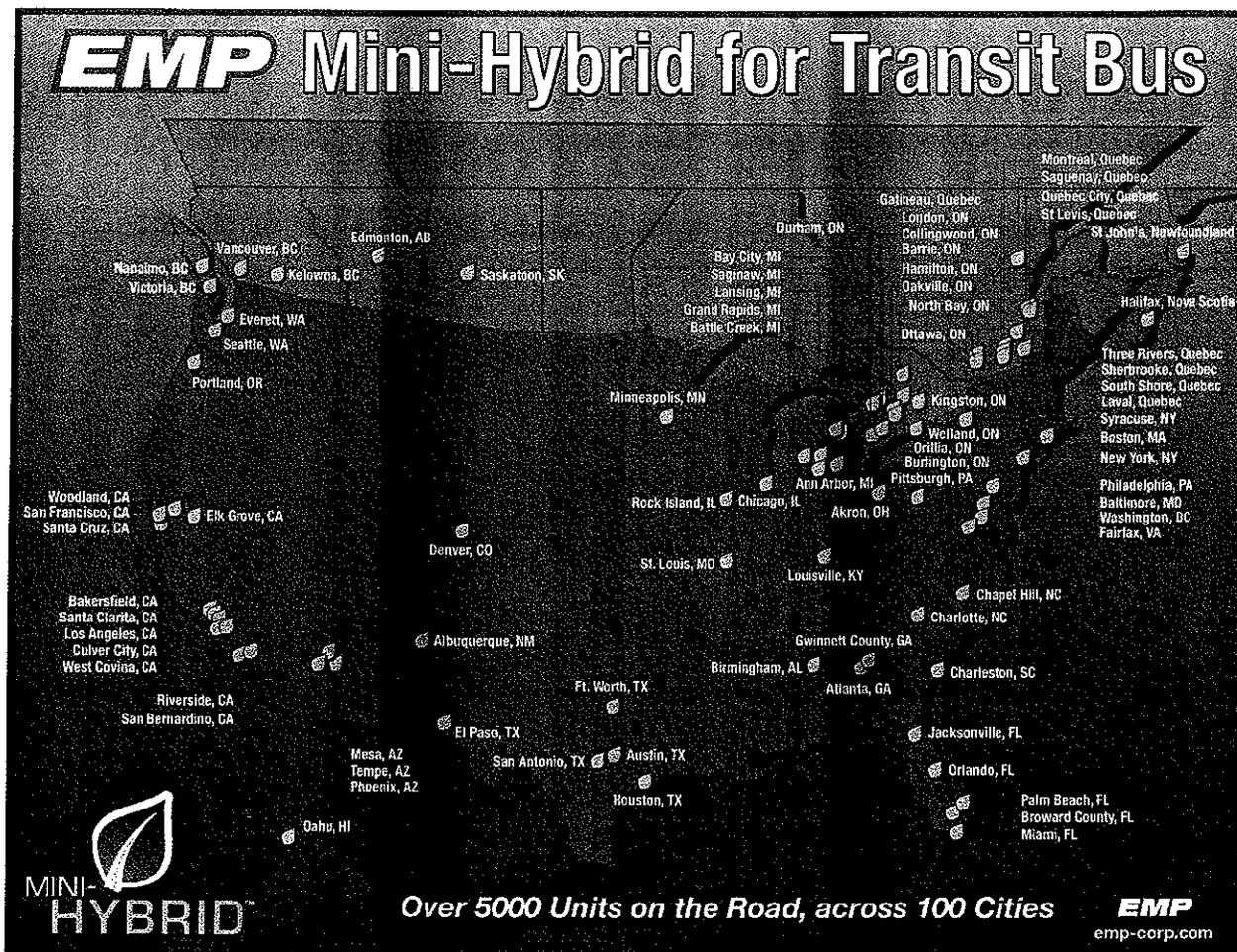
The cooling system has three independently controlled circuits: engine,

transmission oil and charge-air. Feedback control systems incorporate strategically placed thermistors as inputs to maintain the fluid temperature of each circuit. Diesel Grade electric cooling fans and electric coolant pumps replace the belt-driven water pumps and the motors used in the electric fans are reversible, helping clean debris from the radiator. Each of the fans is controlled individually, running only in response to cooling load requirement, which results in reduced parasitic power loss.

Bedogne said the system is now on its third generation and is lighter and more efficient than earlier versions. The kit's maximum size is 11 in. long, 51 in. wide and 31 in. high and weighs 100 lb.

With the PRTC buses, the Mini-Hybrid system needed to be placed above the rear-mounted engine.

"The reason it works is it doesn't depend on that air to be drawn in from the curbside or the side of the bus it can take the air from anywhere," Bedogne said. "As long as our fans are able to draw cool air in across those heat exchangers and charge-air coolers, it



This map indicates where EMP's Mini-Hybrid Thermal System has been installed in a transit bus application.

maintains the optimum level of heat rejection so the engine runs better."

After the cooling system was installed at EMP's Escanaba facility, the bus was returned to PRTC and placed into regular service. Marx said the commission took great pains to make sure numbers used to monitor fuel usage compared "apples to apples."

"We controlled for as many factors as we could," Marx said. "We had the same (two) buses, the same bus operators, the same routes, the same weather and the same idle times to get (the comparison) as close as possible."

At the end of the four-week comparison, the retrofitted bus had demonstrated its 15% fuel savings and Marx estimated that the cost of the cooling system retrofit could be recovered in less than three years.

By the end of 2013, more than one-third of PRTC's fleet will have the EMP

Mini-Hybrid Thermal System equipment either installed originally at the factory as part of a new bus manufacture or retrofitted under this program.

Bedogne said the fuel improvement stems in part from reducing weight in the vehicle.

Since the buses have rear-mounted engines, they can't rely on ram air to cool the heat exchanger, he said. The MCI buses use two larger belt-driven fans and an oversized heat exchanger to provide cooling.

"Because of the thickness of the core and because there's no ram air, they need a fan that can be belt-driven off the engine and that fan probably accounts for 120 to 150 hp from the engine," Bedogne said. "To run those two fans on the regular Mini-Hybrid, it's about 70 hp so there's a tremendous gain in fuel economy because we take that parasitic load away from that large

fan and that belt and we reduce the weight by hundreds of pounds."

Bedogne said Mini-Hybrid Thermal Systems already in the field have shown fuel savings of 5 to 7%.

"What we're finding is once you take off the parasitic loads — you take off pulleys, belts, pulley dampers, drive shafts, things that weigh hundreds of pounds and then you get this 19 ft. belt that no longer has to be running on it and that's a lot of parasitic load that comes off."

The company has been in talks with manufacturers about placing the Mini-Hybrid system on new products, he said.

"You're seeing a paradigm shift from hydraulic and beltless to electric," Bedogne said. **dp**

Diesel Weblink

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