

Energy Management & Evaluation in Vehicle Pre-heat Applications

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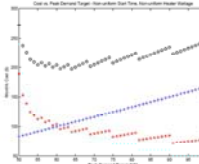
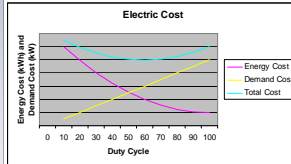
Electric Block Pre-heat Control

- Developed Control Algorithm for Cost Optimal Pre-heating in Phase I
- Balance Demand and Energy Costs
- Schedule-driven System
- Phase II to help PMD Harden System for Commercial Deployment
- Partners:



Energy vs. Demand

- Operate at Economic Minimum
- Longer Heating Times Save Money

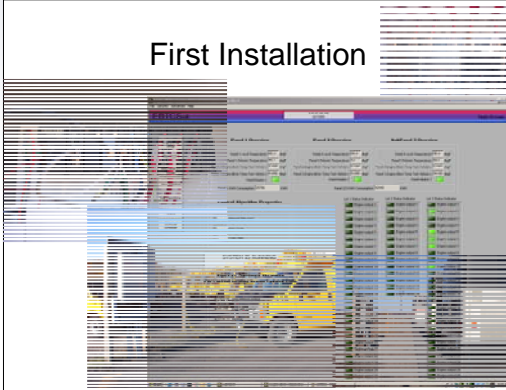


Savings Opportunity (NY)

- Plug & Forget Still Common

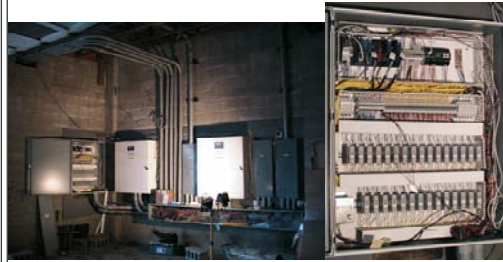
Heating Assumptions	Common Practice	Conservative Practice	Potential Savings
Weekdays Return 5:00p Depart 6:00a	13 h x 5	3 h x 5	
Weekends Idle, but heating	24 h x 2	ZERO h	
Heating Time Per Bus	113 h / wk	15 h / wk	98 h / wk
Heating Season Buses in NYS \$ / kWh	Dec, Jan, Feb, Mar		x 17 wk x 45,000 x \$0.105++
			Each Year \$7.9M

First Installation



New Hardware

- Located at Brown Coach, Scotia Facility



Diesel Fired Coolant Heater Demonstration & Evaluation

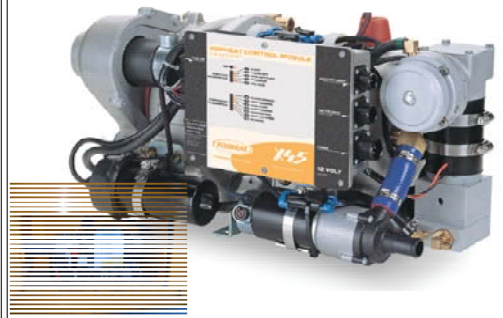
- Helped Brown Coach, Inc. author proposal for DFCH demonstration project
- Alternative to Electric Immersion Coolant Heaters
- Use diesel fuel to fire heater in coolant loop
- Our primary role is in data analysis and evaluation



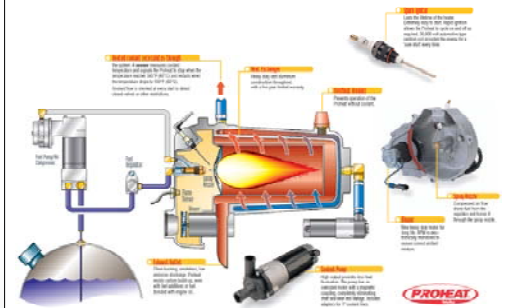
Anticipated Benefits

1. Pre-heating to near full operating temperature without the need for engine idling; reducing cold start emissions
 - 1b. Possibility of Defrost without Idle
2. Inter-run cabin auxiliary heating to facilitate anti-idling
3. Supplemental heat during the drive cycle for better engine efficiency, reduced emissions, and increased passenger comfort

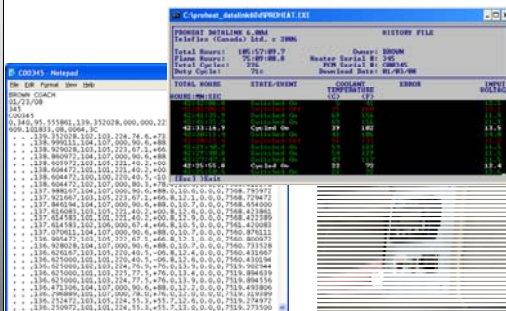
Teleflex Pro-Heat X45



How it Works



Control Module Data Logging



Engine Diagnostics

- Supplement X45 Data
- Fixed Sample Route Testing
 - Coolant Temp @ Engine
 - Engine Load (%)
 - Engine Speed (RPM)
 - Vehicle Speed (MPH)
- Also Log Overnight Cabin Temperature



Coolant Temperature

- Identical Drive Cycle (15min pre-trip, 45min total)
- With and Without Preheat & Supplemental Heat

