

# Alternatives to Truck Idling Workshop

De Moines, Iowa

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Project Manager

SMUD Energy Efficiency and Customer R&D Group



**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT

The Power To Do More.<sup>SM</sup>

# **Sacramento Municipal Utility District (SMUD) is a leader in innovative uses of electricity to improve air quality and save money**

- SMUD generates, transmits and distributes electric power to a 900 sq. mi. area in Sacramento & Placer Counties
- Provide power to a population of 1.33 million
- 10,000 GW-h/ y energy sales



# **SMUD Electric Transportation Mission and Objectives**

## **Mission (1990 Board Resolution Summary)**

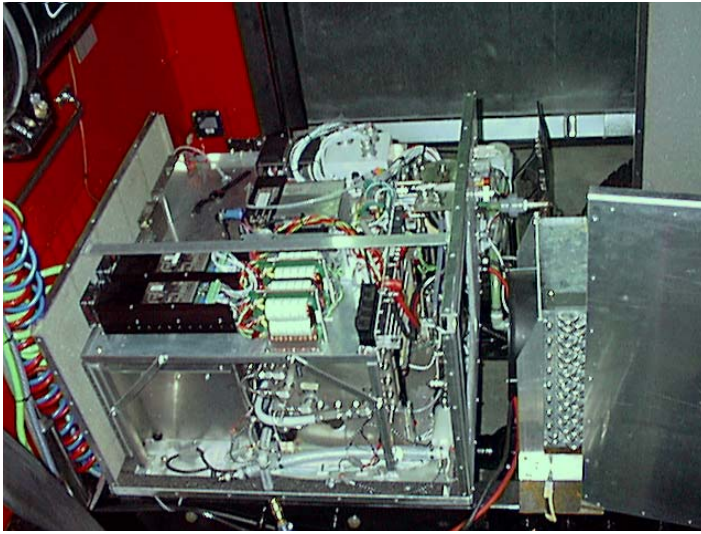
- **“SMUD is dedicated to improving air quality in Sacramento Region through use of electricity as a alternative fuel to petroleum in all forms of transportation”**

## **Objectives**

- **Develop new products and programs that help customers comply with air quality regulations by use of electricity**
- **Educate and enable the community to use electricity as an alternative fuel**
- **Directly reduce emissions in our community**
- **Work at both a local and a national level to achieve environmental improvements**



# PACCAR, ISE Research & SMUD Fuel Cell Auxiliary Power Unit Project



- **Scope:** Design, Develop, Install and Test a 5 kW Fuel Cell APU on a Kenworth Truck
- **Participants:** PACCAR Technical Center, ISE Research, SMUD
- **Project Completed** Sept. 2003



# During 2003- SMUD Developed Simplified Approach to support Customer needs

- **49er Travel Plaza Electrification Approach Developed for the Truck stop owner**
  - Minimal infrastructure,
  - Reduced above ground footprint
- **Onboard System developed for local customer and EPA Proposal**
  - Allows autonomous or grid connected truck idle off sleeper habitat
  - 110 V power is all that is needed for grid tie



# 49er Travel Plaza Electrification

- 16 Spaces electrified for Pilot Demo
- 14 spaces 110V
- 2 Spaces 240 V
- Outlets placed to minimize damage potential
- Trucks can connect to system with 110 V battery charger, or directly with AC appliances



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# 49er Travel Plaza Infrastructure Achieves Low Cost Goal

- Engineering Design Cost: \$3,946
  - Hardware Cost: \$10,450
  - Installation: \$27,864
- \$42,260



- Power on July '03
- 16 Parking Spaces
- \$2641 each

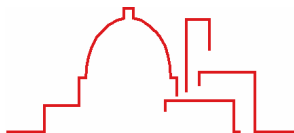


# Shore Power can be part of an attractive truck stop service package

Cost Item	Cost per space	Annual Costs	Daily Costs	Possible Revenue/ hour	Daily Revenue
Capital Installation Cost	2600	\$520.00	\$1.42	\$0.20	
Energy Costs	\$1.53/day	\$558.45	\$1.53	\$0.20	
Maintenance	\$250/year	\$250.00	\$0.68	\$0.10	
Subtotal		\$1,328.45	\$3.64	\$0.50	\$5.00
Other Items: Revenue Collection Marketing Emissions Credits					27%

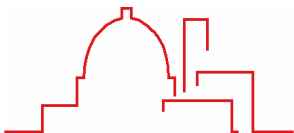


- Profit > 27% sales,
- 5 year capitalization

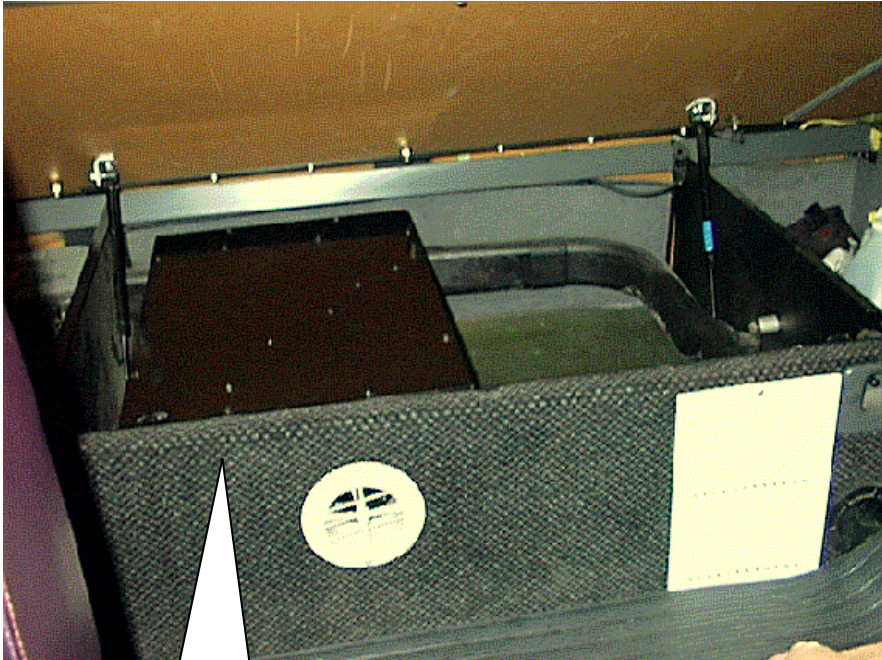


# EPA SmartWay Transportation Project: Demonstrates viability of On Truck Equipment

Project partners include Ozark Trucking, Interstate Distributor Co., H.O. Wolding, Xantrex, Dometic, AAP, Phillips and Temro, GC/RLC & Associates, and EPRI



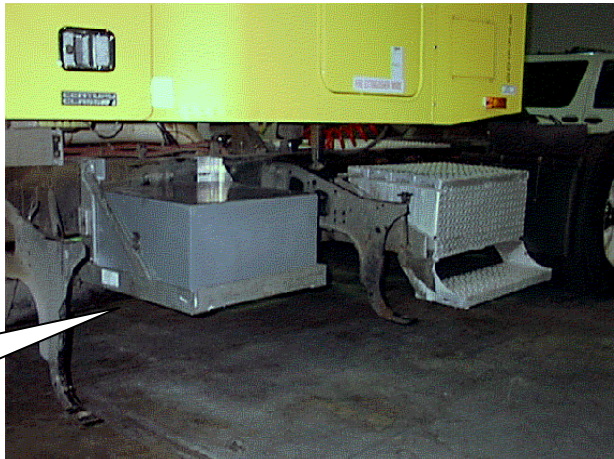
# On Truck Air Conditioner and power system installations



**Dometic Air  
Conditioner**



**Amp hour  
counter  
and Air  
conditioner control  
&  
receptacle**



**Battery Box-  
510 A-h**



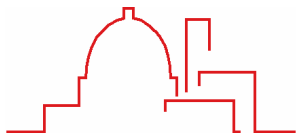
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# Sleeper Compartment Power Budget from Paccar fuel cell APU project

Source	Peak Load (Watts)	Typical Load (Watts)	Duty Cycle	Average Load (Watts)
Audio System	350	50	25%	13
Television/VCR	75	75	15%	11
Satellite or Other Communication System	160	50	10%	5
Laptop Computer	65	65	25%	16
Microwave Oven	1400	1400	3%	42
14,000 BTU Air Conditioning	4400	1700	70%	1190
Refrigerator	85	85	50%	43
Coffee Maker	250	250	2%	5
Lighting	100	60	50%	30
Miscellaneous	100	50	25%	13
Inverter Losses @ 15% of Load	300	290		20
<b>TOTAL</b>	<b>7285</b>	<b>4075</b>		<b>1387</b>



Source: PACCAR



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# Air Conditioning Dominates Energy Budget

Air Conditioning Duty Cycle is Based on the following:

- 40 Degree F Temperature Difference: 6700 BTU/h
- Solar Load through Windows: 3000 BTU/h
- Heat Rejection from Appliances: 700 BTU/h
- Sensible and Latent Heat of Occupants: 400 BTU/h

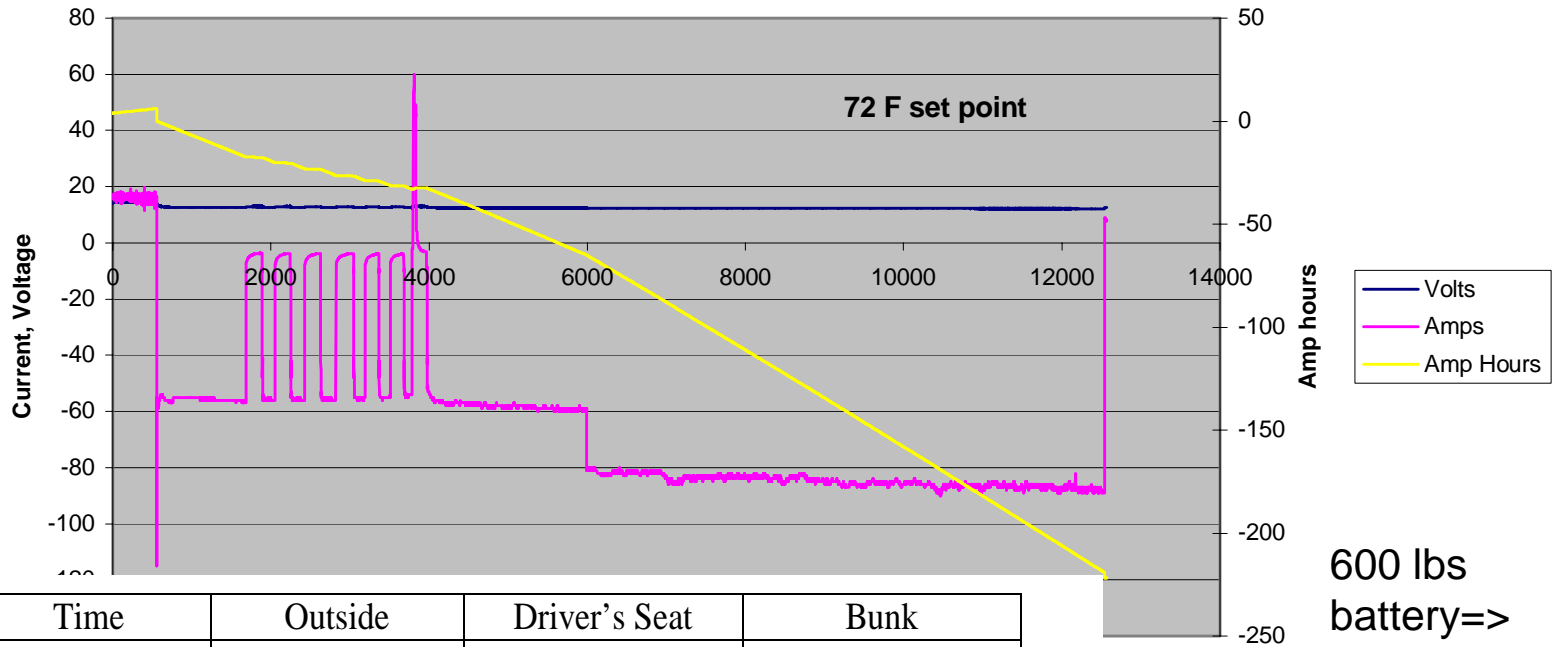
Total: 10,800 BTU/h

More heating capacity may be needed for > 40 F dT



# Testing shows duty cycle required- sleeper stays cool in 104 F Heat

Ozark Truck 596, Dometic 7000 BTU/h Air conditioner

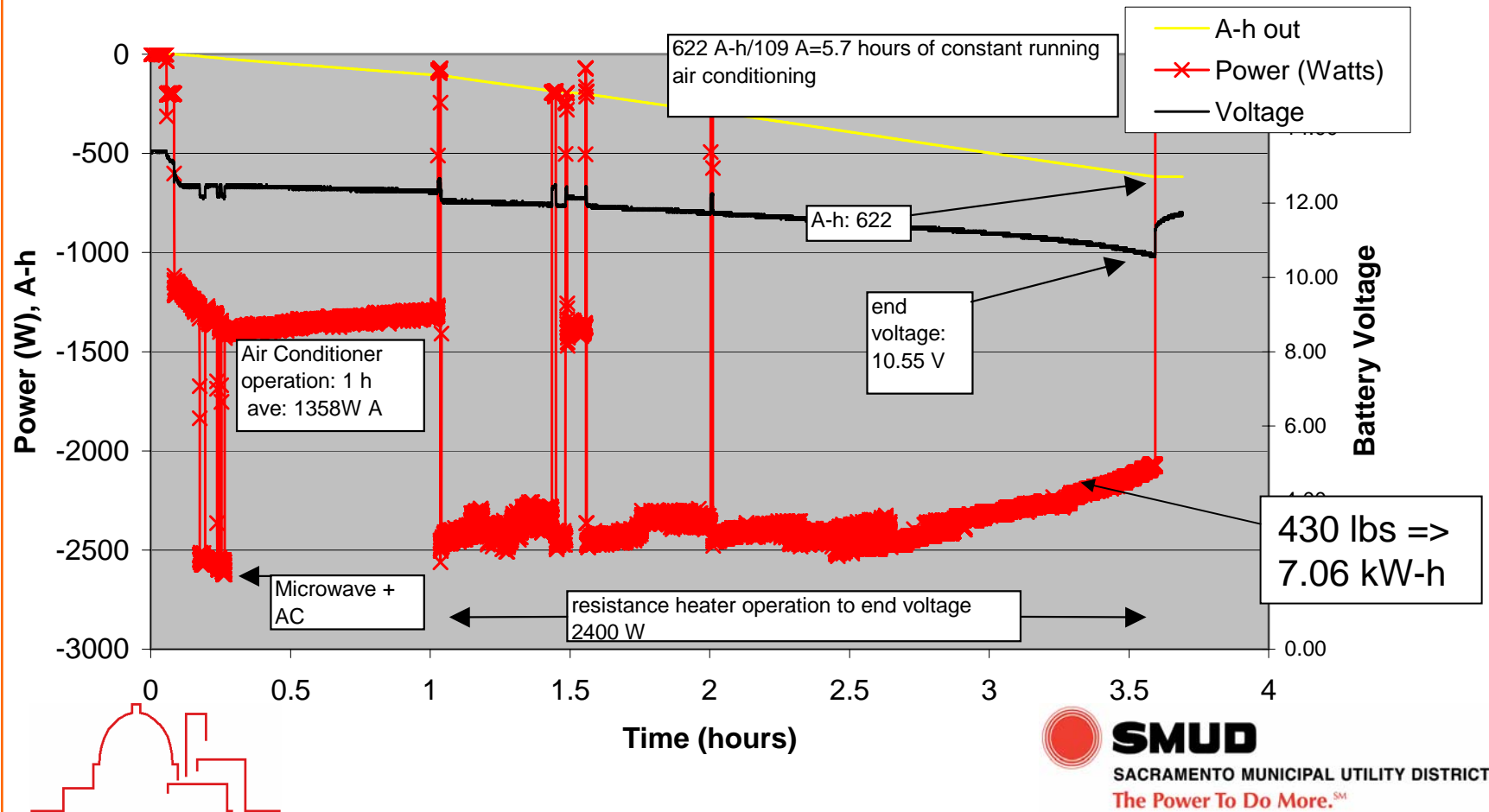


600 lbs  
battery=>  
7.74 kW-h,  
15.72 h

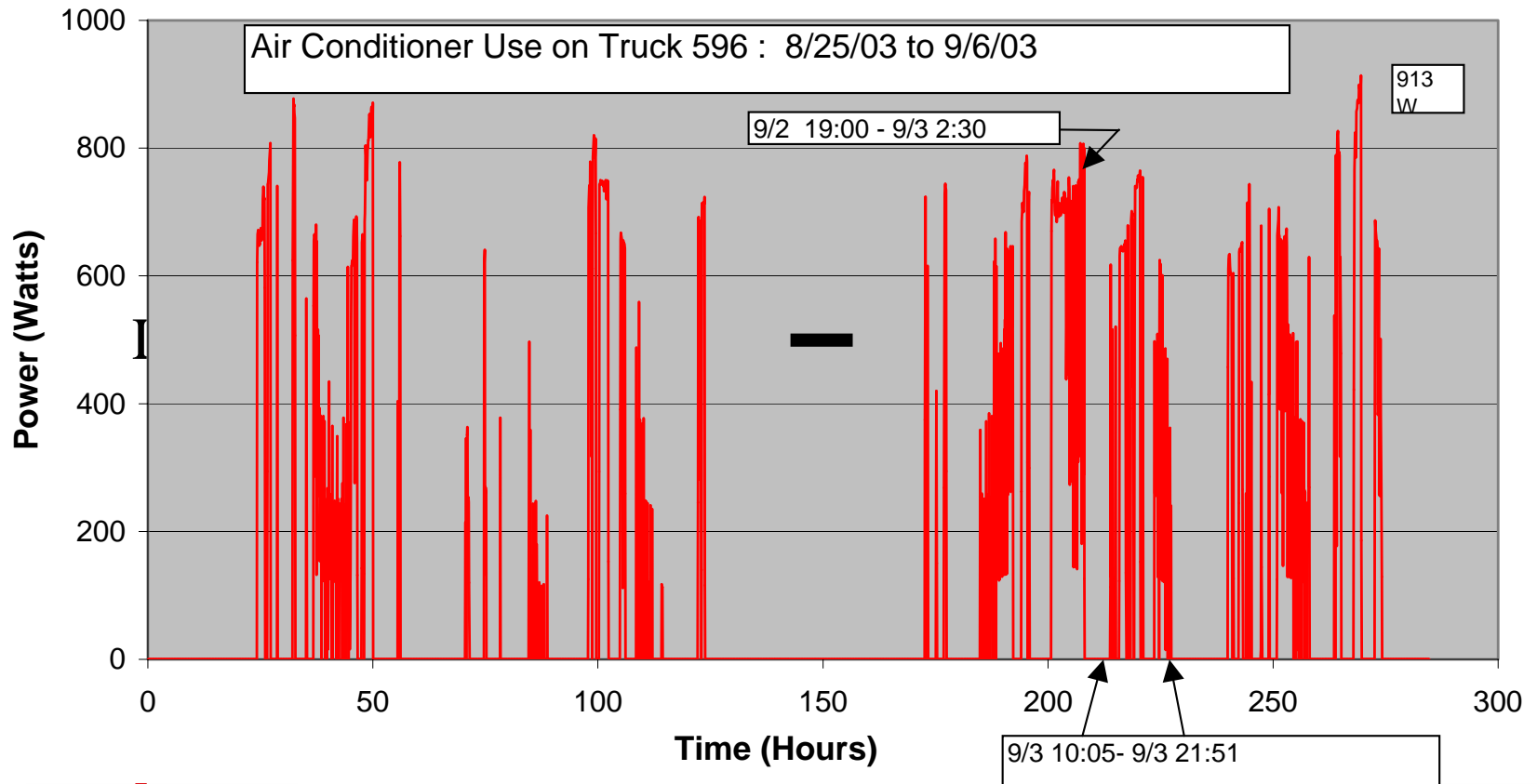
Time	Outside	Driver's Seat	Bunk
15:00	104.1	87.1	76.5
15:25	-	86.8	77.0
15:30	102.8	88.6	76.8
15:45	-	86.8	77.4
16:00	102.6	88.1	76.3

# Truck 572 System with Air Conditioner & Resistance Heater

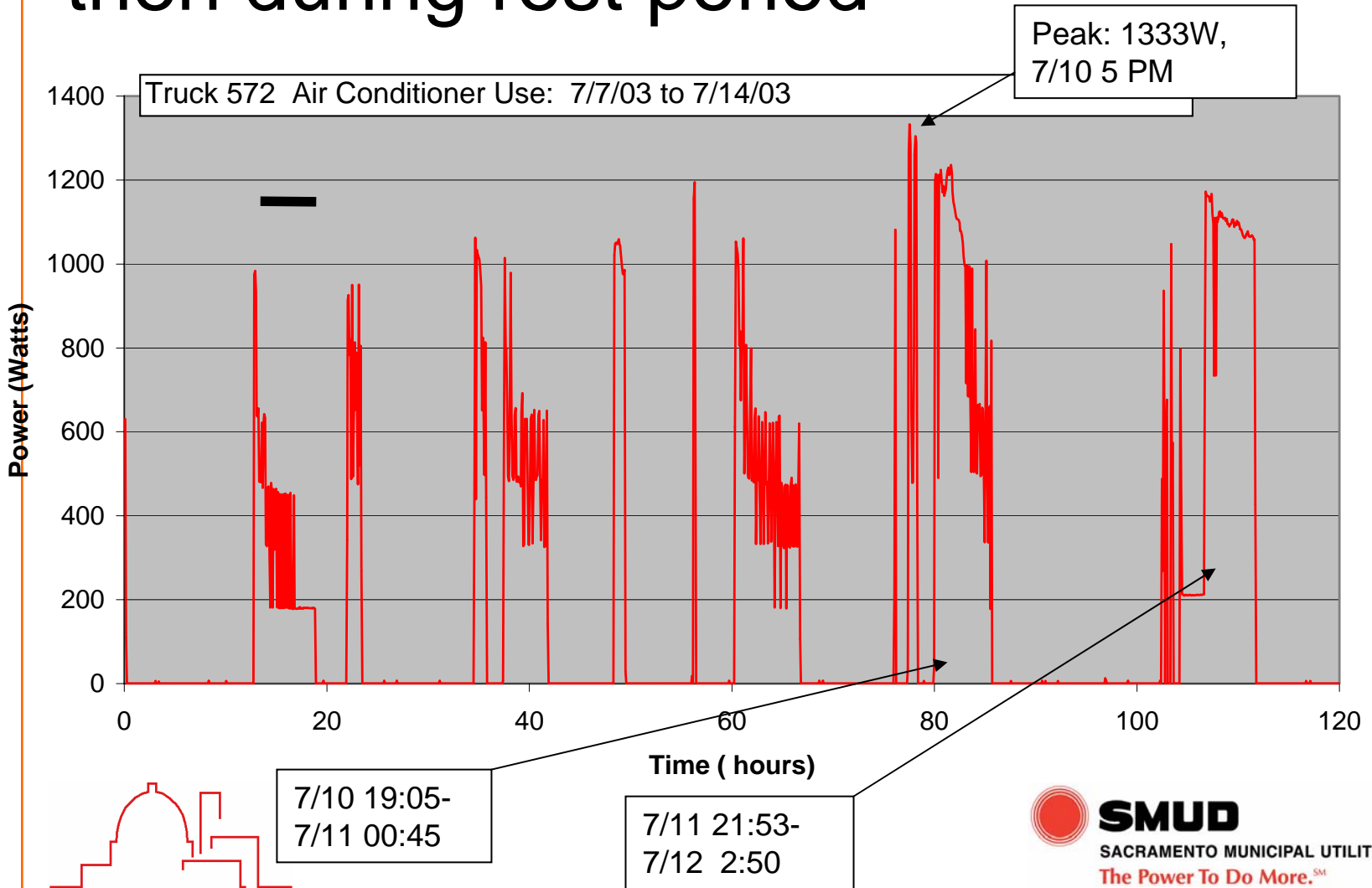
Ozark Discharge on Truck 572 on May 12, 2003



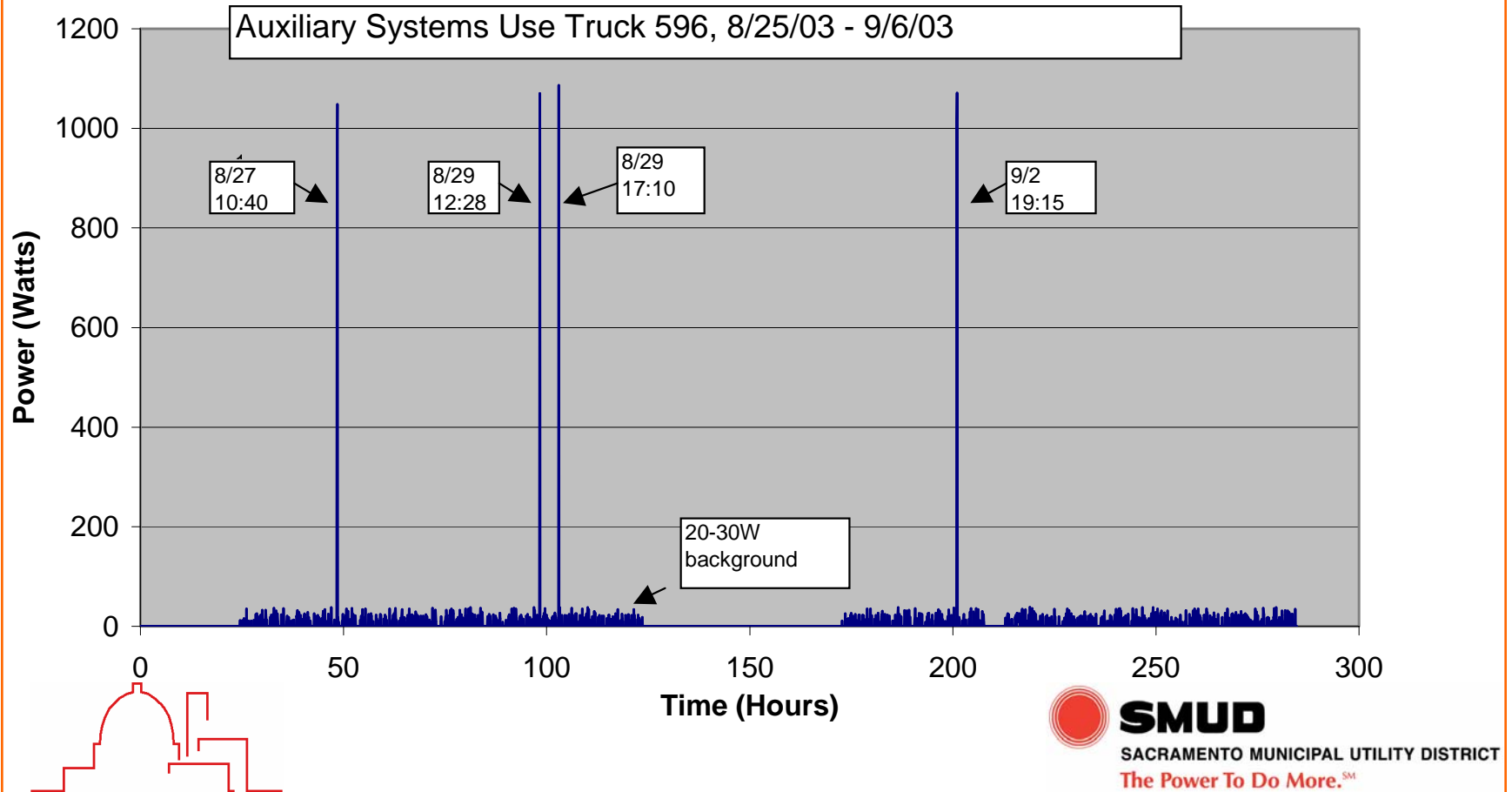
# Two Week period shows variability of Trucking Business



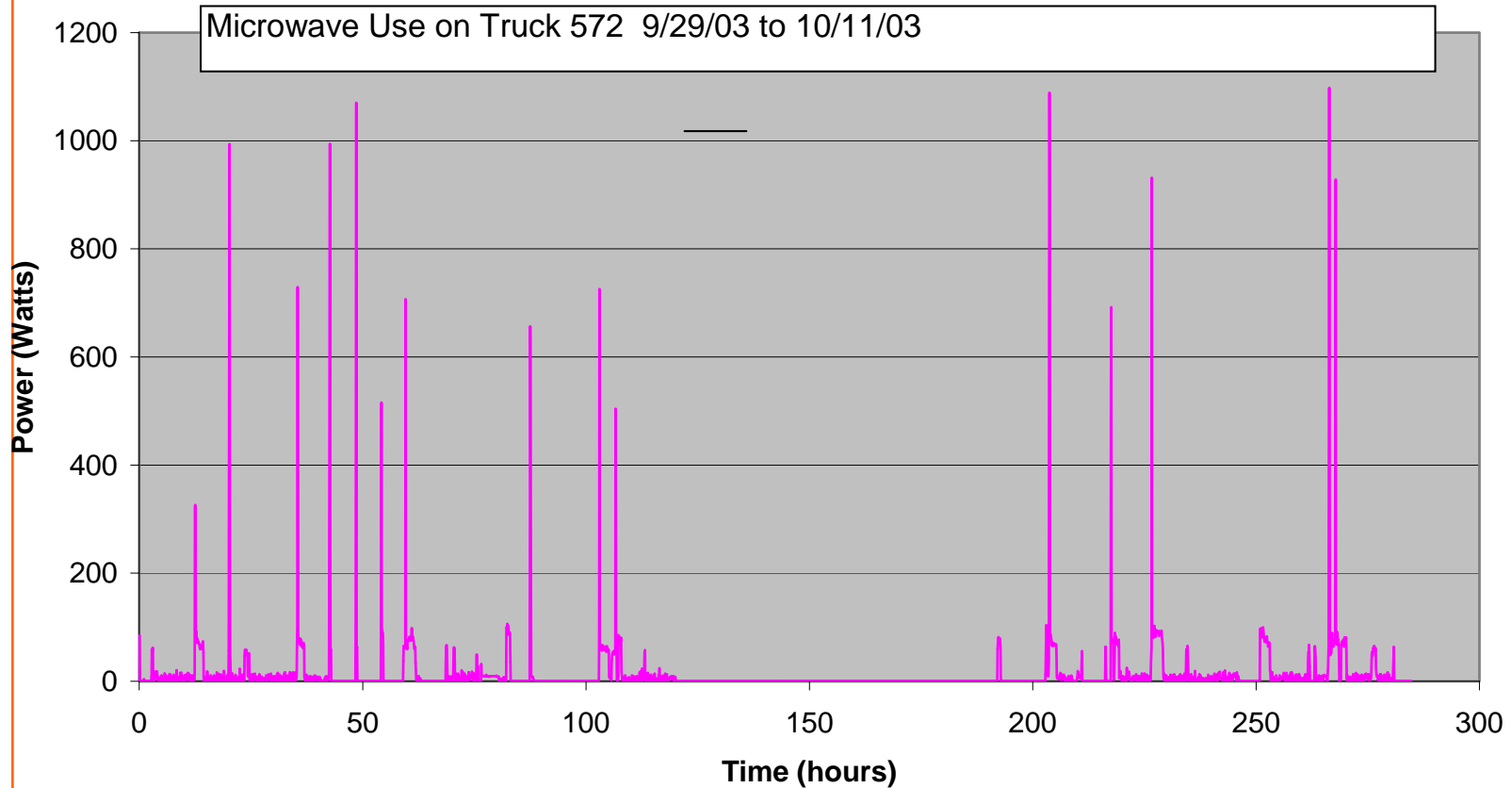
# Air Conditioner used during unload and then during rest period



# Microwave Use in Truck 596- any time of day



# Microwave Use on Truck 572



# Lessons from on truck electric air conditioning systems:

- 7000 BTU per hour air conditioner is adequate –would benefit from added insulation
- Tested in 104 F weather, curtain closed
- Batteries give 6-10 hours
- 2500 W inverter or 120V 20 A runs microwave plus air conditioner

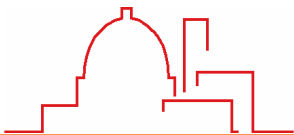


# Insulation greatly decreases power needs

- Insulated Cab by
- Idle Free.net- Robert Jordan
- uses <40 A-h at 12V over night in freezing weather



• Air conditioner being tested



# Barriers to change:

- Truck drivers idle because that's what they do... plugging in is a new behavior (as is using an APU, fuel fired heater, or phase change cooler)
- Truck Stops believe truckers don't have equipment- so why install infrastructure?
- Truckers state there are no places to plug in – so why install electrical equipment on the truck?



# Conclusions

- Electric Air Conditioning and appliances in the cab can improve driver comfort
- Quieter, better air, and less expensive than idling
- Fuel cost savings result from shore power and on truck equipment
- Systems can use existing block heater infrastructure, but more plug in locations are needed to maximize savings

