

Railroad Emission Reduction Technology

Strategies to reduce emissions from locomotives



A presentation to: Metropolitan Washington Area Council of Governments
Metropolitan Washington Air Quality Committee
June 10, 2005



Two Emissions types to consider

1. Emissions while working.
2. Emissions while idling.

EcoTrans Technologies Focus:
Idle Reduction Emissions

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Reduction of Impacts from Locomotive Idling



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A U.S. Department of Energy Laboratory
Operated by The University of Chicago



Locomotives idle for several reasons

- **To keep engine warm to ensure it starts**
 - antifreeze generally not used
- **For hotel load while waiting**
 - on sidings and at terminals
- **To keep battery charged**
- **To heat toilet water**
 - frozen toilets cause service loss
- **To avoid Terminal Brake Test**
- **Perceived futility of shutdown**
- **Ingrained operating habits**



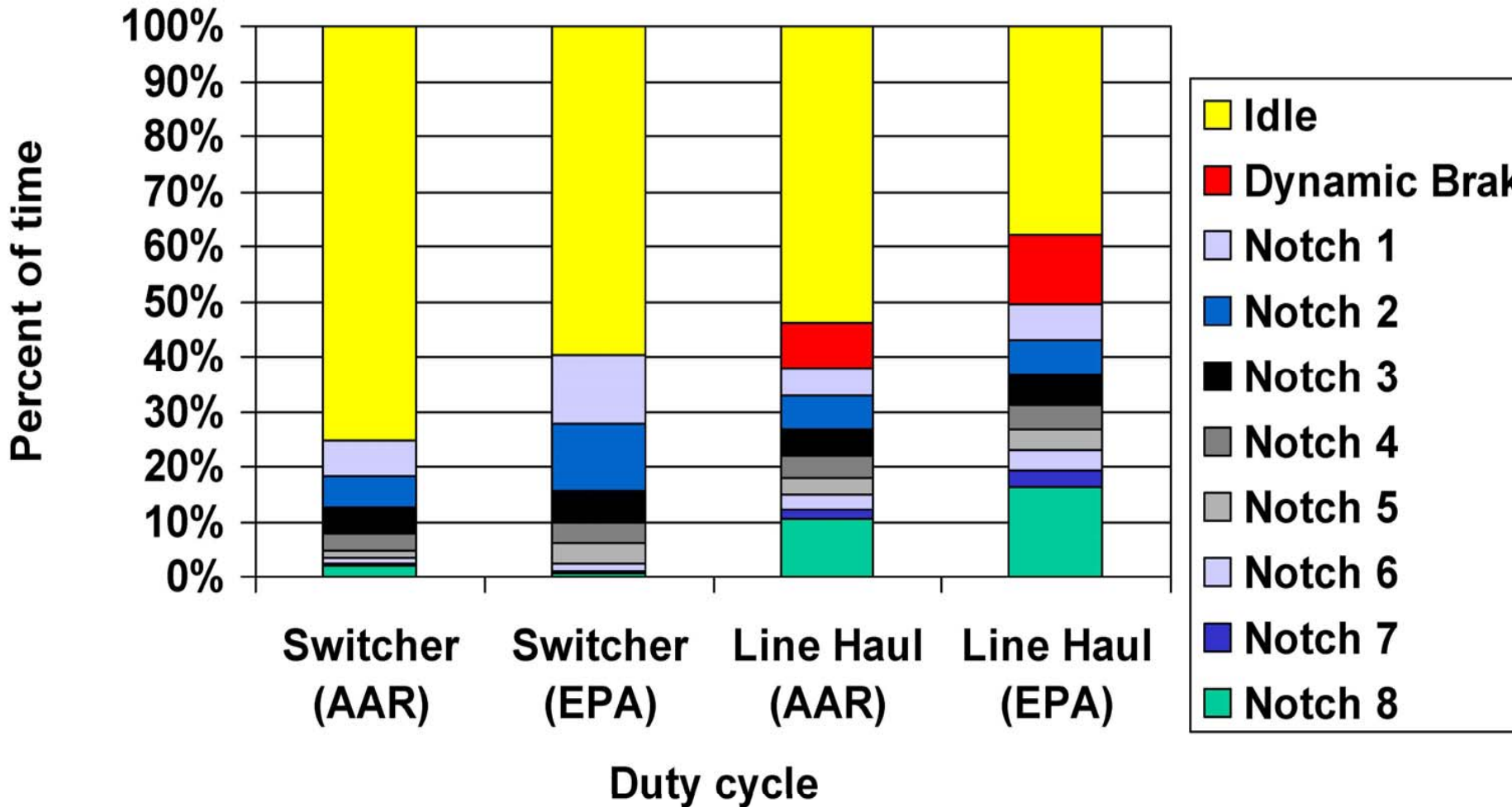
Why don't locomotives use antifreeze?




Typical 4400 HP locomotive diesel engine ... weighs 46,000 pounds

- **Idling protects against**
 - Freezing water
 - Cold oil that's too stiff for cranking
- **Antifreeze can damage bearings in large diesel engines**
- **Antifreeze would reduce HP output**
 - Water better heat transfer fluid
 - Allows 20% smaller radiators
- **Environmental impacts of leaks**

Even road locomotives idle



A large, faint, light-colored globe with a grid of latitude and longitude lines is centered in the background of the text.

EcoTrans Technologies
Promotes the use of the award winning

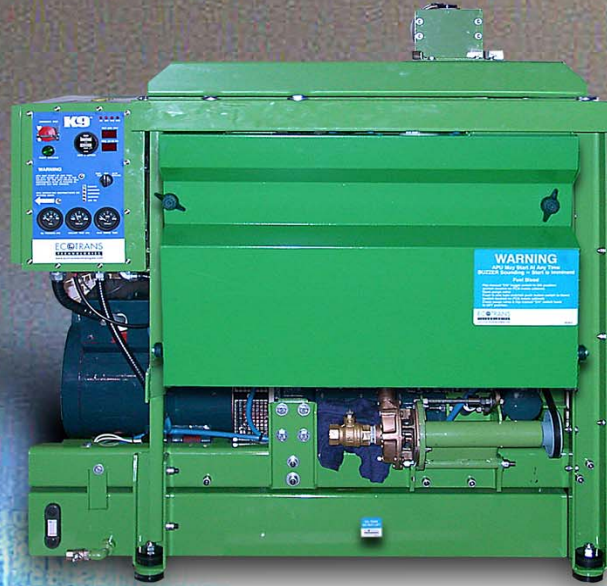
K9®

Auxiliary Power Unit

A large, 3D, metallic-looking logo for "K9". The letters are rendered in a bold, sans-serif font with a brushed metal texture and sharp edges. A small registered trademark symbol (®) is located at the bottom right of the "9".

K9®





K9®

Auxiliary Power Unit (APU)

ECOTRANS K9 APU



- BACKGROUND
- PRODUCT DESCRIPTION
- OPERATING CHARACTERISTICS
- FUEL BENEFITS
- EMISSIONS COMPLIANCE
- NOISE LEVELS
- RECOGNITION
- WHAT CAN BE DONE TO INCENT?
- CONTACTS



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BACKGROUND



EcoTrans Technologies Inc. was formed for the purpose of marketing it's revolutionary new Auxiliary Power Unit (APU) to the rail transportation industry.

With offices in the United States and Canada, EcoTrans Technologies is an integral part of a network of privately held corporations that designs, manufactures and markets (among other things) engineered locomotive auxiliary power units, fuel savings technologies, cooling systems and nameplates/decals for the rail transportation and rapid transit industries in North America.

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PRODUCT DESCRIPTION



- The K9® APU system consists of an auxiliary diesel engine/genset and an engine shutdown timer (EST). Together, these two components provide for a significant reduction in main engine idle time.

- The heart of the K9® APU consists of a Kubota V2003-T-B diesel engine mated to a 60 hertz 240 volt single phase 16KW generator set.



- The system uses a water/coolant heat exchanger for APU engine cooling and main engine heating. Locomotive water pump, locomotive lube oil pump, and a fuel supply and return are part of the system.

- Additional heaters are included, 9KW for water, and 1.5 KW for oil. Locomotive oil and water are re-circulated whenever the APU runs. Locomotive batteries also receives a trickle charge whenever the APU runs. The APU always receives a trickle charge from the Locomotive batteries.

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PRODUCT DESCRIPTION (Cont.)



- The APU has its own engine oil system, with a 15 gallon sump. This arrangement allows for 2 year oil change intervals.
- The APU is designed to start up and shut down automatically, in response to locomotive water temperature, locomotive batteries, or operator demand. No operator action is required.
- The APU can be used to power common household equipment such as air conditioners and heaters. This flexibility permits locomotive shutdown while maintaining crew comfort.
- The APU will attempt to start five times before it issues an alarm. It will also self-protect and issue an alarm for high temperature, low oil pressure, overspeed, or overcrank.
- The main engine shut down timer (EST), forces the main engine into a shutdown after a period of idle activity. Shortly after a shutdown, locomotive lights automatically drop out to conserve batteries.



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OPERATING CHARACTERISTICS



Protect Your Investment



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OPERATING CHARACTERISTICS



If the following conditions exist, the EST will shutdown the main engine:



- APU has not issued an alarm or fault
- APU has a healthy 12 volt battery
- APU mode selector is in either “autocycling” or
- continuous run
- APU emergency stop is pulled out
- Idle exceeds 30 minutes (reverser centered for 30 minutes, no activity in trainline.)
- Prior to a forced shutdown, the EST will issue three beeps, alerting an operator that a shutdown is approaching..
- Two minutes following a shutdown, the lights will drop off of the battery. A reset switch in the cab allows for re-energization of lights for two minutes.



OPERATING CHARACTERISTICS (Cont.)



- During the shutdown, the APU will remain dormant until it receives a signal to start.
- The APU has two inputs to start.
 - It will start on temperature, warm up, and energize heaters and the battery charger when M.E. water temperature drops to less than 60 degrees F. It will cool down and shutdown when water temperature exceeds 100 degrees F.
 - It will also start on low M.E. battery voltage <62 V, this will also energize heaters (if necessary) and the battery charger. It will cool down and shutdown when the battery voltage has reached >67 V.
- To restart the locomotive, simply follow normal starting procedures for the locomotive engine class. The APU will automatically shutdown and the EST timer will reset for the next shutdown.
- **Note: If the APU is not “healthy” as described above, the main engine will not shutdown.**



FUEL BENEFITS



Rescue Your Fuel Budget



FUEL BENEFITS

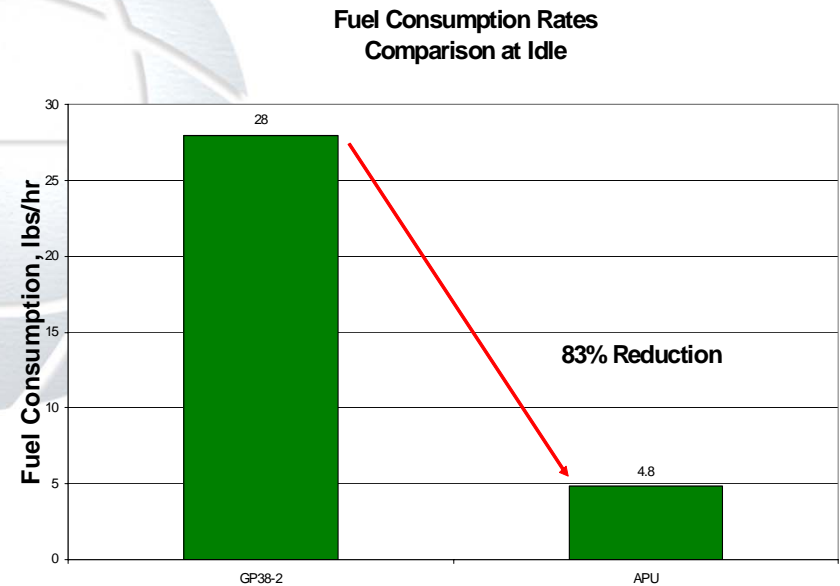


THE APU SAVES FUEL & LUBE OIL

- **EPA Switcher Duty Cycle = 59.8%**
Idle factor = 5238.5 total idle hours/year
- **Assume 75% main engine shutdown with APU kit = 3928.9 hrs/yr**
- **GP38-2 idle fuel rate = 4 gal/hr**
- **Fuel Savings @ \$1.25 / gallon = \$18,659 / year / locomotive**

Idle Fuel Savings

(*test data from Southwest Research Institute)



EMISSIONS COMPLIANCE



The Railroads Best Friend



EMISSIONS COMPLIANCE



The K9® APU is a part of a locomotive Tier 0 package certified to meet EPA's 1997 locomotive rule and conform with the EPA's idle reduction strategy. This assists in bringing the locomotive into compliance without the significant fuel penalty associated with other emission reduction kits.



EMISSIONS COMPLIANCE (Cont.)



Locomotive	NO,	HC,	CO,	PM,	¹ SO ₂ ,
Engine Model	Gms/hr	Gms/hr	Gms/hr	Gms/hr	gms/hr
EMD 12-567BC	578	529	382	19	48
12-645E	987	92	81	22	55
12-645E3	1366	95	432	26	82
12-645E3Z	850	103	349	24	42
16-567C	110	150	211	26	45
16-645E	1247	124	283	27	85
16-645E3	135	185	564	34	86
16-645E3B	1717	137	445	32	129
16-645F3	3024	228	617	57	167
16-645G3	99	99	99	99	99
20-710G3	1064	63	80	20	56
20-645E3	1541	242	1017	40	111
and GE					
GE Dash-9 Turbo kit	209	218	349	25	27
Dec-00	209	218	349	25	27
16-3000	278	290	464	33	36
16-3600	320	333	534	38	41
AVERAGE	1338	169	390	29	79

• Idle Emission Reduction Kits and certifications are available for the following EMD engine families:

- 8, 12, & 16-645E
- 16-645E3, E3B, & E3M
- 8 & 16-645E3C
- 16-645E3B
- 16-710G3B, G3B-EC, & G3B-ES
- 20-710G3B-ES
- GE Dash-9 Turbo kit

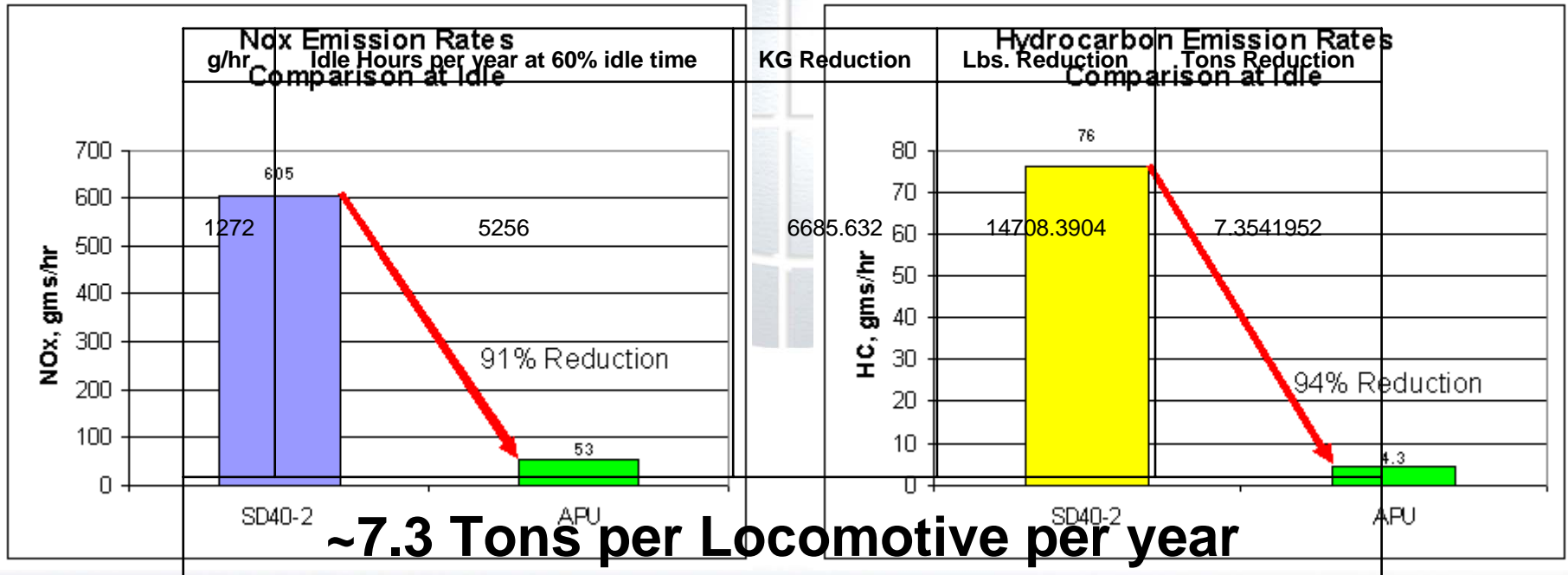


EMISSIONS COMPLIANCE (Cont.)



Idle Emission Reductions NOx Reduction Per Year (SD40-2 16-645E3 vs APU)*

What does this mean?
(*test data from Southwest Research Institute)



EMISSIONS COMPLIANCE (Cont.)



HC Reduction Per Year

What does this mean?

g/hr	Idle Hours per year at 60% idle time	KG Reduction	Lbs. Reduction	Tons Reduction
164.7	5256	865.6632	1904.45904	0.95222952

~1 Ton per Locomotive per year



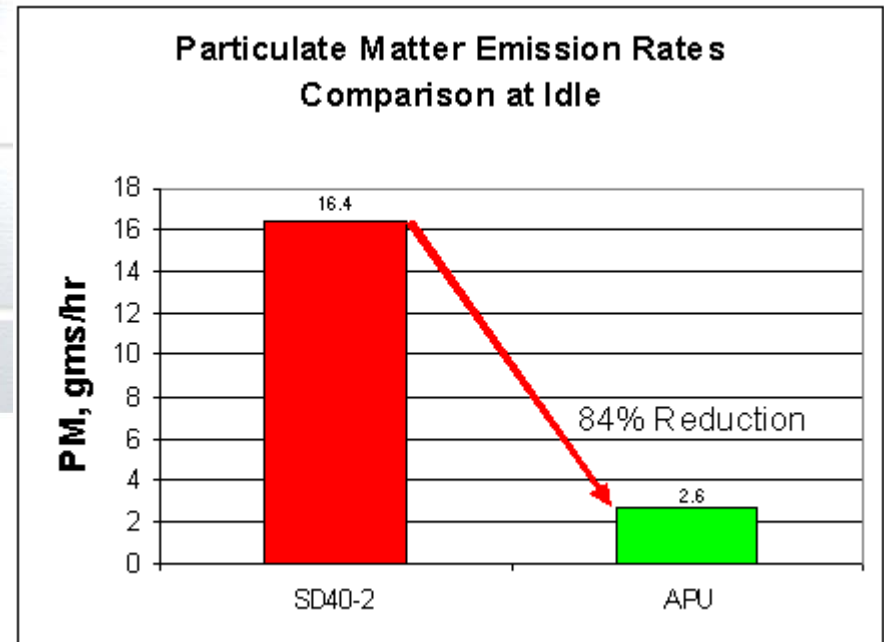
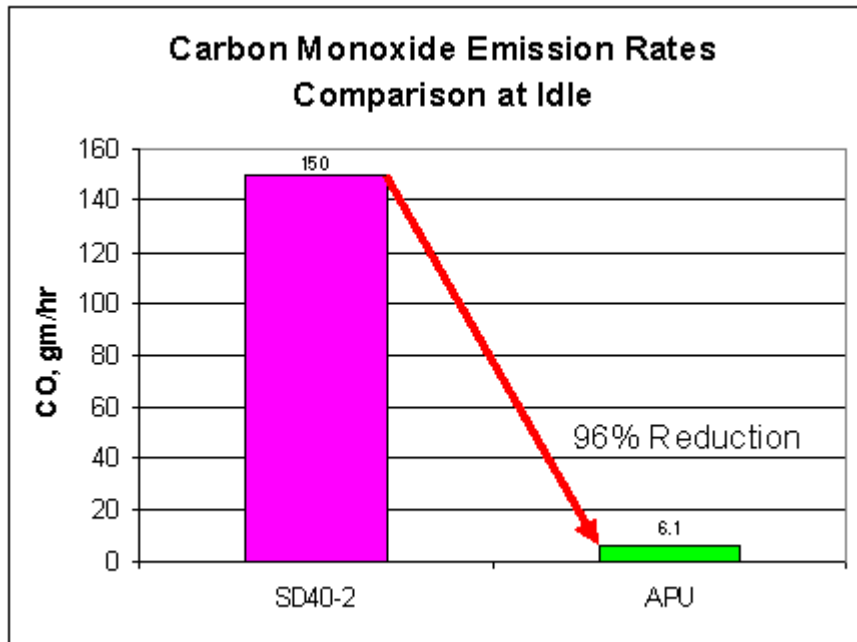
EMISSIONS COMPLIANCE (Cont.)



Idle Emission Reductions

(SD40-2 16-645E3 vs APU)*

(*test data from Southwest Research Institute)



EMISSIONS COMPLIANCE (Cont.)



CO Reduction Per Year

What does this mean?

g/hr	Idle Hours per year at 60% idle time	KG Reduction	Lbs. Reduction	Tons Reduction
383.9	5256	2017.7784	4439.11248	2.21955624

~2.2 Tons per Locomotive per year



EMISSIONS COMPLIANCE (Cont.)



PM Reduction Per Year

What does this mean?

g/hr	Idle Hours per year at 60% idle time	KG Reduction	Lbs. Reduction	Tons Reduction
26.4	5256	138.7584	305.26848	0.15263424

~300 pounds per Locomotive per year



EMISSIONS COMPLIANCE (Cont.)



SO₂ Reduction Per Year

What does this mean?

g/hr	Idle Hours per year at 60% idle time	KG Reduction	Lbs. Reduction	Tons Reduction
72.5	5256	381.06	838.332	0.419166

~1/2 Ton per Locomotive per year



EMISSIONS COMPLIANCE (Cont.)



CO₂ Reduction Per Year

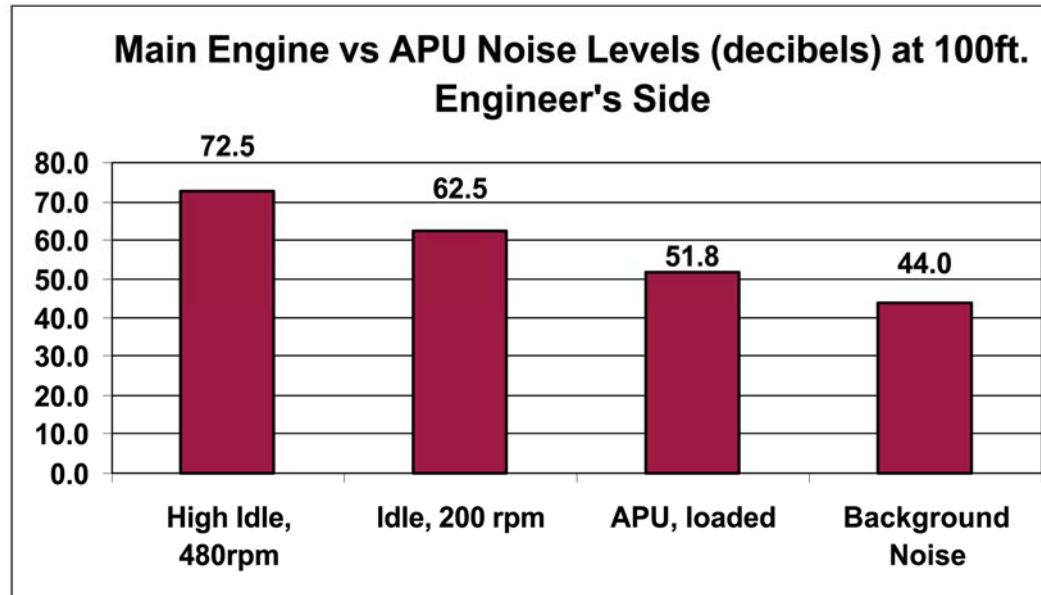
What does this mean?

g/hr	Idle Hours per year at 60% idle time	KG Reduction	Lbs. Reduction	Tons Reduction
33477.6	5256	175958.2656	387108.1843	193.5540922

~193 Tons per Locomotive per year

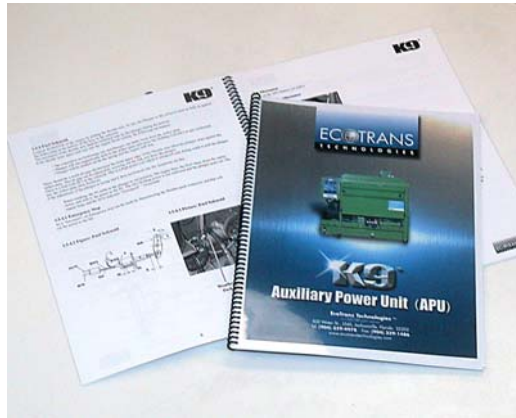


NOISE LEVELS



- Noise generated from the APU, in normal operating mode with the locomotive carbody doors shut is virtually indistinguishable from normal background noise at a distance of 100 feet.

TECHNICAL SUPPORT



EcoTrans will provide all the necessary technical support including:

- Installation Instructions
- Operating manuals
- On Site Training



SPARE PARTS PROGRAM



EcoTrans will provide all the necessary support including:

- Recommended Spare Parts List
- Illustrated Parts Booklet



WARRANTY PROGRAM



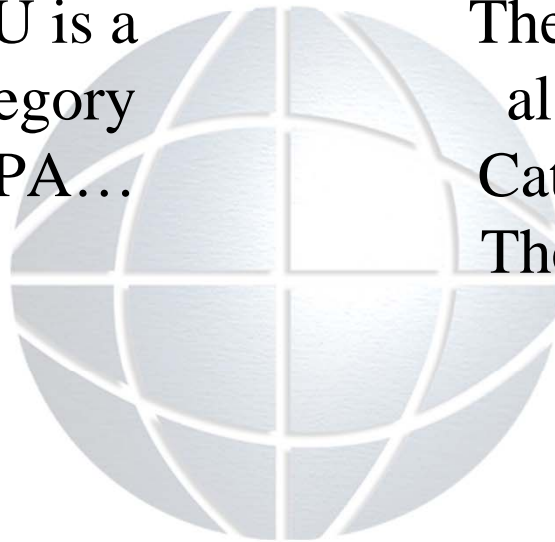
- 2 Years on Major Components.



RECOGNITION



The EcoTrans K9® APU is a recent Technology Category award winner at The EPA...



The EcoTrans K9® APU is also a 2003 Technology Category award winner of The Texas Environmental Awards



**Texas Environmental
Excellence Award**



Given all the benefits, why aren't railroads employing LIRS's more rapidly?

1. Maximum fuel saving estimated at 4% of annual use.
2. Ingrained operating habits.
3. The three lies.
4. Lack of legislative harmony across "fictitious" borders.
5. Competition for capital expenditure dollars.





What can be done to expedite emissions reduction?

1. Command and control legislation?
 - Tier limits have already been implemented.
2. Cash Incentives?
 - Perhaps, but don't forget about the "three lies."
3. Market based ERC's?
 - But then we have to have consistency across legislative jurisdictions.



What do we recommend?

1. A simplified prospective and/or retrospective ERC program.
2. The ERC programs should be cross-jurisdictional to motivate participation and minimize data gathering.



What effect could this have?

1. Using say a base idle emissions reduction factor of 5 tons of NO_x per year per locomotive and a market price of \$5,000 per ton, the locomotive owner could earn as much as \$25,000 per year in credits.
2. This would bring the payback of an APU installation to less than one year.



What is the potential say based on 1,000 locomotives?

1. 5,000 tons of NO_x could be eliminated
2. 193,000 tons of CO₂ could be eliminated
3. 1,000 tons of Hydro Carbon gone.
4. 500 tons of sulfur-dioxide gone..
5. And maybe a few fewer kids carrying puffers.



CONTACTS



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