Attachment 1: Description of Emission Reduction Measure Form

Please fill out one form for each emission reduction measure. See instructions in Attachment 2.

Title: Reducing unproductive fuel uses in the transportation sector in relation to locomotive idling by encouraging electrification

Type of Measure (check all that apply):

- ☐ Direct Regulation
- ☒ Market-Based Compliance
- ☐ Monetary Incentive
- ☐ Non-Monetary Incentive
- ☒ Voluntary
- ☐ Alternative Compliance Mechanism
- ☐ Other Describe:

Responsible Agency: CARB, local air quality management district

Sector:

- ☒ Transportation
- ☒ Electricity Generation
- ☐ Other Industrial
- ☐ Refineries
- ☐ Agriculture
- ☐ Cement
- ☐ Sequestration
- ☐ Other Describe:

2020 Baseline Emissions Assumed (MMT CO2E): 3.148 MMT per year (pursuant to CARB 2004 estimate)

Percent Reduction in 2020: 2% - 11% (0.07 - 0.35 MMT)

Cost-Effectiveness ($/metric ton CO2E) in 2020: High cost-effectiveness with possible payback to implementing actor within 1 - 3 years.

Description:

This is a technological strategy to reduce emissions from locomotives when no useful work is being performed, i.e., reducing the time locomotive spend idling by providing shore power to the locomotives at rail yards and maintenance facilities. Depending upon whether a locomotive is used for long-haul or rail yard switching, the locomotive may spend from 40% - 75% at idle. Some of this idling may be for the purpose of freeze protection, cabin climate controls, avoiding difficult start-ups, and maintaining the instantaneous availability of the locomotive.

The proposed regualtory action plan includes a feasibility/GHG emission reduction study of reducing locomotive idling at railyards through electrification (shore power). An initial step could be CARB updating findings of its Roseville Rail Yard Study to

incoprorate opportunities for electrification.
http://www.arb.ca.gov/diesel/presentations/rrstudypres.pdf

This is envisioned as a voluntary measure that will be implemented based upon a cost-effectiveness study performed by the rail yard/electric utility at a specifc rail yard. This idea incorporates "fuel switching" that results in a reduction of the Statewide GHG emissions (Health & Safety Code section 38505(m)) and maximizes the total benefits to Califonia. Therefore, CARB's emission reduction regulations must recognize and accomodate for the increased load to electric sector. (Health & Safety Code section 38562(b)(1)).

Based upon the CARB study, however, the installation of shore power could be encouraged through financial incentives to the incorporating sector (e.g., rail, municipality, or electric utility) if needed.

Emission Reduction Calculations and Assumptions:

Assumption: Idling locomotives account for 45% of rail emissions. CARB Roseville Rail Yard Study at 21.

Assumption: Idling is reduced by 5%-25% through use of shore power applications.

Calculation 1 : (5% reduction) X (45% of annual emissions) X (3.148 MMT) = 0.071 MMT annual reduction

Calculation 2 : (25% reduction) X (45% of annual emissions) X (3.148 MMT) = 0.354 MMT annual reduction

Cost-Effectiveness Calculation and Assumptions:

Assumption: One manufacturer states that installation costs very from $3,000 - 14,500 per unit. http://www.kimhotstart.com/kimhotstart/sub.aspx?id=3868

Assumption: Idling reduction results in fuel savings of 7,500 gallons per year per locomotive.

Assumption: Electricity rate is $0.08 per kWh.
http://www.roseville.ca.us/electric/rates_reliability_n_billing/commercial_rates.asp

Assumption: Fuel cost is $2.17 per gallon.
http://www.up.com/investors/attachments/secfiling/2007/upc10q_072607.pdf

Assumption: 1 gallon of diesel/hour performs the equivalent work of 12.5 kwh of electricity.

(7,500 gallons) X ($2.17 per gallon) = $16,275 annual fuel savings per locomotive.
(7,500 gallons) X (12.5 kWh) X ($0.08) = $7,500 annual electricity bill per locomotive

Payback to rail company in approximately 1 - 3 years.

Implementation Barriers and Ways to Overcome Them:

Technolocigal barriers: Minimal to none. Shore power technologies are available.
http://www.kimhotstart.com/kimhotstart/sub.aspx?id=3868

Operational barriers: May result in operational process changes at rail yards. Locomotives must be loacted near shore power units. In some cases, electric utility infrastructive such as poles, wires, and transformers may be required.

Regulatory barriers: Fuel switching to the electric sector will adversely impact utilities by increasing the electric load as compared to 1990 levels unless CARB's regulations recognize this shift as an emission reduction to California.

Public and political barriers: None. CARB and the federal EPA have reviewed idle reduction technoligies and methods.
http://www.epa.gov/smartway/idlingtechnologies.htm#loco-stat-epsds

Potential Impact on Criteria and Toxic Pollutants:

Collateral benefits to idle reduction includes an analogous decrease in criteria and toxic polutants based on the percentage of idle reduction achieved. Collateral benefits include lower fuel consumption, lower oil consumption, lower ambient noise levels, and the decreased potential for health problems in surrounding areas. Due to locations of some railyards, the reduction of emissions, noise, and health issues may positively impact environmental justice issues.

Name: Bruce McLaughlin
Organization: None
Phone/e-mail: (916) 531-5566 / bruce6450@yahoo.com

Roseville Rail Yard Study

Presentation for the Placer County Air Pollution Control Board

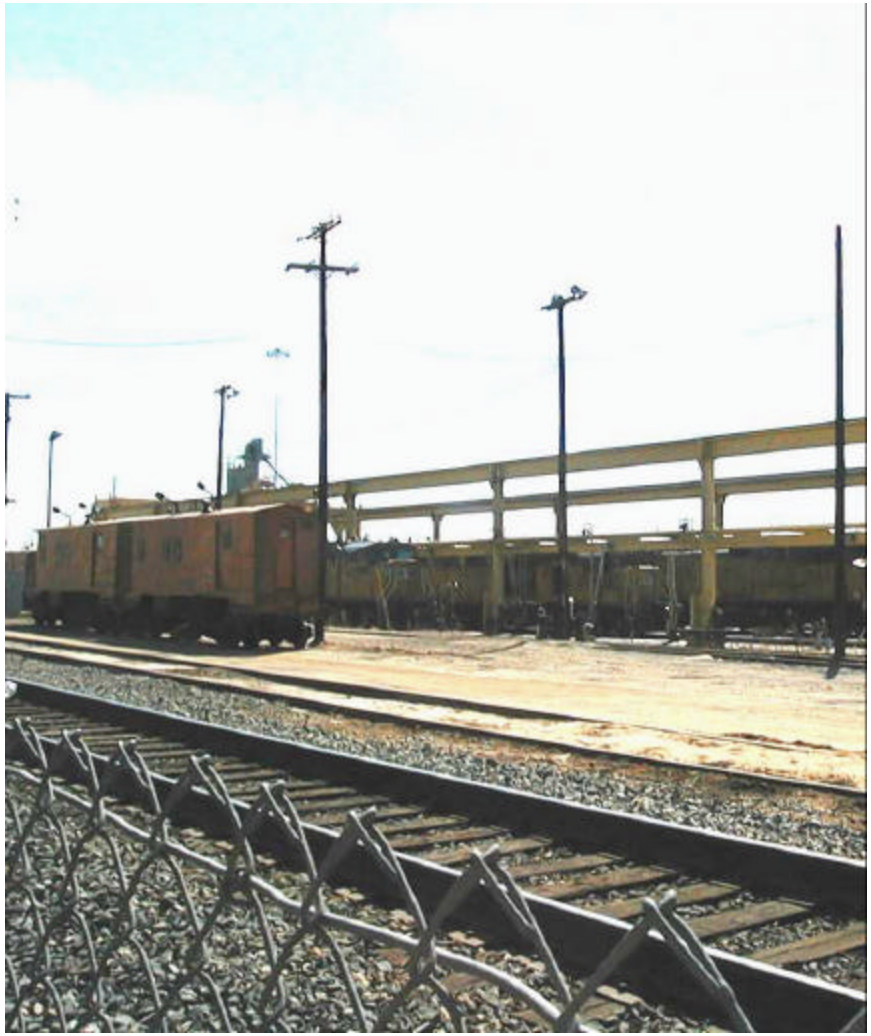
October 14, 2004

Dan Donohoue, Chief
Emissions Assessment Branch

California Air Resources Board

Overview

- Background
- Roseville Rail Yard
- Study Approach
- Results
  - Diesel PM Emission Inventory
  - Health Risk Assessment
- Conclusions and Recommendations



Background

Study Objectives

- Estimate diesel PM emissions from locomotive activities at the Yard
- Conduct air dispersion modeling to estimate the ambient concentration of diesel PM
- Characterize the exposures to nearby residents and estimate increased potential cancer risk

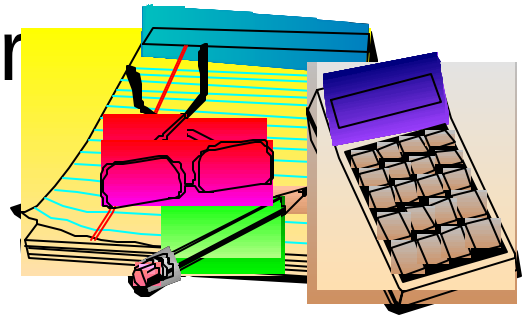
Why Are We Concerned About Diesel PM?

- Diesel PM is a toxic air contaminant
  - Causes cancer
  - Increases premature deaths, hospital admissions, respiratory diseases

- Diesel NOx and ROG contribute to ozone and PM formation

What is a Health Risk Assessment?

- Evaluation of the potential for a chemical to cause cancer or other illness



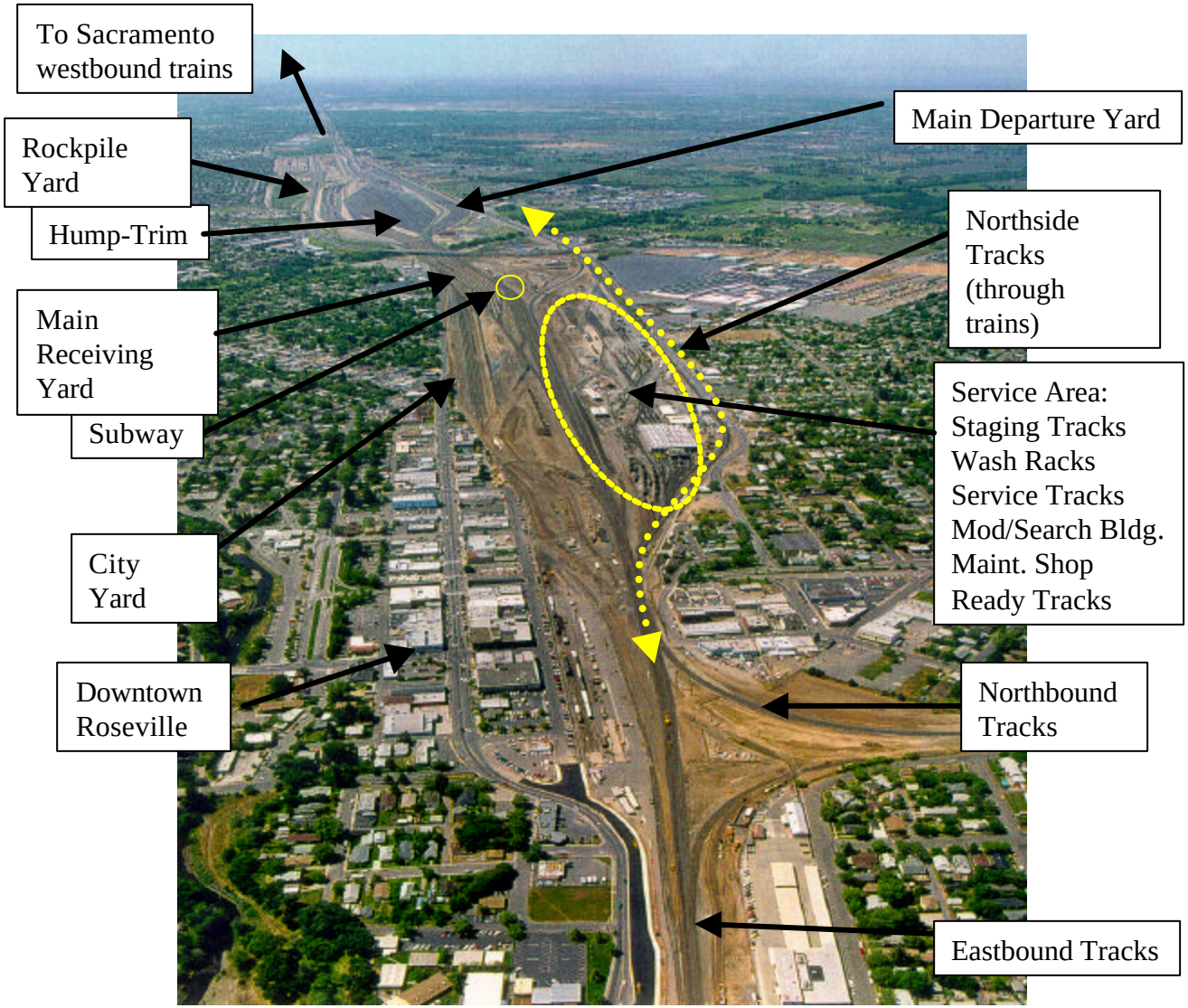
  - uses mathematical models to estimate exposures (risk)
  - risk expressed as number of excess cancers in a population of a million over a 70-year lifetime

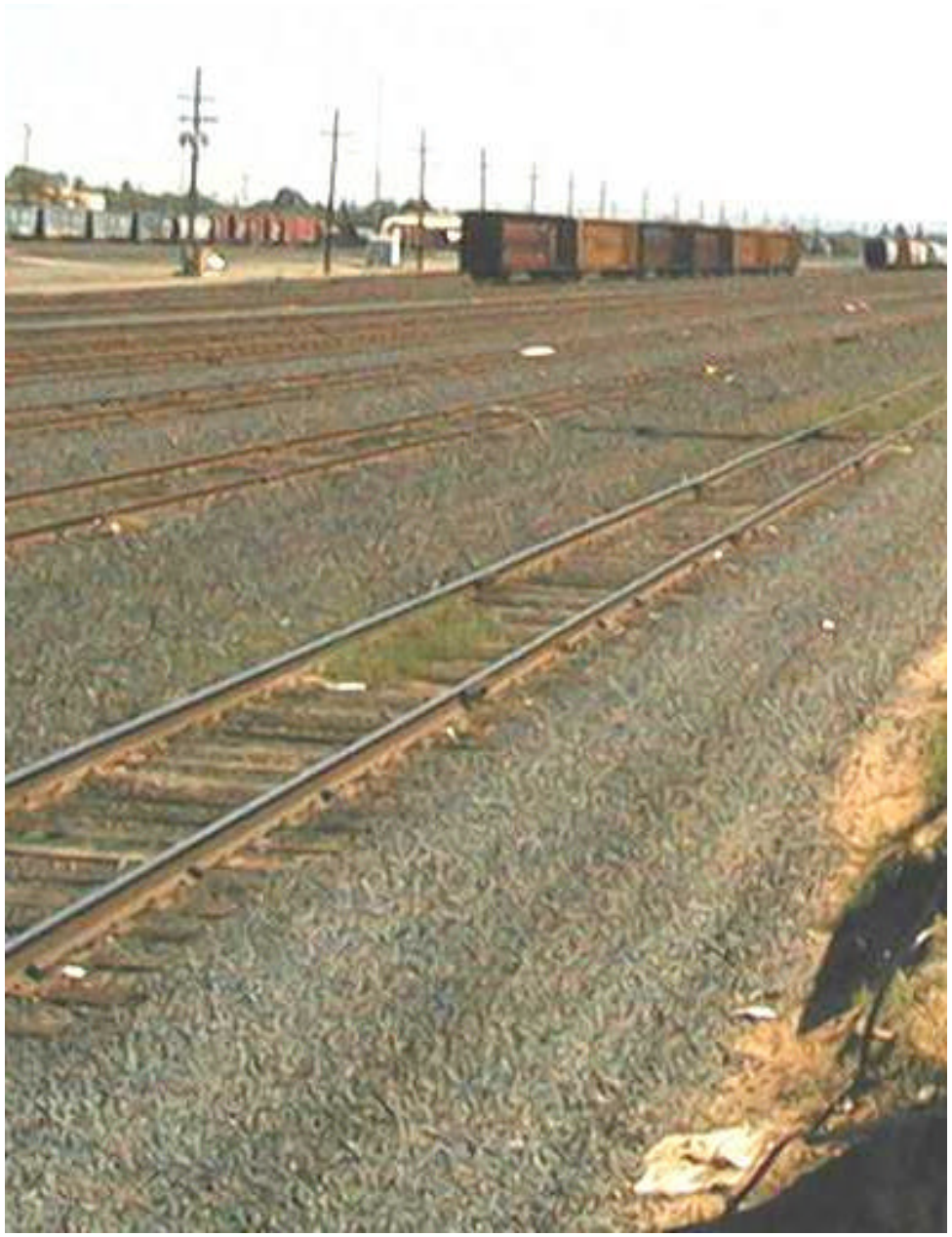
Roseville Rail Yard

Roseville Rail Yard

- Located near City of Roseville
  - Occupies about 950 acres, 2/3 in Placer County and 1/3 in Sacramento County
- Maintenance, service and classification yard (24/7 operation)
- In operation since 1905
- About 31,000 locomotives stopped at the Yard in 2000
  - additional 15,000 trains passed through on northside tracks

Roseville Rail Yard





Study Approach

Study Approach

- Estimated diesel PM emissions from all locomotive activities
  - movement
  - idling
  - testing
- Allocated emissions to appropriate area in Yard
- Key activity assumptions and data inputs provided by UPRR

Study Approach (cont.)

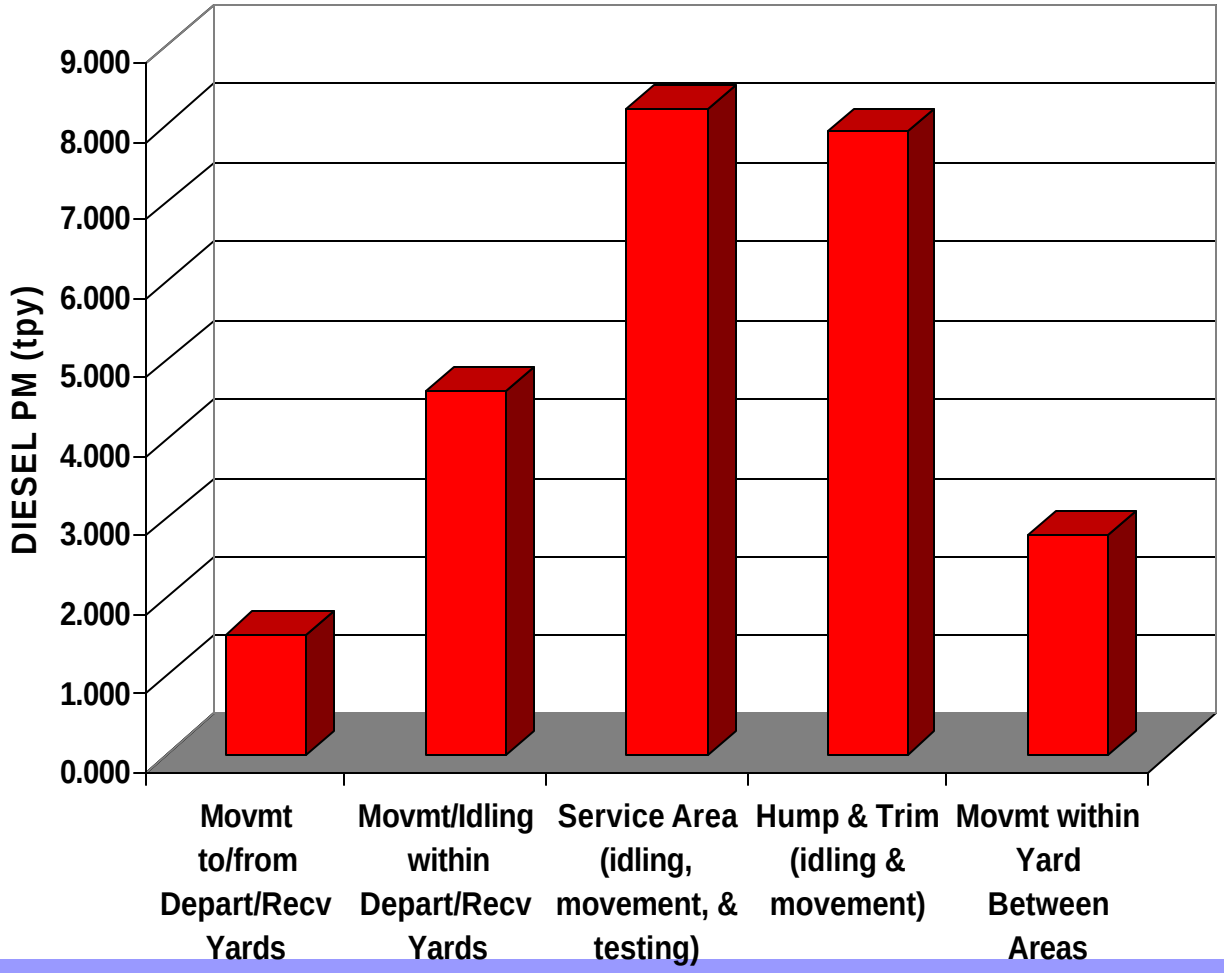
- U.S. EPA ISCST3 model
- Two meteorological datasets (Roseville and McClellan)
- Urban dispersion for near source risks and rural for regional
- Followed OEHHA Guidelines for Health Risk Assessments

Results

Diesel PM Emission Inventory at the Roseville Rail Yard

- Estimated 22-25 tons of diesel PM in 2000
- Monthly and hourly emissions fairly constant
- Locomotive movement, idling, testing responsible for about 50%, 45% and 5% of emissions, respectively

Contribution of Diesel PM by Area and Activity



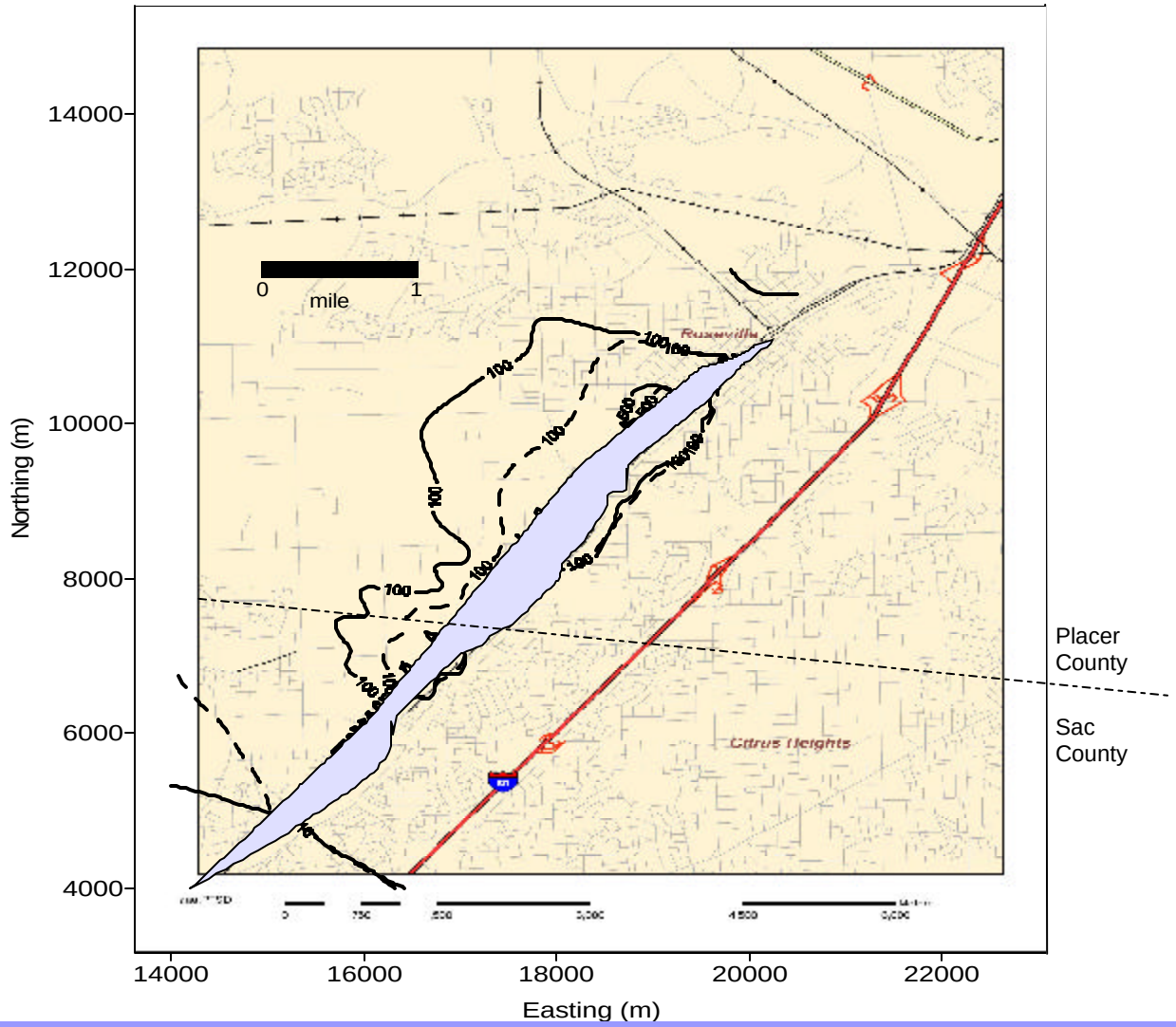
Health Risk Assessment Results

- Risks are depicted as isopleths overlaid on a regional map
- Near source risk is high by two areas
  - Nearby the *Service Track* and *Hump and Trim* areas
- Elevated concentrations and risks extend over a very large area

Estimated Cancer Risk from the Yard

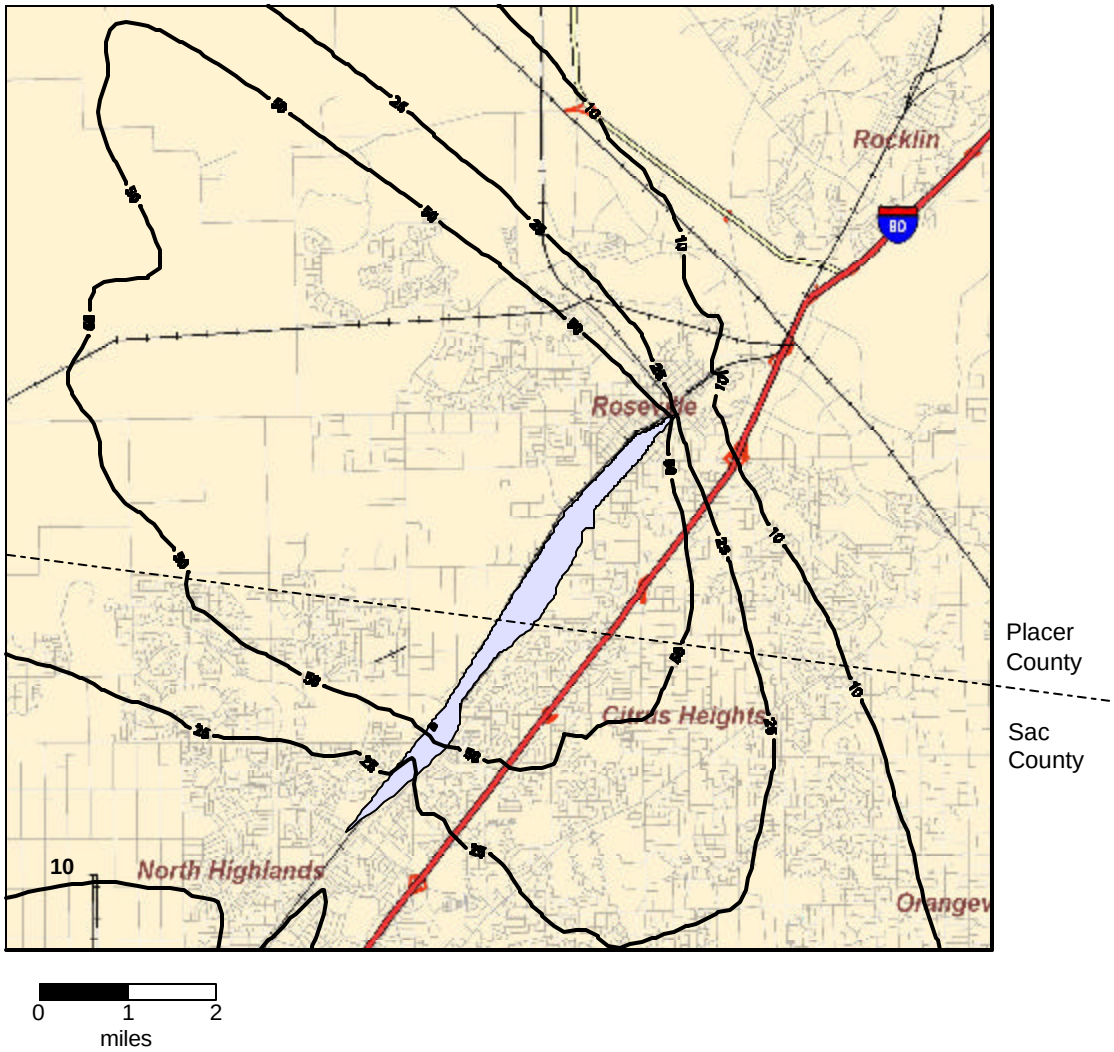
100 and 500 in a million risk isopleths

Solid line - Roseville Met data; Dashed lines - McClellan Met Data



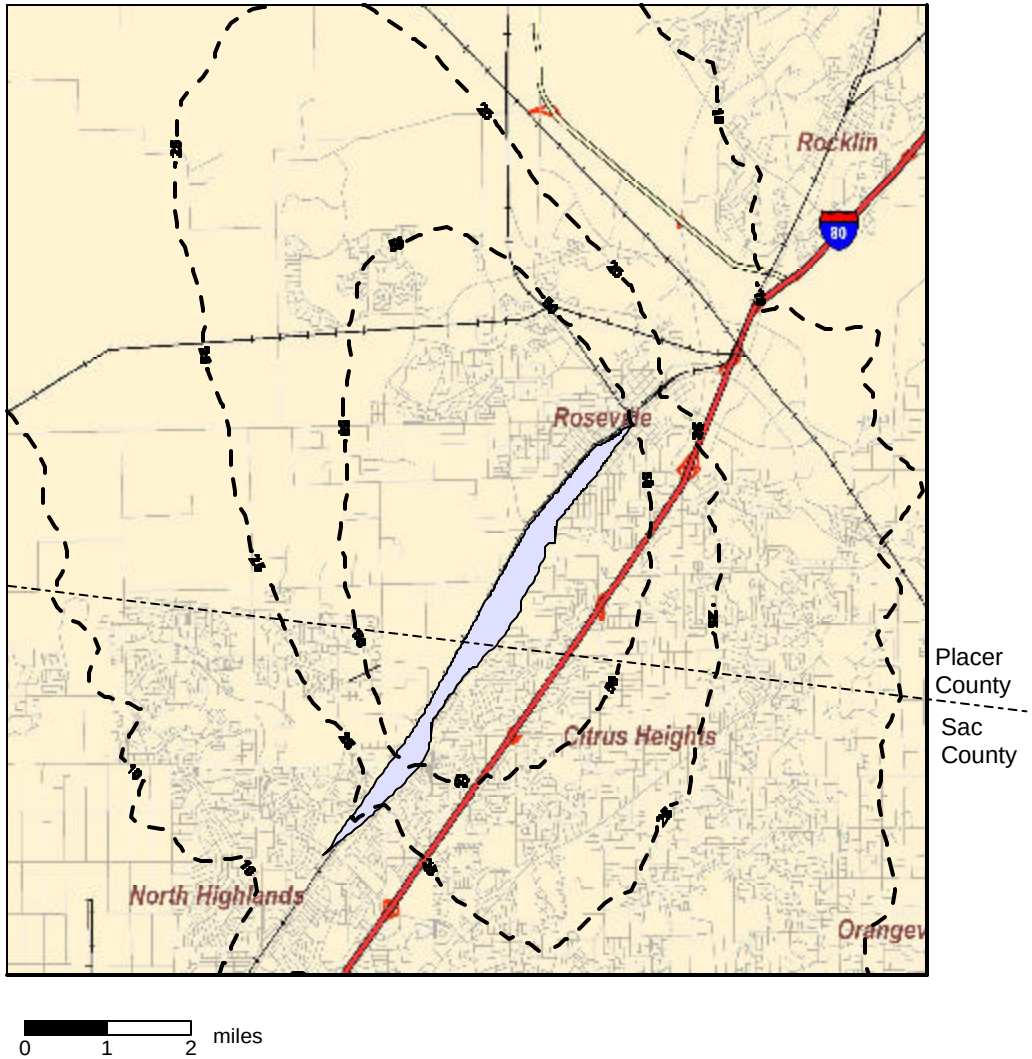
Estimated Cancer Risk from the Yard

10, 25, and 50 in a million risk isopleths, Roseville Met Data

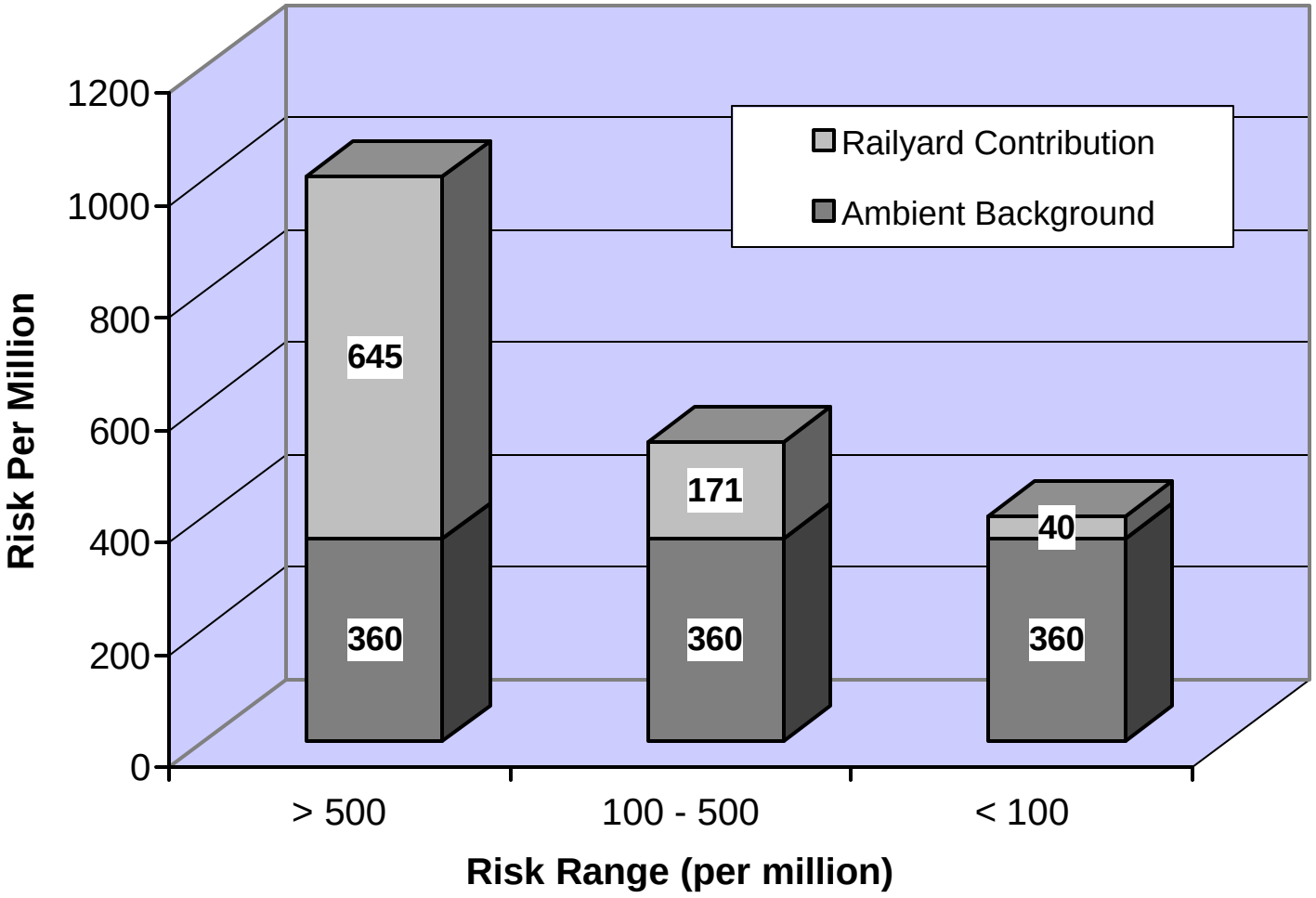


Estimated Cancer Risk from the Yard

(10, 25, and 50 in a million risk isopleths, McClellan Met Data)



Comparison of Roseville Rail Yard Risks to Ambient Background Level in Sacramento Region



Findings

- Year 2000 Diesel PM emissions: 25 tons
  - Moving locomotives account for about 50 percent of emissions, idling locomotive about 45% and testing accounts for about 5%
- Large region impacted by the Diesel PM emissions from the Yard
  - Potential cancer risks greater than 500 in a million occur northwest of the Service Track area and Hump and Trim (10-40 acres)
  - Potential cancer risks greater than 100 in a million occur over a 700-1600 acres
  - Potential cancer risk greater than 10 in a million occur over 46,000-56,000 acres impacted between 140,000 and 155,000 people

Air Resources Board Recommendations

- Short-term and long-term mitigation measures are needed
  - Cleaner fuels
  - Idling reduction
  - Accelerate rebuilt/replacement
  - Inspection & maintenance practices
  - Improved engine technology & exhaust aftertreatmant

Technical Contact

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Emissions Assessment Branch
California Air Resources Board

ddonohou@arb.ca.gov

(916) 322-6023

www.arb.ca.gov/diesel/documents/rrstudy.htm

Idle Reduction Technologies

EPA Region 1 Workshop

April 28, 2004

Terry Judge

Kim Hotstart Manufacturing Company

Where Are We?

KIM HOTSTART
SINCE 2542

Our Mission

To develop superior engine heating solutions that help our customers:

- Improve operating efficiencies
- Extend engine life
- Reduce emissions
- Reduce fuel consumption

HOTSTART
SINCE 1942

Applications

In many applications (heavy duty trucks, locomotives, generator sets, gas pipeline compressor stations, construction & mining equipment, etc.), heating large diesel engines above 100F allows them to start easily with minimal engine wear and provide full power quickly without idling.

HOTSTART
SINCE 1942

Idle Reduction

We've been doing it since 1942

HOTSTART

SINCE 1942

Today’s Operator

Today’s switchyard locomotive is operated via remote control. No demand for creature comforts.

Today’s long-haul truck is an apartment-on-wheels. Big demand for creature comforts.

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SINCE 1942

Keeping Engine Above 100F

- Bus and Truck engines (300-850 CID)
  - 750-1500 watts to the coolant.
- Locomotive engines (4,000-15,000 CID)
  - 18,000-30,000 watts to the coolant
  - 0-6,000 watts to the oil

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Let’s Examine Locomotive Idling

A GP38-2 locomotive consumes 4.5 gallons per hour of fuel at normal idle. When outside temperatures drop to 10-15F, the locomotive is idled at notch 3 to keep the engine warm. At notch 3 the locomotive consumes 11 gph.

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% Time Spent Idling?

	Line Haul	Switch
EPA	**38.0%**	**59.8%**
AAR	**54.0%**	**75.4%**

AAR = American Association of Railroads

How much fuel is wasted?

- Assume locomotive has 92% availability
  - 8,760 hrs/yr x 92% = 8,059 in-service hours/year
- Assume EPA Switcher Duty Cycle
  - 8,059 hrs/yr x 59.8% = 4,819 idle hrs/year
- Assume no notch 3 idling.
- GP38-2 consumes 4.5 gph at normal idle
  - 4.5 x 4,819 = <u>21,685 g/yr</u>
  - 59 g/day

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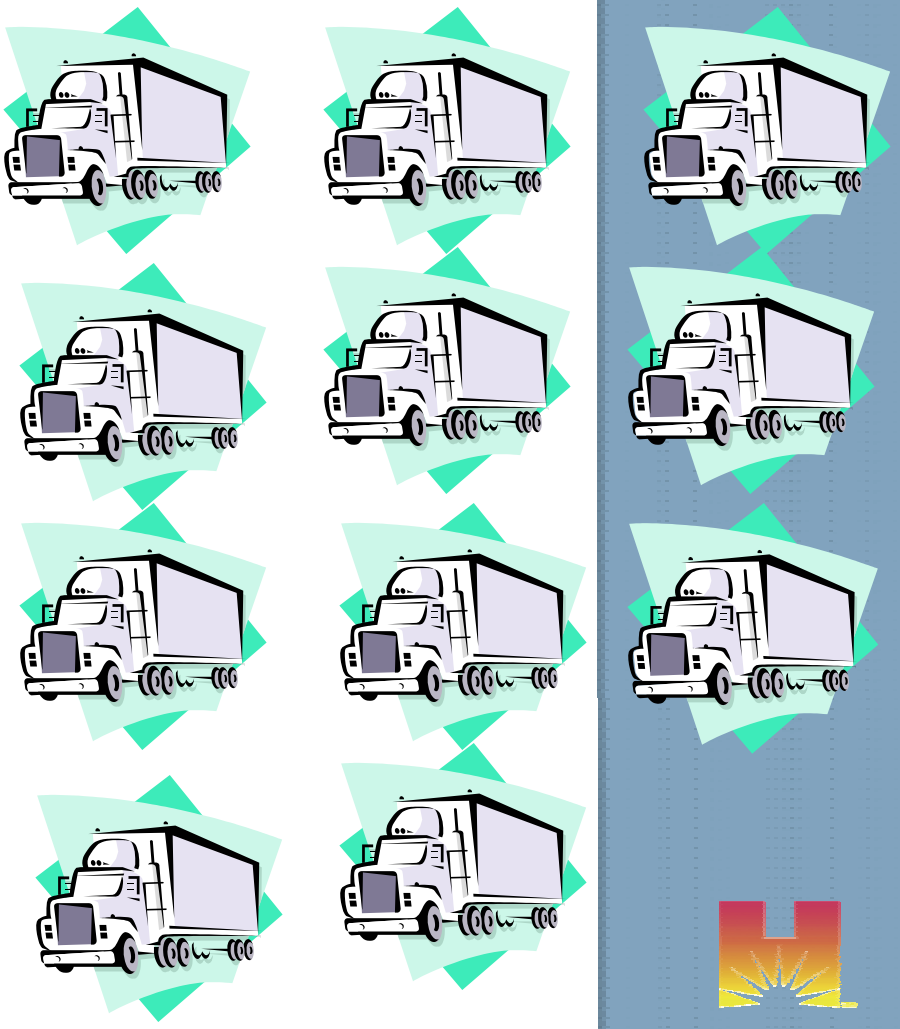
21,685 gallons/year!

=



One idling locomotive consumes as much fuel as 11 idling trucks assuming truck consumes 0.8 gph, 8 hrs/day, 300 days/yr (see EPA420-R-02-025).

Idling Problems

- Fuel consumption
- Oil consumption
- Emissions
- Noise
- Souping-up
- Engine wear

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Why Idle?

- Avoid difficult start-ups
  - Cold engine (T< 100F)
  - Weak batteries
- Ready for immediate service
- Freeze Protection – no antifreeze
  - Must keep engine > 32F

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Idle Reduction Technologies

In general, across all applications, idle reduction technologies fall into three distinct categories:

- Shore power, plug-in systems
- Stand-alone heating systems
- Automatic start-stop systems

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Idle Reduction Technology Using Shore Power

Kim Hotstart's plug-in engine heating system (left) and battery charger (middle) are used on Chicago's METRA commuter locomotives (right) and in EPA Region 1 by New England Southern Railroad, Maine Central Railroad, Massachusetts Central Railroad, Bay Colony Railroad and others.

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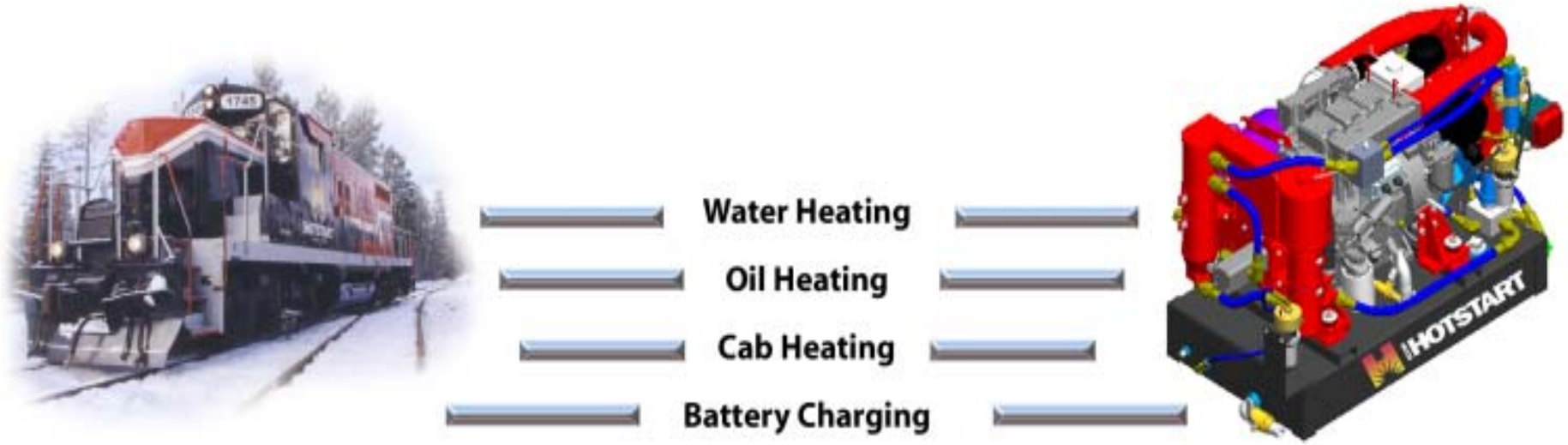
Locomotive Shore Power

- Advantages
  - Proven Technology
    - 1st installation in 1965
    - Over 2,000 installations
  - Low Maintenance
  - $3,000-$14,000 Investment
  - Very Low $/ton NOx Reduced
- Disadvantage
  - Have to park near external power source to shutdown

Stand-Alone Solution



Kim Hotstart's DDHS (Diesel Driven Heating System) was developed in response to the railroads who wanted the flexibility to shutdown their locomotives anywhere and still be able to easily restart the engine when needed.

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Idle Reduction

Using DDHS

- No external plug-in. Allows locomotive to be shut down anywhere.
- Operates automatically.
- Uses EPA Certified 3-Cylinder, 27hp diesel engine.
- Engine is direct-coupled to centrifugal water pump.
- Waste heat is transferred through heat exchangers to locomotive coolant and oil.
- Operates at multiple speeds to produce required heat.
- Maintains locomotive coolant between 100-120F.
- Powers cab heaters and charges batteries through 72vDC alternator.
- Successful field experience since 1998 with reported ambients down to -38F.
- Selected for first EPA locomotive idle reduction project.
- Installed on 14 different locomotive models by 11 different railroads.

Walkway Installation

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DDHS Consumes Little Fuel Compared to Locomotive

Throttle Setting	Idle (gph)	Notch 3 (gph)
SW12/SW15	3.0	9
GP7/GP9	3.7	8
GP38-2 SD38-2	4.5	11
GP40-2 SD40-2	5.1	11
DDHS	0-1.23	0-1.23

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Adding SmartStart Adds Benefits

- **Autoshutdown of locomotive**
- **Autorestart of locomotive**
- **Maintains brake pressure**
- **Fuel savings reports**
- **Remote monitoring (Optional)**
- **Failsafe redundancies**
- **Year round system**

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EPA-Chicago Project Results

- Fuel Savings per day = 42.7 gallons
- Fuel Savings per year = 14,339 gallons
- NOx reduced per year = 2.4 tons
- PM reduced per year = 0.07 tons
- Noise pollution reduced 8-15 decibels

Win-Win-Win

Cleaner environment for our citizens!

Fuel Savings!

Reduced air and noise pollution!

<u>Left to Right</u>
Tom Skinner, EPA
Marcia Jiminez, Chicago
Craig Hill, BNSF

Opportunities in Region 1?

- Perhaps not the best targets
  - Class 1 railroads (BNSF, CSX, Norfolk Southern, etc.)
    - Already implementing idle reduction solutions.
  - Military bases
  - Industrial (plants, mills, ports, etc.)
  - Tourist railroads
  - Amtrak
- Best Targets
  - Commuter Railroads
  - Short Line Railroads

Opportunities by State

218 Short Line & Commuter Locomotives

- Massachusetts (88)
- Maine (61)
- Vermont (28)
- New Hampshire (27)
- Connecticut (14)
- Rhode Island (?)

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Opportunities in Massachusetts

- MBTA Commuter Rail (55)
- Providence & Wooster (21)
- Massachusetts Central (7)
- Pioneer Valley (5)
- STS Rail System
  - Springfield Terminal
  - Boston & Maine
  - Maine Central

Opportunities in Maine

- Bangor & Aroostook (40)
- St. Lawrence & Atlantic (9)
- Belfast & Moosehead (6)
- Maine Coast (4)
- Aroostook Valley (2)

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Opportunities in New Hampshire

- Green Mountain (7)
- New Hampshire Northcoast (6)
- New Hampshire & Vermont (3)
- Berlin Mills (3)
- Quincy Terminal (3)
- Claremont Concord (2)
- Milford Bennington (2)
- New Hampshire Central (1)

Opportunities in Connecticut

- Housatonic (8)
- Connecticut Central (3)
- Central New England (3)

Opportunity in Region 1

- Assumptions
  - 218 locomotives
  - 90% not equipped with solution
  - Use EPA-Chicago results for reductions in fuel consumption, NOx and PM.
- Total available reductions
  - 2.8 million gallons of diesel per year
  - 471 tons of NOx per year
  - 14 tons of PM per year

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Opportunity by State

State	# Locos	Fuel (mgal/yr)	NOx (tpy)	PM (tpy)
MA	88	1.1	190	5.5
ME	61	0.8	132	3.8
VT	28	0.4	60	1.8
NH	27	0.3	58	1.7
CT	14	0.2	30	0.9
RI	0	0.0	0	0.0
Total	218	2.8	471	14

Please let us know
how we can help.

Thank You!