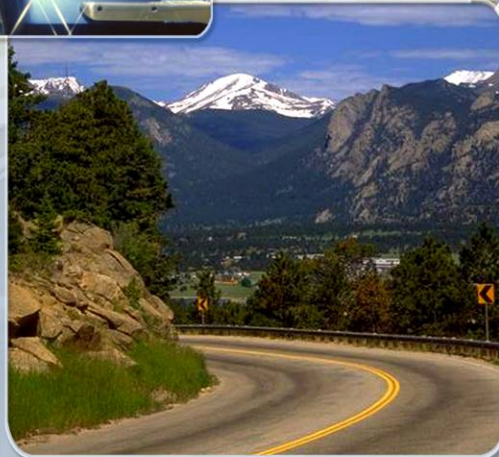


Idle Reduction Technologies

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Review of the 21st Century Truck Partnership
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Outline of Presentation

- **Impact of idling reduction and importance to 21CTP**
- **Goals and objectives for Idle Reduction Program**
- **Roles of 21st Century Truck partners**
- **Activities and accomplishments by 21st Century Truck partners**
- **Major barriers to success**
- **Future needs**



Idling trucks have significant impact on fuel use and air quality

- Over 500,000 long-haul trucks crisscross the United States every day
 - These trucks compete for about 300,000 parking spaces
 - Federal Hours of Service rules require a 10-hour rest after 11 hours of driving
- Truck idling uses approximately 3 billion gallons of fuel per year
 - Approximately 1 billion gallons for overnight idling
 - Roughly 2 billion gallons for workday idling
 - No good data exist for either
- Every hour a truck idles unnecessarily
 - Is equivalent to about 8-10 miles of on-road driving
 - Costs about 15¢ for maintenance
- States need to reduce emissions to meet their EPA-required State Implementation Plans for air quality
 - EPA estimates of emissions from overnight idling alone total about 180,000 tons of NO_x, 5,000 tons of PM, and 7.6 million tons of CO₂
 - States use anti-idling regulations and electrified parking spaces to enable compliance



Why do trucks idle?

- To keep fuel and engine warm
- For resting driver's comfort
- To mask out noises and smells
- For safety

- Overnight (Class 8)
 - At truck stops and rest areas
 - In parking lots
 - On roadsides
 - Near first appointment
 - Home
- Waiting for hours in queues (all classes)
 - At ports, terminals, delivery sites
 - At border crossings





Several technologies can reduce idling

- All reduce fuel use, emissions, and noise to varying degrees
- The best choice depends on how and where the truck is used, cost of equipment, and many other factors
 - Analysis enables comparison
- Types of on-board equipment
 - Automatic engine stop-start controls
 - Auxiliary power units (APU) and similar devices
 - Cab and block heaters
 - Air conditioners
- Types of electrified parking spaces (EPS)
 - Single system electrification requires no on-board equipment
 - Shore power allows driver to plug in on-board equipment (dual system)





21CT partners' goal is to reduce fuel use and emissions from idling engines

- **Actions to accomplish goal:**
 - **Establish an industry/government collaboration to promote R&D and deployment of cost-effective IR technologies**
 - **Establish an education program for truck and bus owners to promote IR**
 - **Develop a mix of incentives to encourage adoption**
 - **Facilitate development of consistent electrical codes and standards to enable both on-board and stationary electrification**
 - **Develop and demonstrate add-on IR equipment that meets driver cab comfort needs; payback period of ≤ 2 yrs.; & lower emissions than truck meeting 2010 standards by 2009**
 - **Develop a truck with a fully integrated IR system that eliminates component duplication, weight, and cost by 2012, *achieved in 2007 MY***
 - **Develop and demonstrate a viable fuel cell APU system of 5-30 kW capable of operating on hydrogen directly or using a diesel fuel reformer**



21CT partners collaborate on many approaches to reduce idling

- **Data collection**
 - Emissions and air quality measurements
 - Compilation of IR manufacturers
- **Analysis**
 - Full fuel cycle analysis on emissions and energy use
 - Differentiating conflicting claims of economics of IR devices
- **Research, Development and Demonstrations**
 - Fuel cell APU
 - More Electric Truck
 - Validation of various heating and cooling systems
 - OEM APU installation
 - CoolCab evaluation
- **Education and communication**
 - Conferences and workshops
 - Newsletters and websites
- **Legislative measures and implementation**
 - Financing options
 - Demonstrations of equipment in real-world situations



Data collection lays the foundation for our efforts

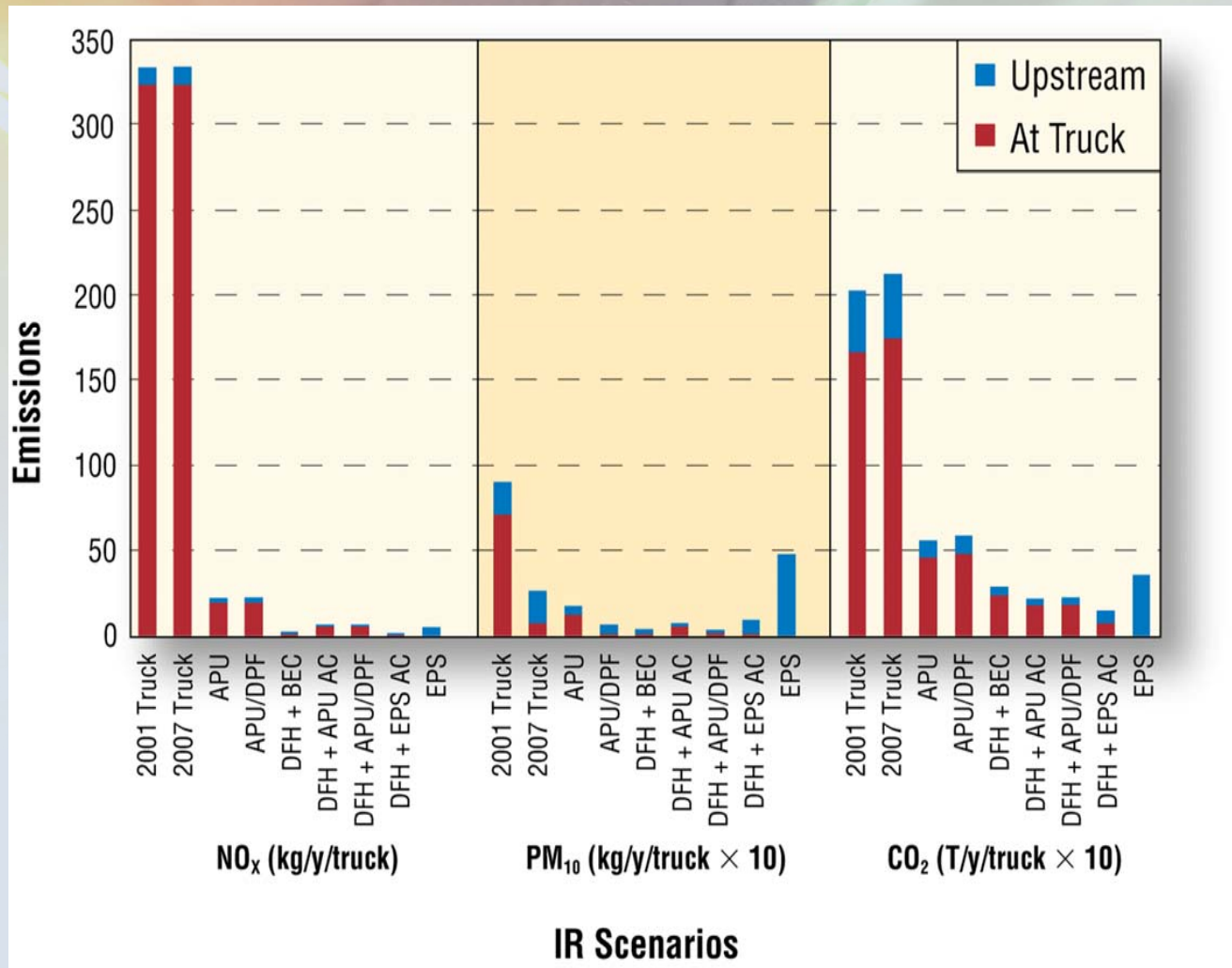
- EPA and DOE funded measurements of emissions from idling truck and IR equipment at DOD Aberdeen Proving Grounds
 - Confirmed that IR equipment reduced emissions and fuel use
 - Preliminary measurements of 2007 truck idling emissions show 95%+ PM emission reductions, not NO_x
 - <http://www.epa.gov/otaq/smartway/documents/epaidlingtesting.pdf>
- EPA funded measurement of air-quality inside truck cabs at truck stop
 - Showed that the truck itself plays a major role in contributing to the pollutants both outside and inside the cab
 - Emissions come from the tailpipe and other sources, such as leaks from the engine compartment that enter the cab through the floor
 - <http://www.epa.gov/otaq/smartway/idle-testing.htm>
- FHWA funded ORNL to measure air quality at truck stops and nearby
 - Showed significant increase in concentration of PM and NO_x due to truck stops
- EPA SmartWay compiled a website list of IR manufacturers
 - Includes equipment for locomotives as well
 - <http://www.epa.gov/otaq/smartway/idlingtechnologies.htm>





Argonne analysis enables comparison of idling reduction technologies' impacts

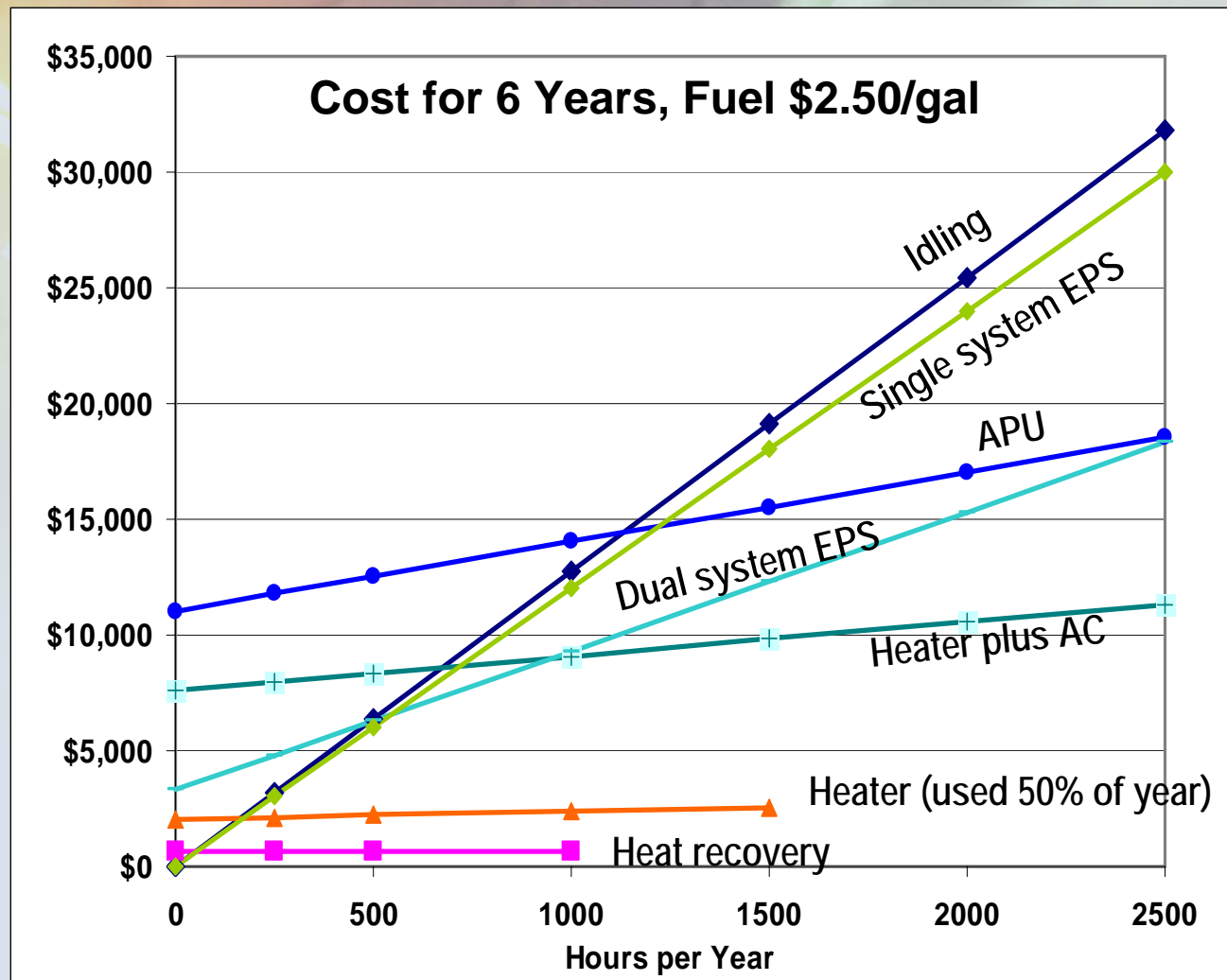
- Emissions at the truck represent only part of the impacts
 - Calculated upstream emissions are significant
- We need to identify where high population exposures result
- Results apply to other technologies as well, e.g., plug-in hybrids





Argonne analysis can help truck owners choose the most economical equipment

- Increased interest in idling reduction led to proliferation of suppliers and devices, with conflicting claims about their financial merits
- Worksheet allows truck owner to calculate payback time
- Benefits are sensitive to fuel price, device cost, climate, and hours idled
- Benefits to other stakeholders need to be determined



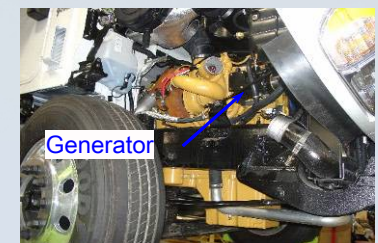
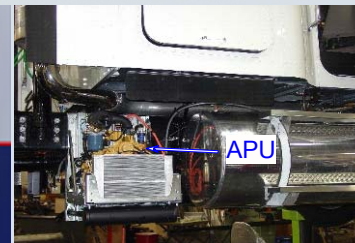


Fuel cells could reduce APU local emissions and noise

- **DOE sponsored two projects on diesel-fueled solid oxide fuel cells (SOFC) for APUs**
 - **Cummins - International technical accomplishments**
 - **Completed comprehensive APU system specifications study for Class 7/8 trucks**
 - **Began subsystem design**
 - **Completed SOFC APU design review**
 - **Delphi - Volvo Truck North America – PACCAR - Electricore technical accomplishments**
 - **Defined APU system requirements for heavy-duty trucks**
 - **Developed vehicle and APU system concepts to meet requirements**
- **Both projects have been on hold since early FY 2006 due to lack of DOE funding**

Caterpillar More Electric system eliminates engine-driven A/C compressor

- DOE – Caterpillar – Kenworth – Emerson – SRDrives – EMP developed More Electric Truck
- DOE – Caterpillar – International - Cox Transfer ran fleet tests
- Effect of More Electric system on IR:
 - Fuel savings were up to 2% on road plus 6% from IR
 - HVAC unit can be driven by APU (0.2 gal/hr of fuel) during rest periods
 - The truck can plug into shore-power electrical service, eliminating fuel consumption
- More Electric Trucks idle 12.8% of time vs. 26.5% for control vehicles
- Caterpillar will demonstrate creep capability of More Electric Truck





Fleet validations supported by DOE lead to installation of cab comfort devices

- **Schneider National fleet-tested heaters and two cooling systems**
 - Diesel-fired cab heaters provided 2.4% fuel savings and payback <2y at \$2.40/gal (100 trucks)
 - Phase-change system cooled for 10 h at 85°F ambient, but only 7 h at 90°F (19 trucks) and reduced idling 3%
 - Battery-powered cab system cooled for 6.5 h after 6-8 h recharge (70 trucks) and also reduced idling 3%
 - Cab insulation, A/C performance, installation, airflow need work

As a result of these tests, Schneider installed 6,000+ heaters and expects to have ~80% of its fleet equipped this winter

- **Wal-Mart – International - Espar tested combined diesel heating and electric cooling systems (20 trucks)**
 - Also tested TriPac APU for heating, cooling, and accessory power (5 trucks)

Wal-Mart is outfitting entire fleet with TriPacs (7000 units)





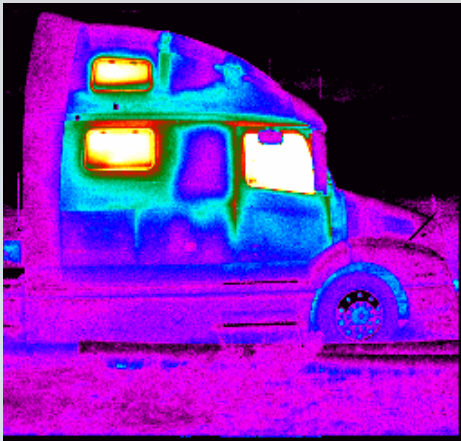
Demonstration of factory IR system installation leads to offering as option on 2007 trucks

- **DOE supported International and partners to test OEM integration of on-board IR technology in factory-installed systems**
- **Four main components:**
 - Auxiliary power unit
 - Electric A/C
 - Cab and engine heater
 - Improved cab insulation
- **Participants designed, fabricated, installed, and tested 5 custom vehicles**
 - Project is now in fleet monitoring phase
- **Two OEM factory-installed options now available: cold climate (fuel-fired heater) and hot/cold climate (APU, shore power)**
- **International has orders for 60 factory-installed APU systems**
 - **Goal of 2,000 units for 2007**



CoolCab project designs effective thermal management systems

- DOE/ NREL - Schneider National-Volvo-International project evaluated truck cab insulation
- Objective:
 - Keep the cab comfortable through extremes of ambient exposures
 - Improve performance of efficient IR technologies
- Technologies and analysis tools evaluated included:



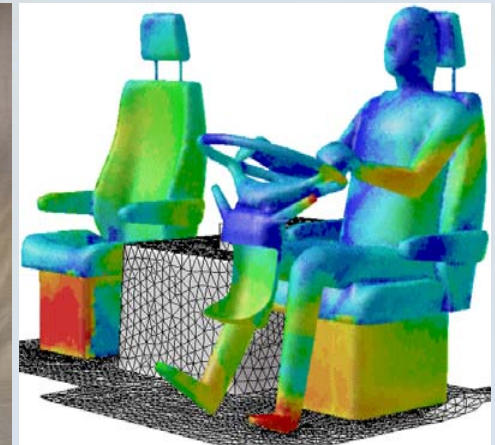
Cab Insulation



Solar Reflective Glazings



Thermal Comfort Manikin



Integrated Numerical Modeling



Other demonstrations also enhance chances of commercial success

- **DOE, DOT, and EPA supported demonstrations of EPS that helped technology provider get follow-on funding for expansion**
- **EPA's SmartWay Transport Partnership granted \$1 million in 2004 for 9 EPS locations and \$5 million additional grants in October 2005**
 - Truck Engine IR Technology Demonstration Program (*Texas A&M Research Foundation*)
 - Ohio and Midwest TSE Corridors Demonstration, Evaluation, and Development Project (*Ohio Department of Development*)
 - Everybody Wins - Phase II (loans for APU purchases) (*Lane Regional Air Pollution Authority (Oregon)*)
 - Demonstration of Integrated Mobile Idle Reduction Solutions (*American Transportation Research Institute*)
 - Truck OEM APU Prep Kit Design and Installation (*North Carolina State University with Volvo*)
- **DOE Clean Cities Program funded 2 programs totaling \$150,000 to educate bus school bus drivers**
 - Utah/Nevada program includes developing idle-reduction curriculum, training in six school districts, and dissemination of the school bus idling reduction model to schools nationwide
 - Oklahoma project includes development and demonstration of techniques to reduce idling and the benefits of idling policies, training, and dissemination of results



Education and outreach accelerate market penetration of IR equipment

- **Multi-stakeholder meetings**
 - DOT - EPA workshops on Idle-Free Corridors
 - DOT - EPA workshops on electrical connections led to new industry standard (in progress)
 - DOT – DOE – EPA – DOD – NYSERDA National Idling Reduction Planning Conference in May 2004 laid the groundwork for
 - 400-pound APU weight exemption in EPA Act 2005
 - EPA Model Idling Reduction law
 - Recognition of need for loans for IR equipment, not grants
 - DOE Clean Cities “Advancing the Choice” workshops series educated local stakeholders



Information educates stakeholders about benefits of IR

- **Real-time electronic information exchange**
 - **Newsletters**
 - DOE monthly *National Idling Reduction Network News and Clean Cities Now*
 - EPA SmartWay quarterly newsletter to partners
 - **Websites**
 - EPA SmartWay list of EPS locations and non-attainment areas
 - DOE Clean Cities truck stop locator
 - Workshop presentations
 - Cost calculators
- **Publications**
 - *A Municipal Official's Guide to Diesel Idling Reduction in New York State*
 - *Cummins Idle Talk: How the Regulations Affect You*
 - Numerous papers at professional conferences



Financing accelerates implementation of IR

- **DOT's Congestion Mitigation and Air Quality (CMAQ) Improvement Program has funded approximately \$25 million in EPS projects across the country**
- **Changes in 2005 transportation reauthorization (SAFETEA-LU) are beneficial to IR. The law:**
 - **Defines the term “advanced truck stop electrification system” to include on-board equipment as well as EPS**
 - **Calls out specific eligibility for projects under the CMAQ and Surface Transportation Programs**
 - **Allows facilities to be constructed on interstate rights-of-way (previously prohibited)**
- **EPA SmartWay loan program for Upgrade Kits includes APUs**
- **Many state and local agencies offer funding**



Technical challenges still remain

- **Several approaches could allow APUs on 2007+ trucks to meet California requirements:**
 - Route APU exhaust through main engine exhaust
 - Reduce emissions from small APU engines
 - Develop a PM filter for APU exhaust
- **Additional efforts should be devoted to design of completely integrated APU/HVAC systems**
 - Avoid duplication of equipment
 - Reduce weight
 - Install as true OEM equipment
- **Creep devices could enable reduced emissions in queues**



Institutional barriers need to be addressed

- **States have not conformed regulations to EPA's draft Model Idling Reduction law**
 - Patchwork of State and local anti-idling regulations remains level
- **States have not all adopted the 400-pound APU weight waiver**
 - Federal law allows waiver but does not require it
- **Funding for IR equipment is often oversubscribed**
- **The number of long-haul trucks far exceeds the number of parking spots for them at both public and private facilities**
- **Benefits of IR equipment have not been verified by a third-party organization**
- **No trade association for IR equipment is currently active**



Future Needs

- **Continue analysis of workday idling**
 - Obtain data
 - Evaluate need for “creep mode” device
 - Formulate operational idling reduction strategies
- **Complete impact analysis to determine most cost-effective IR technologies**
 - Determine new engine and IR device emissions with ULSD
 - Determine direct and indirect costs to truck owners and other stakeholders
 - Estimate impacts and geographical distribution of full fuel-cycle emissions
 - Support development and deployment as appropriate
- **Integrate APU function with vehicle HVAC to eliminate redundancy of components**
- **Reduce emissions from IR equipment**
- **Investigate application of high-performance insulation and glazing materials**
- **Conduct further R&D into phase-change materials for application to stand-alone cab-cooling devices**



Questions

