



# CoolCab Truck Testing Project Update

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**NREL/PR-540-42396**

Presented at the 21<sup>st</sup> Century Truck  
Project Meeting held October 31, 2007  
in Chicago , Illinois.



# CoolCab Project

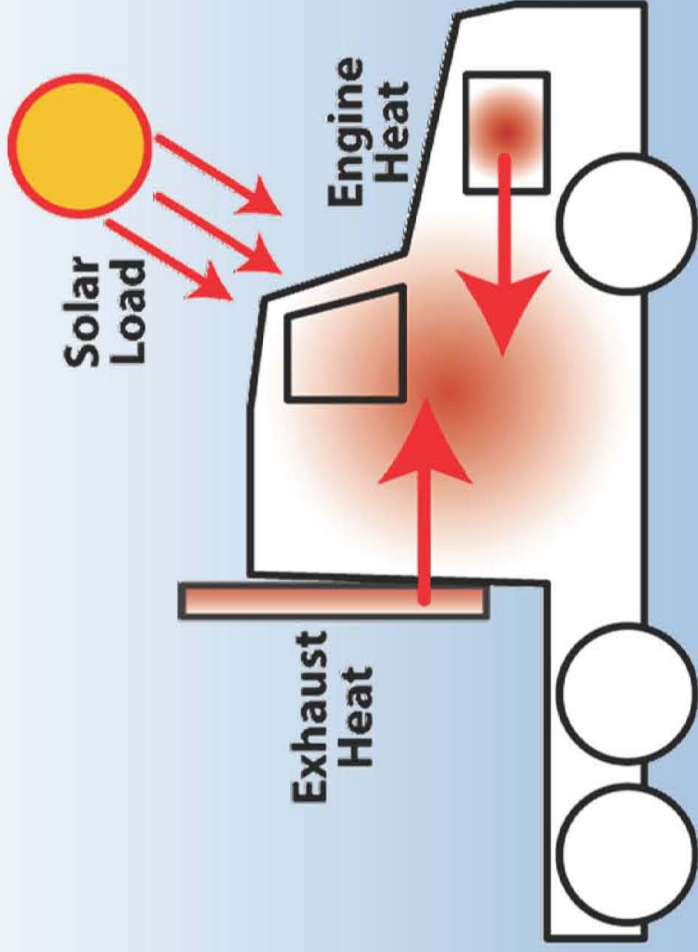


- The Problem
  - Trucks consume 2.5 million barrels of oil per day
  - Idling consumes 838 million gallons of fuel per year
  - Future emissions requirements
    - lower fuel economy
    - increase underhood temps.

Redesigning the Heavy Truck is an opportunity to  
reduce oil importation

# CoolCab Project

- The Challenge
  - Cab climate control requires idling to provide comfort
  - Varying thermal conditions inhibit use of idle reduction technologies



# CoolCab Project

- The Solution

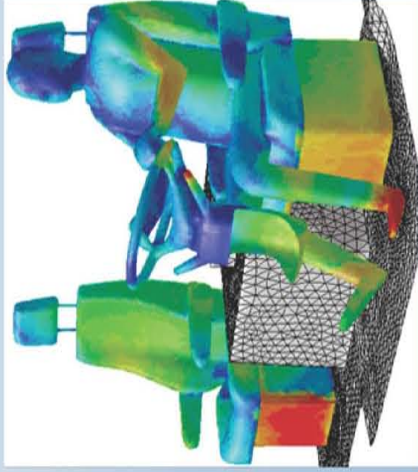
- Design efficient thermal management systems
  - Keep the cab comfortable
  - Eliminate excessive idling



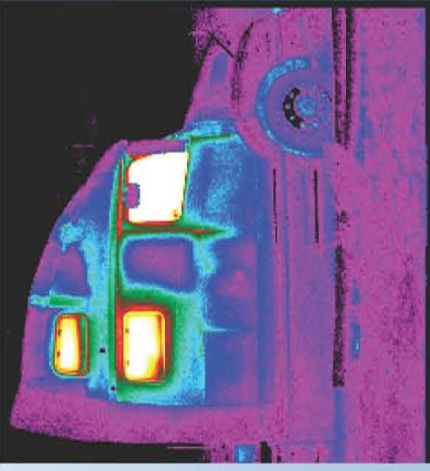
**Thermal Comfort  
Manikin**



**Solar Reflective Glazings**



**Integrated Numerical Modeling**



**Cab Insulation**

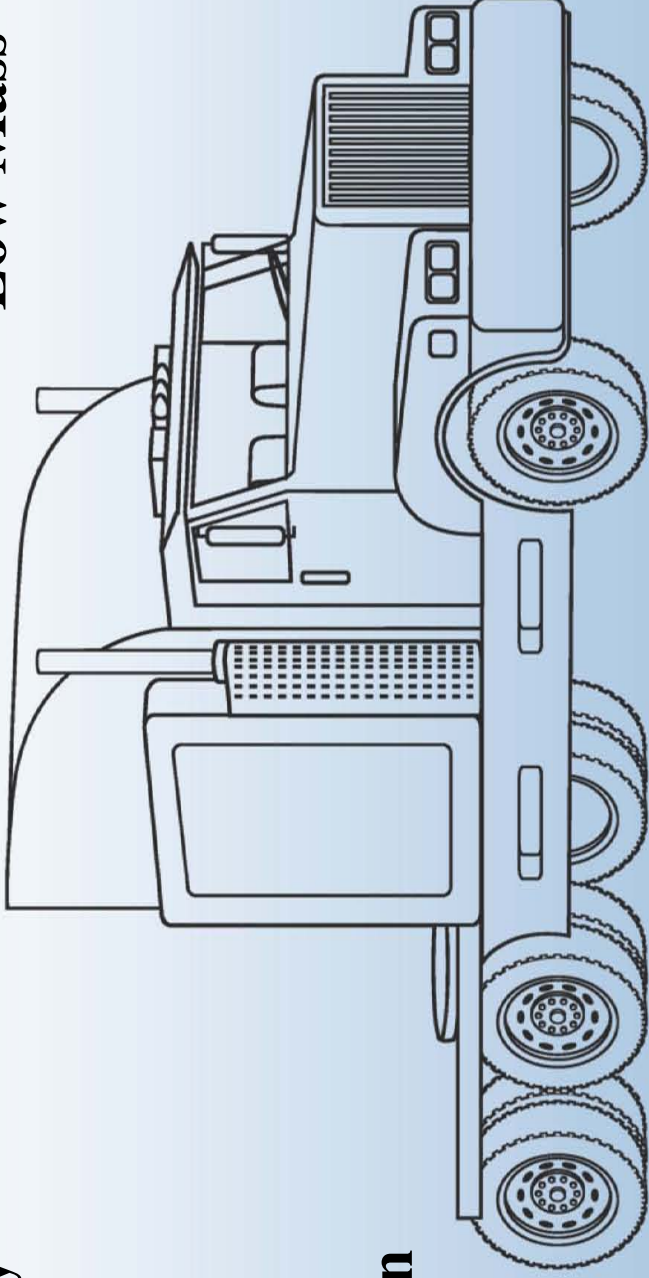
# CoolCab – Advanced Technologies

**Exhaust Heat  
Recovery**

**Advanced  
Seating –  
Low Mass**

**Insulation**

**IR  
Reflective  
Materials**



**Advanced  
Glazings  
or Shades**

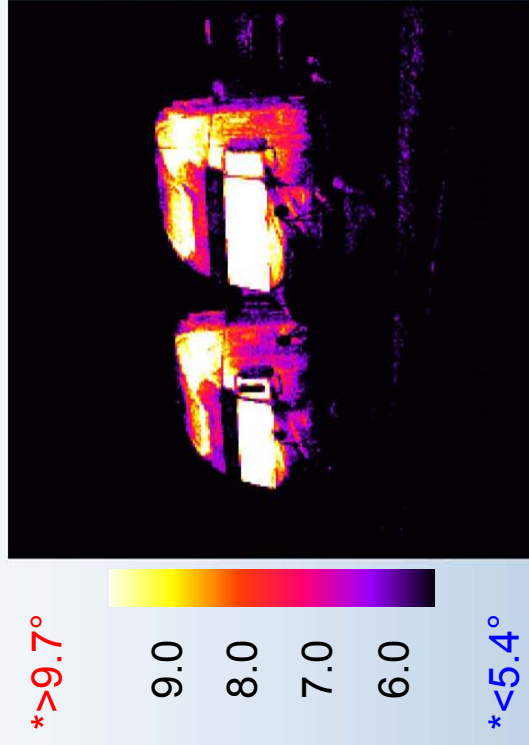
**Efficient  
HVAC  
Equipment**

**Comfort  
Based Air  
Distribution**



# Infrared Image Test – Schneider National

- Investigate potential for improving cab efficiency
- Qualitative comparison
  - Identify high heat loss areas
  - Note areas with greatest potential for improvement



# CoolCab Testing with Volvo

- Volvo Truck at NREL for testing
  - 77” sleeper cab
  - On-board idle reduction technologies
    - Bergstrom battery electric AC
    - Airtronic diesel-fired heater
- Objectives
  - Quantify truck cabin heat transfer
  - Identify potential areas for improvement



# Testing Approach

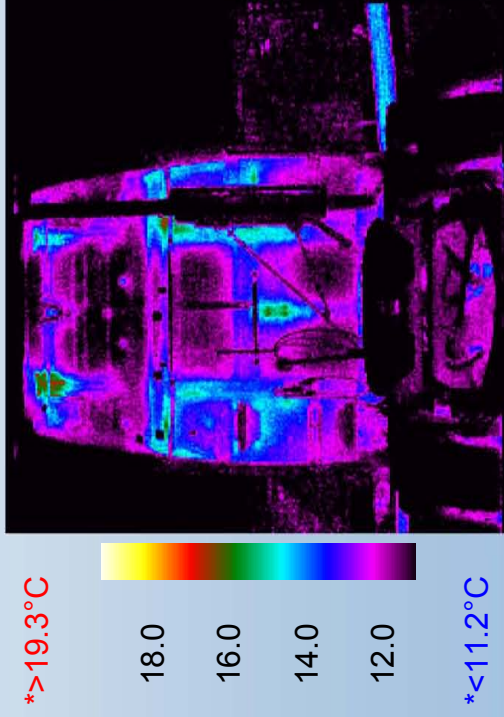
- Co-heat tests to determine UA
  - Measure effect of sleeper curtain and window shades
  - Insulate windows to quantify loss
- Measure air exchange rate
- Solar soak tests to determine solar effects
  - Soak with windows insulated
- Infrared imaging to examine high heat loss areas
  - Hot spots





# Volvo Test Results

- Heat transfer
  - UA = overall heat transfer coefficient = 65 W/K
  - 15% reduction (improvement) with sleeper curtain closed
  - 20% reduction with windows covered
- Solar heat soak
  - $\Delta T$  = temperature rise above ambient = 15°C
  - $\Delta T$  = 5°C with windows covered
- Air leakage rate
  - ~1 air change per hour



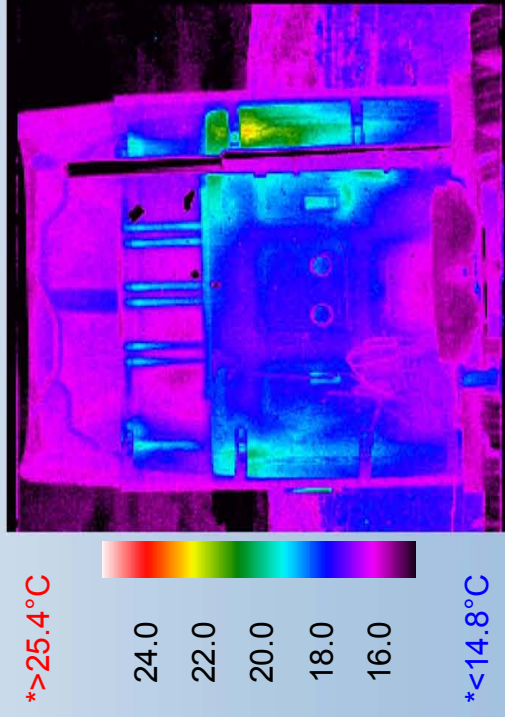
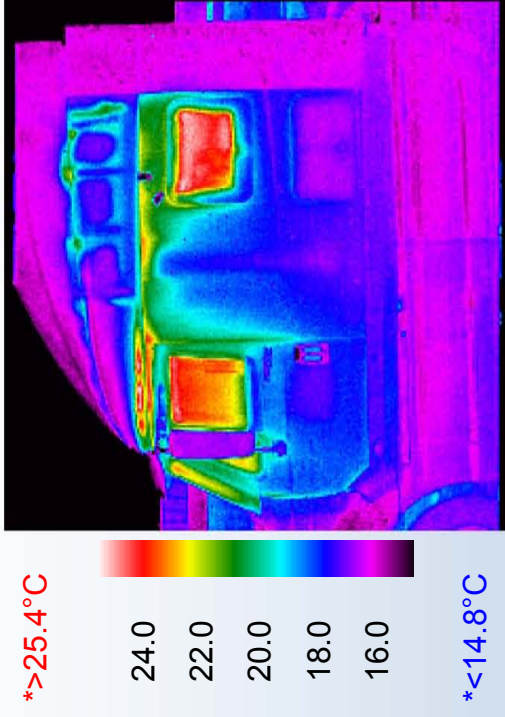
# CoolCab Testing with International

- International Truck at NREL
  - ProStar sleeper cab tractor
  - Electric HVAC system with battery APU
- Objectives
  - Quantify truck cabin heat transfer
  - Predict HVAC system load requirements
- Began spring 2007



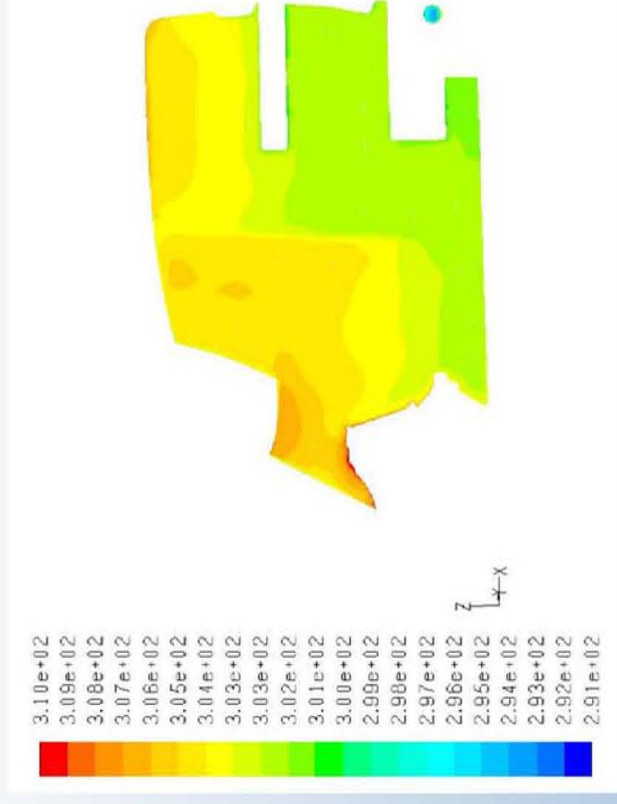
# International Test Results

- Heat transfer
  - UA = overall heat transfer coefficient = 50 W/K
  - 20% reduction (improvement) with sleeper curtain closed
  - 25% reduction with arctic curtain
  - 13% reduction with windows covered
- Solar heat soak
  - $\Delta T$  = temperature rise above ambient = 11°C
  - $\Delta T$  = 7°C with windows covered
- Air leakage rate
  - ~0.5 air change per hour



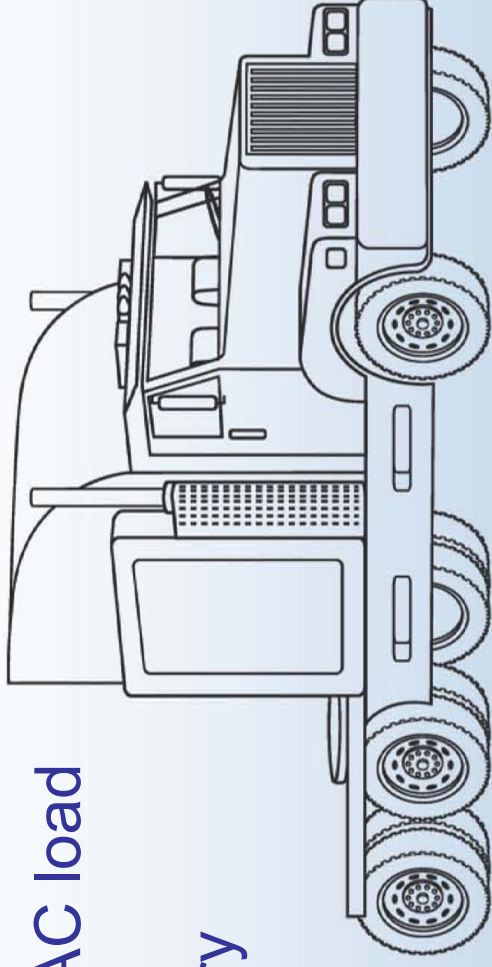
# Thermal Modeling

- Previously developed model for International
  - Fluent CFD
  - Radtherm
- Validate with test data
  - Solar soak air temperatures predicted within 3°C
  - Apply multiple configurations
- Simulation runs
  - Baseline A/C case
  - Increased cab insulation
  - Solar reflective glass



# Next Steps – FY08

- Begin development of HVAC load calculation tool
- Generic truck cab geometry
- Input key parameters
  - Climatic conditions
  - Vehicle geometry
  - Material properties
- Estimate potential load reduction
- Work with industry to define requirements
  - Truck OEMs
  - Idle reduction technology manufacturers





# Contact Information

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