# Alternative Fuel Tools
# and Technical Assistance Activities

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Sponsored by Dennis Smith and Linda Bluestein

**Project ID #T1063**

# OVERVIEW: ANL Clean Cities Tools and Technical Assistance

## Timeline

- Annual, fiscal-year project

## Budget

- Vehicle Technologies Office
- Budget Categories
  - Technical Assistance
- $1.375 M

## Areas of Expertise

- Environmental & economic analysis
- Electric-drive
- Idling reduction
- Renewable natural gas
- Workshop planning
- International training

## Barriers Addressed

- Lack of information on total cost of ownership (TCO) for alternative fuel vehicles (AFVs) as well as petroleum use, GHGs, and air pollutants data
- Lack of case studies highlighting real-world fleet experiences
- Fleet reluctance to purchase AFVs or institute petroleum reduction practices
- Need for economic impacts of alternative fuels and idle reduction technologies

## Team Members

- Project Lead – M. Rood, ANL
- Technical Team – A. Burnham, L. Gaines, M. Mintz, D. Santini, P. Weikersheimer, ANL
- Communications and Logistics Team – ANL
- Feedback and data – Clean Cities coordinators and industry

## Partners and Contracts

- Energetics
- Center for Climate and Energy Solutions
- RCF

# RELEVANCE: Tools and Technical Assistance

## Objectives

- **Tools**

    1. **AFLEET Tool** – TCO, petroleum, GHGs, & air pollutant emissions of AFVs

    2. **JOBS NG** – Economic and employment impacts of NG infrastructure

- **Idle Reduction Analysis and IdleBox Toolkit** – Fact-based communication products for idling reduction

- **Case Studies** – Analysis of fleet use of CNG, LNG, RNG, LPG, and idling reduction

## Supports DOE Vehicle Technology Deployment

- Identifies technical data and information needed to promote AFVs

- Presents information in easy-to-use formats

- Disseminates information and data through the Clean Cities network and web sites

- Accelerates the deployment of AFVs in support of the President's "All of the Above" strategy

# PROJECT APPROACH: Tools and Technical Assistance

## Key Activities

- **Tools—Aim for User Friendliness, Widely Accepted, Consistent Platforms**

  1. **AFLEET**

     - Based on methodologies from existing DOE tools
     - Examines light/medium/heavy-duty vehicles
     - Contains 15 fuel/vehicle technologies

  2. **JOBS NG**

     - Based on existing JOBS H2 and JOBS FC models
     - Spreadsheet tool to estimate impact of user-defined scenarios
     - Consistent platform to analyze employment and economic impacts
     - Captures impact via supply chains & induced effects
     - Uses input-output methodology to convert expenditures to economic impacts

**AFLEET Examines Life-Cycle Impacts of AFVs**

| | | | |
|---|---|---|---|
| Biodiesel | 1 - Soy | 1 | |
| | 2 - Algae | | |
| Ethanol | 1 - Corn | 1 | |
| | 2 - Switchgrass | | |
| CNG | 1 - North American NG | 1 | |
| | 2 - Non-North American NG | | |
| | 3 - Landfill Gas | | |
| LNG | 1 - North American NG | 1 | |
| | 2 - Non-North American NG | | |
| | 3 - Landfill Gas | | |
| North American NG | | Conventiona | Shale |
| | | 66% | 34% |
| LPG | | NG | Petroleum |
| | | 69% | 31% |
| Source of Electricity | | | |
| | 1 - Average U.S. Mix | 1 | |
| | 2 to 11 - EIA Region Mix (see map) | | |
| | 12 - User Defined (go to 'Background Data' sheet) | | |
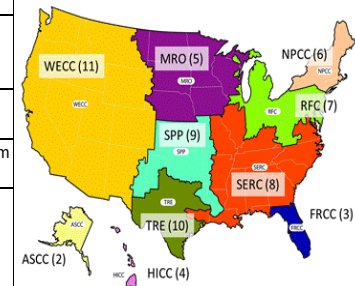
*NG stations impact multiple supply chains*
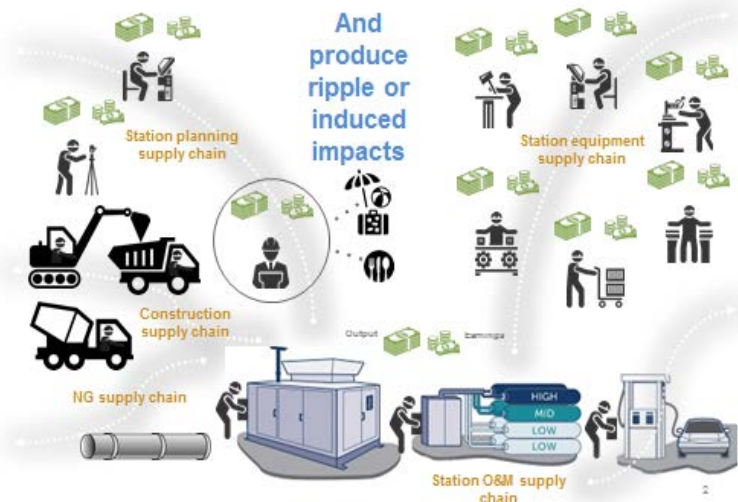
# PROJECT APPROACH: Tools and Technical Assistance

- **IdleBox**
    - 22 communication products for coordinators and others to learn about and advance idle-reduction technologies
    - First module focus is on light- and medium-duty fleets
    - Five webinars for Clean Cities coordinators, staff, and interns on how to use IdleBox
    - IdleBase
        - A companion product tracks idling regulations by state and localities for all vehicle sizes

- **Results: IdleBox received Award of Excellence from the Society for Technical Communication's International Summit Award competition**
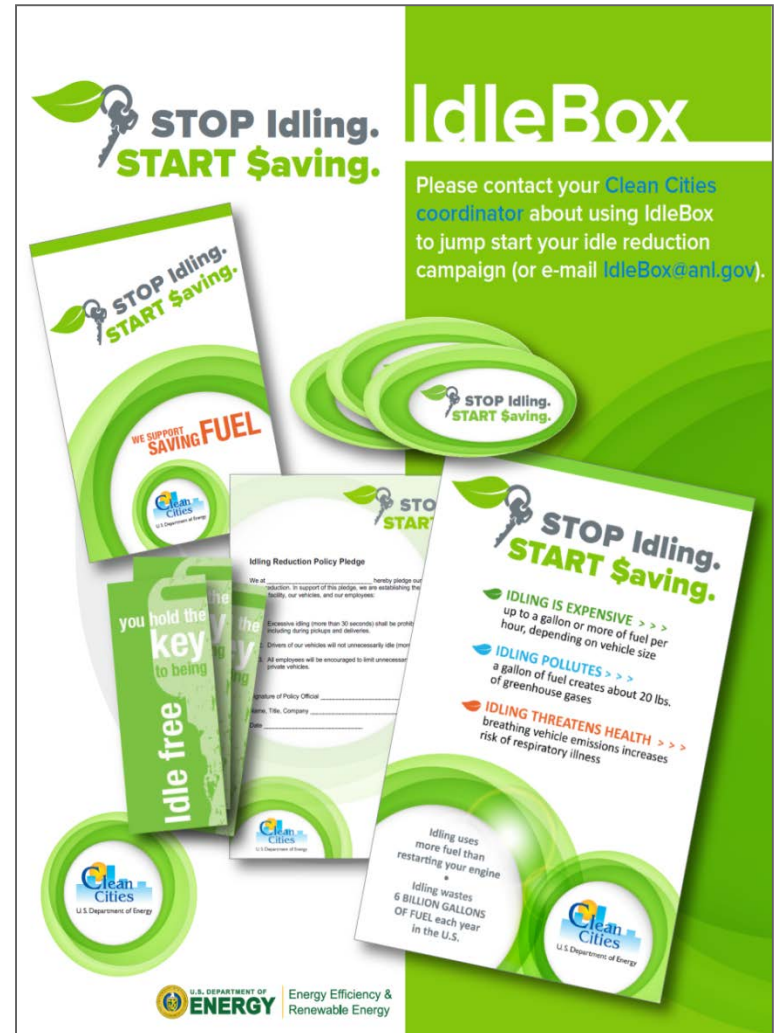
# PROJECT APPROACH: Tools and Technical Assistance

- **Case Studies**
  - Based on real-world fleet experiences and data from American Recovery and Reinvestment Act (2009) projects
  - Foundation for niche-market toolkits

- AFLEET Tool—provided the data on payback periods, GHGs avoided, & petroleum reduced http://greet.es.anl.gov/afleet

- **Results: LNG regional-haul, CNG refuse, & propane school bus case studies that provide real-world operational data and lessons learned**

# MILESTONES: Tools and Technical Assistance

**FY 2014 Milestones**

- Quarterly Reports (Due 30 days after the end of each quarter (Qtr.))
  - *Provided FY14 Quarterly Reports on Tools, IdleBox, Case Studies, PEV Analysis, and Meeting Support* (Completed 1st, 2nd, 3rd, and 4th Qtrs.)

- Final Reports on Markets Trends (Due 4th Qtr.)
  - *Produced: "White Paper Discussing the Latest Advancements in Alternative Fuels and Advanced Vehicle Technologies"* (Completed 4th Qtr.)

**FY 2015 Milestones**

- **Tools**
  1. **AFLEET**
     - *Examine current literature on costs of environmental externalities of conventional fuels compared to AFVs for future estimates in AFLEET* (Due 2nd Qtr.; Completed 2nd Qtr.)
     - In process of including estimates to AFLEET
  2. **JOBS NG**
     - *Investigate additional economic impacts in the areas of maintenance facilities, LNG, and combined time/fast fill stations* (Due 4th Qtr.)
     - In process of adding new data on utility interconnection and maintenance facilities

# MILESTONES: Tools and Technical Assistance

**FY 2015 Milestones, Continued**

- **Idle Reduction Analysis and IdleBox**
  - ***Prioritize niche markets for greatest petroleum savings using IR technologies or changes in driver behavior and add one module to IdleBox*** (Due 3rd Qtr.)
  - Completed paper: "Status and Issues for Idling Reduction in the United States: Alternative Fuel and Advanced Vehicle Technology Market Trends"
  - In process of developing Heavy-duty, Long-haul and Emergency Vehicle modules for IdleBox
- **Case Studies**
  - ***Draft Case Study and materials on RNG Projects*** (Due 3rd Qtr.)
  - In process of drafting case study on Landfill and Food Waste RNG for Toolkit

**Other FY 2015 Milestones**

1. ***Initiate Strategic Planning Process*** (Due 1st Qtr.)
   - Began process on October 22 leading to Strategic Planning Workshop held on February 25

2. ***Develop and refine consumer information on plug-in powertrain choices*** (Due 4th Qtr.)
   - In process of developing decision-tree and populating data for on-line tool

# Outreach Is Key For FY15: QR Cards & DOE's AFDC

U.S. DOE/Clean Cities' Alternative Fuels Data Center tools/calculators (http://www.afdc.energy.gov/tools)

# PROJECT ACCOMPLISHMENTS & PROGRESS:
## AFLEET Tool and Air Pollutant Emissions Webinar

- **AFLEET Tool**
  - 3,765 downloads (released: 11/13 – 3/15)
  - 15 Clean Cities using for their Green Fleet program efforts
  - Many organizations using the tool
    - In process of making AFLEET user friendly and adding infrastructure costs
- **Air Pollutant Emissions Webinar**
  - 72 participants; 65 views on YouTube
  - Have incorporated learnings into draft heavy-duty GREET report
    - Once GREET report is finalized, will include data in AFLEET



| | Gasoline | Diesel | Gasoline HEV | Gasoline PHEV | Gasoline EREV | EV | B20 | B100 | E85 | LPG | CNG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Petroleum Use | 125.0 | | 89.3 | 72.3 | 26.9 | 1.3 | | | | 42.2 | 0.7 |
| GHG Emissions | 72.2 | | 51.6 | 48.3 | 44.8 | 42.6 | | | | 64.0 | 62.1 |
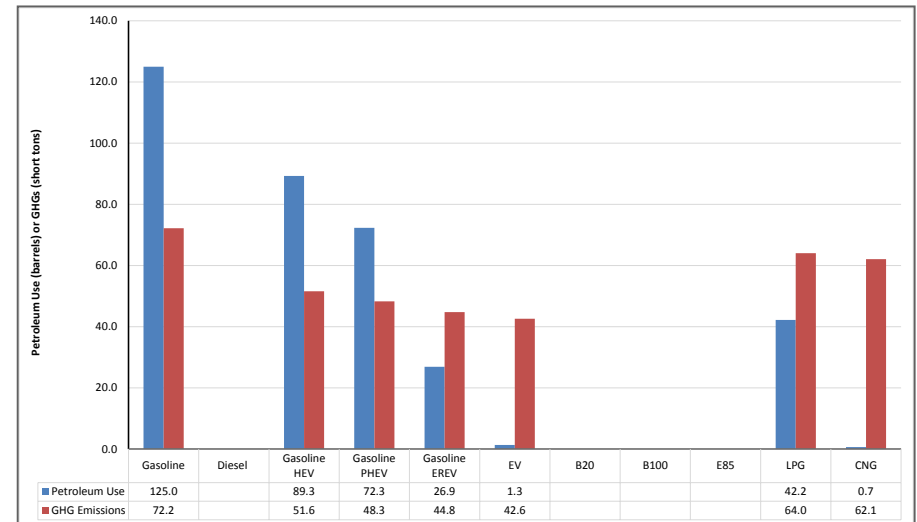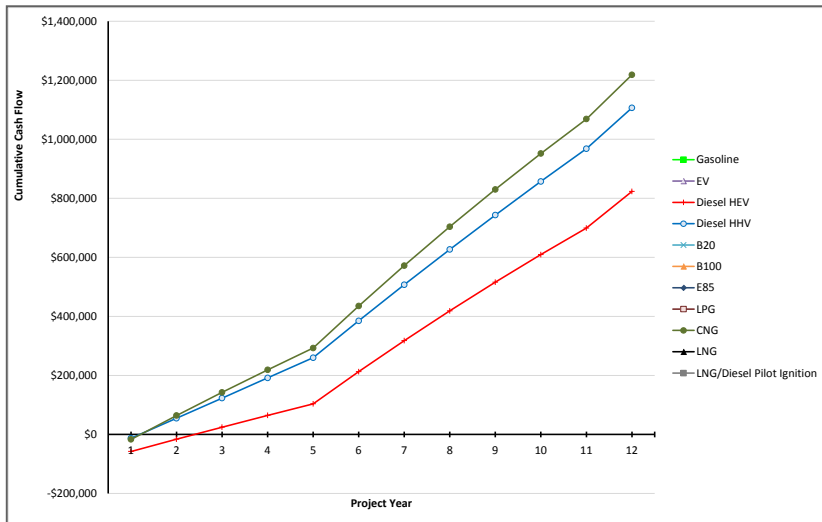
# PROJECT ACCOMPLISHMENTS & PROGRESS: AFLEET Tool

- **Stakeholders provided key guidance in development**
  - 11 Clean Cities Coordinators and staff provided guidance
  - Key industry groups reviewed AFLEET: NGVA, PERC, EPRI, & NTEA
  - Further assistance from EPA and NREL

- **To demonstrate AFLEET's capabilities, analyzed potential AFV purchases for City of Indianapolis's effort to reduce its fleet's petroleum use**
  - Examined 70 Ford F-550 work trucks and 60 refuse trucks using city's data
    - Examined economic payback due to refuse truck MPG uncertainty
  - Payback for F-550s = 7 yrs for LPG & CNG
    - Oil reduction for LPG = 1,900 bbl/yr & CNG = 2,900 bbl/yr
  - Payback for refuse trucks = 11–15 yrs for hybrids & 10–16 yrs for CNG
    - Oil reduction for hybrids = 800 bbl/yr & CNG = 6,400 bbl/yr
  - Demonstrated importance of testing HDV in fleet prior to purchase
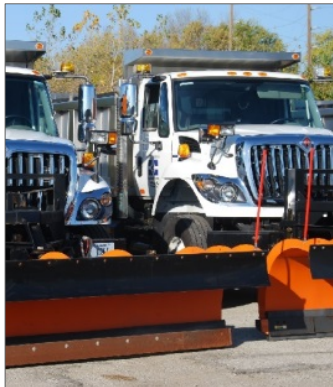
# JOBS NG: An Illustrative Scenario Describes Impacts

## User Inputs — Model Defaults

| Region = US | New 700 scfm stations completed | Stations in operation | CNG Dispensed (gge/mo) | Local share (LS)* of expenditures | CNG pump price |
|---|---|---|---|---|---|
| 2015 | 100 | NA | -- | 100 | $2.50 |
| 2016 | 100 | 100 | 60,000 | 100 | $2.50 |
| 2017-2023 | 600 | 200→800 | 60,000 | 100 | $2.50 |
| 2024 | 100 | 900 | 60,000 | 100 | $2.50 |

*JOBS NG is a tool, not a forecast. Users must specify number of stations and analysis region.*

## Resulting CNG Fuel Sales
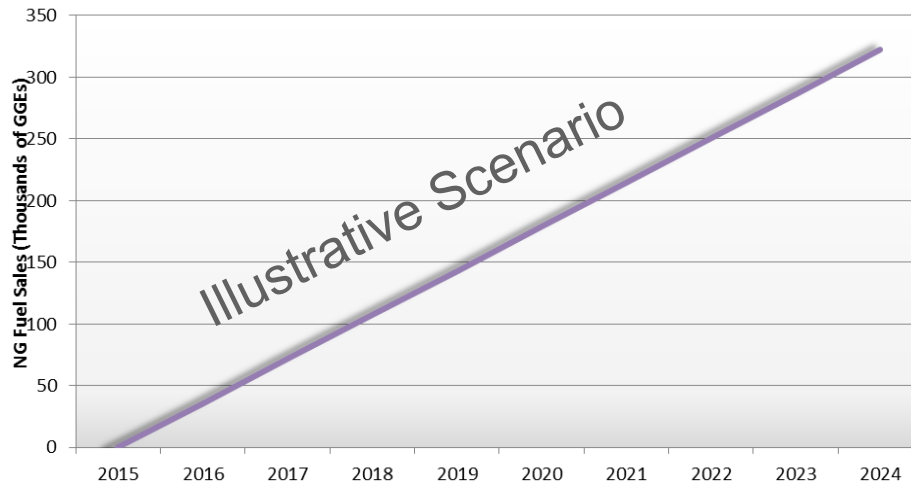


## Default Station Expenditures ($1.8 m)*



JOBS NG 1.0

Contingency, 3%
Engineering, 5%
Site Prep., 3%
Installation, 20%
Shipping, 2%
Misc., 4%
Card reader, 1%
Hoses, 0%
Dispenser, 6%
Storage, 6%
Dryer, 6%
Compressor, 43%
Permitting, 2%
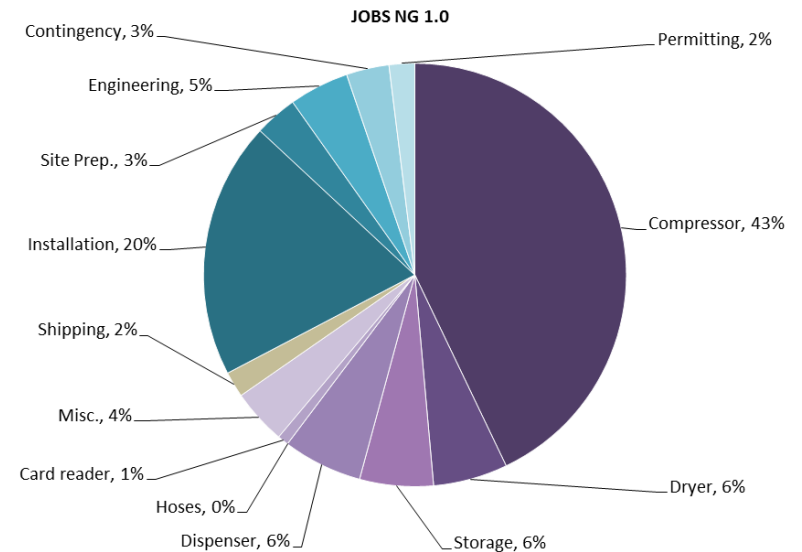
* Excluding land & structures.

# PROJECT ACCOMPLISHMENTS & PROGRESS: JOBS NG Tool and Case Studies

- **JOBS NG**
  - Invited 18 Clean Cities Coordinators and three industry partners to participate in the beta testing of the tool
  - Developed press release on JOBS NG and distributed to the media after release at the NGV OK in Tulsa on September 25, 2014
  - Held interviews with local Tulsa business reporter and *NGV Today* (Based on the press release and interview, the story was picked up by 13 outlets.)
  - Downloaded by ~200 users since the release at the end of FY14.

- **Case Studies**
  - Featured a total of nine Clean Cities ARRA (or related-funded projects) throughout the Clean Cities network
  - Distributed ~700 case studies and >7,700 downloads
  - In process developing case studies and toolkits: Airport Shuttles; Cement-Mixers; Bakery; and Landfill and Food Waste RNG.
  - In process of completing LPG school-bus toolkit and promotion

# PROJECT ACCOMPLISHMENTS & PROGRESS:
## Idle Reduction Analysis and IdleBox

- **Idle Reduction Analysis**

  - *National Idling Reduction Network News,* a monthly newsletter, transitioned to fully electronic delivery in May 14; subscribership has increased from ~1,500 to more than 4,600.
  - Determined that idling of alternatively fueled vehicles had not been analyzed; identified available equipment
  - Analyzed technical aspects and economics of idling reduction for work trucks via hybridization and APUs; prepared fact sheet
  - Examined idling reduction in emergency vehicles, prepared fact sheet, & instituted case study
  - Updated economic study of IR options for long-haul trucks
  - Released starter and battery wear study

- **IdleBox**

  - Broadened outreach beyond Clean Cities coalitions to realize greater impact
    - Decision made in mid-FY14 to expand IdleBox outreach corresponds to markedly higher page views and downloads (increases of 75% to 165%; a total of ~7,000 downloads)
    - Presented IdleBox at conferences and webinars to support broader outreach
  - Redesigned idling calculator
  - Added PowerPoint presentation targeted to everyday drivers
  - Developing modules for long-haul, emergency, and other service vehicles

# IdleBox Has Impact

IdleBox tapped by Clean Cities coalitions and others for uses ranging from policy development to fleet outreach to messaging to the general public



Bank of Utah used IdleBox materials to encourage its drive-through-window users to shut down rather than idle while waiting in line (February 2015)



West Palm Beach, Florida, used IdleBox materials for the launch of its no-idling policy for public utility vehicles (November 2014)

# COLLABORATION & COORDINATION AMONG PROJECT TEAM: Tools and Technical Assistance

- **Tools**
  - Both tools received input from industry partners: NGVAmerica, EPRI, PERC, NBB
  - Before launch both tools had beta test groups composed of Clean Cities coordinators and industry
  - Collaboration with other national lab partners
  - Collaboration with other DOE funded-programs, such as Workplace Charging Challenge, Hydrogen and Fuel Cells Program (JOBS H2 and JOBS FC)

- **Idle Reduction Analysis and IdleBox**
  - Collaboration with other DOE programs, such as National Parks Initiative, Clean Cities University Workforce Development Program, and Clean Cities coalitions

- **Case Studies**
  - Collaboration with ARRA recipients and Clean Cities coalitions

# SUMMARY: Tools and Technical Assistance

- **Relevance** – Assist DOE, Clean Cities coordinators, and stakeholders to:
  - Estimate TCO, petroleum use, GHGs, and air-pollutant emissions of AFVs
  - Understand real-world experiences of fleets using AFVs
  - Examine fleet opportunities to use AFVs and petroleum reduction practices
  - Calculate economic impacts of alternative fuel infrastructure development

- **Approach** – Develop fact-based tools and communication products that are user-friendly

- **Project accomplishments and progress** –
  - AFLEET Tool, JOBS NG, IdleBox, case study development, and outreach
    - AFLEET Tool, ~4,000 downloads; coordinators using for Green Fleet programs
    - JOBS NG, ~200 downloads
    - Case studies, >7,700 downloads and nearly 700 distributed
    - IdleBox, ~7,000 downloads; *National Idling Reduction Network News*: ~4,600 subscribers

- **Collaborations** –  Active partnerships with Clean Cities coordinators, industry stakeholders, national labs, Energetics, Center for Climate and Energy Solutions, National Governors Association, local governments, & RCF

# Technical Back-up Slides

# Analysis Enables More-Advanced IR Technology Comparison

- APU has lowest cost for truck that idles 40 h/week
  - Capital cost spread over many hours
  - Adding heater increases investment and reduces winter fuel cost a bit
- Electrified parking spaces look good for low idler and very high fuel cost
  - Use of small electric heater reduces cost with low investment
  - Plug-in fee $0.99 instead of $2.19
  - Full service only needed for summer
- Fuel-fired heater is inexpensive way to supply heat in winter



Total Cost for 5 Years (1000 h/y)
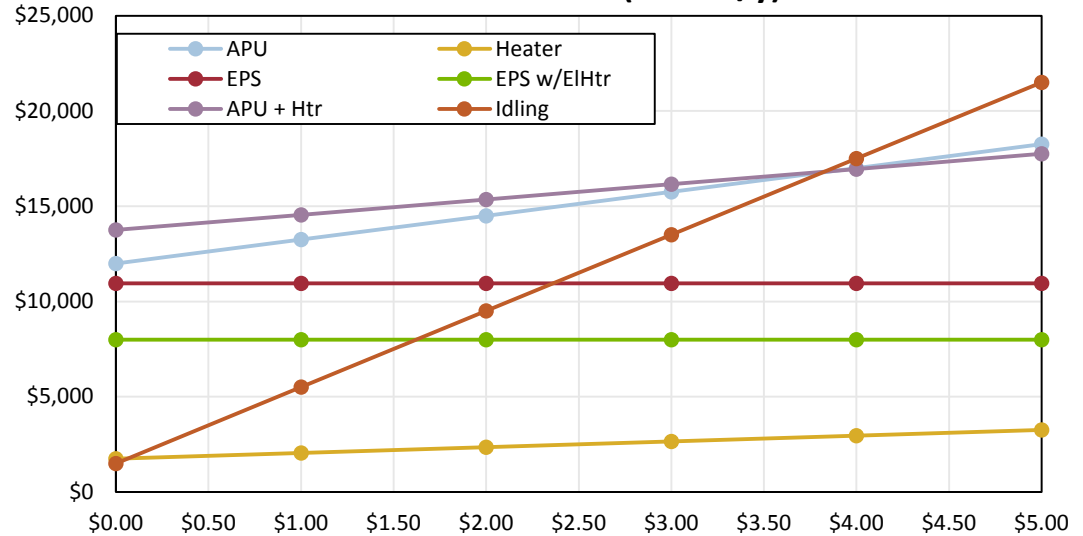


Total Cost for 5 Years (2000 h/y)
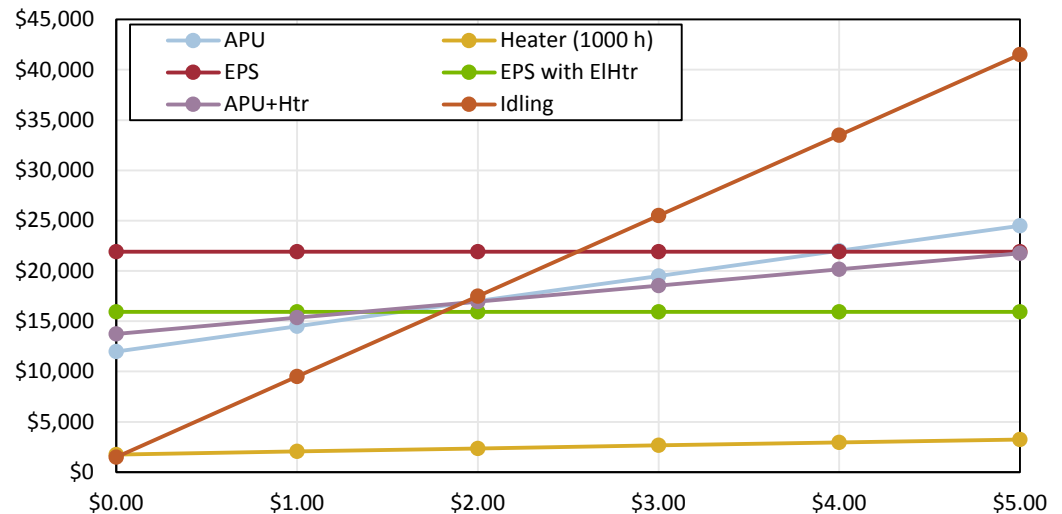
# Acronyms and Abbreviations

AFDC = Alternative Fuels Data Center

AFLEET = Alternative Fuel Life-Cycle Environmental and Economic Transportation

APU = auxiliary power unit

AFV = alternative fuel vehicle

ARRA = American Recovery and Reinvestment Act of 2009

bbl = barrel(s)

CCUWDP = Clean Cities University Workforce Development Program

CNG = compressed natural gas

DEQ = diesel emissions quantifier

EPRI = Electric Power Research Institute

gge = gasoline gallon equivalent

GHG = greenhouse gases

GREET = Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation

# Acronyms and Abbreviations, cont.

IR = Idle Reduction

JOBS FC = jobs model fuel cell infrastructure

JOB H2 = jobs model hydrogen infrastructure

JOBS NG = jobs model natural gas infrastructure

LNG = liquefied natural gas

LPG = liquefied petroleum gas (propane)

LS = local shares

mo = month(s)

MPG = miles per gallon

NAFA = National Association of Fleet Administrators

NBB = National Biodiesel Board

NG = natural gas

NGVA = Natural Gas Vehicles for America

NREL = National Renewable Energy Laboratory

NTEA = National Truck Equipment Association

# Acronyms and Abbreviations, cont.

PERC = Propane Education and Research Council

QTR = Quarter

RNG = renewable natural gas

scfm = standard cubic feet per minute

VICE = Vehicle and Infrastructure Cash-Flow Evaluation

yr = year(s)

# Publications, Presentations, and Webinars

**AFLEET**

- "Tapping Resources for Alternative Fuels: Clean Cities Tools and Resources" National Association of Fleet Administrators 2015 Institute and Expo, April 14, 2015.

- "AFLEET Tool Training," Clean Cities Coordinator 101, March 20, 2015.

- "AFLEET Tool and CNG Refuse Case Study Overview," Project for Israel, March 12, 2015.

- "Natural Gas Vehicle Technology Market Trends," Department of Energy's Clean Cities Strategic Planning 2015 Meeting. February 25, 2015.

- "Alternative Fuel and Conventional Vehicle Air Pollutant Emissions," Department of Energy's Clean Cities Webinar. January 28, 2015.

- "Green Fleet Program Development for Clean Cities Coalitions" at Clean Cities Coordinator Workshop, December 11, 2014.

- "AFLEET Tool To Analyze the Costs and Benefits of Alternative Fuel Vehicles" Natural Gas Vehicle Conference & Expo, November 13, 2014.

- "AFLEET Tool Training" Green Fleet Conference, October 28, 2014.

- "AFLEET Tool" SAE Commercial Vehicles Tour of Argonne National Laboratory, October 8, 2014.

- "AFLEET Tool," Clean Cities Coordinator 101, July 28, 2014.

# Publications, Presentations, and Webinars

**AFLEET, cont.**

- "AFLEET Tool," Chicago Area Clean Cities Coalition's GREEN DRIVE$ 2014 Event, May 21, 2014.
- "AFLEET Tool," Argonne National Laboratory's Earth Day Event, April 22, 2014.
- "'AFLEET Tool' To Analyze the Costs and Benefits of Alternative Fuel and Advanced Work Trucks," Green Truck Summit, March 4, 2014.
- "AFLEET Tool Training," prior to Green Truck Summit, March 3, 2014.
- "AFLEET Tool's AFV Air Pollutant Calculations," to Northwest Region Clean Cities Coordinators, February 24 2014.
- "'AFLEET Tool' To Analyze the Costs and Benefits of Alternative Fuel Vehicles," Natural Gas Vehicle Technology Forum, January 15, 2014.
- "AFLEET Tool to Analyze the Costs and Benefits of Alternative Fuel Vehicles," DOE's Clean Sustainability Assistance Network Webinar, Dec. 19, 2013.
- "Introduction to AFLEET Tool and IdleBox," Chicago Area Clean Cities Meeting, Dec. 12, 2013.

# Publications, Presentations, and Webinars

## AFLEET, cont.

- "AFLEET Tool to Analyze the Costs and Benefits of Alternative Fuel Vehicles," DOE's Clean Cities Webinar, Nov. 12, 2013.

- Lee, K.; Burnham, A. "Valuating the per ton cost of air pollutant emissions from vehicles," Argonne National Laboratory Technical Memo. 2014.

- Burnham, A. 2013. "User Guide for AFLEET Tool 2013," Argonne National Laboratory.

# Publications, Presentations, and Webinars

**IdleBox**

- Webinar for Southeast Louisiana Clean Fuel Partnership (April 23, 2015).
- "Status and Issues for Idling Reduction in the United States: Alternative Fuel and Advanced Vehicle Technology Market Trends" and presentation for the Department of Energy's Clean Cities Strategic Planning 2015 Meeting (February 25, 2015; Washington, DC).
- Webinar for National Governors Association (February 18, 2015).
- Presentation for the Southeast Alternative Fuels Conference (October 22, 2014; Raleigh, NC).
- Presentation for the Growing Sustainable Communities Conference (October 7, 2014; Dubuque, IA).
- Presentation for Chicago Area Clean Cities (September 11, 2014).
- Webinar for Clean Cities "Reaching Out to Media: Simple Strategies for Today" (July 24, 2014).
- Webinar for Clean Cities, "Success with Idlebox: Implementation Strategies" (July 16, 2014)
- Webinar for National Conference of State Fleet Administrators (May 14, 2014).
- Presentation for Green Truck Summit (March 4, 2014; Indianapolis, IN).
- Presentation for St. Louis Clean Cities and the local NAFA chapter (October 24, 2013; East St. Louis, IL).

# Publications, Presentations, and Webinars

## IdleBox, cont.

- "Stop and Restart Effects on Modern Vehicle Starting System Components: Longevity and Economic Factors" (May 2015).

## JOBS NG

- Webinar for National Governors Association (February 18, 2015).
- "JOBS NG" presentation at Natural Gas Vehicle Conference & Expo, (November 13, 2014; Kansas City, MO).
- JOBS NG, an Excel-based model that estimates the economic impact of natural gas fueling stations, was introduced at the NGV OK Conference (September 25, 2014; Tulsa, OK).