IDLE-REDUCTION TECHNOLOGIES

The fuel costs faced by the trucking industry are a significant part of the expense to operate a tractor-trailer in North America. Fuel costs are now approximately $0.37 per mile, accounting for 22% of a fleet's total operating costs—the second-largest expense for fleets behind only driver wages. The price per gallon for diesel as of May 2019 is around $3.16 per gallon, and all indications are that fuel prices will continue to be volatile. Thus, the industry is in need of solutions that reduce its fuel dependency if it is to remain profitable.

In addition, the United States Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) have enacted greenhouse gas emissions regulations on commercial vehicles, extended to 2030, which require manufacturers to develop and sell technologies to improve efficiency. These factors have driven fleets, manufacturers, and others to improve the efficiency of over-the-road tractor-trailers.

Fortunately, myriad technologies that can cost-effectively improve the fuel efficiency of Class 8 trucks are readily available on the market today. Unfortunately, multiple barriers have stymied industry adoption of such technologies, including a lack of data about the true performance gains these technologies offer and a lack of confidence in the payback for investment into these technologies. To overcome those barriers and facilitate the industry's trust in and adoption of the most promising cleaner operating technologies, the North American

Council for Freight Efficiency (NACFE) produces a series of Confidence Reports, of which this report on idle-reduction technologies is the latest.

To operate their sleeper tractors, fleets in the United States used over a billion gallons of diesel while idling in 2017, approximately 8% of the total fuel burned. Due to the volatility of fuel prices, concern about the impact of diesel emissions on the environment, and a desire to minimize engine wear, the trucking industry is under pressure to reduce or even end the idling of engines. Although some level of idling is unavoidable, a plethora of new idle-reduction systems now on the market is capable of reducing idling significantly below current averages. Unfortunately, most currently have moderate to low rates of adoption. The goals of this Confidence Report are to: (a) explain the importance of reducing idle time; (b) describe the benefits, costs, and challenges of various available idle-reduction technologies; and (c) provide recommendations for adoption of the technologies.

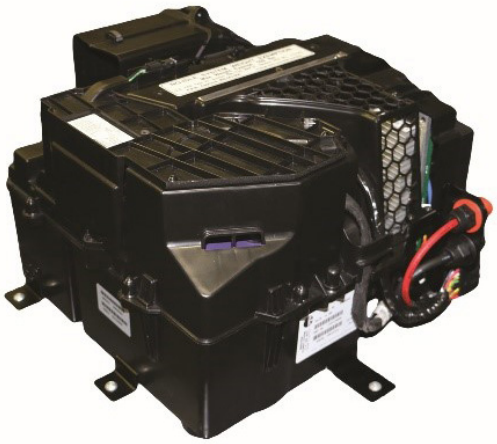
SCOPE OF THE REPORT

This report only considers idle-reduction technologies that are currently available on the market for over-the-road applications. It focuses on five of the eight reasons for idling in terms of the "benefits" that fleets would seek to obtain from any idle-reduction technology they might adopt. These include cab heating and cooling, battery state of charge, hotel loads, and engine heat. In addition, this report focuses on solo drivers and does not deal with team drivers, as the percentage of team drivers is relatively low.

IDLING OVERVIEW

Idling is important to trucking fleets for various reasons. Idling makes restarting a diesel engine in cold temperatures much easier, as the engine oil is already warm and therefore at a lower viscosity, and it also prevents the cold-weather gelling of diesel fuel. Idling also allows the cab and especially the sleeper berth to have a controlled indoor climate while the truck is parked. And idling helps keep the truck's batteries charged—an important factor today with drivers relying on lighting, cell phones, laptops, gaming devices, refrigerators, and CPAP machines.

However, over the past two decades—either to meet operating goals or under mandates that cut or eliminated truck idling across North America—reducing idling has become the norm for the industry. Several rounds of EPA-mandated emissions controls have substantially lowered allowed levels of truck emissions, in addition to requiring diesel particulate filters and selective catalytic reduction systems. Local restrictions on idling have also increased significantly, creating a complicated patchwork of regulations, all of them stricter than what the industry faced in the past. The American Transportation Research Institute periodically publishes a compendium of idle regulations to assist fleets in understanding this complicated patchwork. You can find and download a copy of this report at **https://atri-online.org/2019/01/09/idling-regulations-compendium/**.



PHOTOS COURTESY OF BERGSTROM INC.

METHODOLOGIES

NACFE's research for this report included interviewing key people with firsthand knowledge of idle-reduction technologies at fleets, manufacturers, and industry groups. The full report includes a list of references to assist readers interested in pursuing more detail. These references were researched with the same diligence and thoughtful processes NACFE uses with its other technology Confidence Reports and Guidance Reports.

Not only are government regulations intensifying, but the trucking industry has also been impacted by an increased awareness of sustainability among the general society and within the industry itself. This incentivizes serious advances in the adoption of environmentally friendly technologies and practices, including idle reduction.

However, there are countervailing pressures to allow trucks to idle to meet increasing driver expectations for in-cab comfort when the truck is not moving and for infotainment while they are on their mandated rest periods.

This has led fleets to look more closely at how to handle idling to meet emissions standards, achieve sustainability goals, and at the same time make sure drivers are comfortable and have their hotel loads met.

IDLE-REDUCTION TECHNOLOGIES

Idle-reduction technologies can be distinguished at a most basic level by the pathways by which they reduce the need for idling. Some of the systems are "active" in nature and provide a specific set of benefits to the vehicle and driver, while other idle-reduction methods are "passive" and simply work to minimize the need for the active systems.

FUEL-OPERATED HEATERS

Fuel-operated heaters—which include air heaters and coolant heaters—use diesel fuel to provide heat to the sleeper cab (bunk or air heaters) or to provide heat to the truck engine (water or coolant heaters). Both types of heaters can operate when the truck's engine is off, therefore avoiding idling. These heaters are relatively inexpensive to purchase and maintain, are easy to install (air heaters) or factory installed (coolant heaters), and operate very quietly. However, they do not provide any cooling (and coolant heaters do not provide bunk heating), do not provide AC power for hotel loads, and create some emissions while operating.

AUXILIARY POWER UNITS

Auxiliary power units (APUs)—either diesel or battery-powered units that do not source their energy from a truck's main diesel engine—are a key component of the idle-reduction strategy of many fleets, as they can provide cooling, heating, and electric power when the truck's main engine is shut off. Diesel APUs can operate as long as the truck has fuel, while battery APUs—typically called battery HVAC systems—are limited in the hours of cooling they can provide before truck engine restart and battery

recharging are required. Diesel APUs can also operate in more extreme temperatures, while extreme hot and cold weather negatively affect the capability of battery systems. However, diesel APUs are more expensive to purchase, install, and maintain than battery HVAC systems and other idle-reduction technologies. And while diesel APUs need fuel to operate, thus generating emissions and noise, battery HVAC systems have been described as true zero-idle solutions since they do not use any type of engine while in operation. Many truck OEMs offer battery HVAC systems as factory options.

AUTOMATIC ENGINE START/STOP SYSTEMS

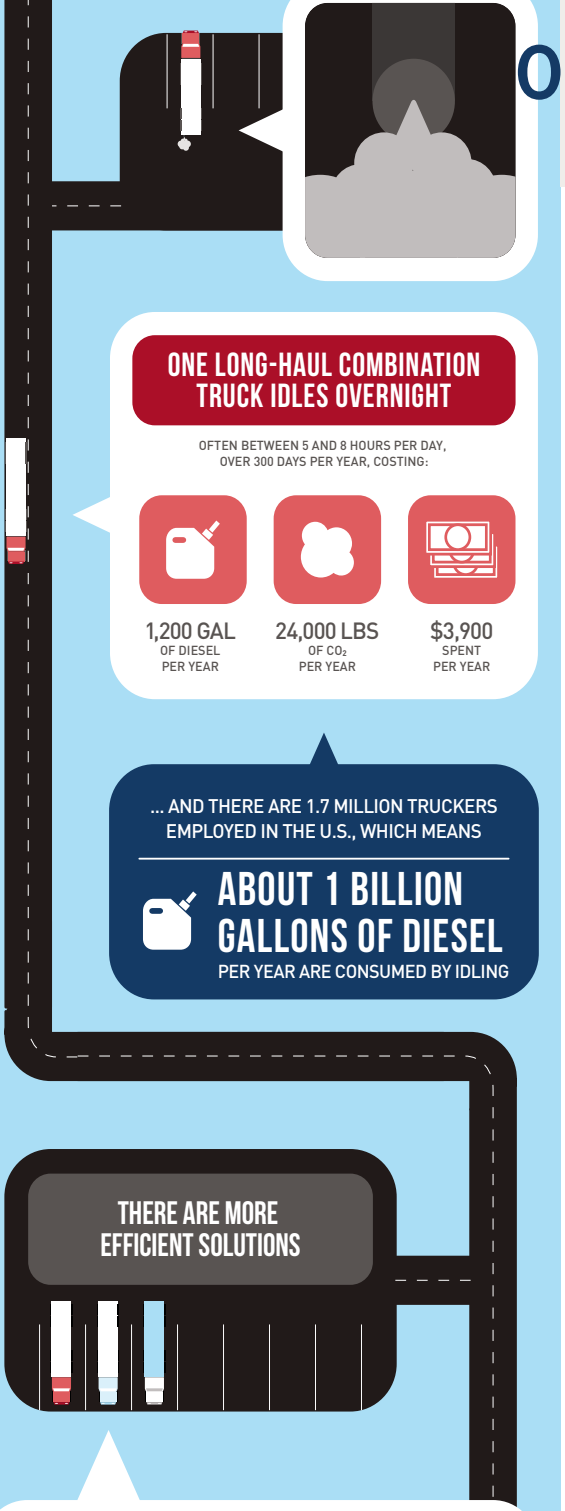
Automatic engine start/stop systems start and stop the main diesel engine in an unattended fashion to provide a variety of features without requiring the truck's engine to idle continuously. These systems have a set of inputs to ensure that it is safe to start the engine without anyone at the controls, such as checking that the truck is not in gear and that no one is working under the hood. There are two types of automatic engine start/stop systems—one that maintains a cab's interior temperature while the vehicle is occupied and one that maintains the batteries' state of charge. These systems do not require additional HVAC components, can be combined with other technologies, and can avoid violating idle regulations. However, the noise and vibration of these systems can interrupt driver sleep, and by requiring the main engine to idle they create additional hours of wear on the main engine.

VEHICLE CONTROLS AND DRIVER BEHAVIOR

The vehicle itself can help in a fleet's idle-reduction efforts via electronic engine parameter settings. In addition, the way drivers manage their vehicles, both while moving and while stationary, has a huge impact on the vehicle's fuel economy. Fleets can motivate desired behavior or penalize/prevent undesired behavior to obtain optimal reductions in idling via electronic controls and by training and incentivizing drivers to follow best practices.

ELECTRONIC ENGINE IDLE PARAMETERS

Programmable engine parameters can play a major role in the various idle-reduction strategies and technologies that fleets employ. These parameters not only control the exact speed at which an engine will idle, they also set the idle timer length and establish boundaries for when idling



AUTOMATIC IDLE SHUTDOWN SYSTEMS

Trucks can be programmed to shut down after a certain amount of time. Extreme temperatures will override the program.

DIESEL APUS

Diesel APUs can provide cooling, heating and electric power to the sleep cab while the truck's engine is off.

BATTERY HVAC SYSTEMS

Battery HVAC systems provide climate control for sleeper cabs and are described as zero-idle solution.

AUTOMATIC ENGINE START/STOP SYSTEMS

Automatic engine start/stop systems start and stop the engine.

FUEL-OPERATED/DIESEL-FIRED HEATERS

These units use diesel to provide heat to the sleeper and to the truck engine in an unattended fashion, and to provide a variety of features without requiring the truck's engine to idle continuously.

is allowed for cold and hot temperature extremes. The exact parameter names, ranges, and defaults differ among engine OEMs. Since these are now standard equipment, there is no cost for using them. However, there are some challenges, including the possibility of being able to modify the settings outside of desired ranges, the diversity of terminology among engine manufacturers, and the difficulty in getting buy-in from drivers who may feel the fleet is trying to restrict the way they drive.

DRIVER TRAINING

For idle-reduction systems to be effective, drivers must know how to operate them properly. Some fleets provide ongoing education via drivers' meetings, newsletters, emails, or videos downloaded directly to the truck via an onboard satellite system. Some systems are more complicated to operate than others, and some require drivers to periodically do minor maintenance checks while on the road. Regardless of the system, drivers can help optimize its capabilities by following some general rules such as precooling the cab before shutting the truck down at night and parking on concrete instead of asphalt. Other rules are described in the full report.

DRIVER INCENTIVES

Due to the large impact that drivers have on idle reduction, many fleets have incentive systems to encourage drivers to be involved in reducing the fleet's fuel expenses by sharing the savings between the truck owners and the drivers. These incentives may cover many different elements of fuel use, including vehicle speed, time spent in top gear, percent idle time, and use of idle-reduction solutions. Fleets should select incentive programs and benefits that fit their driver demographics and characteristics to ensure the biggest impact.

"There are a lot of really good reasons to limit the idling of the main engine in a truck—providing the driver with the most comfortable conditions to spend his or her breaks, saving a little fuel, saving a little wear and tear on the engine, and, last but not least, it's good for the environment."

—Kevin Otto, Team Lead for NACFE Idle-Reduction Technologies Confidence Report

ADDITIONAL SOLUTIONS

Other technologies that can be beneficial in a fleet's idle-reduction efforts include additional cab insulation, light-colored paint on the outside of the cab and sleeper, an additional CPAP battery, ultracapacitor starting systems, solar panels, using shore power, and even having the driver stay in a hotel or dormitory instead of sleeping in the vehicle.

COMPLEMENTARY IDLE-REDUCTION TECHNOLOGY PACKAGES

The most efficient and effective idle-reduction solution for a fleet will entail a combination of complementary technologies among those cataloged in this report. For instance, several of the technologies, namely electronic engine parameters, driver incentives, and extra cab/sleeper insulation, are going to contribute positively to almost any solution chosen. The right combination will depend on a given fleet's routes, fuel costs, climate in the fleet's area of operation, shop costs, maintenance cycles, training methods, driver support, fleet policies, and other factors.

The industry is having the most success by choosing one of four technologies as the "anchor" of their overall idle-reduction strategies, and then adding other technologies that best complement or support the anchor. In this way, the full system best suits each fleet's needs.

The four anchor choices are:

1. Driver Controls + Fuel-Operated Heater
2. Diesel APU + Fuel-Operated Heater
3. Battery HVAC + Fuel-Operated Heater
4. Automatic Engine Start/Stop System

"Drivers are not interested in this technology to save fuel and reduce idling. They are interested in staying comfortable in the truck while they are required to be in it."

—Ben Curtis, fleet maintenance, J. P. Noonan Transportation, and formerly fleet manager, Boyle Transportation

Once one of these options has been identified as the best for a fleet's specific needs and goals, ancillary solutions can be evaluated for their potential to reduce idling even further. Finally, fleets should consider the conditions under which sleeping in the truck for an hours-of-service restart is not the optimal solution. If the main engine will need to idle for the entire restart period to maintain comfortable temperatures and provide hotel loads, especially in very hot weather, a hotel room or dormitory may actually be a more cost-effective choice for the fleet, not to mention a preferable option for the drivers.

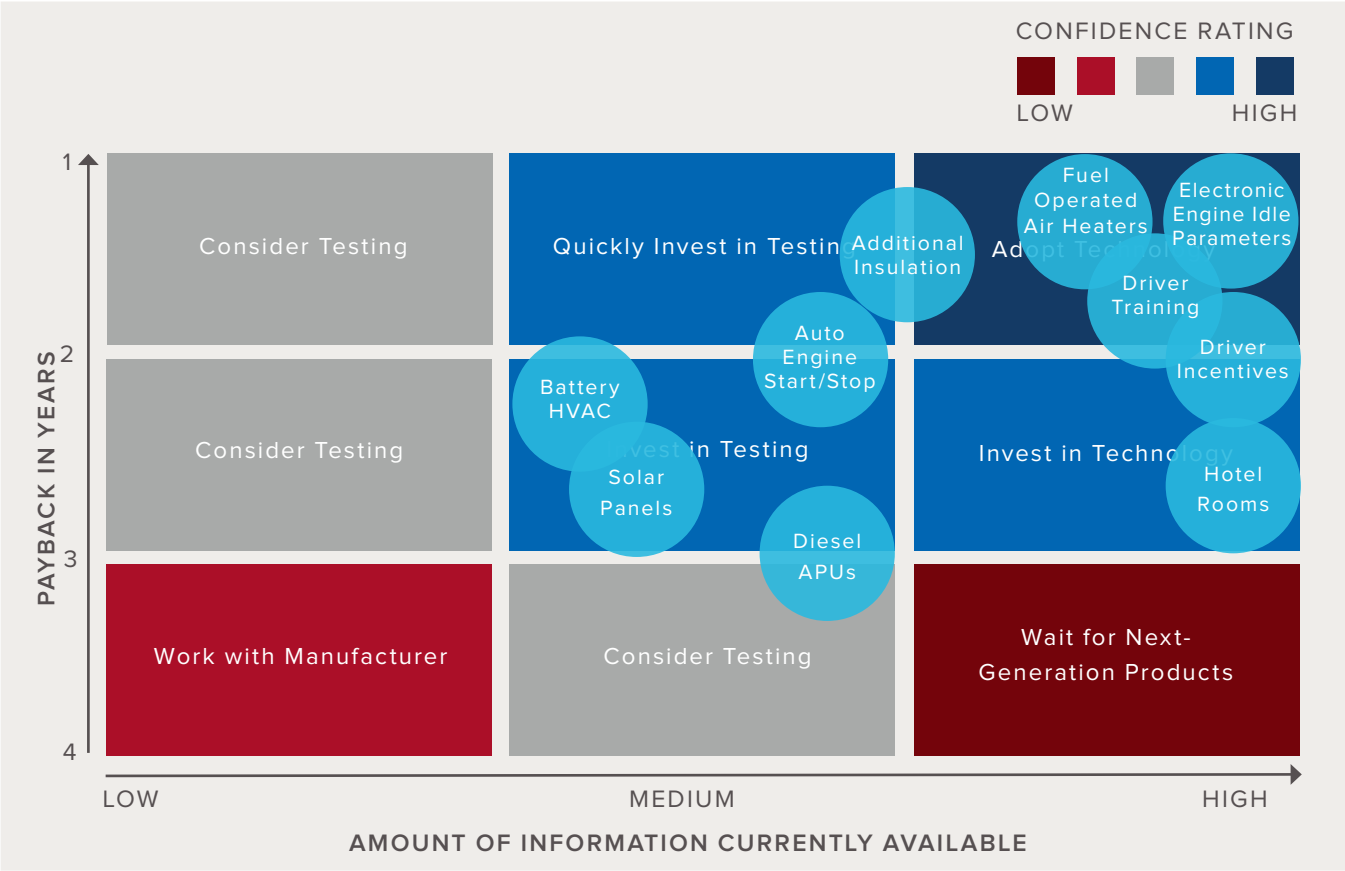
CONFIDENCE RATING

The technologies covered in each of NACFE's Confidence Reports are plotted on a matrix in terms of the expected payback in years compared to the confidence that the study team has in the available data on the technology—that is, not only how quickly fleets can expect payback on their investment but also how certain NACFE is in the assessment of that payback time.

The matrix below indicates how confident the NACFE study team believes trucking fleets should be in the investment case for idle-reduction technologies. Given these conclusions, NACFE believes that fleets should seriously consider investing in idle-reduction technologies following the best practices described in this Confidence Report.

FIGURE ES1

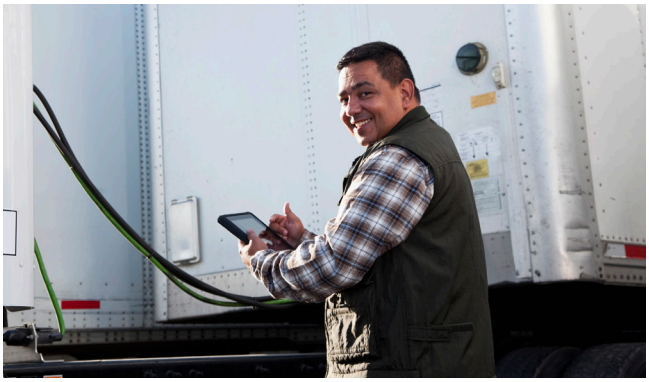
CONFIDENCE MATRIX FOR IDLE REDUCTION



CONCLUSIONS AND RECOMMENDATIONS

Reducing idle time, particularly on sleeper cabs, saves fuel, improves a fleet's "green image," and probably saves a small amount of wear and tear on the main engine. In terms of fuel savings, a 10% annual reduction in idling is worth about 1% in fuel economy, translating to about $500 to $700 annually at $3.00/gallon fuel prices and 100,000 miles/year. And a reduction of 20% is not unreasonable if the right combination of technologies is employed and managed. Drivers are also a very important—if not the most important—part of successful management of idle times.

There is no "one-size-fits-all" solution to idle reduction. Many technologies are available and well proven, but each has pros and cons that need to be evaluated. Every fleet and operation has different goals. Therefore, the costs, benefits, and challenges of each of the technologies need to be weighed along with overall fleet objectives. The good news is that there are a large number of choices to satisfy the needs of individual fleets, and many can be combined to provide the optimal solution for the fleet.



"To me, idle reduction is simple: We have to get a technology figured out to support the battery system. I don't think anyone wants to idle just to be idling; they do it because we have to provide those creature comforts."

—Mike Jeffress, Vice President of Maintenance, Maverick Transportation LLC

NACFE

The North American Council for Freight Efficiency (NACFE) is a nonprofit organization dedicated to doubling the freight efficiency of North American goods movement. NACFE operates as a nonprofit in order to provide an independent, unbiased research organization for the transformation of the transportation industry. Data is critical, and NACFE is helping the industry with real-world information that fleets can use to take action. In 2014, NACFE collaborated with Carbon War Room, founded by Sir Richard Branson and now a part of Rocky Mountain Institute (RMI), to deliver tools and reports to improve trucking efficiency. These reports include a series of Confidence Reports that detail the solutions that exist, highlight the benefits and consequences of each, and deliver decision-making tools for fleets, manufacturers, and others. As of June 2019, NACFE and RMI have completed 17 such reports, covering nearly all the 85 technologies available.

www.nacfe.org

ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; the San Francisco Bay Area; Washington, D.C.; and Beijing.

www.rmi.org

GET INVOLVED

NACFE provides an exciting opportunity for fleets, manufacturers, and other trucking industry stakeholders.

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