Idling: Cruising the Fuel *In*efficiency Expressway

By

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Introduction

What is the purpose of idling? The scale of idling can be small, as when parents idle their vehicles while waiting for their children outside of school, or it can be large, as when ocean liners are in port. In many cases, the primary purpose for idling is to control the temperature of a passenger or freight compartment. Large line-haul trucks idle overnight to keep fuel and the engine warm, for the resting driver's comfort, to mask out noises and smells, and for safety. In addition, all classes of trucks idle during the workday at ports and terminals, busy delivery sites, border crossings, and restaurants. They may be idling to enable slow movement in a queue (creep idling) or to provide other services. Bus drivers also idle their vehicles while they wait for passengers and to warm up in the morning. Even locomotive engines are idled so they start, for hotel load, to keep the battery charged, to keep the toilet water from freezing, and for air brakes, or because the operator idles out of habit. Although this paper focuses on long-haul trucks, much of the information applies to other vehicles as well.

The impacts of idling are substantial, with as much as 2 billion gallons of fuel burned unnecessarily each year in the United States at a cost of over $4 billion. The extra hours of engine operation also cost the owners money for more frequent maintenance and overhauls. In addition, idling vehicles emit particulates (PM_{10}), nitrogen dioxide (NO_2), carbon monoxide (CO), and carbon dioxide (CO_2). These emissions, along with noise from idling vehicles, have led to many local and state restrictions on idling.

Two main factors have combined to create a surge of interest in idling reduction (IR):

1. Increasing restrictions on idling for heavy vehicles and
2. The price of diesel fuel.

Because stakeholders focus their efforts on reducing different factors (air quality, fuel economy, noise), they do not necessarily agree on the most advantageous technological alternatives to implement.

In addition, although many equipment manufacturers have tried to educate customers and government agencies, they often provide conflicting claims about the comparative merits of different devices. This makes it difficult for truck owners to choose the right equipment for their needs.

This study presents the first comparison of IR technologies with each other and with idling on the basis of both costs and full fuel-cycle emissions, for different locations, fuel prices, and idling patterns. The preferences described are for the technologies that reduce total emissions the most and cost truck owners the least. We also discuss how regulatory issues and legislation affect IR, what financial incentives help to promote IR, and how outreach and education approaches can be adopted to reduce the need to idle. Finally, we offer a prediction of how future research and development (R&D), regulations, and citizens can help to improve fuel economy and clean the air.

Idling-Reduction Technologies

All of the idling-reduction technologies considered here reduce emissions of CO_2, NO_x, and PM_{10} by a factor of three or more compared to idling. All pay back the truck owner's investment in three years or less at the current diesel fuel price of over $2.50 per gallon.

Cab comfort (heating and cooling) is required during extended rest periods because the operator generally sleeps in the truck. In the past, idling the main engine was the standard method of providing these services. Because of the adverse air-quality and public-health impacts associated with diesel exhaust from idling trucks, as well as rapidly varying fuel costs (Figure 1), numerous IR technologies are being implemented or demonstrated (EPRI and EPA 2006; ATRI 2006; EPA 2006a). Devices are available for stand-alone installation aboard the truck or use at wayside installations. Onboard devices can be used wherever and whenever the truck is stopped, but they add weight to the truck. Although P.L. 109-58, the Energy Policy Act of 2005 (EPAct 2005), permits a weight waiver, individual states are not compelled to grant this waiver. **Diesel-fired heaters** (DFHs) supply warm air to the cab/sleeper. An engine block heater can also be included. Fuel use and emissions by diesel heaters are very low, because they supply heat directly from a small combustion flame to a heat exchanger. Standard diesel fuel is used. Cab heaters can be coupled with air-conditioners if the trucker's service area includes both cold winters and hot summers. **Thermal storage and battery-electric air-conditioners** (storage cooling, or SC) are available. In either case, the energy to recharge the storage device is supplied by the truck's engine during operation. The engine uses a small quantity of extra diesel fuel for this, and the emissions from burning this fuel are on the highway, not at the truck stop or depot. **Auxiliary power units** (APUs) consist of a small diesel-fueled internal combustion engine that powers a generator to provide electricity and space conditioning. Fuel cell units are also being developed. Emissions are compliant with small engine standards, but California requires additional controls, such as a diesel particulate filter (DPF) for APUs on trucks built in 2007 or later. The U.S. Environmental Protection Agency (EPA) maintains a list of equipment manufacturers at http://www.epa.gov/SmartwayLogistics/transport/what-smartway/idling-reduction-available-tech.htm.

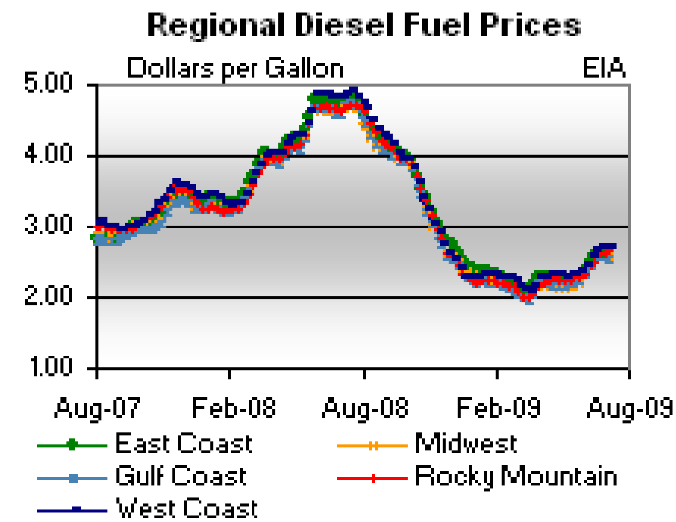


FIGURE 1. Regional Diesel Fuel Prices

Electrified truck parking spaces (EPS) (also known as truck stop electrification or TSE) provide heating, cooling, and other services to parked vehicles. These fixed wayside systems add little or no weight to the truck and cause no local emissions, because no diesel fuel is consumed. There are, of course, upstream emissions from generating the electricity and producing and transporting the power plant fuel. "Single"-system EPS supplies services from equipment on the ground through a duct inserted into the cab window. The map (Figure 2) shows the approximately 140 locations operated by the leading operator. "Dual"-system EPS allows the trucker to plug electrical equipment on the truck into a pedestal connected to the electric power grid. This type of system is available at only a small number of locations so far, which are listed below:

FIGURE 2. Locations of Electrified Truck Parking Spaces

- Seven Feathers Truck/Travel, Canyonville, OR**,** I-5 Exit 99
- Mollie's Truck Stop, Klamath Falls, OR, US 97 North
- Truck 'n Travel/TA, Coburg, OR, I-5, Exit 199
- Jubitz Travel Center, Portland, OR, I-5, Exit 307
- Gee Cee's Truck Stop, Toledo, WA, I-5, Exit 57
- Broadway Flying J Travel Plaza, Ellensburg, WA, I-90 Exit 109
- Arrowhead Travel Plaza, Pendleton, OR, I-84 Exit 216
- Big Boy's Truck Stop, Kenly, NC, I-95 Exit 105

The AFDC website includes a locator so that a trucker can search for a location near where he/she would like to stop. The address is http://www.afdc.energy.gov/afdc/vehicles/idle_reduction_stations.html.

ECONOMICS

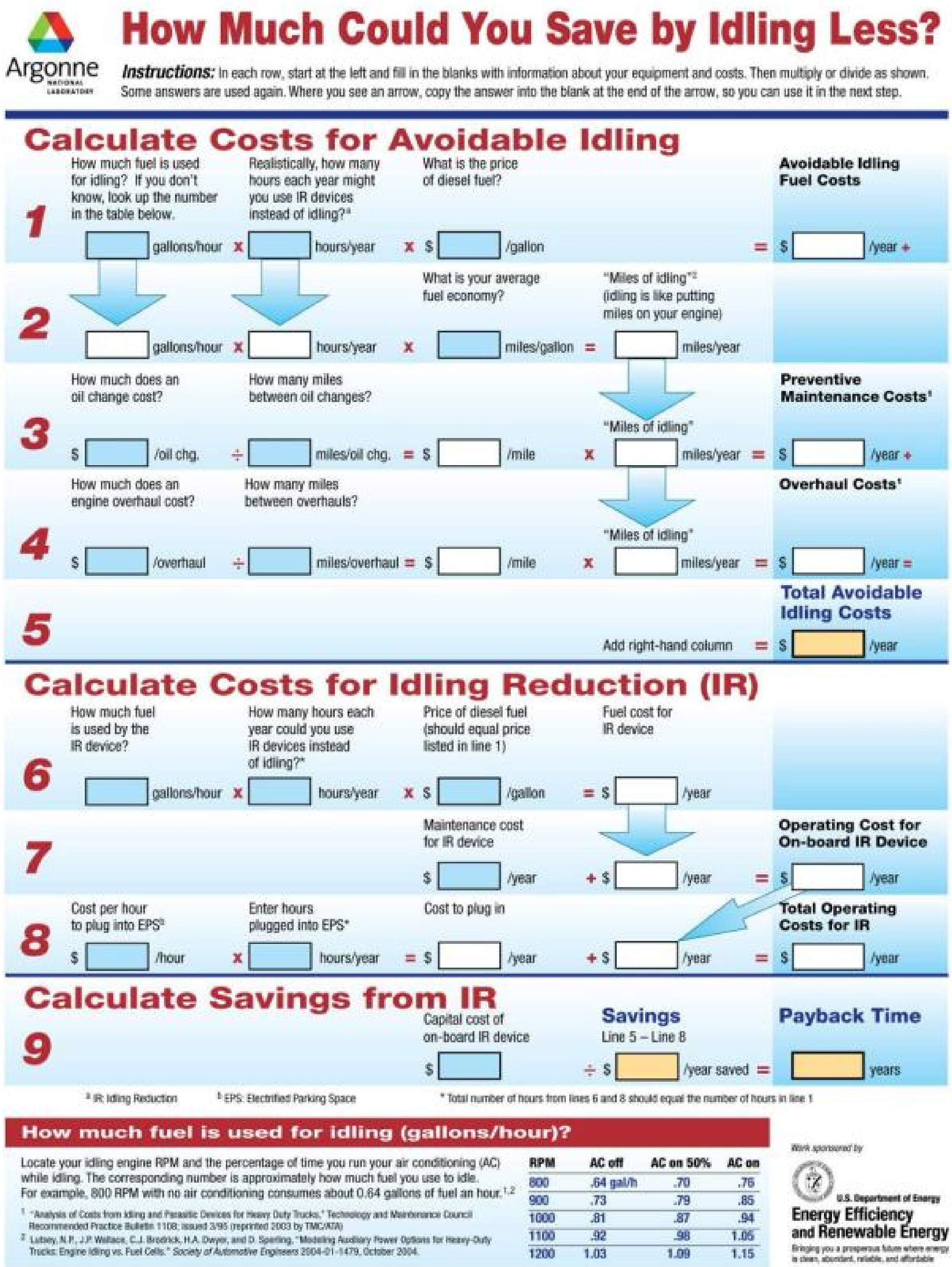
Table 1 compares typical costs and fuel consumption of selected IR options to those for idling. These costs were obtained from an informal survey of equipment manufacturers. Both costs to the truck owner for on-board equipment and costs to the infrastructure provider for capital equipment are shown. Operating costs for the infrastructure are not shown. These depend strongly on labor costs.

TABLE 1. Cab Comfort Technology Summary

System	Services	Fuel Use/hr	On-board Cost ($)	Maintenance ($/hr)*	Infrastructure cost ($/space)	Usage Charge ($/hr)
Idling 2001 truck	All	0.77 gal heating 0.98 gal cooling	0	0.12	0	0
Idling 2007 truck	All	0.53 gal heating 0.72 gal cooling	0	0.12	0	0
Cab/bunk heater	Heating	0.06 gal	1,250	0.07	0	0
Storage air conditioner	Cooling	0.20 gal	4,000	0.13	0	0
APU or generator set	All	0.23 gal	8,000**	0.33	0	0
Electrified parking space (single on gantry)	All	2.4 kWh heating 1.7 kWh cooling	10	0	16,700	2.45
Electrified parking space (single on pedestal)	All		10	0	9,000-11,000	1-2
Electrified parking space (dual system)	All		2,500	0.07	Up to 6,000	1

* Estimated for IR technologies by pro-rating annual maintenance over 1,500 hours per year
** Add $1,000 for diesel particulate filter (DPF)

We created a worksheet (Figure 3) to allow truck owners to calculate savings from reducing idling and used it to compare technologies. The graphs that follow compare costs to the truck owner for idling and alternatives.



How Much Could You Save by Idling Less?

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Instructions: In each row, start at the left and fill in the blanks with information about your equipment and costs. Then multiply or divide as shown. Some answers are used again. Where you see an arrow, copy the answer into the blank at the end of the arrow, so you can use it in the next step.

Calculate Costs for Avoidable Idling

1 How much fuel is used for idling? If you don't know, look up the number in the table below. ___ gallons/hour × Realistically, how many hours each year might you use IR devices instead of idling?[a] ___ hours/year × What is the price of diesel fuel? $ ___ /gallon = **Avoidable Idling Fuel Costs** $ ___ /year +

2 ___ gallons/hour × ___ hours/year × What is your average fuel economy? ___ miles/gallon = "Miles of idling"[2] (idling is like putting miles on your engine) ___ miles/year

3 How much does an oil change cost? $ ___ /oil chg. ÷ How many miles between oil changes? ___ miles/oil chg. = $ ___ /mile × "Miles of idling" ___ miles/year = **Preventive Maintenance Costs[1]** $ ___ /year +

4 How much does an engine overhaul cost? $ ___ /overhaul ÷ How many miles between overhauls? ___ miles/overhaul = $ ___ /mile × "Miles of idling" ___ miles/year = **Overhaul Costs[1]** $ ___ /year =

5 Add right-hand column = **Total Avoidable Idling Costs** $ ___ /year

Calculate Costs for Idling Reduction (IR)

6 How much fuel is used by the IR device? ___ gallons/hour × How many hours each year could you use IR devices instead of idling?* ___ hours/year × Price of diesel fuel (should equal price listed in line 1) $ ___ /gallon = Fuel cost for IR device $ ___ /year

7 Maintenance cost for IR device $ ___ /year + $ ___ /year = **Operating Cost for On-board IR Device** $ ___ /year

8 Cost per hour to plug into EPS[b] $ ___ /hour × Enter hours plugged into EPS* ___ hours/year = Cost to plug in $ ___ /year + $ ___ /year = **Total Operating Costs for IR** $ ___ /year

Calculate Savings from IR

9 Capital cost of on-board IR device $ ___ ÷ **Savings** Line 5 – Line 8 $ ___ /year saved = **Payback Time** ___ years

[a] IR: Idling Reduction [b] EPS: Electrified Parking Space * Total number of hours from lines 6 and 8 should equal the number of hours in line 1

How much fuel is used for idling (gallons/hour)?

Locate your idling engine RPM and the percentage of time you run your air conditioning (AC) while idling. The corresponding number is approximately how much fuel you use to idle. For example, 800 RPM with no air conditioning consumes about 0.64 gallons of fuel an hour.[1,2]

RPM	AC off	AC on 50%	AC on
800	.64 gal/h	.70	.76
900	.73	.79	.85
1000	.81	.87	.94
1100	.92	.98	1.05
1200	1.03	1.09	1.15

[1] "Analysis of Costs from Idling and Parasitic Devices for Heavy Duty Trucks," Technology and Maintenance Council Recommended Practice Bulletin 1108; issued 3/95 (reprinted 2003 by TMC/ATA)

[2] Lutsey, N.P., J.P. Wallace, C.J. Brodrick, H.A. Dwyer, and D. Sperling, "Modeling Auxiliary Power Options for Heavy-Duty Trucks: Engine Idling vs. Fuel Cells." *Society of Automotive Engineers* 2004-01-1479, October 2004.

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FIGURE 3. Worksheet for Calculating the Savings from Reducing Idling

We used the worksheet procedure in an Excel spreadsheet to estimate the costs for a wide variety of equipment costs, fuel prices, and idling hours. Using this approach, we were able to show how the costs incurred during hours that the vehicle would otherwise have been idling depend on these parameters.

Figure 4 shows how, for on-board options, the hourly cost is directly proportional to the price of diesel fuel, while for EPS, the hourly cost is fixed. Wayside systems therefore become more attractive as the fuel price rises.

Figure 5 shows total cost to the truck owner, which includes the capital cost of the equipment, as well as fuel and maintenance costs or hourly charges. For low idling rates, options with little or no capital investment are most economical for the truck owner, but for high idling rates, options with low hourly costs would be favored. Although costs to the owner of the wayside equipment have not been analyzed in detail, high usage rates would yield the highest revenues and therefore be favorable.

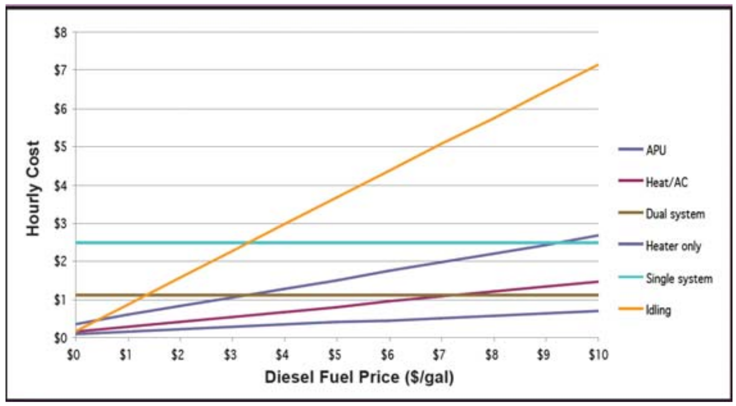

FIGURE 4. Hourly Operating Cost as a Function of Diesel Fuel Price

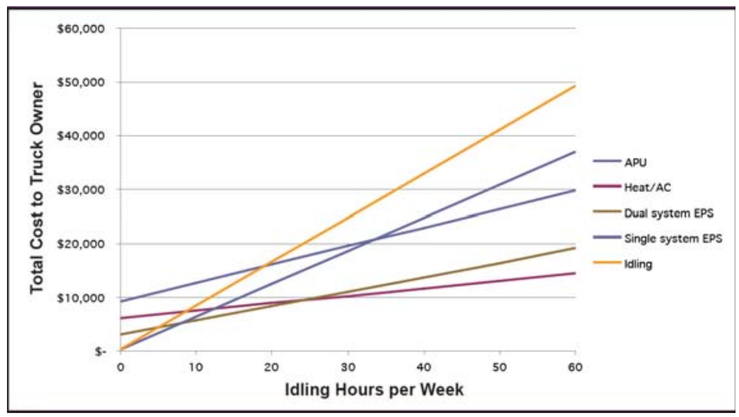

FIGURE 5. Total Cost for 5 Years' Operations vs. Weekly Idling Hours, for $4.50/gal Fuel, U.S. Average Location

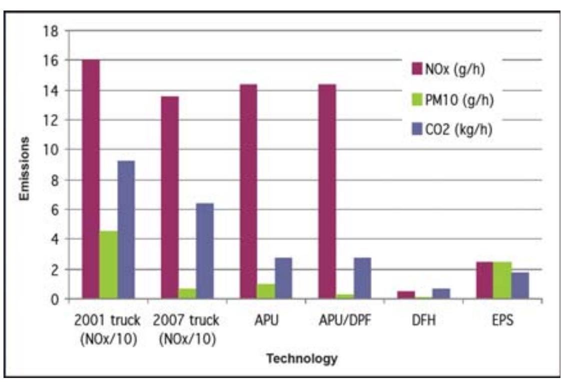

FIGURE 6. Hourly Emissions for Heating Options, U.S. Average Location

EMISSIONS

Figure 6 shows hourly emissions of NO_x, PM_{10}, and CO_2 for a 2001 truck and one meeting 2007 emission standards and several options for providing heat to the resting driver. Of the IR options, the APU produces the highest emissions of NO_x and CO_2, and EPS produces the highest PM_{10} (although most of this is in rural areas). The DFH produces the lowest emissions in all categories. Note that none of the emissions from EPS are at the truck -- all are upstream, the result of producing the power source used by the equipment.

Figure 7 shows emissions for cooling options. Although no option has a clear advantage, EPS does have the lowest NO_x and CO_2 emissions. The NO_x emissions from storage cooling are created during truck operation and therefore decline as trucks meet more stringent regulations. So, they will be reduced drastically on 2010-compliant trucks.

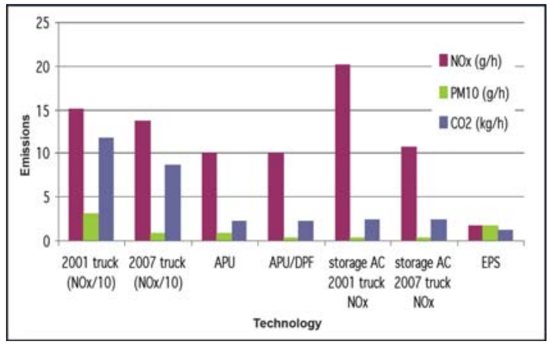

FIGURE 7. Hourly Emissions for Cooling Options, U.S. Average Location

COST-EFFECTIVENESS

The cost-effectiveness of different technologies depends on the location and idling duration. Figure 8 compares costs and emissions for a high-idling case. In this case, there are enough hours to economically amortize the capital costs over five years, and hourly operating costs for single-system EPS reduce savings. The heater-plus-storage air-conditioner saves the most money and minimizes all emissions. The high fraction of Illinois electricity generated by coal leads to high particulate emissions for EPS, although they are primarily rural.

Figure 8 shows a low-idling case, in a location where electricity is generated with low emissions. Again, the heater-plus-storage air-conditioner minimizes emissions, with close-to-maximum cost savings. In this case, the increase in PM_{10} with electrification is less pronounced than for Illinois (Figure 9), because little coal-based power is used in California. In 20 hours per week, it is difficult to pay back a capital-intensive device like an APU in just five years. The added cost of a DPF (as required on 2007 and newer trucks with APUs in California) makes the device a net financial loser for this low-idling case.

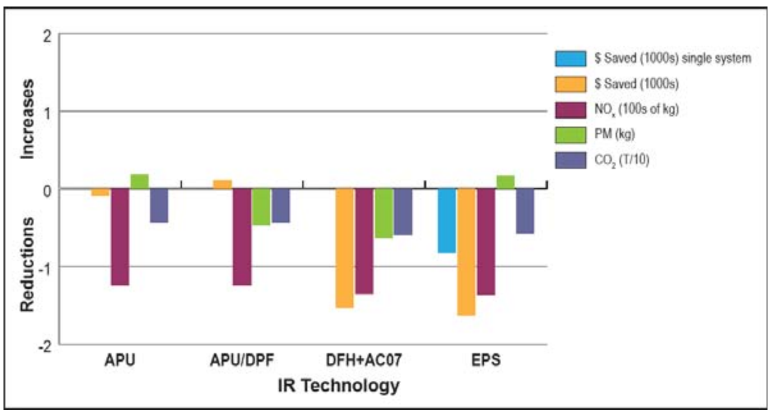

FIGURE 8. For California, Annual Financial Savings to Truck Owner and Emission Benefits for Idling Reduction Options, Compared to 2007 Truck, 20 hours/week Idling, $4.50/gal fuel

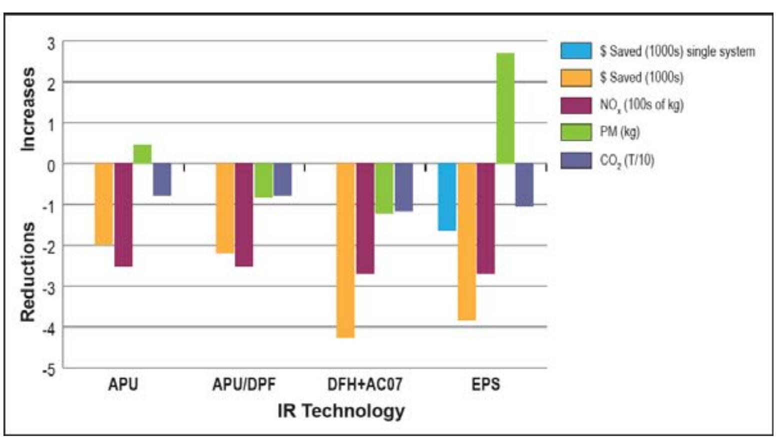

FIGURE 9. For Illinois, Annual Financial Savings to Truck Owner and Emission Benefits Compared to a 2007 Truck for Idling Reduction Options, 40 hours/week Idling, $4.50/gal fuel

Conclusions about Technologies

For trucks that idle fewer than about 20 hours per week, technologies with low capital investment are the most attractive from a total cost perspective. These include EPS and idling. From an emissions standpoint, of course, idling is the least attractive alternative. Again, heaters supply heat with the lowest impacts, and the most desirable methods for supplying air-conditioning are storage air-conditioning if the truck is a 2007 or later model or EPS. For older trucks, there is a trade-off.

For trucks that idle over 20–30 hours per week, technologies using on-board equipment, including dual-system EPS, result in the lowest total cost to the truck owner over five years of operation, while single-system EPS results in the highest total cost of idling alternatives. NO_x emissions from pre-2007 trucks and CO_2 emissions can be reduced by air-conditioning via EPS, but this results in an increase in PM_{10} because of the use of coal in the grid mix in all states. However, most of these PM_{10} emissions are upstream, in rural areas, leading to low population exposure and resultant health costs. One significant advantage of wayside systems is that they guarantee that local emission reductions occur at their locations, although this may be at the expense of emissions upstream.

In summary, heating-plus-storage air-conditioning and dual-system EPS are among the options preferred on both economic and environmental grounds over a wide range of idling behaviors, regardless of location.

Regulatory Issues and Legislation

Clean Air Act

By way of background as to why we are involved in this field, we have to go back to the Clean Air Act (CAA) of 1970 (Title 42, Chapter 85, of the U.S. Code). The enactment of the CAA resulted in a major shift in the federal government's role in air pollution control. This legislation authorized the development of comprehensive federal and state regulations to limit emissions from both stationary (industrial) sources and mobile sources. Four major regulatory programs affecting stationary sources were initiated: the National Ambient Air Quality Standards (NAAQS, pronounced "knacks"), State Implementation Plans (SIPs), New Source Performance Standards (NSPS), and National Emission Standards for Hazardous Air Pollutants (NESHAPs). Furthermore, enforcement authority was substantially expanded. The adoption of this very important legislation occurred at approximately the same time as the National Environmental Policy Act, which established the EPA on May 2, 1971, in order to implement the various requirements included in the CAA of 1970. This law was modified in 1977 and 1990.

Many public agencies are looking at ways to discourage or prohibit unnecessary idling. Policy mechanisms favored by regulators to alleviate the impacts of truck idling include restrictions on idling time or proximity to certain facilities, such as schools (ATRI 2008). The California Air Resources Board (CARB) adopted a first-of-its-kind idling regulation that imposes a virtual ban on overnight idling within the state and sets strict new requirements for idling alternatives (CARB 2006). One compliance option is for diesel APUs to be equipped with a DPF or to be configured so that the APU exhaust is routed through the truck's main engine diesel particulate filter. Devices that comply with California regulations are now on the market, but no operating data are available.

IDLING REDUCTION REGULATIONS

According to the American Transportation Research Institute (ATRI), some type of idling restriction had been enacted in all or parts of 25 states as of July 2008 (ATRI 2008). Although EPA did write a Model State Idling Law (http://www.epa.gov/smartway/documents/420s06001.pdf) in 2006 that they hoped states would adopt, many had already passed legislation when the document had been released, and others have chosen to adopt other restrictions. ATRI keeps a current list of regulations, and its compendium is updated frequently because of continuing legislative activity. The list was last updated in August 2009 and can be found at the ATRI website (http://www.atri-online.org/index.php?option=com_content&view=article&id=164&Itemid=70) and at the AFDC site as well (http://www.afdc.energy.gov/afdc/incentives_laws.html). The ATRI site includes a four-page cab card for truckers to carry with them when they travel across different jurisdictions. The site lists over 40 different sets of rules for states, counties, or cities. For each location, it shows maximum idling time (ranging from 0 to 15 minutes), exemptions (sleepers may or may not be exempt), and penalties. It does not note whether the regulations are actually enforced, which they often are not. Each entry also includes a link to the relevant legislation for reference.

Many of the IR devices, especially APUs, add significant weight to the truck. This can be a problem if the vehicle tends to be weight-limited (i.e., at the maximum weight limit for the road; 80,000 lb in most of the United States). In that case, the additional equipment weight would reduce the freight that could be carried and thus impact the carrier's revenues. To avoid this dilemma, EPAct 2005 allowed for a national 400-lb exemption for the additional weight of IR technology on heavy-duty vehicles. However, the law only allowed, **but does not mandate**, the exemption. It is thus up to individual states to enable the exemption or not. Table 2 shows the current status of adoption of the weight exemption.

TABLE 2. State Enforcement of 400-Pound Auxiliary Power Unit Exemption to GVW Limit: 23 CRF 658.17(n)

State			
Alabama	*Indiana*	**Nebraska**	**South Carolina**
Alaska	**Iowa**	**Nevada**	**South Dakota**
Arizona	**Kansas**	**New Hampshire**	*Tennessee*
Arkansas	*Kentucky*	**New Jersey**	**Texas**
California	**Louisiana**	**New Mexico**	**Utah**
Colorado	**Maine**	**New York**	**Vermont**
Connecticut†	**Maryland**	*North Carolina*	**Virginia**
Delaware	*Massachusetts*	**North Dakota**	**Washington**
Florida	**Michigan**	**Ohio**	*West Virginia*
Georgia	**Minnesota**	**Oklahoma**	**Wisconsin**
Hawaii	**Mississippi**	**Oregon**	*Wyoming*
Idaho	**Missouri**	**Pennsylvania**	
Illinois	**Montana**	*Rhode Island*	

States in **black** allow the 400-lb weight exemption; states in ***italic*, as well as the District of Columbia,** do not permit the exemption.
† Effective October 1, 2009

National Legislation

From the point of view of long-haul fleet owners and owner-operators, IR equipment is expensive to purchase and is also very heavy, especially if it is battery powered. Companies operating on tight margins are interested in saving fuel, but they need money to purchase equipment that could cost as much as $10,000 for each truck. Some of these companies and independent owners lack the good credit to afford this equipment, too.

Two other bills have been introduced in the 111th session of Congress that pertain to idling reduction. Sen. Susan Collins (R-ME) is behind S. 855, which would establish an Energy Assistance fund to guarantee low-interest loans for IR equipment and advanced insulation for heavy trucks, among other things. There is no companion bill in the House of Representatives. Sen. Ron Wyden (D-OR) has introduced S. 1098, the EnergySmart Transport Corridors Act of 2009, which would amend EPAct 2005 to authorize appropriations through FY 2015 for the Idle Reduction and Energy Conservation Deployment Program. Again, there is no companion bill in the House.

Section 121 of Subtitle C of H.R. 111-137, The American Clean Energy and Security Act of 2009, currently has language supporting plug-in hybrid vehicles, both light-duty and heavy-duty, and accompanying infrastructure. It would encourage the use of plug-in charging stations at highway rest stops, where one could suppose a truck could plug in and not have to idle. In addition, section 221 of Subtitle C would modify section 841 of the CAA to allow state or metropolitan planning organizations to consider ways to reduce vehicle idling, including idling associated with freight management, construction, transportation, and commuter operations.

Financial Incentives

Strategies to reduce vehicle idling include not only regulations (the “stick”) but also financial incentives (the “carrot”). Although IR devices pay for themselves over time, and sometimes fairly quickly, the upfront costs can be daunting. Financial incentives that reduce barriers include tax credits, grants (matching or otherwise), and loans.

Tax Credits at the National Level

To meet some of these needs, there has been national legislation that offers tax advantages to buying equipment and weight allowances for it. The Economic Energy Improvement and Extension Act of 2008 (P.L. 110-340) provides for incentives to purchase IR units. The Act eliminates the 12% heavy-vehicle excise tax on the cost of qualified IR units. The list of qualified equipment is at http://epa.gov/smartway/transport/what-smartway/idling-reduction-fet.htm.

Legislation is often introduced in Congress but never enacted into law, for a variety of reasons. For many years, Rep. Kay Granger (R-TX) has proposed a tax credit for the purchase of APUs. She has enlisted Rep. Earl Blumenauer (D-OR), the mover behind the 12% excise tax exemption, in this cause. Their legislation, the Idling Reduction Tax Credit Act of 2009 (H.R. 3383), would allow for a 50% tax credit, with a cap of $3,000, for fleets to install this equipment. At the time of this writing, there is no companion legislation in the Senate.

EPA's National Clean Diesel Emissions Reduction Program

The National Clean Diesel Emissions Reduction Program, created under Title VII, Subtitle G (Sections 791–797) of EPAct 2005, authorizes funding for projects, including IR initiatives, that improve air quality and protect public health. In addition to regular appropriations, H.R. 1, the American Recovery and Reinvestment Act (ARRA), has provided an infusion of funds to these programs. Funding may take the form of grants, matching funds, and loans.

Administered by EPA, the program makes awards to states, regions, agencies, nonprofit organizations, and public-private partnerships. Examples of IR technologies eligible for funding are:

- APUs and generator sets,
- Fuel-operated heaters,
- Battery heating and air-conditioning systems,
- Automatic shut-down/start-up systems, and
- Shore connection systems and alternative maritime power.

The National Clean Diesel Emissions Reduction Program comprises national and state programs (see http://www.epa.gov/otaq/diesel/grantfund.htm#overview for more information).

The EPA's National Clean Diesel Campaign comprises a partnership between leaders from federal, state, and local governments; the private sector; and environmental groups. It provides funding assistance for EPA-verified and CARB-certified diesel emission reduction technologies. In 2009, the EPA's National Clean Diesel Campaign is distributing funding through not only 2009 appropriations, but ARRA monies.

The national program includes the SmartWay Clean Diesel Finance Program, which allows the EPA to issue competitive grants to establish low-cost revolving loans or other financing programs that help fleet owners achieve reduced emissions. Cooperative agreements establish finance programs for buyers of eligible diesel equipment. The financing reduces the costs for buyers by providing lower interest rates, longer repayment terms, greater likelihood of loan approval, or some other financial incentive.

Another component of the national program is EPA's Clean Diesel Emerging Technologies Program, which fosters the deployment of innovative technologies through a grant competition. EPA's Clean School Bus USA Program, which also provides grants, has an IR component. Finally, the Emerging Technologies Program enables EPA to provide funding assistance to eligible entities to deploy diesel emission reduction technologies not yet verified or certified by EPA or CARB.

The EPA State Clean Diesel Grant Program makes funds directly available to states seeking to establish new programs for the reduction of diesel emissions. Earlier in 2009, each state and the District of Columbia were awarded $1.73 million through this program. States may fund projects directly (e.g., TSE), open the funds for grant application, or provide funds to organizations (e.g., New York State Energy Research and Development Authority) that offer their own grant programs.

Funding Opportunities at the State and Regional Levels

Federal agencies other than EPA also offer IR funding opportunities. The U.S. Department of Transportation's (DOT's) Congestion Mitigation and Air Quality (CMAQ) Improvement Program has funded several IR projects (see http://www.fhwa.dot.gov/environment/cmaqpgs/index.htm). DOT's Transportation Investment Generating Economic Recovery Discretionary Grants (TIGER) program offers funding opportunities for those pursuing emissions-reduction projects. The U.S. Department of Energy's (DOE's) Clean Cities Program, of course, advances the use of IR technologies and offers incentives.

Another current potential funding opportunity lies with DOE's Energy Efficiency and Conservation Block Grants–Recovery.

Information about current IR funding opportunities can be found at http://www1.eere.energy.gov/vehiclesandfuels/resources/fcvt_national_idling.html.

States that are particularly active in offering grants or loans for the purchase of IR equipment or TSE include those in the list below. Some states have ARRA funding to begin or continue an already established program. Others, however, may have been subject to the vagaries of state budgets at the present time and may no longer be active.

- Arizona Department of Environmental Quality
- Arkansas Department of Environmental Quality
- California Air Resources Board and Air Quality Districts
- Connecticut Department of Environmental Protection
- Louisiana Department of Environmental Quality
- Maine Public Utility Commission
- Maryland Port Administration and Maryland Environmental Service
- New Hampshire Department of Environmental Services
- New Jersey Department of Environmental Protection
- New York State Department of Transportation
- North Carolina Department of Environment and Natural Resources
- Oregon Department of Energy
- Pennsylvania Department of Environmental Quality
- South Carolina Department of Health and Environmental Control
- Tennessee Department of Transportation
- Texas Commission on Environmental Quality
- Wisconsin Department of Commerce.

Outreach and Education

ARRA and Clean Cities Awards

Both DOE and EPA have used their ARRA funding, along with regular appropriations, to award grants to state organizations, non-profits, and others to reduce idling. DOE used some of its almost $400 million for transportation electrification for a specific project with Cascade Sierra Solutions, as well as to support education at several universities. DOE's Clean Cities program has made some recent awards to develop education and outreach materials and workshops related to biodiesel, ethanol, natural gas, propane, fuel economy, and idle reduction. Materials will be disseminated nationwide through workshops with Clean Cities coalitions.

Some state organizations will most likely be receiving ARRA money for idling reduction under DOE's state block grant component, but awards have not been announced for every state.

ARRA funding for EPA's National Clean Diesel Program is also shown in the table below.

TABLE 3. ARRA and Clean Cities Awards Having an Explicit IR Component
[DOE awards are shown in **bold** font; EPA awards in normal font]

Organization	Purpose of Grant	Total Funding
Cascade Sierra Solutions	**TSE at 50 sites along major interstate corridors in three western states and provide 5,450 rebates for truck modification to idle reduction technologies**	**$22.2 million**
Cascade Sierra Solutions	SmartWay Clean Diesel Finance Program	$9 million
Alabama Clean Fuels Coalition	TSE (Baldwin and Montgomery Counties)	$1.25 million
Arizona Department of Environmental Quality	TSE along the United States – Mexico border	$1.73 million
Connecticut Department of Environmental Protection	TSE of up to 100 spots	$380,256
Maryland Port Administration and Maryland Environmental Service	Retrofit, repower, replacement, and installation of idle-reduction devices on transportation equipment at the Port of Baltimore	$3.5 million
Massachusetts — Chelsea Collaborative	New England Produce Market trailer refrigeration unit electrification	$1,563,480
Massachusetts Department of Environmental Protection	Vehicle IR toolkits for 16 municipalities	$9,760
Massachusetts Port Authority	Dockside power at Boston Fish Pier	$100,000
Minnesota Environmental Initiative	Emissions-reduction projects, including idle reduction	$3 million
Nebraska — University of Nebraska-Lincoln Nebraska Transportation Center	Funding to conduct a sub-grant process to retrofit approximately 187 vehicles with EPA-verified idle-reduction technologies	$1 million
New York State Department of Transportation	Switch-locomotive repower with gen-set technology	$1.05 million
North Carolina State University	**Clean Transportation Education Project (CTEP)**	**Up to $401,852**
Pennsylvania — Allegheny County	Emissions reduction projects, including switch-locomotive repower with gen-set technology	$3.49 million
Tennessee — East Tennessee Clean Fuels Coalition	Crossville I-40 Corridor TSE	$581,849
West Virginia University Research Corporation	**National Alternative Fuels Training Consortium (NAFTC) Clean Cities Learning Program**	**Up to $1.6M**
Wisconsin Department of Natural Resources	Installation of idle-reduction technology (stop/start devices) on 40 switcher locomotives	$571,107

Trade Associations

The number of trade associations involved with idling reduction is very small. At one time, the Idle Elimination Manufacturers Association (IEMA) had been active, but it is not so at present (telecon with Rex Greer, IEMA, August 26, 2009). When it had been active, IEMA claimed credit for the 400-lb weight exemption for auxiliary power units in EPAct 2005.

IR activities are peripheral to the mission of some other trade associations, such as the American Trucking Associations, the Diesel Technology Forum, the Engine Manufacturers Association, and the Truck Manufacturers Association.

National Idling Reduction Network News

The National Idling Reduction Planning Conference, held in May 2004 in Albany, New York, brought together almost 250 stakeholders who had an interest in reducing idling of all modes of heavy vehicles nationwide. The purpose of the conference was to lay the foundation for a national plan, which never came to fruition, to reduce idling. There were two concrete outcomes of the conference, however: one was EPA's Model State Idling Law, and the second was a communication mechanism called the *National Idling Reduction Network News*. This electronic newsletter has been published almost monthly since July 2004 and is distributed to a mailing list of about 1,500 people. The secondary distribution is unknown. It covers items of interest to these stakeholders: solicitations; regulatory news; updates on legislation; recent publications and presentations from meetings, conferences, and meetings; and what is going on in the areas of ports, railroads, electrified parking spaces for trucks, IR calculators, and new IR products from manufacturers. The newsletter attempts to be a comprehensive digest of information and is likely the only product of its kind in this field of interest.

Future Directions

Role of R&D

There are several things that could be done to enable broader and more economically attractive penetration of idling-reduction equipment into the heavy vehicle sector. The first is simply data gathering. Such data could be gathered by fleets, government agencies, or environmental groups. Aside from a few studies that examined small samples of Class 8 trucks, there is very little information about actual idling behavior either overnight or during the workday by various classes of trucks and buses. Actual data would allow researchers, technology developers, and policy makers to target programs to enable maximum impact. If analysis of data shows that heavy trucks spend a significant amount of their time in queues, then development of a creep-idling device to enable slow propulsion should be considered. Alternatively, creep capability would be another benefit to include when evaluating the benefits of heavy vehicle hybridization.

Another development that would reduce the cost and weight of IR equipment would be complete integration of the APU into the original truck design, rather than the addition of a separate piece of equipment with a redundant generator and compressor. Cutting cost would weaken a major barrier to equipment purchase. Another way to reduce the initial cost barrier for on-board equipment is to provide loans to cover all or part of the purchase price. Since the equipment pays for itself quickly (if the vehicle idles a significant fraction of the time), the loan will be repaid, and the money can be loaned out again. Leasing agreements serve the same purpose.

A third potentially fruitful area for investigation is the possible integration or synergistic use of IR equipment and trailer refrigeration units (reefers).

On the institutional side, there is a big mismatch between truck routes and jurisdictions. It is perhaps too late to harmonize idling restrictions across the country, but cooperation among jurisdictions could level the playing field between on-board and wayside IR systems. Under current EPA rules, emissions reductions from EPS locations in a state's non-attainment area can be counted in the SIP for bringing its emissions into compliance with the CAA. But, emissions reductions from on-board IR equipment will occur wherever the truck happens to be driven. Therefore, a state or local entity has an incentive to fund EPS instead of on-board equipment. An electronic tracking system that allowed on-board equipment to earn emissions reductions for the location in which it was used, the funding location, or some combination would remove the inequity. A simple card, swiped at the entry and exit of the truck stop, would enable the tracking. Such a card could also simplify the collection of data.

REGULATORY OUTLOOK

Jurisdictions may want to enact new laws to reduce idling, particularly for trucks, because idling trucks are noisy and their emissions negatively affect air quality.

Many laws are on the books but are rarely enforced. Sometimes, enforcement can be as simple as reprogramming the electronic devices that enforcement officers carry so that tickets can be written for idling infractions (George Pakenham, a citizen activist mentioned below, claims to have been instrumental in bringing this situation to the government of New York City). In other situations, idling regulations are part of a SIP, and when that is the case, enforcement can be at the federal level. Boston has been particularly active in fining school bus and refuse-hauler fleets to the tune of tens and hundreds of thousands of dollars for idling beyond the mandated limit.

Remote starters for passenger vehicles are becoming more common, particularly in cold-weather climates, and are now being offered as standard equipment on some new vehicles. Environmental groups may react negatively to these devices as emissions from passenger vehicles still affect air quality, particularly if vehicles idle in residential driveways and parking lots for as long as 20 minutes before the devices cut off.

Always the pacesetter, California restricts the idling of trucks, even those equipped with sleeper cabs, to 5 minutes. Other states may follow that example.

HOW ACTIVISM HAS HELPED REDUCE VEHICLE IDLING

Many jurisdictions have enacted laws restricting idling specifically for diesel-powered engines and occasionally for gasoline-powered vehicles, too. It is highly probable that activists, both non-governmental organizations and private citizens, were behind a significant number of these laws. For example, the Natural Resources Defense Council's campaign, "Dump Dirty Diesel," against diesel buses in New York City brought about the purchase of natural gas and clean-diesel buses for New York City Transit.

Another example of how activists effected change was what schoolchildren did in Vermont in 2007: they petitioned their General Assembly and testified about how they did not like breathing in diesel fumes from idling school buses (page 5, May 2007 issue, *National Idling Reduction Network News*, http://www1.eere.energy.gov/vehiclesandfuels/pdfs/idling_news/may07_network_news.pdf). As a result of the activism of children, Vermont's Act 48 now generally restricts school buses from idling on school property for more than 5 minutes in any given 60-minute period (http://www.northeastdiesel.org/pdf/FINAL-RULE-BUS-IDLING-Mar08.pdf).

Idle-Free VT, Inc., estimates that the 1,800 school buses transporting Vermont's 75,000 school children now save up to 100,000 gallons of fuel every year. Cost savings of course depend on the price of diesel fuel, but at current prices (EIA, week of August 24, 2009, for New England PAD) of $2.749/gal that would

be an annual saving of $274,900. Idle-Free VT also estimates up to 1,120 tons of avoided CO_2 emissions. Act 48 also mandated that the Vermont Department of Education adopt a model policy for all vehicles other than school buses. That policy is at http://www.education.vermont.gov/new/pdfdoc/resources/model_vehicle_idling.pdf and http://www.leg.state.vt.us/docs/legdoc.cfm?URL=/docs/2008/acts/ACT048.HTM.
[picture from http://www.idlefreevt.org/schools.index.html]

Clean Cities Vermont had been on top of this matter, as noted in its June 7, 2007, issue (http://www.uvm.edu/~cleancty/pdf/CCeNewsletter14.pdf).

Another example from the state level is how the Clean Air Board of Carlisle, Pennsylvania, lobbied hard for a state-wide anti-idling regulation. Until February 2009, only Philadelphia and Allegheny County (Pittsburgh area) had laws limited idling. The Board was tired of the very poor air quality in their region, which is in a valley where the Pennsylvania Turnpike (I-76) and I-81 intersect and truck traffic is very high. According to a study conducted by the Pennsylvania Department of Environmental Protection (DEP), freight trucks idled in this area of an increasing number of warehouses a combined 2.3 million hours a year — more than any other county in Pennsylvania. By contrast, nearby Dauphin County, which ranks 8th in terms of idling time, had idling numbers of 700,000 hours. Fed up with poor air quality, the Clean Air Board petitioned DEP's Environmental Quality Board for a state-wide regulation. While it took about two years for the legislative process, there is now a statewide regulation in the Commonwealth of Pennsylvania.

A different approach is that of George Pakenham, an international mortgage banker in New York City, who has carefully tracked his "encounters" with drivers of all manner of idling vehicles to and from his way to work and on weekends. He approaches the driver and asks if he or she is aware that there is a law in New York City that restricts idling to no more than three minutes. Regardless of the response, he thanks them for their time and hands them a business-size card imprinted with the short version of the law and its legislative citation. Over the past several years, he has reached out to several thousand people and feels that he is doing his part to educate the public and improve air quality. He is also in the process of seeking funds to create a video.

The *National Idling Reduction Network News* serves many roles, including providing information to people and organizations who wish to be more involved in promoting IR. Organizations that have had their information published in past issues of the newsletter are listed below. IR signage, case studies, and data can be found in this list, which is certainly not complete nor is there any endorsement implied by the writers of this primer nor of DOE:

- Chicago Conservation Corps (http://chicagoconservationcorps.org/blog/wp-content/uploads2/2009/06/What%20Are%20You%20Waiting%20For.pdf)
- Connecticut Department of Environmental Protection (http://www.ct.gov/dep/cwp/view.asp?a=2684&q=322086&depNav_GID=1619)

- Department of Transport (U.K.) (http://www.warwickshire.gov.uk/Web/corporate/pages.nsf/Links/B73E7DCC51542EE0802572FD0073F398/$file/Final+report+anti-idling+march08.pdf)
- EPA Clean School Bus USA (http://epa.gov/cleanschoolbus/antiidling.htm)
- George Pakenham (http://verdantvigilante.com/default.htm)
- Idle-Free VT (http://www.idlefreevt.org/idlingfacts.index.html)
- Illinois EPA Illinois Green Fleets Program (http://www.illinoisgreenfleets.org)
- Massachusetts Department of Environmental Protection (http://www.mass.gov/dep/air/community/depirkit.pdf)
- Mississauga, Ontario, Canada (http://www.mississauga.ca/portal/residents/idle-free)
- Natural Resources Canada (http://oee.nrcan.gc.ca/communities-government/idling.cfm and http://fleetsmart.nrcan.gc.ca/idling-reduction-toolkit/section2.cfm?attr=16)
- Puget Sound Clean Air Agency (http://www.airwatchnorthwest.org/wa/NO_IDLE/#top)
- Repair Our Air (http://www.repairourair.org/Idling_Campaign.doc)
- Utah, which includes work from Utah Clean Cities (http://www.idlefree.utah.gov/)

For Further Reading

A Municipal Official's Guide to Diesel Idling Reduction in New York State
(http://www.nyserda.org/publications/09-06GuidetoDieselIdlingReduction.pdf)