U.S. Department of Transportation, Climate Change Center
Climate Strategies that Work

IDLE REDUCTION TECHNOLOGIES & STRATEGIES

Idle reduction technologies minimize emissions, enhance efficiency, and improve quality of life for communities and operators by reducing unnecessary engine idling.

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OVERVIEW

Best Suited for:
Long Term & Short Term
Urban, Suburban, Rural, & Tribal

Idling vehicles and equipment adversely impact air quality, often near densely populated areas, and contribute to greenhouse gas emissions. Idle reduction technology (IRT) refers to devices that enable diesel engine operators to refrain from long-duration idling of the main propulsion engine (referred to as "extended idle") by using an alternative power source. **IRTs can reduce emissions and enhance fuel efficiency by enabling operators to power essential functions without relying on main engines.** In addition, IRT can optimize engine performance in stop-and-go traffic conditions.

Engines are kept idle for a variety of reasons, such as to keep vehicles warm or cool and to power emergency lighting, communications, or off-board equipment. According to Argonne National Laboratory, U.S. passenger cars, light-duty trucks, and medium- and heavy-duty vehicles consume more than 6 billion gallons of diesel fuel and gasoline each year—without movement. About half of this fuel use is attributed to personal vehicles (cars and trucks), which emit about 30 million tons of CO_2 every year just by idling (Argonne National Laboratory, n.d.). In 2019, idling highway vehicles spent nearly 170 billion gallons in gasoline equivalents (Department of Energy, 2019).

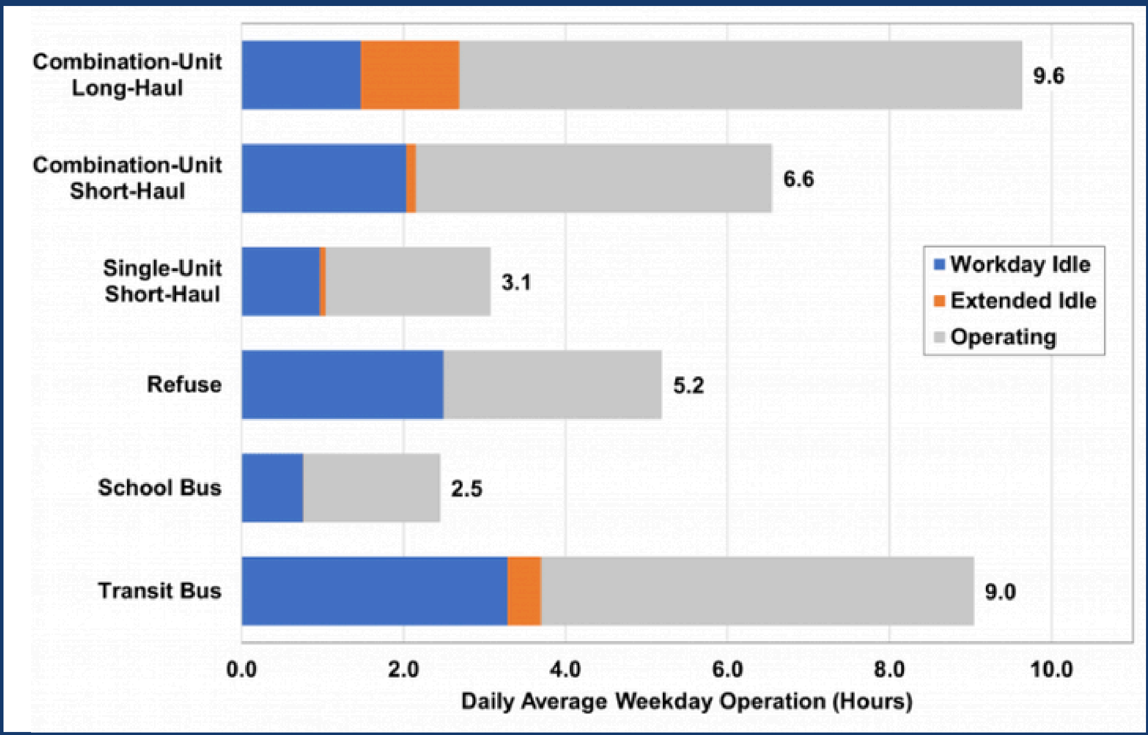
Beyond Technology: Minimizing idling requires a comprehensive approach that extends beyond just technology. Operational strategies involve practices and procedures designed to optimize performance and minimize emissions. These strategies can include:

- Scheduling and Planning
- Regulation and Enforcement
- Innovative Delivery Solutions
- Supply Chain Optimization
- Mode Selection and Overall Efficiency
- Alternative Fuels and Technologies

Read about Freight Operational Strategies, here.

How long do vehicles typically idle?

- **Long-haul trucks** typically idle 6 hours per day, or 1,830 hours per year, but actual practice varies, from idling 1-2 nights per week to hardly ever turning the engine off (Argonne National Laboratory, n.d.).
  - *This equates to 35,570 lbs of CO_2 per year and $5,640 per truck (North American Council for Freight Efficiency, 2019).*
- **Line-haul locomotives** idle for 38% of their operating time, or about 1,650 hours per year (EPA, 2008).
- **Transit buses** idle for an average of 3.7 hours per day (DOE, 2021).
- **School buses** idle 2 hours a day (DOE, February 2015).
- **Police cars** idle about 60% of the time according to a Department of Energy study (DOE, February 2015).
- **Emergency vehicles**, including ambulances and fire trucks, can idle on the scene of fire and medical emergencies or between calls for 30 minutes to an hour or more (Argonne National Laboratory, July 2017).



Average Weekday Operation of Trucks and Buses by Idle Status and Vehicle Type. (Source: DOE, 2021)

Examples of IRTs include:

Shorepower

(Also known as cold ironing)
Ships can connect to the local electric grid while berthed, eliminating the need for auxiliary engines and associated emissions.

Auxiliary Power Units (APUs)

Small, independent diesel engines – can power climate control and other on-board systems, reducing reliance on main engines.

These systems are useful for police vehicles, which require power for communications, emergency lighting, and HVAC while stopped.

Electrified Parking Spaces (EPS) / Truck Stop Electrification (TSE)

Dedicated electrical connections at truck stops allow drivers to power essential systems without idling.

Battery Air Conditioning Systems (BACs)

These electric systems provide climate control in parked trucks, enabling drivers to shut off main engines during rest breaks.

Automatic Engine Stop/Start Systems (AESS)

These systems automatically shut down locomotive engines when not in use, significantly reducing idling time.

Because of their effectiveness and relatively low cost, EPA now requires an AESS on all newly-built Tier 3 and Tier 4 locomotives, and on all existing locomotives when they are first remanufactured.

Stop-Start Technology

Conserves energy by shutting off the gasoline engine when the vehicle is at rest, such as at a traffic light, and automatically re-starting it when the driver pushes the gas pedal to go forward.

Stop and Go Traffic: Argonne researchers undertook a series of measurements to determine how long drivers can idle in a queue such as a drive-through before the impacts of idling are greater than they are for restarting the vehicle. They found that fuel use and greenhouse gas emissions are greater for idling longer than 10 seconds. For more information, see the fact sheet, Which Is Greener: Idle, or Stop and Restart?)

GREENHOUSE GAS REDUCTION POTENTIAL

This section provides an overview of greenhouse gas (GHG) emission reductions associated with the strategy. It highlights key findings and relevant metrics from GHG modeling resources, peer-reviewed studies, and real-world applications.

FREIGHT EMISSIONS IN CONTEXT

In 2019, the three largest ports in the United States in terms of cargo volume processed —the Ports of Los Angeles, Long Beach, and New York and New Jersey—emitted over 2.5 million tons of carbon dioxide equivalents (CO_2e). This estimate includes emissions from ocean-going vessels at port, harbor craft, cargo handling equipment, locomotives, and heavy-duty vehicles (Bertrand and Williams, 2022). At the Port of New York and New Jersey in 2019, on-terminal idling by heavy-duty diesel trucks accounted for 6.6% of CO_2 equivalent emissions port-wide (Park, 2022).

FOCUS ON LONG HAUL TRUCKING

Argonne National Laboratory estimates that rest-period idling by heavy-duty trucks in the U.S. emit about 11 million tons of CO_2 each year. Idling alternatives can result in 95% less fuel use and emissions (Argonne, 2015).

A study by Northeast States Center for a Clean Air Future (NESCCAF) and International Council on Clean Transportation (ICCT) explored various scenarios for reducing heavy-duty vehicle emissions through technology packages that include idle reduction technologies, such as a diesel APU or hybrid system. For example, applying Advanced EPA SmartWay technologies can provide a 28% reduction in CO_2 emissions, while the maximum CO_2 emissions reduction associated with a more aggressive combination package is around 50% (NESCCAF, 2009).

In the National Port Strategy Assessment, EPA estimates that **reducing long-haul truck idle and creep time by 10% reduces CO_2 emissions by 2.6%** (EPA, 2016).

Typical Port Emission Impacts for Each 10% Reduction in Idle/Creep Time, 2020 and 2030.
(Source: EPA, 2016)

Strategy	NOx		$PM_{2.5}$		CO_2	
	Tons	Percent	Tons	Percent	Tons	Percent
10% reduction in Idle and Creep time	-22	-2.0%	-2	-2.6%	-8,940	-2.6%

FOCUS ON OCEAN GOING VESSELS

Connecting a ship to the electrical grid while at berth can reduce air pollution from berthed ships by up to 98%. Shore powering one container ship for one day reduces pollution by as much as taking 33,000 cars off the road for a day (Bertrand and Williams, 2022).

An average cruise ship plugging into shore power at Port of Seattle's Terminal 91 saves the greenhouse gas equivalent of a typical car driving 30 road trips from Seattle to New York (Matlock, 2024).

EPA estimates that shore power reduces exhaust emissions during hoteling by 80 to 97% depending upon ship type.

- The technology reduces per call NOx emissions by 62.1 to 89.9%,
- PM emissions by 62.0 to 89.4%,
- exhaust CO_2emissions by 62.3 to 90.9%,
- and well-to-propeller CO_2emissions by 22.4 to 37.6% (EPA, 2016).

According to the EPA's latest Shore Power Technology Assessment at U.S. Ports, 10 ports in the U.S. at the time of this writing are equipped with high-voltage shore power systems There are also planned projects at the ports of Galveston, Miami, and Philadelphia. (EPA, 2022).

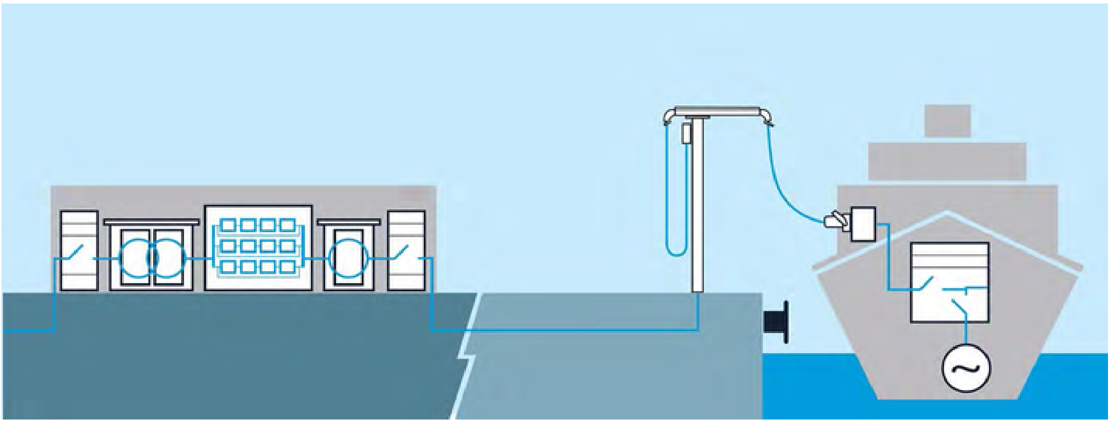


Illustration showing shore power infrastructure, including the electrical substation, cable interface, and ship's electrical equipment.
(*Source:* *EPA, 2022*)

FOCUS ON LOCOMOTIVES

Automatic Engine Stop-Start (AESS) systems on Tier 2 switcher locomotives can potentially reduce CO_2 emissions by 22 tons per year (EPA, 2016).

The primary idle reduction strategies for locomotives involve replacing or rebuilding older engines to Tier 3 or Tier 4 standards, which includes AESS to reduce idling emissions. For example, replacing a pre-Tier 0 or Tier 0 switcher with a Tier 4 engine would reduce CO_2 emissions by 177 tons per year. AESS can also be installed on older locomotives, resulting in a per locomotive CO_2 emissions reduction of 14 tons per year (EPA, 2016).

Wayside power is being explored to reduce idling emissions at stations. Locomotives and stations can be equipped with electrical infrastructure to allow locomotives to plug into the power grid. This setup allows a train to run air conditioning and lighting without idling the main engine (CARB, 2022).

FOCUS ON PASSENGER VEHICLES

Personal vehicles generate around 30 million tons of CO_2 per year just by idling. Eliminating unnecessary idling of personal vehicles would be the same as taking 5 million vehicles off the roads (DOE, 2015).

Idle stop-start technology can reduce fuel consumption and emissions in city driving by 4 to 10% or more, compared to a vehicle using conventional technology. Over 10 years, this reduction corresponds to fuel cost savings of approximately Can$340 to Can$2,000 and CO_2 reductions of 610 to 3,540 kg per vehicle (Natural Resources Canada, 2014).

Research assessing the effectiveness of anti-idling campaigns near school communities in Salt Lake County, Utah, found a 38% decrease in idling time and 11% decrease in the number of vehicles idling at the school drop-off zones following the campaign (Mendoza et al., 2022).

CO-BENEFITS

This section outlines the multiple co-benefits associated with the strategy, including safety benefits, local air quality improvements, and improved accessibility. Each co-benefit presents examples that demonstrate how the strategy enhances regional or community well-being while addressing emissions.

SAFETY

Reducing engine noise associated with idling can create a safer working environment for port personnel and truck drivers (EPA, n.d.; EPA, 2023).

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ACCESSIBILITY AND EQUITY

By reducing emissions from idling equipment, IRTs can contribute to cleaner air for communities often overburdened by health inequities. This can lead to improved public health outcomes and a more equitable distribution of environmental burdens. For resources on community-port collaboration, including toolkits, roadmaps, and primers, visit the EPA Ports Initiative site.

Near-port communities are disproportionately impacted by port operations. For example, nearly all census tracts surrounding the Ports of Los Angeles and Long Beach ranked in the top one-third of the most burdened by pollution in the state. Implementing port projects that reduce air pollution from ships, trucks, and cargo handling equipment can improve health outcomes for sensitive populations (LAO, 2022).

An analysis of 129 ports in the U.S. found that over 20 million people lived within 5 nautical miles of these ports and had a median household income below the 2019 national median. Forty-three (43) of these ports overlapped with lower-income census tracts and areas that do not meet ambient air quality standards (ICCT, 2024).

COST SAVINGS

By minimizing idling time, IRTs allow engines to be shut off during periods of inactivity. This translates directly to lower fuel consumption and maintenance expenses as idling leads to unnecessary engine wear and tear.

A typical long-haul combination truck that eliminates unnecessary idling could save 960 gallons of fuel each year (EPA, 2019).

Considering a railroad that consumes 500 million gallons of diesel fuel annually with 4,000 locomotives, reducing idling time for each locomotive by a conservative 4 hours per day could reduce annual fuel consumption by over 20 million gallons, or 4% of total fuel costs. This equates to $40 million in fuel savings, assuming diesel prices of $2.00 per gallon (Wi-Tronix, 2020).

A European economic analysis of shore power deployments showed net benefit cost ratios ranging from 0.29 (bulk carriers) to 1.64 (container ships). Benefits depend on how shore power is priced and whether monetary incentives are available for shipowners to adopt the technology (Merkel et al., 2023).

AIR QUALITY AND HEALTH

Research suggests idling may contribute up to 34% or more to local air pollution levels (Lee et. al., 2017). By enabling vehicles to power essential functions without relying on idling the main propulsion engine, idling reduction technologies reduce emissions of harmful pollutants and contribute to cleaner air around ports and freight corridors.

Idle reduction technologies can improve in-cab air quality and benefit truck drivers' health. Electrified truck stops provide better in-cab air quality than running the main engine (Lee et al., 2009).

Between 2010 and 2020, Port of New York and New Jersey upgraded 847 trucks to newer diesel engine-year models, or about 30% of the drayage truck fleet, and implemented a maximum idle time of 3 minutes, resulting in an estimated 12.8% reduction in NOx emissions (Park, 2022).

At-berth vessels in the U.S. emitted approximately 27,000 tons of air pollution (nitrogen oxides, sulfur oxides, and particulate matter) in 2019. Prioritizing ports for electrification, including shore power units, can significantly reduce emissions and the amount of pollution that near-port communities are exposed to (ICCT, 2024).

COST CONSIDERATIONS

COST OF IMPLEMENTATION

The cost to implement idle reduction technology varies widely depending on the scale, scope, and location of the project.

Switcher Auxiliary Power Unit

Install: $27,000
Technology: $1,400 - $4,100
(EPA, 2019).

Heavy Duty Trucks

Cab Comfort Options for Heavy-Duty Trucks: Fuel Use and Costs.
(Source: DOE, August 2015)

Power Source	**Services**	**Fuel Use (gal/hr)**	**Typical Equipment Cost ($)**
Idling	All	0.6-1.5	NA
Auxiliary Power Unit	All	0.2-0.5	8000-12,000
Diesel-Fired Heater	Heat	0.04-0.08	900-1,500
Heat Recovery	Heat (Limited Duration)	Negligible	600
Storage Cooling	Air Conditioning	0.15	8,500-8,800
Automatic Engine Start/Stop System	All (Intermittent)	0.25	1,500-2,500

Shorepower

Shipside modifications could range from $300,000 to $2 million depending on the type of vessel and amount of retrofitting needed (Wang et al., 2015).

The Port of Oakland allocated $60 million to install shore power infrastructure at their eleven berths on six terminals (Port of Oakland, 2013).

The U.S, Navy, which has used shore power on their ocean-going vessels for many years, estimates that daily electricity consumption for 14 vessels (35,000 kWh) costs $5,000 per day, or $0.146/kWh (EPA, 2022). The EPA maintains a Shore Power Emissions Calculator here with current electricity costs and power plant emission factors, here.

COST EFFECTIVENESS

Using historical vessel call data, researchers identified opportunities for switching vessels to shore power at U.S. ports. Their findings suggest air quality improvements valued at $70-$150 million annually could be achieved by retrofitting a significant portion of vessels. While initial investments in shore power infrastructure would be required, studies indicate this approach could achieve a no net cost scenario over time, with health and environmental benefits balanced by the cost of ship and port retrofits (Vaishnav et al., 2015).

Analysis shows that idling reduction technologies for high-idling trucks (around 2,000 hours per year) become cost-effective within 5 years when fuel costs exceed $2 per gallon. For lower-idling trucks, the payback period lengthens. The upfront cost of various idling reduction technologies (e.g., auxiliary power units, battery air conditioning systems) needs to be factored in (Argonne National Laboratory, 2017a).

FUNDING OPPORTUNITIES

EPA's **Clean Ports Program** provides for investment in clean, zero-emission port equipment and technology; to conduct relevant planning or permitting in connection with the purchase or installation of such equipment or technology; and to help ports develop climate action plans to reduce air pollutants at U.S. ports.

FHWA's **Congestion Mitigation Air Quality Improvement (CMAQ) Program** supports surface transportation projects and other related efforts that contribute air quality improvements and provide congestion relief. The Program provides a flexible funding source for transportation projects and programs to help meet the requirements of the Clean Air Act, including initiatives to reduce idling.

EPA's **Diesel Emissions Reduction Act (DERA) Program** funds grants and rebates that protect human health and improve air quality by reducing harmful emissions from diesel engines.

USDOT's **Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Discretionary Grant program** funds critical infrastructure projects across the country, prioritizing sustainability and equitable access.

USDOT's **Reduction of Truck Emissions at Port Facilities Grant Program** provides funding to reduce truck idling and emissions at ports, including through the advancement of port electrification. The program also includes a study to address how ports and intermodal port transfer facilities would benefit from increased opportunities to reduce emissions at ports, and how emerging technologies and strategies can contribute to reduced emissions from idling trucks.

> Puerto Rico Terminals received funding to buy zero-emission trucks and install charging equipment, which will reduce diesel fuel use within the terminal by nearly 3,000 gallons each year. Learn more about projects **here**.

MARAD's **Port Infrastructure Development Program** funds projects that improve the safety, efficiency, and reliability of moving goods into, out of, around, or within ports.

Idle Reduction Equipment Excise Tax Exemption: Qualified on-board idle reduction devices and advanced insulation are exempt from the federal excise tax imposed on the retail sale of heavy-duty highway trucks and trailers. The exemption also applies to the installation of qualified equipment on vehicles after the vehicles have been placed into service.

COMPLEMENTARY STRATEGIES

Idling reduction technologies can complement other operational improvements like traffic management systems and optimized scheduling to further streamline port operations and reduce overall environmental impacts.

Upgrading existing engines with cleaner technology or transitioning to zero-emission alternatives like electric trucks or hydrogen-powered cargo handling equipment, alongside IRTs, can significantly improve air quality and contribute to achieving ambitious climate goals.

Idle reduction strategies can be applied to the various modes of transportation involved in intermodal freight, such as trucks, trains, and ships, during loading, unloading, or waiting times. By optimizing processes and using technology like automated scheduling or real-time tracking, intermodal freight operators can reduce idle times, improving overall efficiency and GHG reductions.

View All Strategies

CASE STUDIES

SAVING FUEL IN NEW JERSEY THROUGH TRUCK STOP ELECTRIFICATION

18
Truck Stop Electrification Spaces

227 T
Metric Tons Emissions Saved

19,000
Gallons of Diesel Fuel Saved

Source: New Jersey Clean Cities Coalition

Long-haul truck drivers typically idle their vehicles during mandated rest periods to maintain access to air conditioning, heat, and electricity. The Flying J Travel Plaza in Carneys Point, New Jersey has 18 truck stop electrification spaces that provide trucks with heading and air conditioning, electricity, cable TV, and internet, allowing truckers to use these auxiliary systems without idling. In 2018, the use of the site represented 227 metric tons of mitigated emissions, and nearly 19,000 gallons of diesel fuel savings.

IDLE REDUCTION FOR EMERGENCY VEHICLES

Fire engines and trucks idle on the scene of fire and medical emergencies from 30 minutes to an hour or more. All fire departments in the Argonne study used diesel auxiliary power units, which draw fuel from the main tank, to reduce idling. Like battery auxiliary power units, diesel auxiliary power units power a vehicle's electrical load when the vehicle engine is off. Diesel auxiliary power units use about 80% less fuel than idling the engine and can provide nearly uninterrupted power for long periods. These auxiliary power units displaced 700 to 1,000 idling hours (saving $1,750 to $2,500 at a fuel cost of $2.50/gallon) per vehicle each year. Because of the reduced engine-on time, the system reduces maintenance costs with fewer oil changes and engine repairs.

MISSOULA RAILYARD LINK

8
APUs

95%
Reduction in annual NOx

$2.1 M
Net Savings

During colder weather months line-haul and switcher locomotives located in the Missoula Railyard Link ran and idled continuously to prevent engine freezing. The net idling emission reductions due to the yard idling policy change and auxiliary power unit installation that were done in 2010 are noted below:

- 95% reduction in annual NO_x emissions
- 89% reduction in annual PM emissions
- 60% reduction in in annual CO emissions

Annual fuels savings averaged $235,964 due to the reduced fuel use of the APUs and the implemented idling policy. The APUs and their installation were paid for by cost savings in under two years. The expected lifetime of the APU units is 10 years, so the net savings in fuel costs after purchase and installation of the eight APUs over the ten-year period will be approximately $2,115,642.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT'S WAREHOUSE ACTIONS AND INVESTMENTS TO REDUCE EMISSIONS (WAIRE) PROGRAM

The California South Coast Air Quality Management District (SCAQMD) enacted an Indirect Source Rule regulating indirect warehouse emissions in 2021. The Warehouse Indirect Source Rule was developed to reduce air pollution from mobile sources such as trucks delivering goods to and from the facilities, yard trucks, transport refrigeration units, ships, and trains. The Warehouse Indirect Source Rule operates using a points-based system. The program requires operators to earn a certain number of points each year to offset the annual number of truck trips made to and from the warehouse, with larger trucks such as tractors or tractor-trailers multiplied by two and a half. Points needed to offset vehicle emissions can be earned by implementing projects from a menu (such as EV charging infrastructure) or by paying a mitigation fee, which funds incentives for near-zero and zero-emission trucks and zero-emission charging and fueling infrastructure in communities near warehouses.

IMPLEMENTING IDLE REDUCTION TECHNOLOGIES & STRATEGIES: **WHAT TO READ NEXT**

Many idling reduction technologies like automatic engine start-stop systems for locomotives or battery air conditioning systems for heavy-duty trucks are based on well-established technologies. This translates to relatively simple installation and integration with existing equipment.

Shore power technology offers a significant long-term opportunity for ports to achieve substantial emission reductions. The maritime industry is taking a proactive approach by investing in shore power infrastructure solutions. Standardization efforts are underway to ensure seamless compatibility between ports and vessels, further accelerating adoption. Additionally, innovative financing models and public-private partnerships are being explored to make these investments even more attractive.

Read about California Air Resources Board's (CARB) At-Berth Regulations, here.

Enacting **anti-idling regulations or time limits** can be a readily implementable strategy for various sectors. These regulations are often already established around schools, hospitals, and other sensitive areas, providing a familiar framework for broader adoption.

Some jurisdictions have laws against idling, including:

- New York City
- Massachusetts
- Maryland
- New Hampshire
- New Jersey
- Vermont
- Hawaii
- Parts of California, Colorado, New York, Ohio, Utah, and other states

Check Clean Cities' IdleBase for a list of local and state regulations to see whether your area has laws that restrict idling.

Sample Idle Reduction Policy and Policy Guidance

Sustainable Environment for Quality of Life hosts a Sample School Bus Anti-Idling Policy online. The policy, as well as other action steps are detailed, here.

RESOURCES

GENERAL RESOURCES

EPA Ports Initiative: This initiative works with U.S. ports and local communities to improve environmental performance. The program provides technical resources, such as guides on creating port emission inventories, and toolkits and resources to promote community-port collaboration. The Ports Initiative is currently running pilot projects at four ports to provide technical assistance for community collaboration.

DOE Energy Efficiency and Renewable Energy, Idle Reduction: This resource introduces idle reduction practices, their benefits, and resources for personal and commercial vehicles.

EPA Smart Way Idling Reduction Technologies (IRTs): This resource highlights EPA's SmartWay program, which verifies and promotes clean and efficient technologies, including verified IRTs for reducing emissions from idling trucks.

EPA Best Clean Air Practices for Port Operations: This resource offers best practices for ports to reduce air pollution, potentially including strategies to minimize idling times from ships and cargo handling equipment.

North American Council for Freight Efficiency, Idle Reduction: This webpage details different idle reduction technologies, and their associated benefits and challenges.

EPA Idle-Free Schools Toolkit for a Healthy School Environment: This resource provides guidance and tools for schools to implement idle-free zones around school grounds, protecting children from harmful air pollution.

TOOLKITS AND MODELLING APPROACHES

DOE Office of Energy and Efficiency & Renewable Energy, IdleBox: A Toolkit for Idle Reduction Education and Outreach: This toolkit synthesizes resources for engaging and educating stakeholders and community on idle reduction, and how to start a campaign.

Federal Highway Administration, Congestion Mitigation Air Quality Improvement (CMAQ) Emissions Calculator Toolkit, Diesel Idle Reduction Strategies: This tool provides air quality benefit calculations for diesel idle reduction strategies.

EPA Diesel Emissions Quantifier (DEQ): This tool allows users to estimate air pollutant emissions from various sources, including idling diesel vehicles.

Argonne National Laboratory, Vehicle Idle Reduction Savings Worksheet: This downloadable spreadsheet helps calculate potential fuel cost savings associated with reducing vehicle idling times.

DOE Petroleum Reduction Planning Tool: This online tool helps assess strategies and opportunities for reducing petroleum use across different sectors, including potential benefits from reducing vehicle idling.

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