Commercial Sustainability & Fleet Optimization Through Idle Reduction Technology

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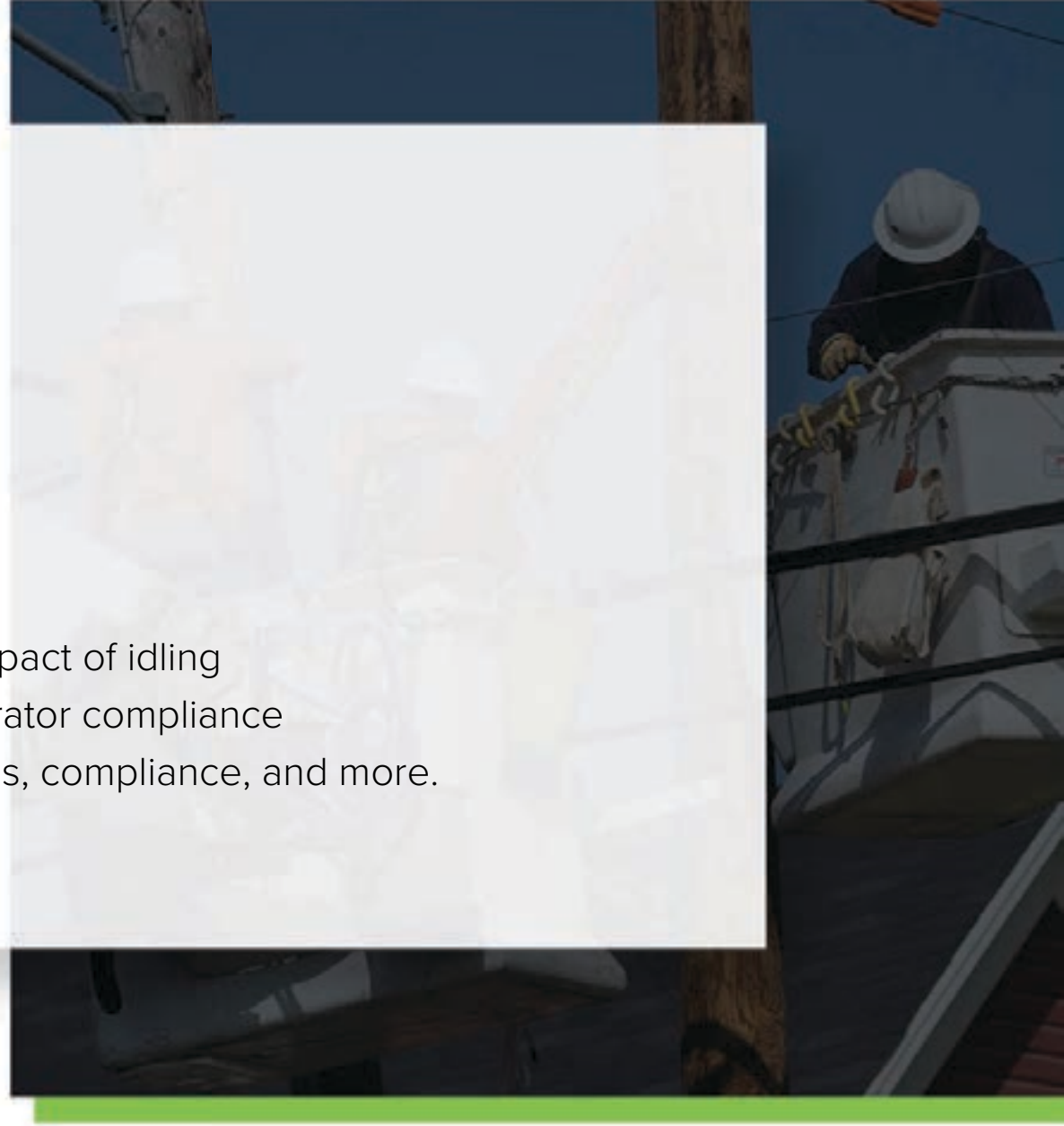


Learning Objectives

1. Identify the environmental, financial, and procurement impact of idling
2. Understand why fleets are idling and how to control operator compliance
3. Implement solutions to idling, operational costs, emissions, compliance, and more.
4. Best practice examples: Customer use cases and results

The Environmental, Financial, and Procurement Impact of Idling

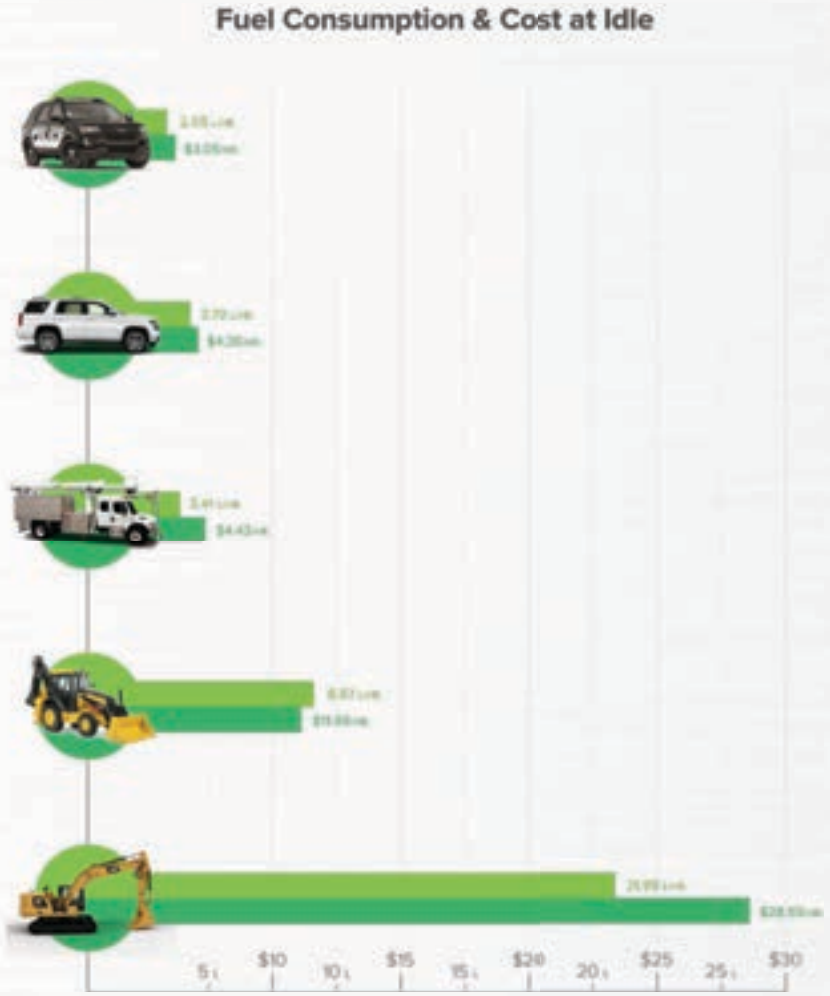
Reduce Emissions. Reduce Costs. Extend Asset Life. Increase Fleet Productivity.

Impacts of Idling: Health & Environment

- Idling contributes to poor air quality
- Idling increases public health issues
  - Respiratory illnesses and deaths
  - Cancer illnesses and deaths
  - Decreased lung function
  - Shortness of breath and dry throat
  - Headaches
  - Cardiovascular deaths
  - Exacerbation of asthma, coughing, wheezing
- CO_2 emissions contribute to climate change

Impacts of Idling: Fuel Consumption

- Idling for 10+ seconds uses more fuel and produces more emissions than stopping and restarting engines
- Researchers estimate that idling from heavy-duty and light-duty vehicles combined wastes about 6 billion gallons ($20B**) of fuel annually
  - Ford 3.7L V6 police Ford Interceptor Utility consumes 2.65 L/hr. (~$3.05/hr*)
  - Chevy Tahoe V8 consumes 3.79 L/hr (~$4.36/hr*)
  - Class 8 diesel bucket truck consumes (no load) 3.41 L/hr (~$4.43/hr)
  - John Deere Loader consumes 8.97 L/hr (~$11.66/hr)
  - Cat D consumes 21.99 L/hr ($28.59/hr)



*Based on $1.15/gal for gasoline and $1.30/gal for diesel. **Argonne National Labs.

Impacts of Idling: Engine Wear & Maintenance

- 1 hour of idling = 53km of engine wear
  - 200 hours of idling represents a 10,000 Km service
  - Idling Impacts maintenance frequency
- Idling damages engine components
  - More frequent oil and filter changes
  - Damage to exhaust and After Treatment Systems including more frequent regenerations (diesel vehicles)
  - Excessive Engine Wear including spark plugs, cylinders, timing chain, bearings, pumps
    - Ex: Port Authority Shunt Trucks average $4,500-$6,200 in annual maintenance costs directly related to idling 50% of the time*
    - Ex: Policing Ford Interceptor SUVs average $2,500 in annual maintenance costs directly related to idling 70% of the time*
- Excessive Idling reduces vehicle life by 1-4 years

**Data obtained by GRIP Idle Management Inc. clients requested anonymity.*

Impacts of Idling: Public Works Example

Freightliner M2 Bucket Truck (Diesel)

Data Used:

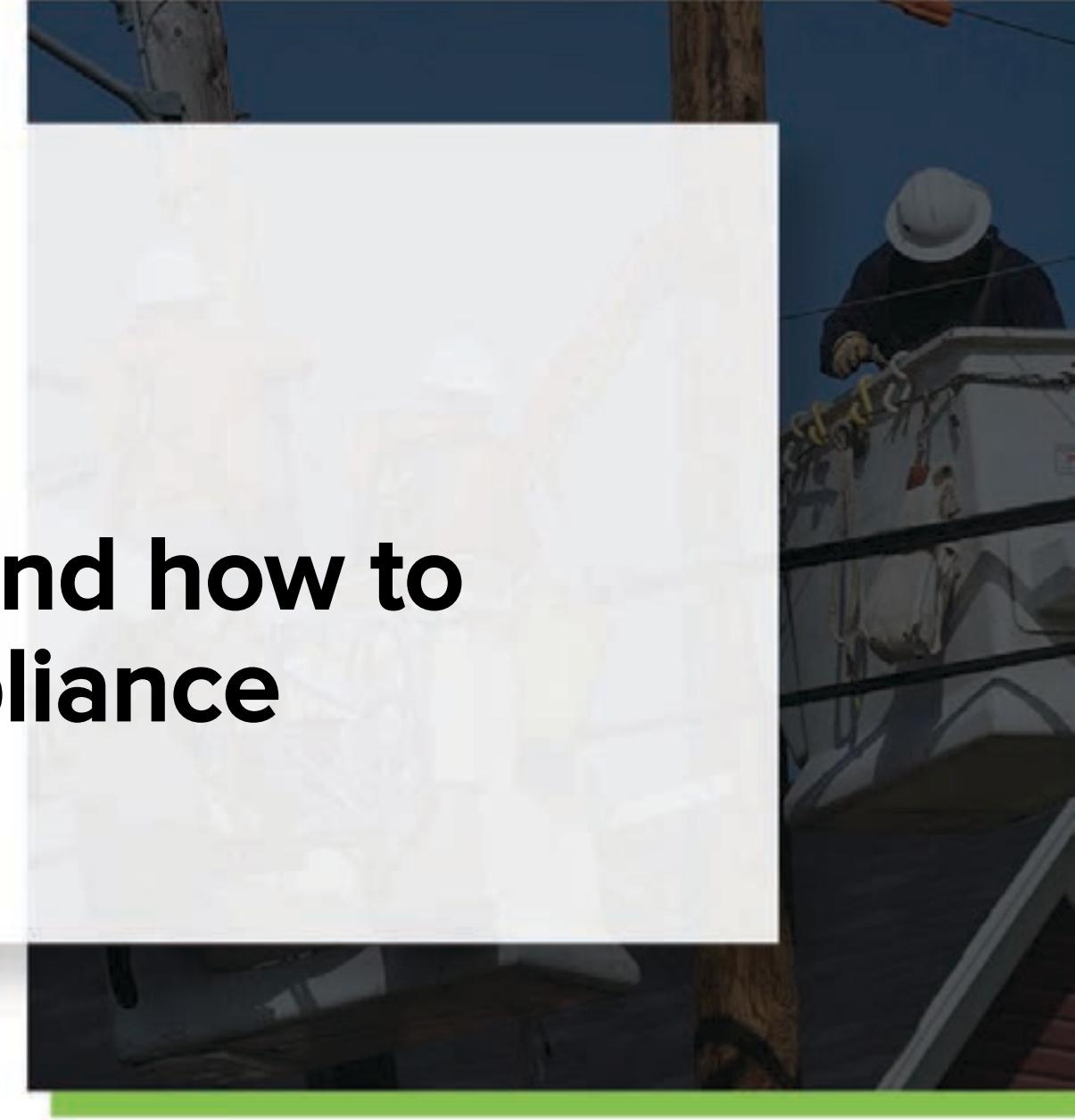
- Average time at idle: 55%
- Litres consumed at idle (hourly): 3.41
- Weekly use hours: 42.5 (five 8.5-hr days)
- Maintenance cost at idle: $0.048/km.
- Idling mileage per shift: 247.78 km
- Cost of diesel/L: $1.30
- CO_2 emissions at idle: 2.68 kg/hr.

Assuming a conservative 35% reduction in Idling

- Savings in fuel
- Maintenance
- Increased availability/operational readiness
- Extended asset life or increased asset disposal value
- Improved operator efficiency
- Reduced Fleet Size

Savings	Daily	Yearly	10-year life
Idling Hours	4.68 hrs.	1,707 hrs.	17,082 hrs.
Fuel Consumption	3.99 L	1,456 L	14,563 L
Fuel Cost	$5.18	$1,893	$18,927
Engine Wear	86.71 km	31,647 km	316,472 km
Maintenance Costs	$11.89	$4,341	$43,411
Emissions	12.53 kg	4,570 kg	45,704 kg

**Data obtained through Argonne National Labs and by GRIP Idle Management Inc. clients whom requested anonymity.*



Why fleets are idling and how to control operator compliance

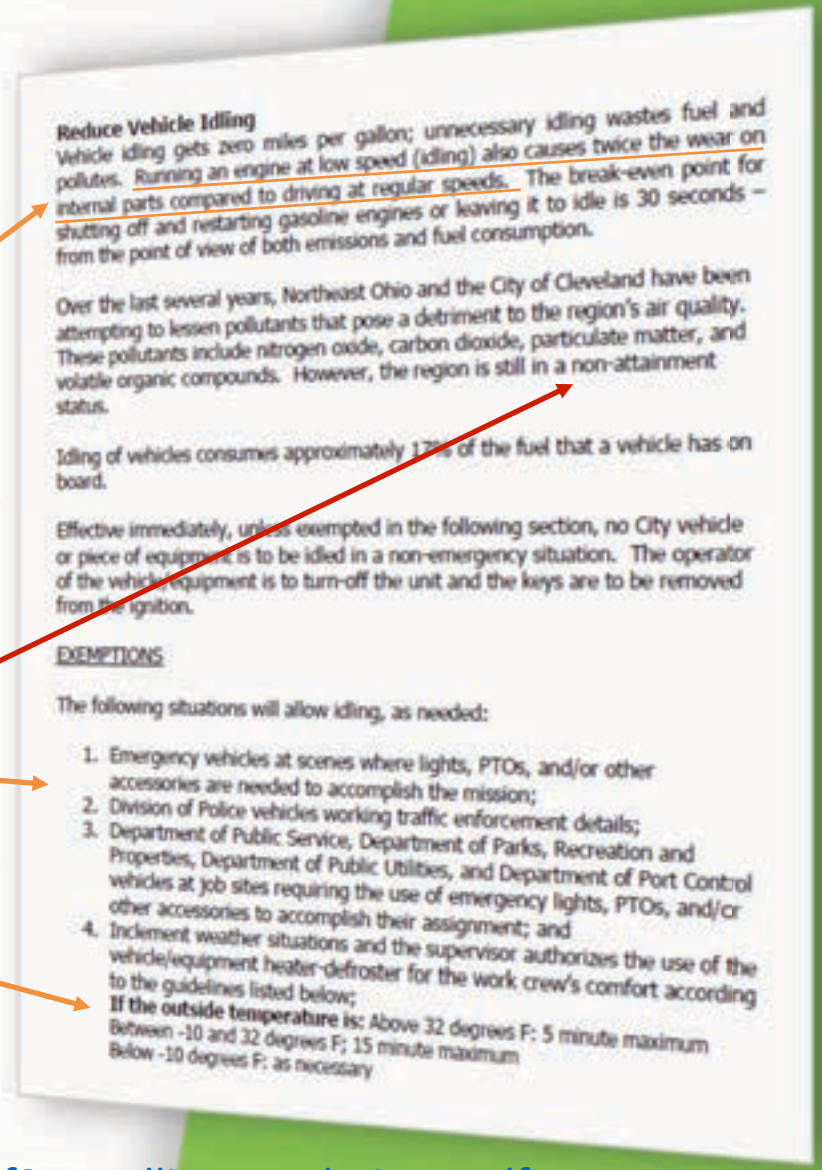
Reduce Emissions. Reduce Costs. Extend Asset Life. Increase Fleet Productivity.

Why do fleets idle?

- The vehicle idles to maintain power to onboard systems
  - Policing- Computer, take down lights, air bags
  - Work Truck- power to PTO, other vehicle systems
- The vehicle idles to maintain occupant comfort
  - Cabin must be maintained for heat or cool, humidity issues
- Other considerations
  - Extreme Climates
    - Concerns over freezing
    - Cooling vehicle or onboard systems
  - Maintaining other engine dependent conditions
    - Air or Hydraulic pressure

City of Cleveland

- Consider Cleveland's ordinance
- 'Running the engine at low speed (idling) also causes twice the wear on internal parts compared to driving at regular speeds'
- Exemptions for 'work' functions
- Exemptions for temperature
- Still unable to meet emissions targets, largely because the highest polluters while idling are exempt from the city's ordinance



Reduce Vehicle Idling

Vehicle idling gets zero miles per gallon; unnecessary idling wastes fuel and pollutes. Running an engine at low speed (idling) also causes twice the wear on internal parts compared to driving at regular speeds. The break-even point for shutting off and restarting gasoline engines or leaving it to idle is 30 seconds – from the point of view of both emissions and fuel consumption.

Over the last several years, Northeast Ohio and the City of Cleveland have been attempting to lessen pollutants that pose a detriment to the region's air quality. These pollutants include nitrogen oxide, carbon dioxide, particulate matter, and volatile organic compounds. However, the region is still in a non-attainment status.

Idling of vehicles consumes approximately 1[illegible] of the fuel that a vehicle has on board.

Effective immediately, unless exempted in the following section, no City vehicle or piece of equipment is to be idled in a non-emergency situation. The operator of the vehicle/equipment is to turn-off the unit and the keys are to be removed from the ignition.

EXEMPTIONS

The following situations will allow idling, as needed:

1. Emergency vehicles at scenes where lights, PTOs, and/or other accessories are needed to accomplish the mission;
2. Division of Police vehicles working traffic enforcement details;
3. Department of Public Service, Department of Parks, Recreation and Properties, Department of Public Utilities, and Department of Port Control vehicles at job sites requiring the use of emergency lights, PTOs, and/or other accessories to accomplish their assignment; and
4. Inclement weather situations and the supervisor authorizes the use of the vehicle/equipment heater-defroster for the work crew's comfort according to the guidelines listed below;

If the outside temperature is: Above 32 degrees F: 5 minute maximum
Between -10 and 32 degrees F; 15 minute maximum
Below -10 degrees F: as necessary

https://www.epa.gov/sites/production/files/documents/CompilationofStateIdlingRegulations.pdf

How to Identify the Idling Problem

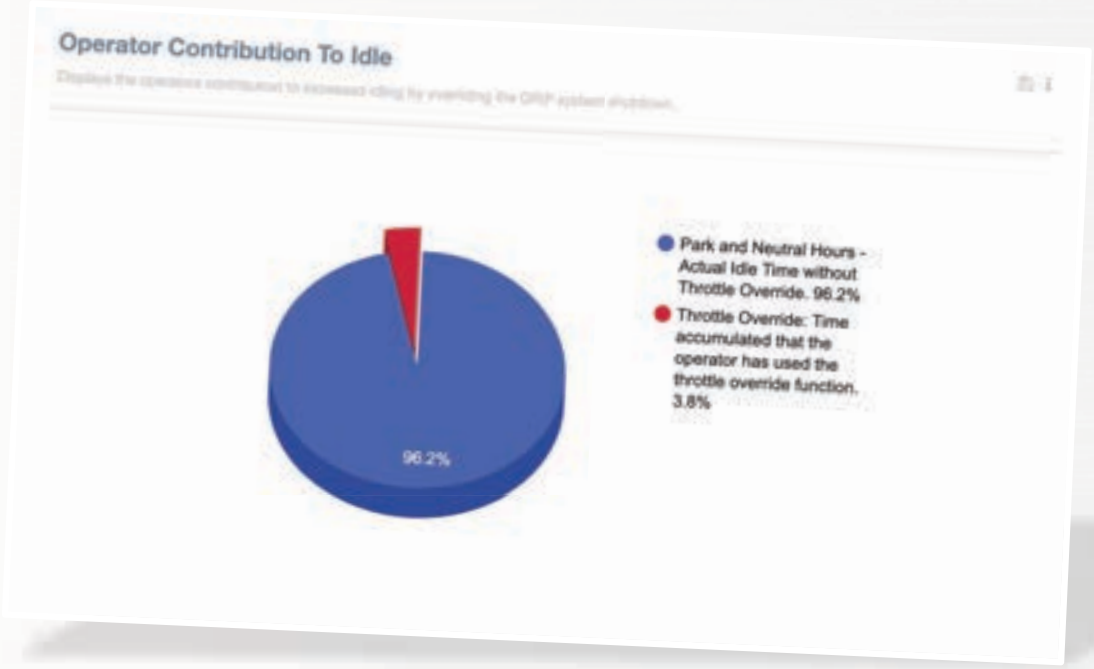
- Customer's own records and observations*
- Vehicle ECU Data
- Telematics
  - Provides relative relative indication based on time and GPS location
- IdleTracker™

How to Accurately Identify Idling

- The *truest*, most *accurate* measurement of idling is based on transmission position, not GPS location.
- The only device that tracks idling based on transmission position is the IdleTracker by GRIP Idle Management Inc.
- IdleTracker also tracks and reports on idling, reasons for idle, operator contribution to idle, and a wealth of idle-specific data.

How GRIP Addresses Non-Compliance

- GRIP identifies system overrides and manual contribution to “cheating” anti-idling systems
  - E-brake applied while in drive
  - Brake pedal applied while in drive
  - Throttle overrides
- The GRIP’s Fleet Dashboard allows for filtering of data by zone (department, locations, etc.), fuel type, and vehicles, and date ranges
  - Identify the specific vehicles/operators that continually contributing to idle and overrides
  - Identify and report on non-compliance by date range



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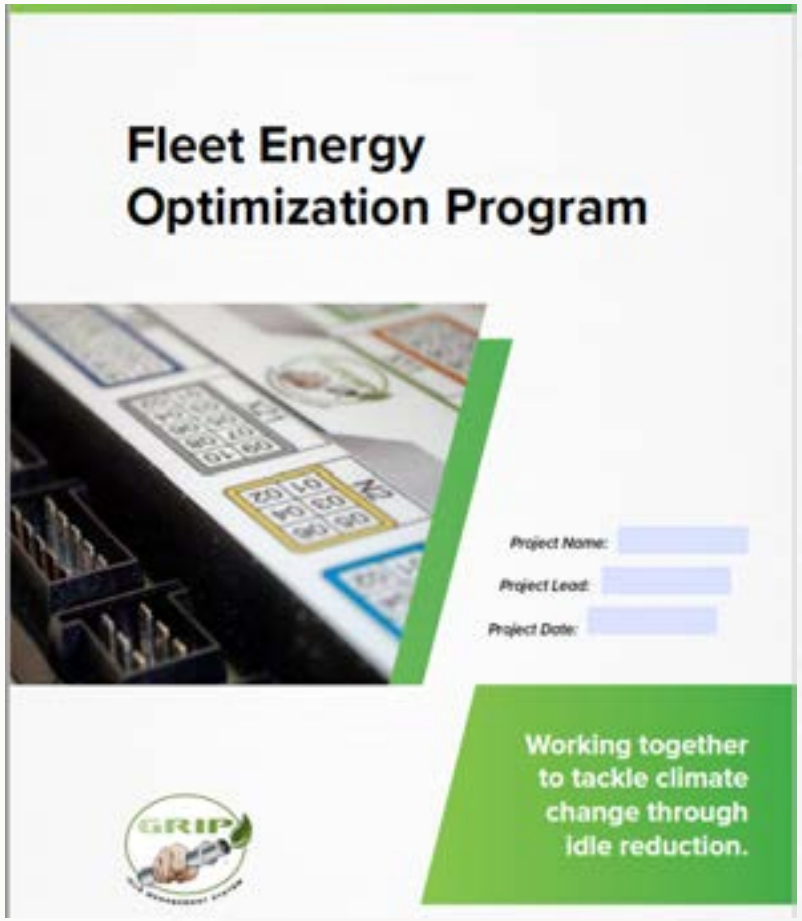
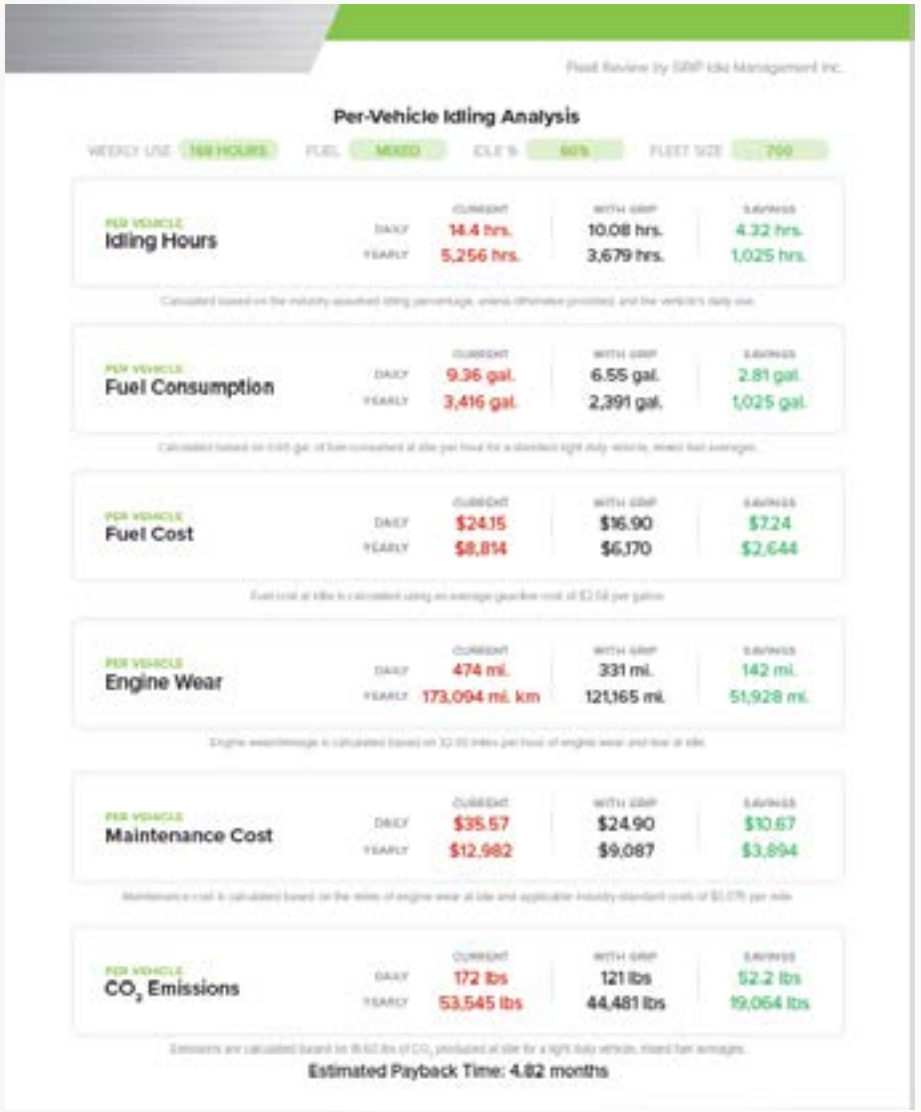
Generating an ROI: Fleet Energy Optimization Program

- Identify Customer's needs/targets/ drivers
- Utilize Fleet Idling data
- Generate Fleet Review/ROI
- Develop project scope and deployment plan
- GRIP's 9 Step process kicks-in



Generating an ROI: Fleet Review and ROI



Per-Vehicle Idling Analysis

		Current	With GRIP	Savings
Idling Hours	Daily	14.4 hrs.	10.08 hrs.	4.32 hrs.
	Yearly	5,256 hrs.	3,679 hrs.	1,025 hrs.
Fuel Consumption	Daily	9.36 gal.	6.55 gal.	2.81 gal.
	Yearly	3,416 gal.	2,391 gal.	1,025 gal.
Fuel Cost	Daily	$24.15	$16.90	$7.24
	Yearly	$8,814	$6,170	$2,644
Engine Wear	Daily	474 mi.	331 mi.	142 mi.
	Yearly	173,094 mi. km	121,165 mi.	51,928 mi.
Maintenance Cost	Daily	$35.57	$24.90	$10.67
	Yearly	$12,982	$9,087	$3,894
CO_2 Emissions	Daily	172 lbs	121 lbs	52.2 lbs
	Yearly	53,545 lbs	44,481 lbs	19,064 lbs

Estimated Payback Time: 4.82 months

- Utilize Fleet Idling data
- Generate Fleet Review/ROI
- Fuel Savings
- Maintenance savings
- Emissions reductions

*does not consider extended asset life or disposal value, operational efficiencies etc....

Implementing solutions to idling, operational costs, emissions, compliance, and more.

Reduce Emissions. Reduce Costs. Extend Asset Life. Increase Fleet Productivity.

Solutions to idling, operational costs, and compliance

- IdleTracker
  - Identify actual fleet idling
  - Identify reasons for idling and eliminate compliance issues
  - Improve sustainability reporting and reductions
- Fleet Dashboard
  - Report on idle hours, reasons for idle, and other idle-related data
  - Report on savings and reductions
    - Operational costs
    - Maintenance costs
    - Fuel costs
- GRIP Idle Management System
  - Automate control of engine on/off
  - Retain power and functionality to onboard systems
  - Remove operator reliance from anti-idling strategies
  - The solution to reducing vehicle idling

Reduce Emissions. Reduce Costs. Extend Asset Life. Increase Fleet Productivity

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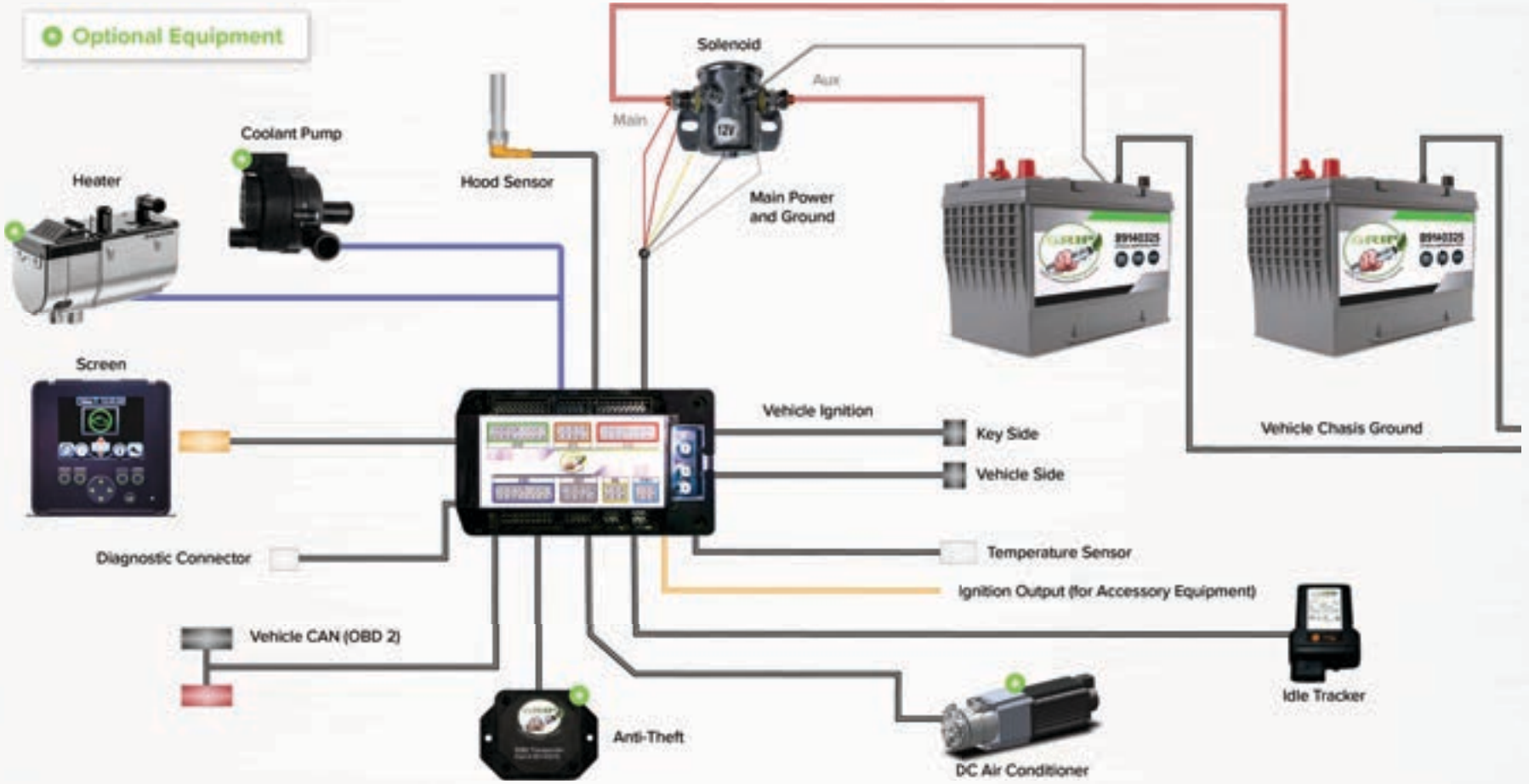
What does GRIP do?

- Scalable solution
  - Applicable to Class 1 (light duty) to Class 8 (Heavy Duty) and Off-Road
  - Multi-Fuel Capable (Gasoline, Diesel, LPG, CNG)
  - Support all major vehicle manufacturers (CAN compliant)
  - OEM warranty compliant
- Integrates and controls auxiliary equipment including Fuel Fired Heaters, Auxiliary Batteries, Solar, Shore Power, DC A/C
- Application-specific capabilities
  - Accessory components allow for applications specific requirements
    - Aerial module for bucket trucks/digger derrick
  - Accessory components allow for climate-specific capabilities
    - Fuel-fired heater integration
    - DC Air Conditioning integration
    - Shore Power integration
    - Solar Panel integration

GRIP's Vehicle Operation



The Environmental, Financial, and Procurement Impact of Idling

Reduce Emissions. Reduce Costs. Extend Asset Life. Increase Fleet Productivity.

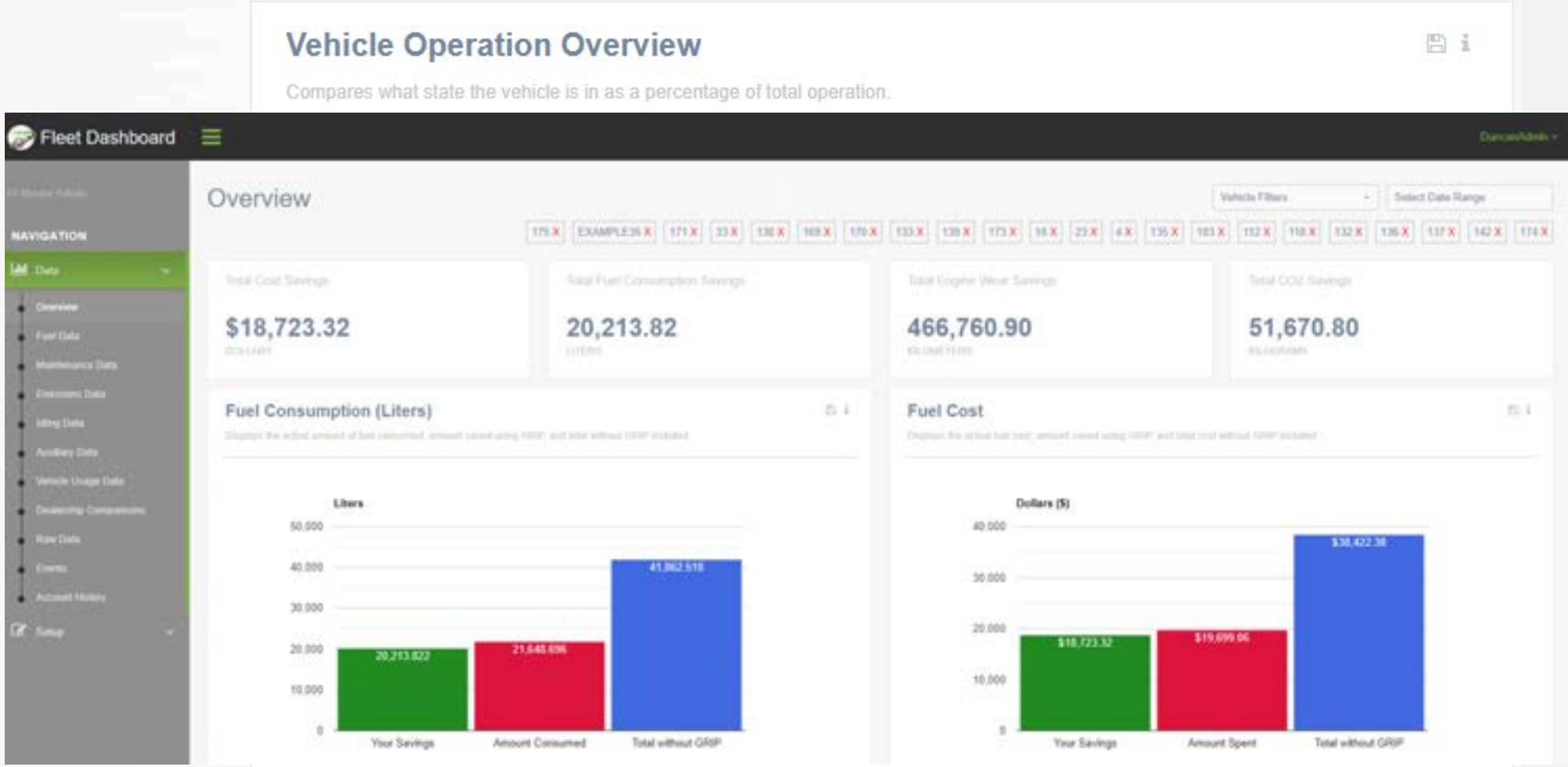
Case Study: London Hydro

https://www.youtube.com/watch?v=Z4o4jnBTdXA&feature=youtu.be

Case Study: London Hydro

Static Vehicle Analysis

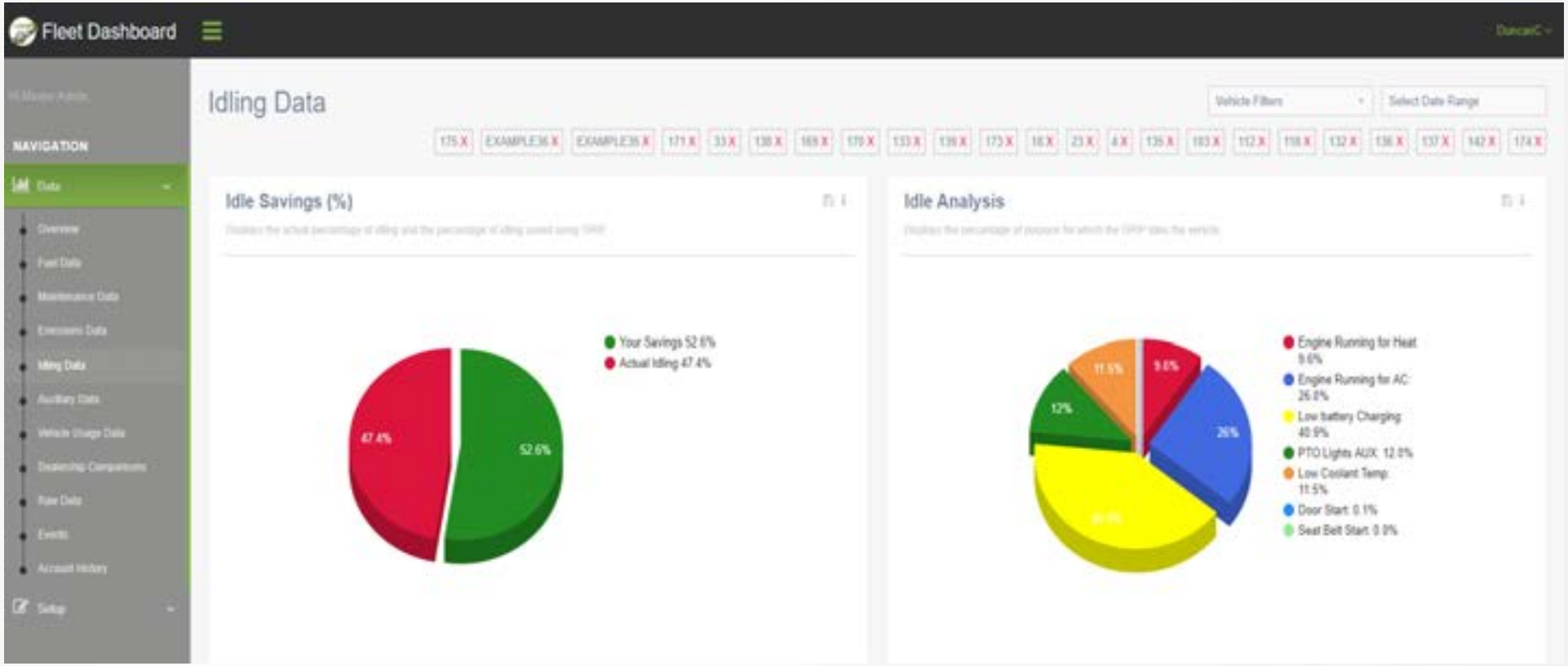
- Vehicle Usage
- Automatically calculate:
- Fuel savings
- Emissions reduction
- Engine wear reduction



Case Study: London Hydro

Idle Analysis

- 52.6% reduction in Idling
- Vehicle Idling for Battery Charging and A/C



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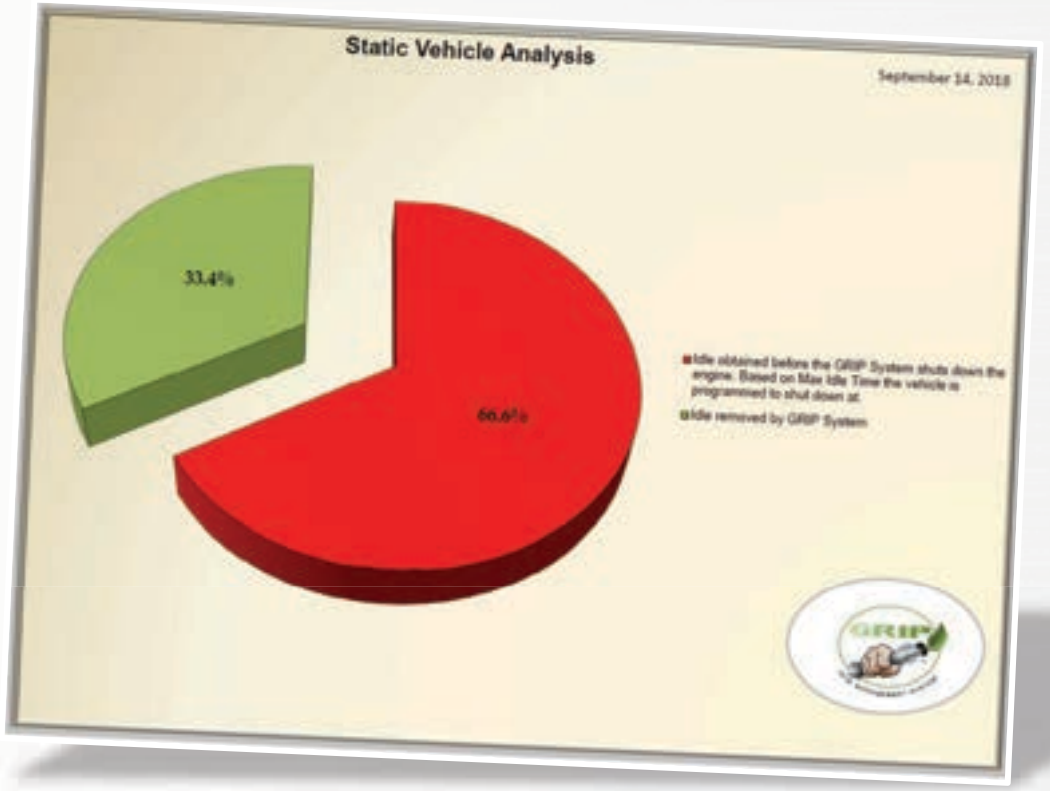
Case Study: Columbus Police Dept.

Static Vehicle Analysis

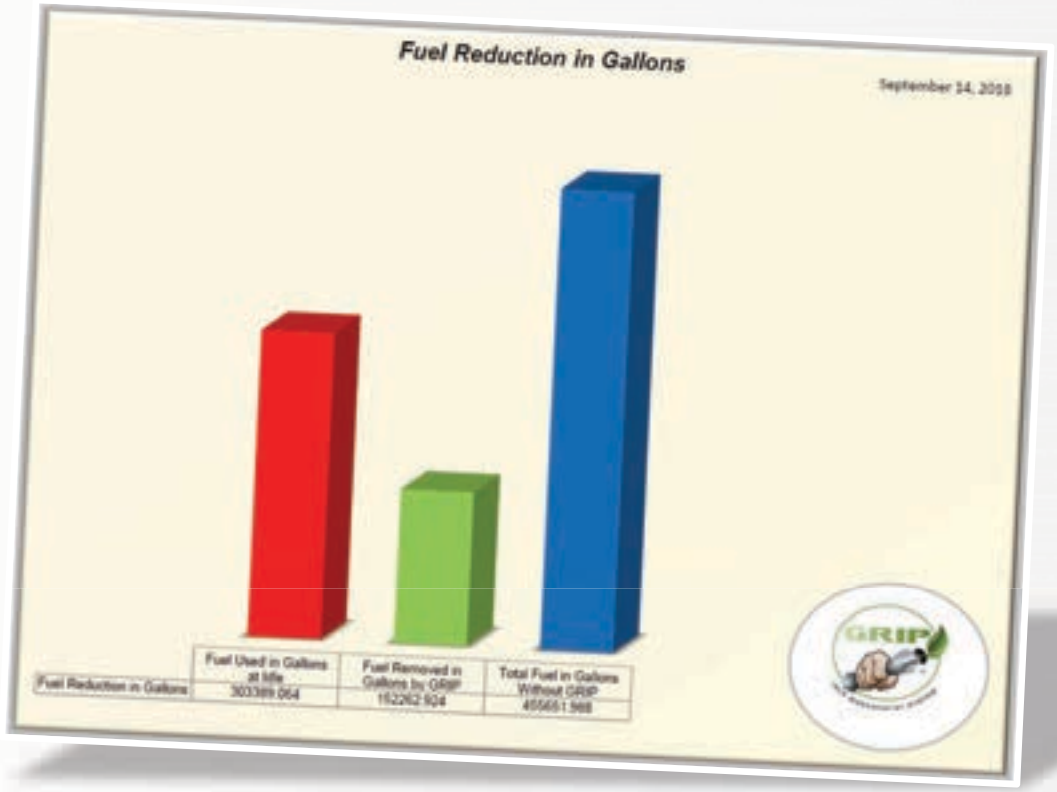
- 34% of Idle time removed by the GRIP System
- 346,052 hours of idling removed
- The addition of an A/C solution could reduce idling by an additional 30%



Case Study: Columbus Police Dept.

Fuel Reduction

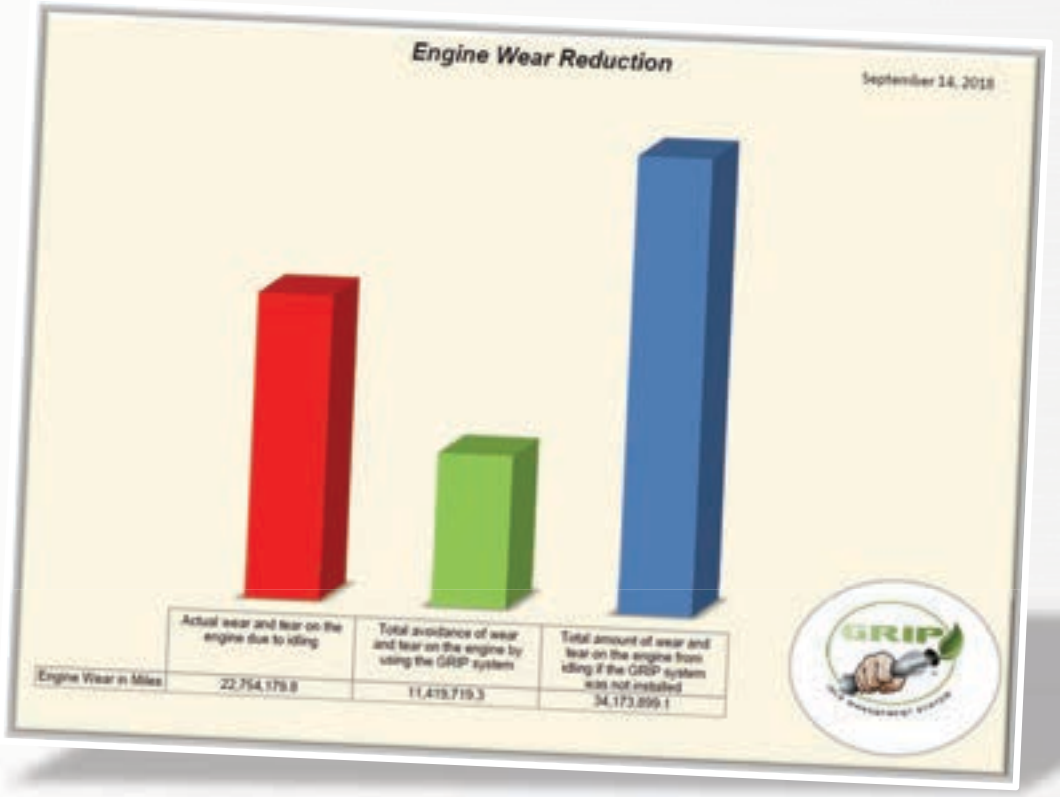
- 576,374 L of Fuel Saved
- 1,148,352 L of Fuel Spent at Idle
- Total fuel savings to date of ~$312,919



Case Study: Columbus Police Dept.

Idle Time Comparison (hrs.)

- One hour of idling is equal to 53km of engine wear
- 18,378,256 km of Wear Removed from Engine
- 36,619,301 km of Actual Engine Wear due to Idling



Case Study: Columbus Police Dept

"The addition of the anti-idle technology will maintain essential systems on the vehicle while, all the time saving fuel for the division and keeping our officers safe. We think it is important to demonstrate our desire to be efficient with our fleet and respectful of the money it takes to operate our fleet of vehicles."

- Kim Jacobs, Police Chief

Case Study: Columbus Police Dept

"We anticipate that once a patrol unit exceeds its useful life using the anti-idle technology, that we will transfer the technology to the new replacement patrol vehicle. GRIP offers a reconditioning program that allows the fleet division to reuse the technology on new replacement units for about one-third the cost of a new system."

- Kelly Reagan, Fleet Manager

2016 Toronto Hydro Annual Report

- GRIP is the preferred idle-reduction technology
- 23% decrease in fuel consumption in cube vans
- 26% decrease in fuel consumption in HD bucket trucks
- 13% reduction in fuel consumption in pickup trucks
- GHG emission reductions of 45 tCO_2e

Anti-Idling Technologies

The installation of Governor to Reduce Idle and Pollution (GRIP) technology on 24 of Toronto Hydro's cube vans (starting in late 2014), has led to a 27% decrease in average annual idling hours in its GRIP-equipped vehicles (compared to non-GRIP equipped cube vans).

In November 2015, Toronto Hydro began GRIP trials in four of its new heavy duty bucket trucks, which has resulted in a 26% decrease in idling amongst those trucks (compared to non-GRIP equipped trucks). In July 2016, the Company trialed the GRIP units in five of its highest idling pick-up trucks.

2016 Toronto Hydro Environmental Performance Report March 3, 2017

Since installing the GRIP system in pick-up vehicles , Toronto Hydro has realized a 22% reduction in idling hours across this pool of vehicles compared to the same period, in 2015 (July-November, inclusive).

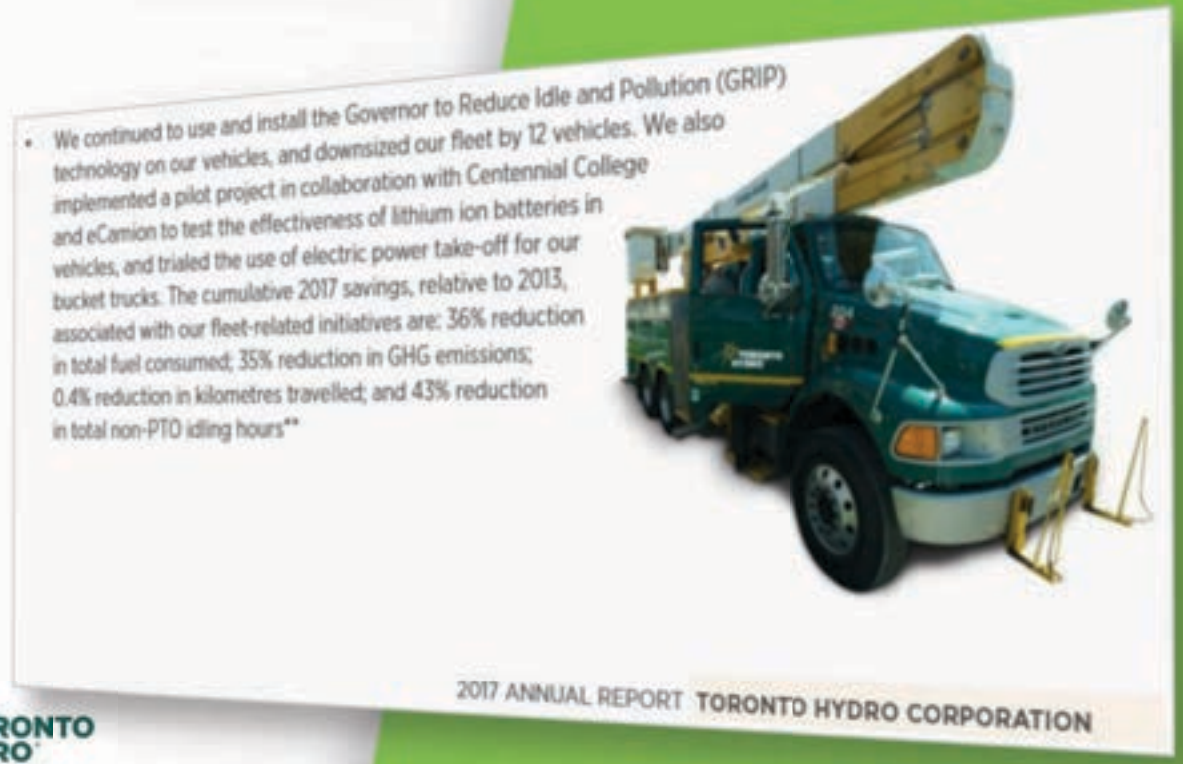
The GRIP system has delivered proven idling reductions and, as such, is currently Toronto Hydro's preferred anti-idling technology. GRIP functions by shutting the engine off after 1 minute of idling and deferring to the auxiliary battery power source requiring long-lasting batteries in order to fully optimize the GRIP system's use. In 2016, Toronto Hydro's Fleet department explored various means of extending auxiliary battery longevity. Solutions currently being trialed are: (1) decreasing load on the auxiliary battery by swapping out the existing inverter for a high-efficiency generator; (2) swapping existing auxiliary battery for a high-efficiency lithium ion battery; (3) reactive reporting on vehicles not plugged into shore power nightly. Preliminary results on the expected benefits of these solutions are anticipated by end of the second quarter of 2017.

As a result of the idling reduction initiatives, in 2016, Toronto Hydro saw a 23% reduction in fuel consumption amongst cube vans - a 6% reduction in fuel consumption amongst bucket trucks - and a 13% reduction in fuel consumption amongst pickup trucks. This led to fuel savings of 16,331 L and reduction in GHGs of 45 tCO_2e, in 2016 relative to 2015.

Reduce Emissions. Reduce Costs. Extend Asset Life. Increase Fleet Productivity.

2017 Toronto Hydro Annual Report

- Reduction in costs and increase in asset availability resulted in Toronto Hydro downsizing their fleet by 12 vehicles
- 36% reduction in total fuel consumed
- 35% reduction in GHG emissions
- 43% reduction in total non-PTO idle hours



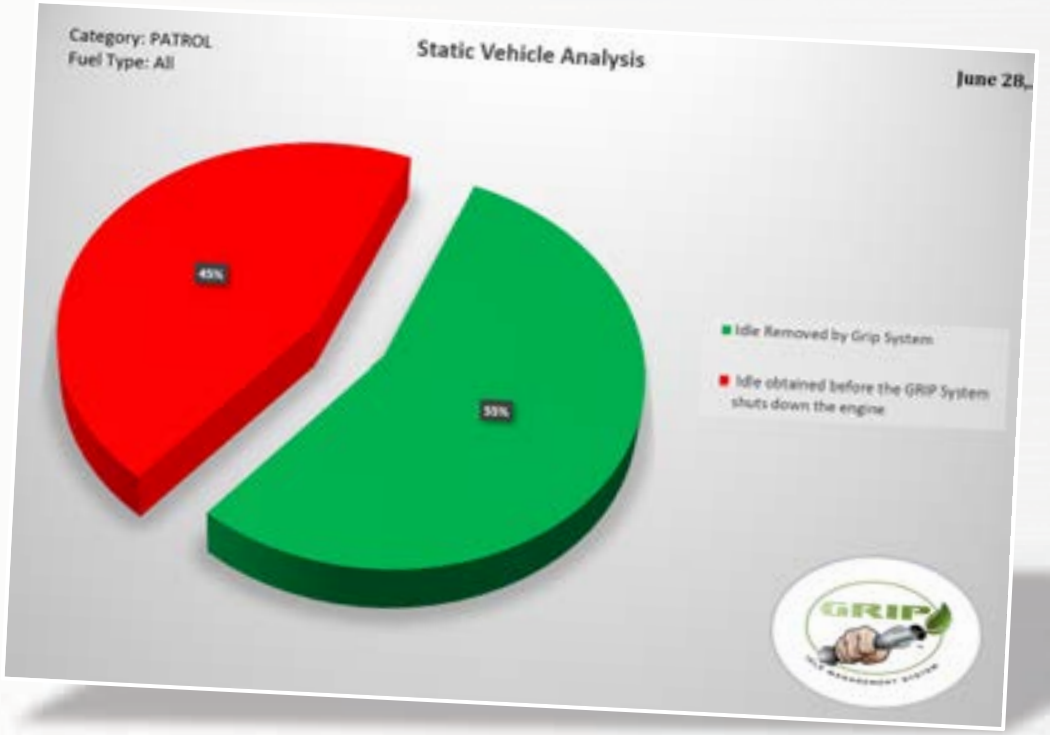
Reduce Emissions. Reduce Costs. Extend Asset Life. Increase Fleet Productivity.

Case Study: Muhlenburg Pa

- Small PD in rural PA., 6 Tahoe's
- Reduced Idling by 55%
- Potential for some increased idle reduction with additional officer training/discipline

"The GRIP system has paid for itself in less than a year, we now look forward to extended asset life as well as continued fuel and maintenance savings"

- Lt. Joe Schlappic, Fleet Manager Muhlenberg PD



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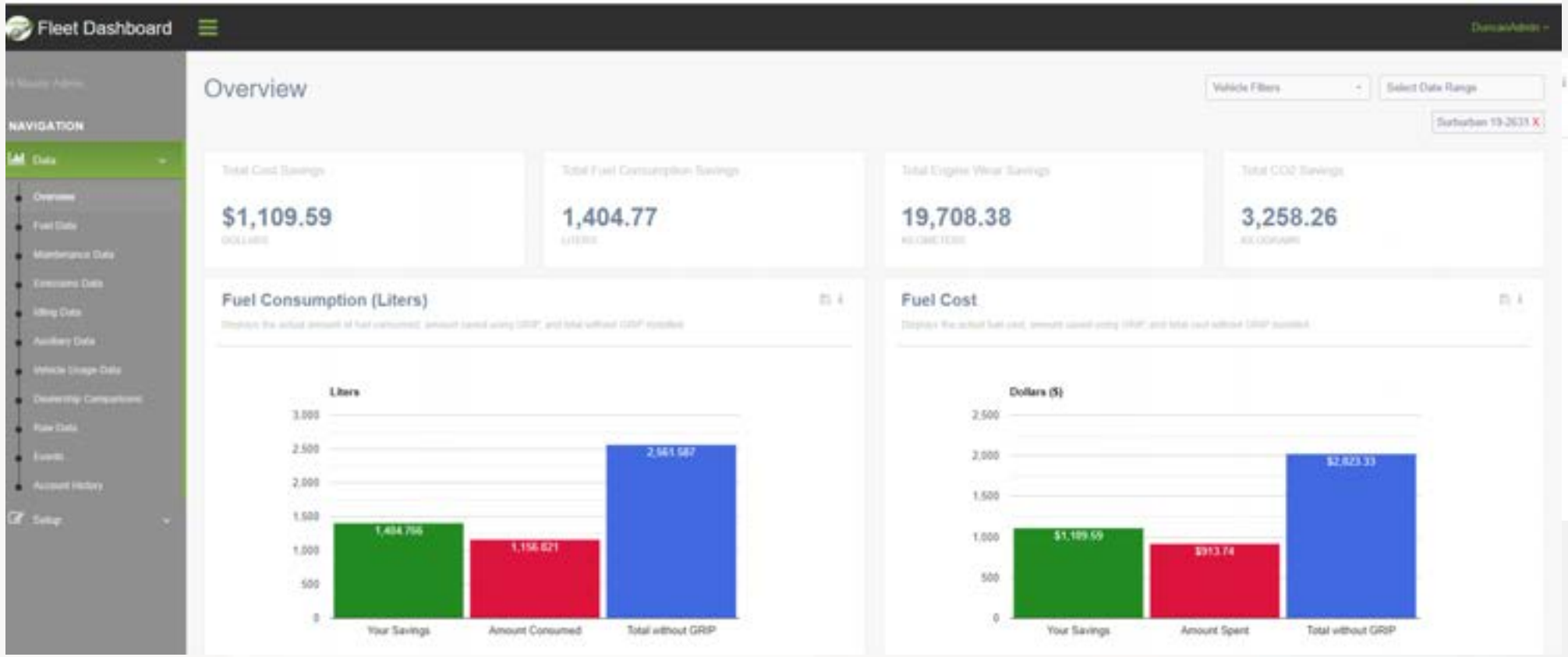
Case Study: Sussex County, De

Static Vehicle Analysis

- Vehicle Usage patterns
- 54.8% Idle reduction
- Automatically calculate:
  - Fuel savings
  - Emissions reduction
  - Engine wear reduction



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Case Study: Sussex County, De

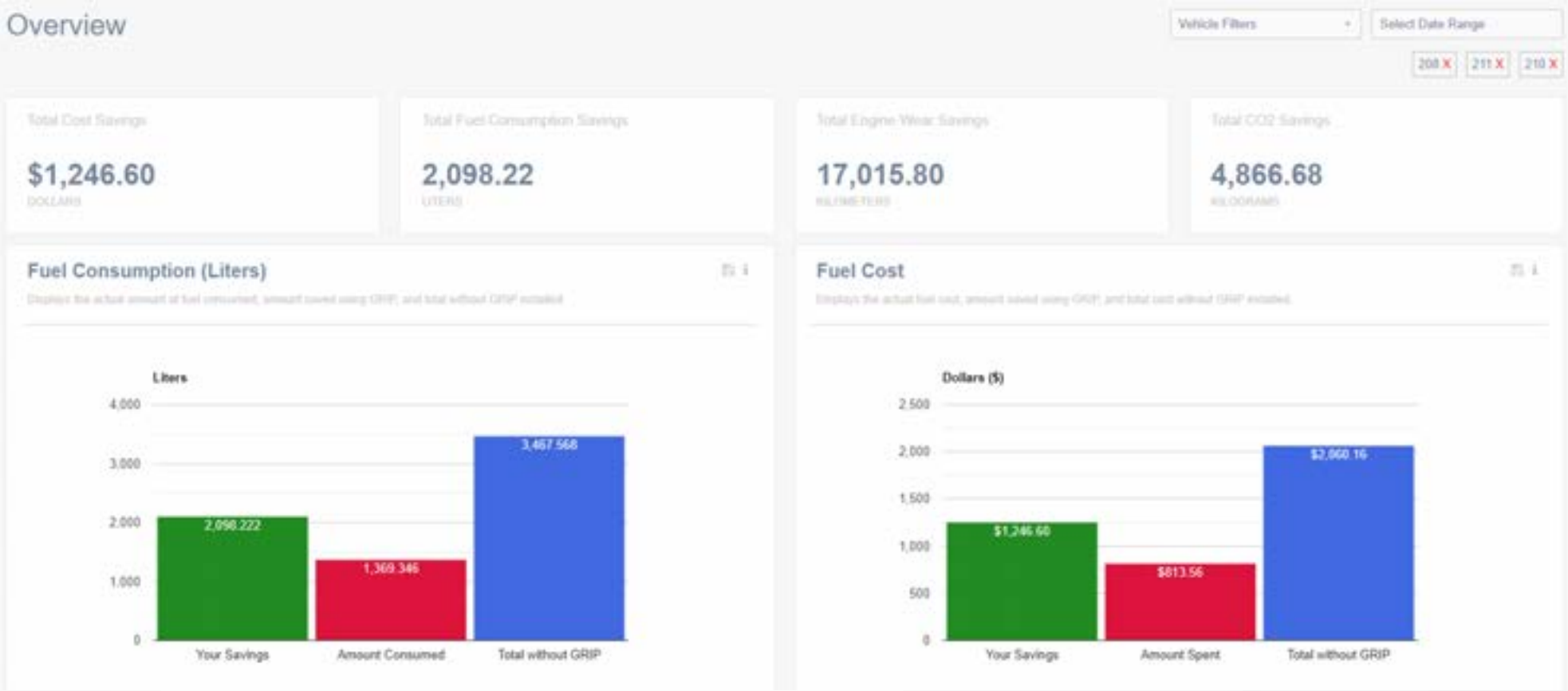
Idle Analysis

- 54.8% reduction in Idling
- Vehicle Idling:
  - Battery Charging
  - Vehicle A/C
- Power of Configuration…
  - 50% improvement in Idle Reduction

Case Study: Woodbridge, NJ

Static Vehicle Analysis

- Vehicle Usage patterns
- 60.7% Idle reduction
- Automatically calculate:
  - Fuel savings
  - Emissions reduction
  - Engine wear reduction



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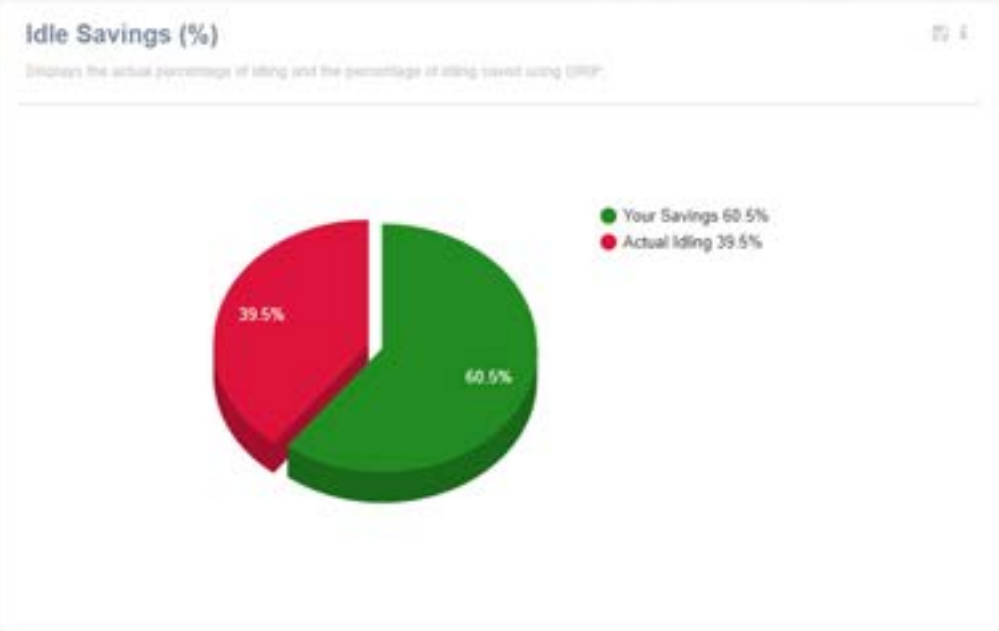
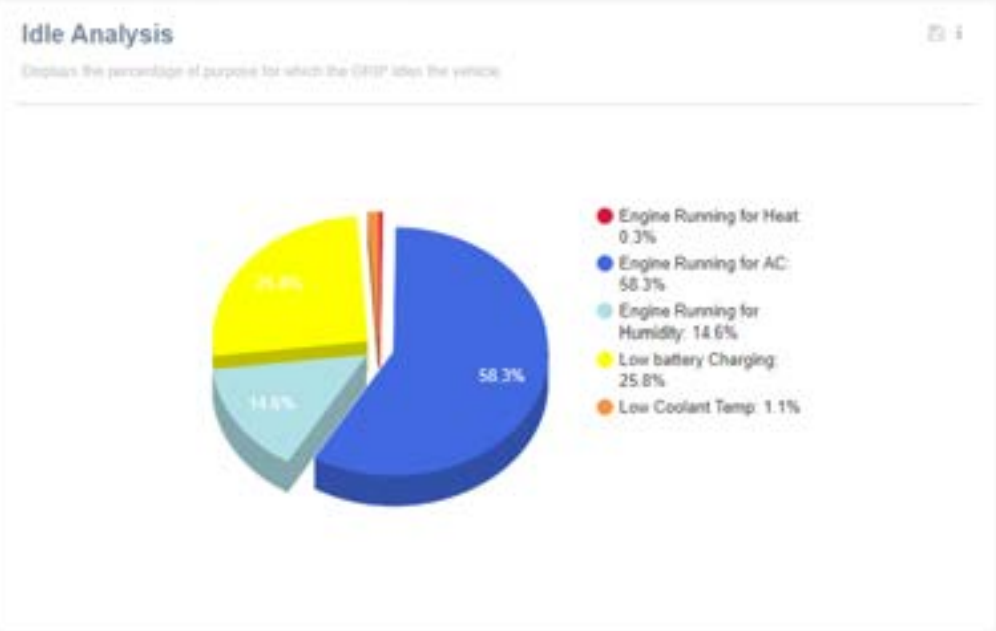
Case Study: Woodbridge, NJ

Idle Analysis

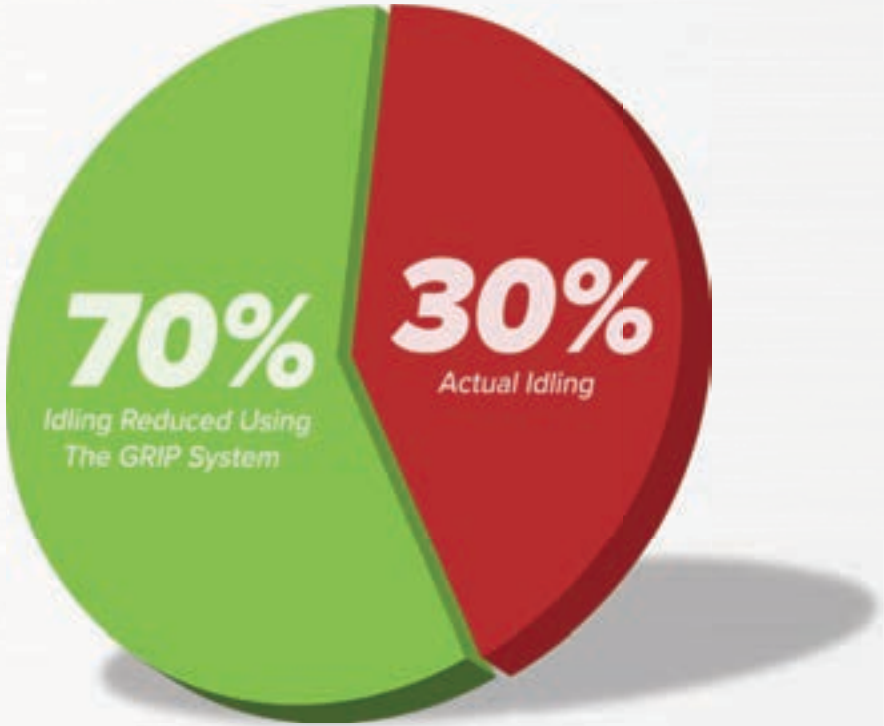
- Vehicle Idling:
  - Battery Charging
  - Vehicle A/C
- Expect improved performance through the winter





Anti-Idling Technology Reduces...

- Unnecessary vehicle idling
- Harmful CO2 emissions
- Fuel costs & consumption
- Maintenance costs and engine wear
- Vehicle downtime
- Operator endangerment and discomfort
- New vehicle purchasing frequency/Life Extension
- Overall operational costs
- Guesswork and data inaccuracies
- Warranty issues



Bonus Slide: Diesel Considerations

ATS- After Treatment Systems

- High Idle- Low MPG Vehicles require service 40% sooner
- EGR/ATS/Exhaust systems impact
- Low Engine temperature at Idle impacts regeneration
- Deploying a FF Heater
- Maintaining greater than 180’ will allow passive regeneration

Table 1: Maintenance Lamp Capability and Maintenance Interval Identification

ESN	ECM Calibration Revision	Maintenance Lamp	Fuel Consumption	
			> 2.3 km/liter [5.5 mpg]	< 2.3 km/liter [5.5 mpg]
79896418 and greater	All	Yes	640,000 km - 800,00 km [400,000 miles - 500,000 miles] 9000 hours - 11250 hours	400,00 km - 640,000 km [250,000 miles - 400,000 miles] 5625 hours - 9000 hours
79802604 to 79896417	All	Yes	640,000 km [400,00 miles]	400,000 km [250,000 miles]
			9000 hours	5625 hours
Less than 79802604	12-Nov-2014 or newer	Yes	480,000 km [300,000 miles]	320,000 km [200,000 miles]
			6750 hours	4500 hours
	Prior to 12-Nov-2014 or unknown	No	320,000 km [200,000 miles]	
			4500 hours	

Bonus Slide: Diesel Considerations

ATS- After Treatment Systems

- ATS Regen for Heavy Duty trucks has an immediate impact in ROI

GRIP IDLE MANAGEMENT SYSTEM

Features

An intelligent in-cab display lets each fleet customize their ignition's start/stop schedule to:

- Power auxiliary equipment, either using the engine, or a Cummins deep-cycling battery.
- Keep the vehicle and engine warm, either using the engine, or a Webasto heater.
- Maintain battery charge.
- Cycle on the air conditioning for operator comfort, humidity control, using the GRIP kit's idle scheduling feature.

Installation

- A Cummins technician installs the GRIP kit through the vehicle auxiliary port in the dash.
- A parallel relay will ensure your ignition is safely independent of our product.

Payback

- As part of our program, Cummins will calculate a payback period for your fleet, expected to be 6-12 months.
- Benefit from a 5 year components warranty, facilitated by Cummins.

For more information, contact your Aftermarket Territory Manager

Bonus Slide: Battery Considerations

AGM- Technology

- Thin plate no chemistry battery allows for high CCA with longer battery life
- Ideal for Cold Climate applications vs Lithium
- Suitable for a broad range of vehicle types and applications