



ADVANCED  
TECHNOLOGY FOR A  
CLEANER FUTURE®

## State of Oregon Presentation

April 2015

# Agenda

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- Diesel Emissions and Addressable Market
- Diesel Emissions Regulations and Impacts
- ESW Group Overview



# Diesel Emissions

- Diesel emissions are a major air pollutant, impacting the State of Oregon and major urban areas such as Portland
  - In our communities, emissions cause respiratory and cardiac health problems
  - Researchers calculate that air pollution results in massive pain and expenses because of illness, missed school, lost work days
- Globally, a portion of diesel particulate (“black carbon”) contributes to climate change
  - Recent research ranks black carbon as the second most important climate change agent (after CO<sub>2</sub>)<sup>1</sup>
- Short-term exposure to diesel exhaust causes “acute irritation (e.g., eye, throat, bronchial), neurophysiological symptoms (e.g., lightheadedness, nausea), and respiratory symptoms (cough, phlegm).”
  - Evidence of immunologic effect with increased allergenic responses to known allergens and asthma-like symptoms
- Long-term exposure is “a chronic respiratory hazard to humans”



[+ View full size](#)

*Benjamin Brink/The Oregonian*

<sup>1</sup> JGR-Atmospheres 118(11)5380-5552(2013)

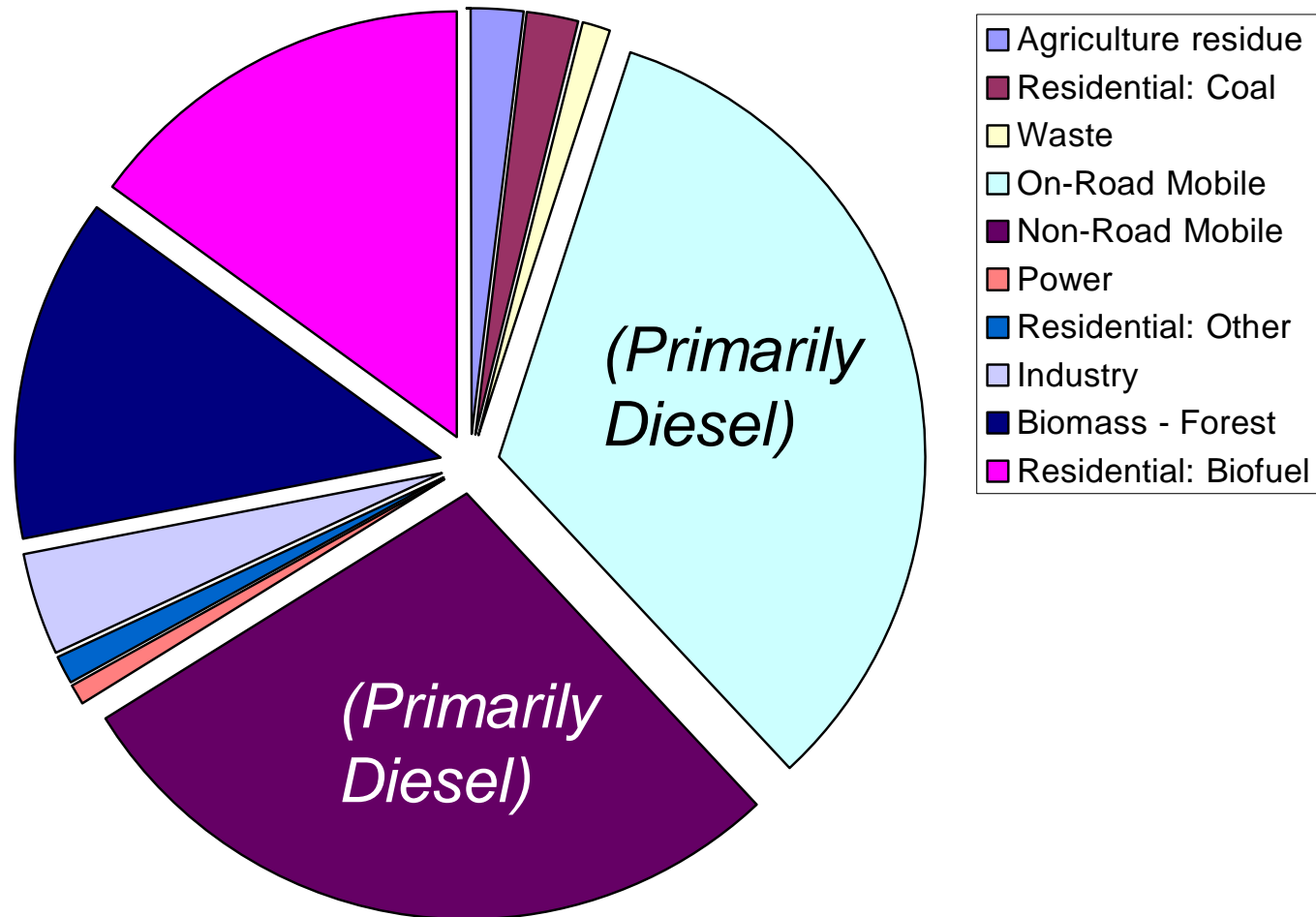
Reference: “Health Assessment Document For Diesel Engine Exhaust”, U.S. EPA, EPA/600/8-90/057F, May 2002



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# Sources of Black Carbon in the United States



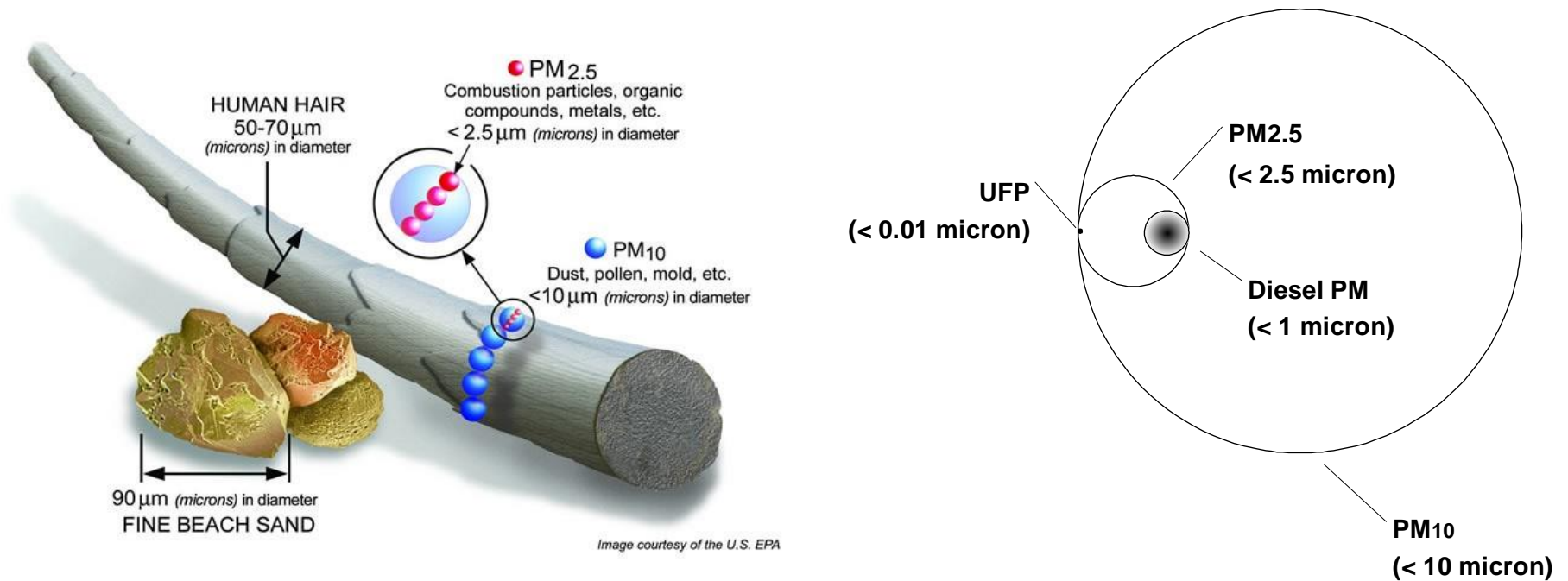
Source: Princeton WWS paper (2009)



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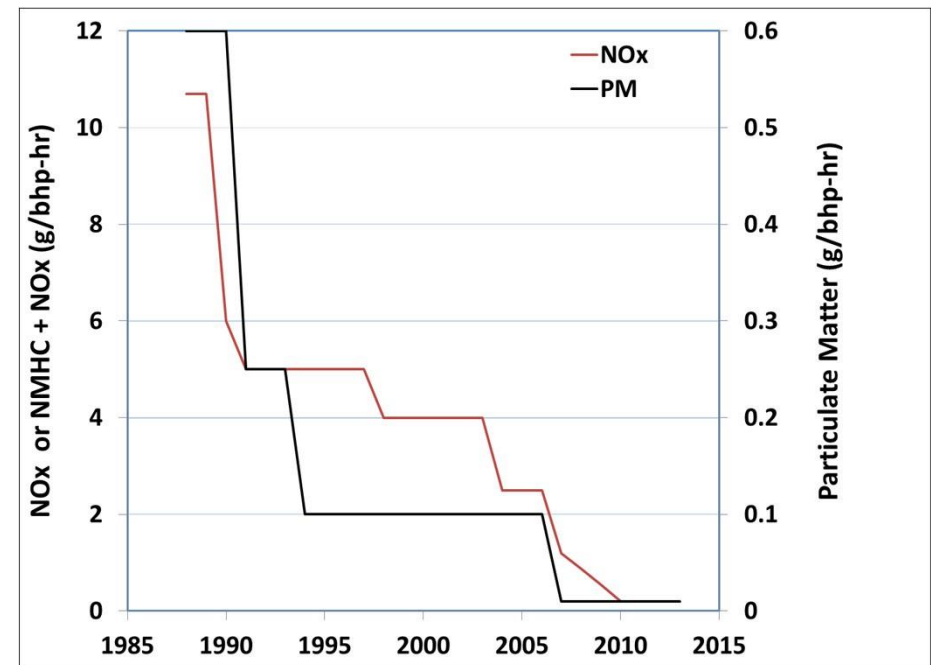
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# Particulate Matter in Context



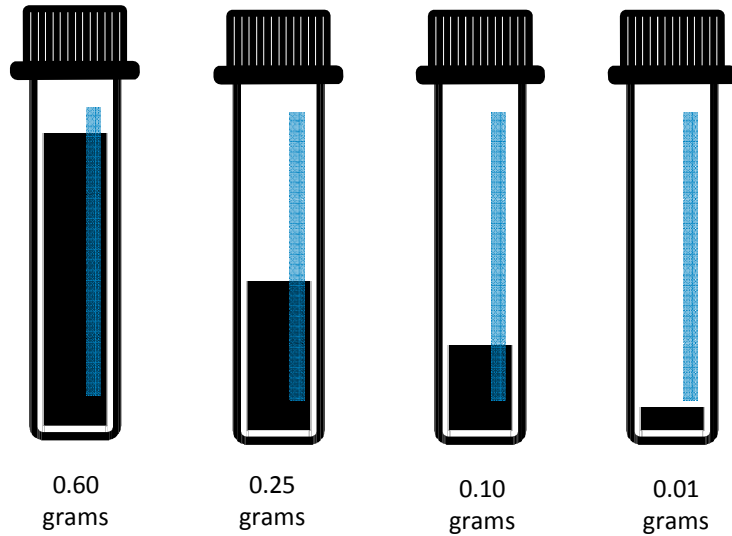
# Revolution in Diesel Engines

- EPA Regulations finalized during administration of G.W. Bush created a diesel revolution for heavy duty trucks and buses
- 2007: diesel particulate emissions slashed from 0.1 to 0.01 g/bhp-hr, requiring a diesel particulate filter (DPF)
- 2010: nitrogen oxide regulations fully implemented
- Compared to a model year 2000 engine, a 2010 emits 95% less nitrogen oxide and 90% less particulate matter



# Consequently, Drastic Decline in Allowable PM Emissions

## On-Road Heavy Duty Trucks



0.60  
grams

0.25  
grams

0.10  
grams

0.01  
grams

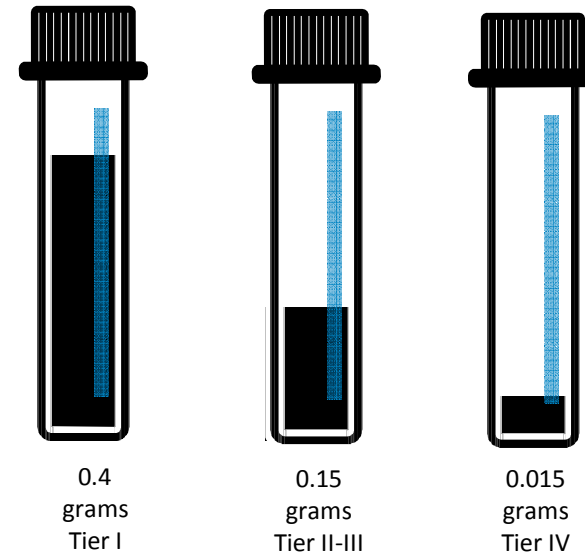
1988

1991

1994

2007

## Off-Road Diesel Engines



0.4  
grams  
Tier I

0.15  
grams  
Tier II-III

0.015  
grams  
Tier IV

1996

2001-  
2003

2010-  
2011

Note: Diesel Particulate Matter (PM) allowed per horsepower-hour per EPA regulation. For 175-750 HP engines only.  
Source: Donaldson Company.

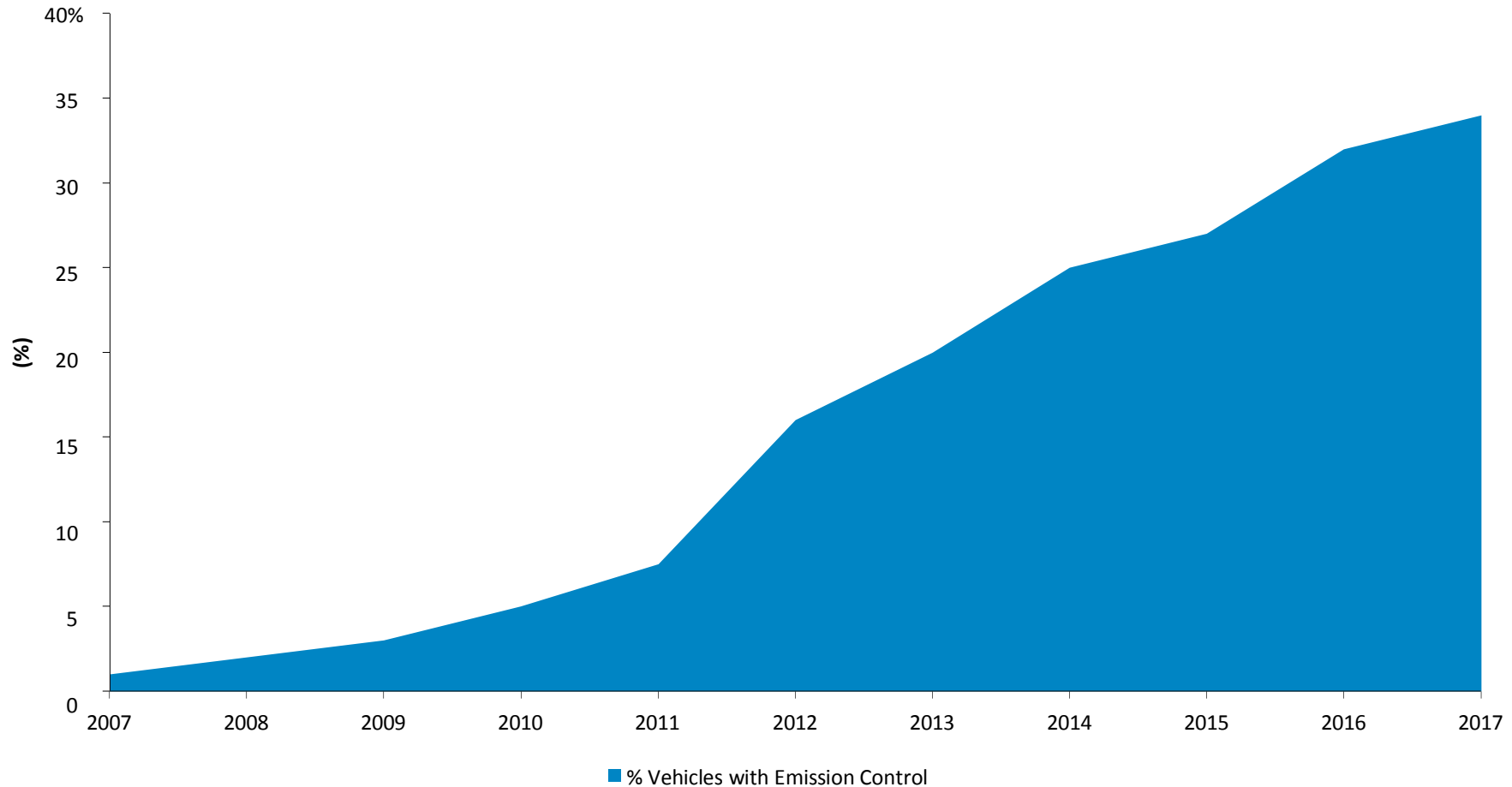


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# But Slow Fleet Turnover Limits Adoption of New Tech

## North American Medium- and Heavy Duty Vehicles with Emissions Controls



Source: Frost & Sullivan analysis, March 2012.



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# Growing Global Regulations for Diesel Emissions

## Increased Regulation of Diesel Particulate Matter in the U.S. and Globally Is Key Growth Driver

- Particulate matter (“PM”), a mixture of solid particles and liquid droplets emitted into the air from automobiles, industries, and power plants, is a growing health concern and contributor to climate change
- Diesel emissions contain several harmful types of PM, such as “black carbon,” the second most important climate change agent
- After the identification in 1998 of diesel PM as a toxic air contaminant, several jurisdictions have taken steps to limit reduce diesel emissions
- In 2008 California initially adopted the California Statewide Truck and Bus Rule that required diesel trucks retrofit or replace engines
- Other states and metropolitan areas have begun to implement additional requirements as well
- Globally, the U.S. and Europe are the leaders in emissions standards
- Developing markets are quickly adopting additional heavy duty diesel regulations

Global Heavy Duty Regulations Summary



Source: JGR-Atmospheres 118(11) 5380-5552 (2013), Data from Princeton WWS paper (2009), Global Regulations from Johnson Matthey.

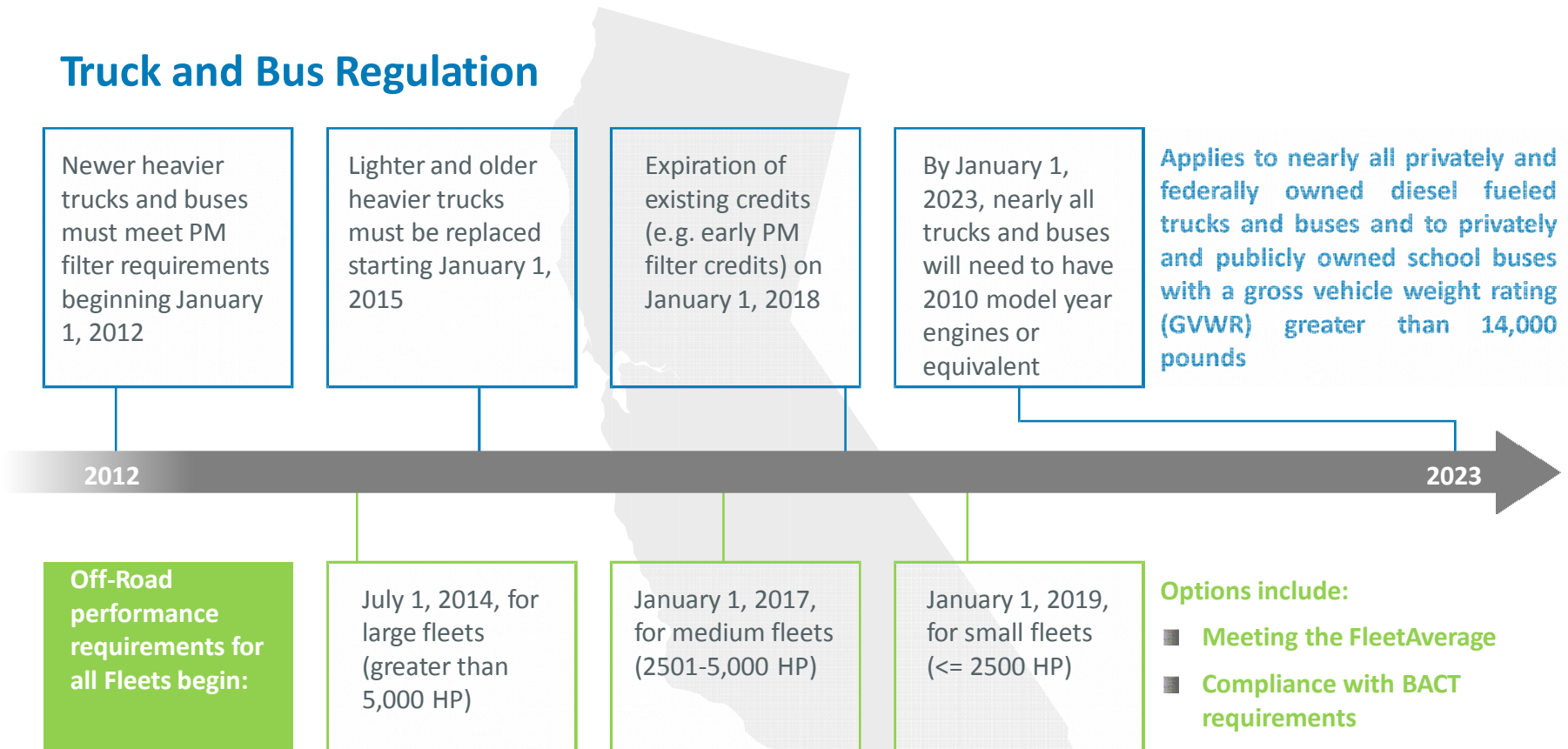


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# California Sets the U.S. Standards in Diesel Emissions...

## Truck and Bus Regulation

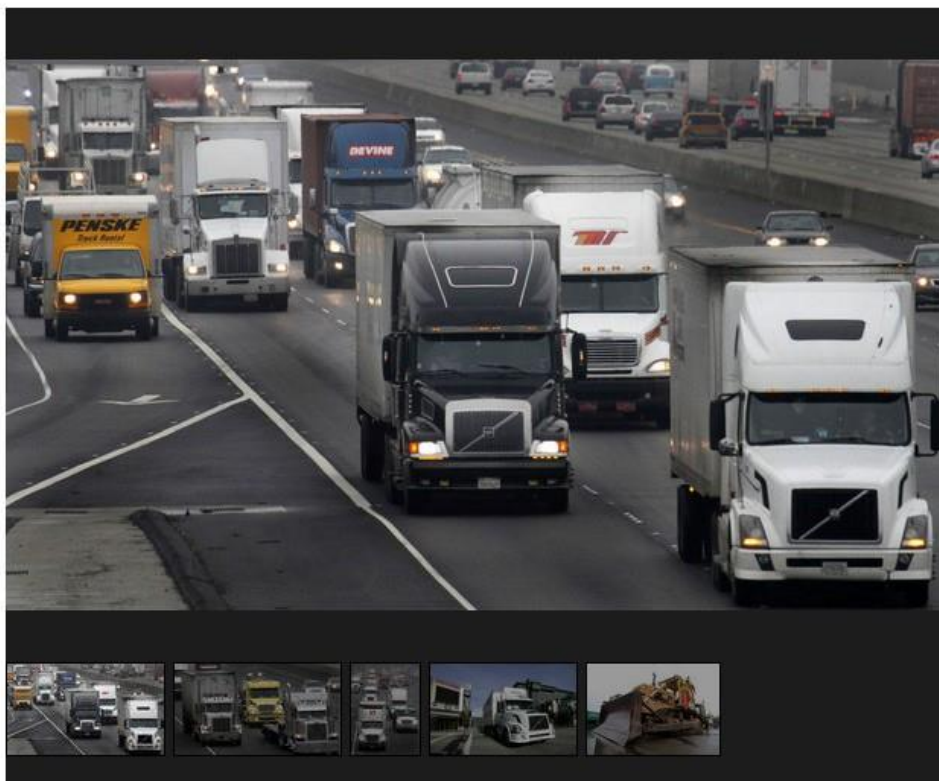


## Off-Road Regulation



## ...and California's Neighbors Pay the Price

### Oregon becomes dumping ground for California's old, polluting diesel big rigs



California is forcing truck owners to get rid of 350,000 higher polluting old big rigs by 2023. Owners are finding willing buyers in Oregon and other states with looser regulation. (AP Photo)

Source: OregonLive, January 23, 2015



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# Multiple Verticals with Compliance Needs in Oregon

Expanding Legislation in North America Provides for Opportunities in Several Different Verticals

## Trucks



- 145,000 older trucks operating in Oregon

## School Buses



- 3,300 school buses
- Oregon HB 2795 requires model years 1994-2006 diesel school buses in Oregon to be retrofitted with diesel emissions control systems by 2017

## Municipal/ State Fleets and Ports



- Oregon DOT fleet alone has over 5,000 pieces of equipment

Source: MECA, OregonLive, Oregon DOT.



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# ESW Group Highlights

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**1** *Growing N. American and Global Markets given Strengthening Regulations*

**2** *Fully-Integrated Solutions Provider*

**3** *Leading Level III and CARB Verified Product Line*

**4** *State-of-the-Art Emissions Testing Facility with Significant Capital Invested*

**5** *Proven Growth Platform with Solid Cash Flow Generation*



# Company Overview

The leading “one-stop-shop” compliance solutions provider to the growing diesel emissions systems market in the wake of increasingly stringent regulations

- Develops, certifies and commercializes advanced emissions solutions, focused on heavy / medium duty on-road and off-road diesel applications
- Manufacturing operations in Montgomeryville, PA and San Diego, CA with a leading state-of-the-art emissions testing facility co-located in its manufacturing facility in PA
- Fully-integrated and seamless approach to research, development and commercialization of leading emissions technologies and best-in-class emissions testing services
- Market leading portfolio of CARB verified diesel emission control systems that have attained the highest levels of particulate matter reduction verification in the United States
  - Primary focus on the Heavy/Medium duty on-road, and off-road diesel applications
  - Focused on emerging market opportunity in the aftermarket replacement parts market (e.g. DPFs)

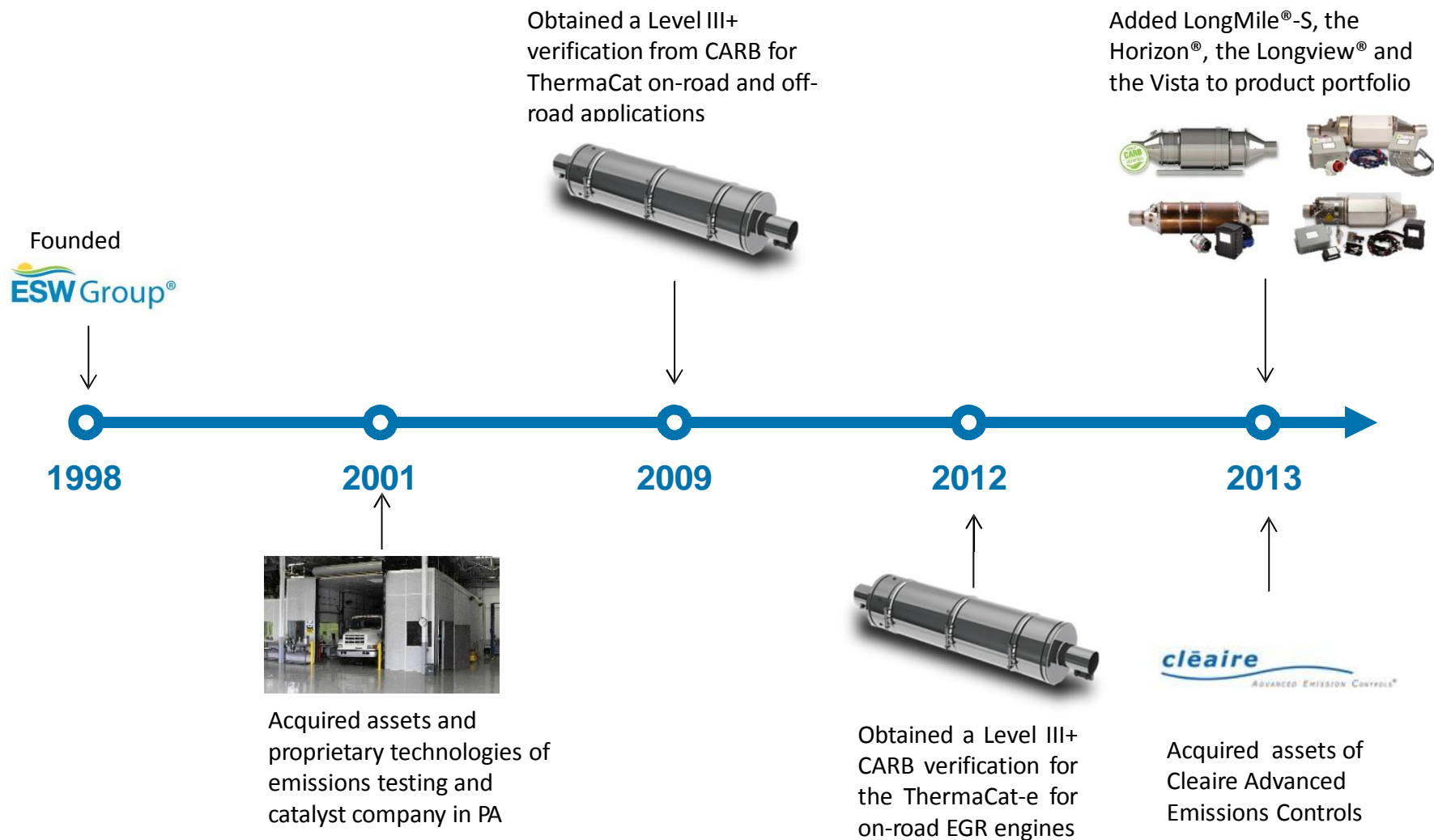


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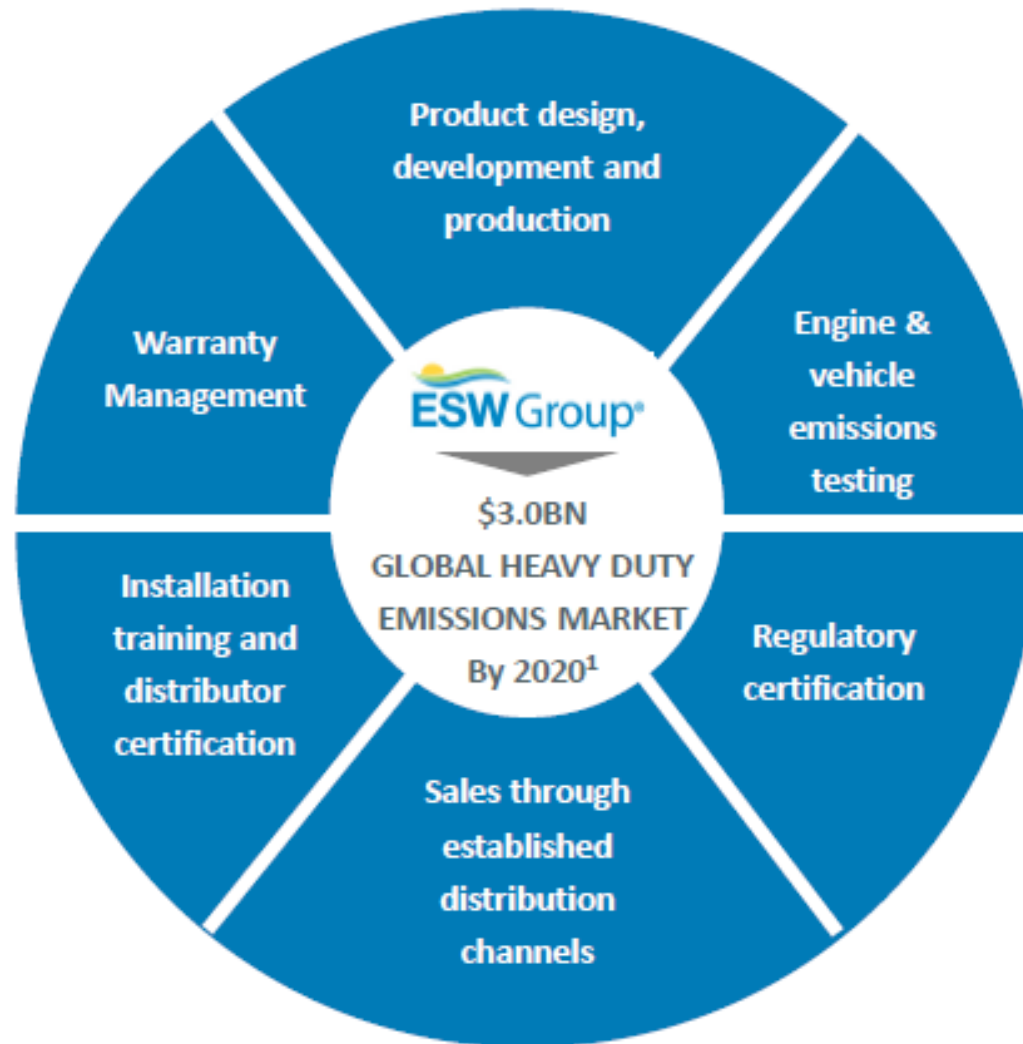
# Company Timeline



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# Vertically-Integrated Capabilities



<sup>1</sup> Source JD Power and JM



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# Leading Level III & CARB Verified Product Line

## On-Road Products

### ThermaCat-e

- Verification: CARB Level 3+
- Filter Type: Active DPF
- Regeneration: Active (flameless)
- Engines: 1996-2006 | 4-13 liters | 150-400 hp
- Learn More: [View ThermaCat-e Specs](#)



### LongMile®-S

- Verification: CARB Level 3+
- Filter Type: Passive DPF
- Regeneration: Passive
- Engines: 1993-2006 | 5.3-16 liters | 175-500 hp
- Learn More: [View LongMile-S Specs](#)



### Vista®

- Verification: CARB Level 3+
- Filter Type: Active DPF
- Regeneration: Diesel Burner
- Engines: 1993-2010 | 100-450 HP | 2.7-13 liters
- Learn More: [View Vista Specs](#)



## Off-Road Products

### Skyline®

- Verification: CARB Level 3+
- Filter Type: Active DPF
- Regeneration: Electric Burner
- Engines: 1960-2006 | up to 15 liters
- Learn More: [View Skyline® Specs](#)



### Horizon®

- Verification: CARB Level 3+
- Filter Type: Active DPF
- Regeneration: Electric Burner
- Engines: 1960-2006 | up to 15 liters
- Learn More: [View Horizon Specs](#)



### Longview®

- Verification: CARB Level 3+
- Filter Type: Passive DPF with NOx reduction
- Regeneration: Passive
- Engines: 1993-2006 | up to 15 liters
- Learn More: [View LongView Specs](#)



## Off-Road Products

### ThermaCat-

- Verification: CARB Level 3+
- Filter Type: Active DPF
- Regeneration: Active (flameless)
- Engines: 1996-2006 | 4-13 liters | 150-400 hp
- Learn More: [View ThermaCat-e Specs](#)



### Phoenix®

- Verification: CARB Level 3+
- Filter Type: Active DPF
- Regeneration: Diesel Burner
- Engines: 1993-2012 | 100-450 HP | 3.4-12 liters
- Learn More: [Phoenix \(off-road\) Specs](#)

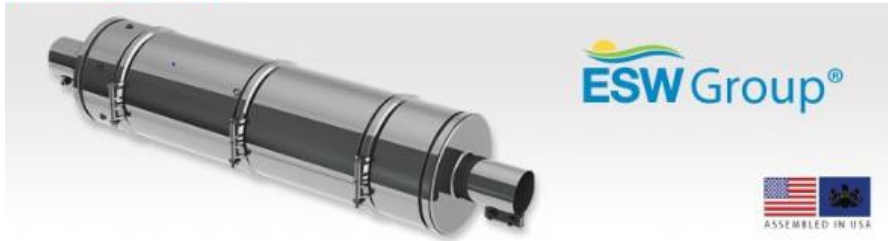


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# Superior Retrofit Technologies

## ThermaCat-e DPF



The ThermaCat-e is specifically designed to provide cost-effective diesel particulate (PM) reduction for in-use diesel engines operating in medium/lightduty on-road applications. ThermaCat-e incorporates a number of unique features including:

- CARB verification to Level 3+ (>85%) for PM
- Diesel exothermic (flameless) technology that takes place real-time
- Requires no driver interaction or downtime while regeneration occurs
- Various sizes and configurations allow for broad engine coverage from 4 to 13 liters / model years 1996 – 2009 / 150 – 400 HP
- Greater than 95% PM Reduction
- Greater than 90% HC and CO Reduction
- CHP compliant for use on school buses

ThermaCat-e Quick Specs	
Filter Type	Active diesel particulate filter
CARB Verification > Engine PM Limit	0.10 g/bhp-hr PM
CARB Verification > Engine Model Years	1996-2009
CARB Verification > Engine Displacement	4-13 liters
CARB Verification > Engine Horsepower	150-400 HP
CARB Exclusions	Consult Distributor
Typical Applications	On-road vehicles including: linehaul trucks, refuse trucks, buses and others and others

## Longview DPF



The Longview® is specifically designed to provide cost-effective diesel particulate (PM) and NOx reductions for in-use diesel engines operating in on-road applications. Features of the Longview include:

Configured in a modular, user-friendly design, Longview integrates a NOx reduction catalyst and a catalyzed wall-flow silicon carbide diesel particulate filter. This provides simultaneous reduction of NOx, PM, hydrocarbons (HC) and carbon monoxide (CO) from one system. Features of the Longview include:

- CARB verification to Level 3+ (>85%) for PM
- NOx reduction of at least 25%
- Proven retrofit solution with over 3,000 in operation
- Uses diesel fuel rather than ammonia or urea as a NOx reduction agent
- Reductions claimable for SIP and Transportation Conformity

Longview® Quick Specs	
Filter Type	Passive diesel particulate filter with NOx reduction
CARB Verification > Engine PM Limit	.01g/bhp-hr PM and lower engines
CARB Verification > Engine Model Years	1993-2006
CARB Verification > Engine Displacement	Up to 15 liters
CARB Exclusions	Consult Distributor
Typical Applications	Transit bus, refuse truck, motor coach, line haul trucks, goods movement trucks and others
PM Reduction	Greater than 85% (Level 3+)
NOx Reduction	At least 25%

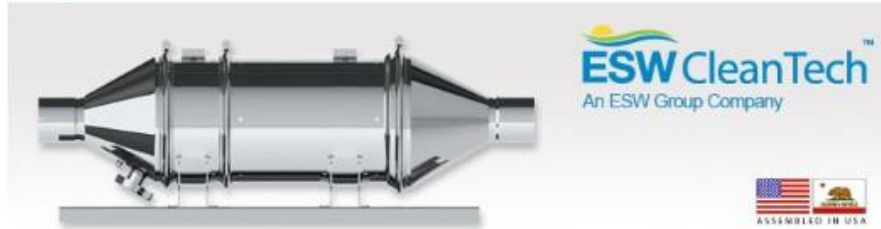


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# Leading Compliance Solutions

## LongMile-S DPF



The LongMile®-S is specifically designed to provide cost-effective diesel particulate (PM) reduction for in-use diesel engines operating in on-road vehicles. Features of the LongMile-S include:

- CARB verification to Level 3+ (>85%) for PM
- Various catalyst and DPF module sizes enable use on diesel engines from 4.2 to 15 liters
- Applicable to a wide range of engine model years between 1993 and 2009, including many 2002-2008 EGR and Caterpillar ACERT engines
- Low exhaust temperature requirement allows for broad application compared to other passive DPFs
- Proven retrofit solution for school buses
- Serviceable DPF module is compatible with most commercially available cleaning machines
- Industry-leading advanced system monitoring, diagnostics and data retrieval

### LongMile-S™ Quick Specs

Filter Type	Passive diesel particulate filter
CARB Verification > Engine PM Limit	0.10 g/bhp-hr PM and lower
CARB Verification > Engine Model Years	1993-2010
CARB Verification > Engine Displacement	4.2-15 liters
CARB Verification > Engine Horsepower	175-500 HP
CARB Exclusions	Consult Distributor
Typical Applications	On-road vehicles including: linehaul trucks, refuse trucks, buses and others
PM Reduction	Greater than 85% (Level 3+)

## Horizon DPF



The Horizon® is specifically designed to provide cost-effective diesel particulate (PM) reductions for in-use diesel engines operating in on-road vehicles and duty cycles including cold exhaust and older engines. Features of the Horizon include include:

- CARB verification to Level 3+ (>85%) for PM
- The practical alternative to vehicle replacement
- Proven retrofit solution for school buses
- Industry leading advanced monitoring, diagnostics and data retrieval
- Durable state-of-the-art stainless steel technology
- Eligible for local, state and federal funding programs

This active regeneration system uses clean electricity, through an integrated heating element, to "cook-off" the captured diesel particulate, much like a self cleaning oven, while the vehicle is parked.

### Horizon® Quick Specs

Filter Type	Active diesel particulate filter with regeneration
CARB Verification > Engine PM Limit	None
CARB Verification > Engine Model Years	1980-2008
CARB Verification > Engine Displacement	Up to 15 liters
CARB Exclusions	Consult Distributor
Typical Applications	Light duty cycle including: school buses, refuse trucks, municipal/utility trucks and others
PM Reduction	Greater than 85% (Level 3+)



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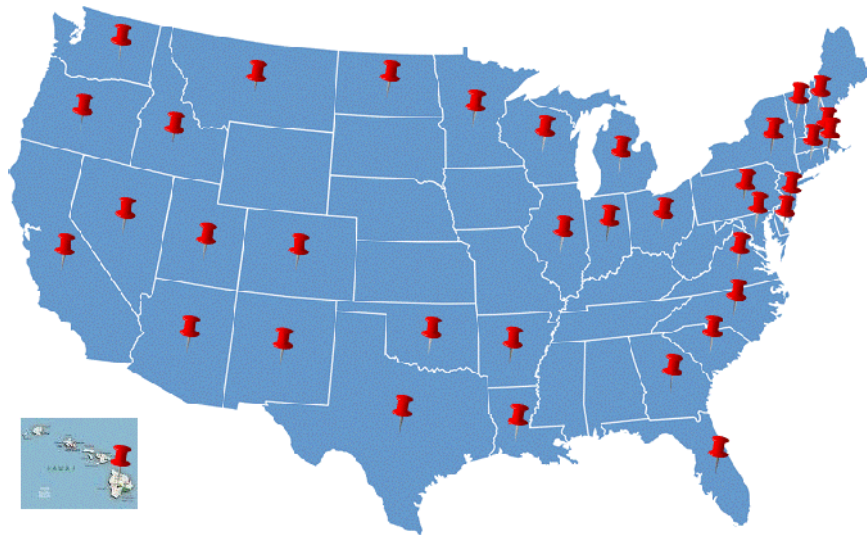
# Leveraging Our Best-in-Class Emissions Testing Facility...

- ISO 9001/2008 accredited emissions testing facility
  - Co-located in a 40,000 square foot facility in Montgomeryville, Pennsylvania (near Philadelphia)
- Durability, performance and emissions testing
  - Six engine dynamometer test cells (from 5 to 1,000 HP)
  - Two chassis dynamometer test cells for light duty (up to 11,000 lbs. Live Inertia) and medium/heavy duty (up to 50,000 lbs. GVW)
  - Single roll AC Motorcycle-ATV-UTV chassis transient motoring dynamometers
- 8 dedicated emissions testing professionals
  - Test planning and project management capabilities
  - Capable of running CARB and EPA verification/certification testing programs
    - Team members have overseen 30+ CARB and EPA certification processes



# ... And Our Established US Distribution Network

## Distributor Coverage



## Select Key Distributors



- Northwest's largest and oldest sales and service distributor for commercial, school and transit bus operators including parts, maintenance and diesel emissions retrofit
- Location in Portland, OR



- Freightliner, Hino, Ford, Isuzu, Sprinter dealer
- New and used vehicle sales, truck leasing and rental, commercial truck parts, service and vehicle financing
- 16 dealerships, parts warehouses collision centers and other service centers in CA and NV



- Freightliner dealer serving the South Texas region for over 12 years
- Authorized dealer for Thomas Bus, Caterpillar, Cummins and others
- Two locations in TX

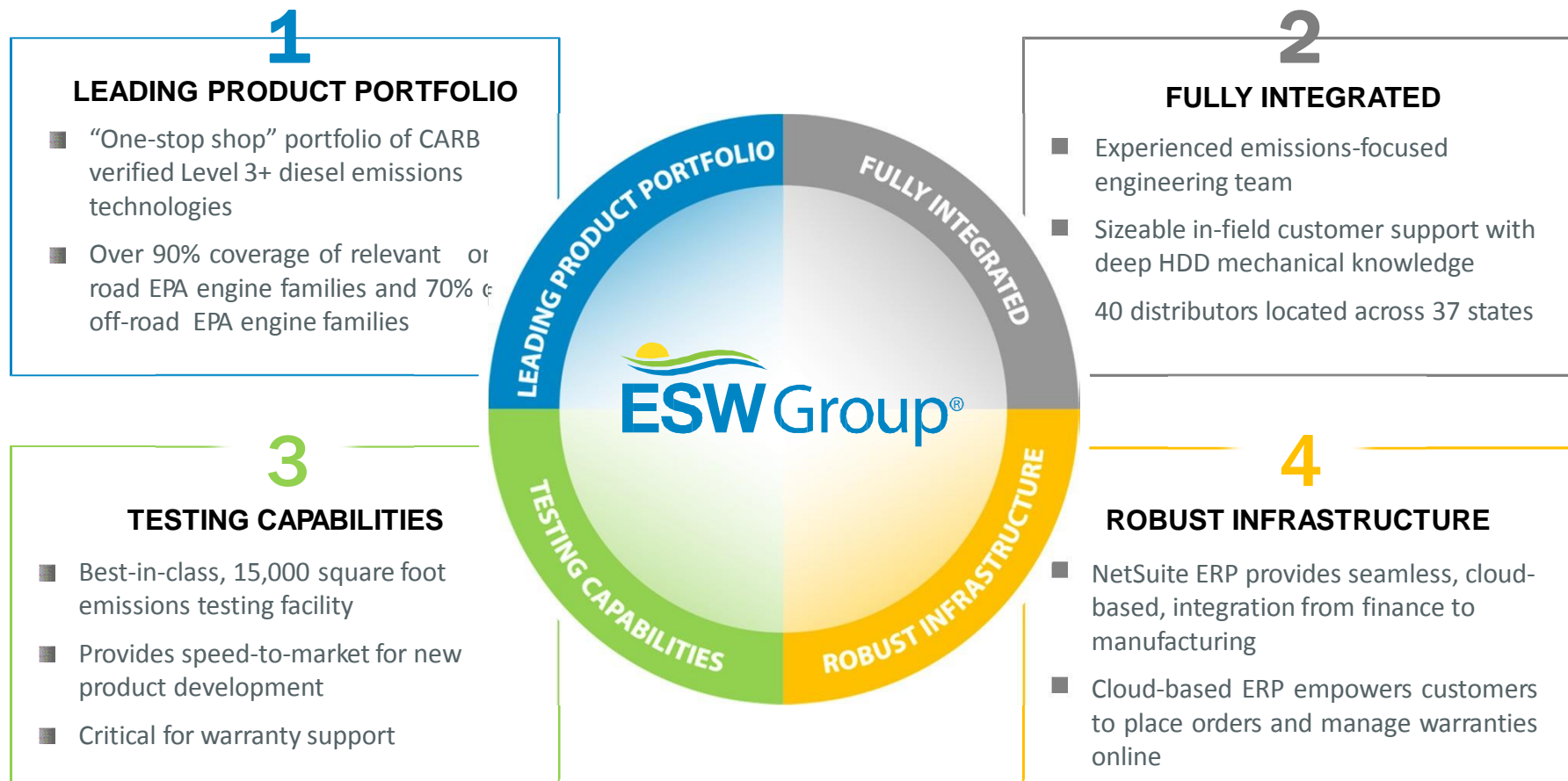
 Current coverage of 37 US States through our distributor network, with on-the-ground capabilities across the U.S.



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# In Summary: ESW's Competitive Differentiation



## Unique Capabilities in its Industry



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# Experienced Leadership Team

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## John Dunlap, Board Member

- Board Member of ESW since 2007
- Served as Chairman of the California Air Resources Board from 1994 to 1999
- Served as Chief Deputy Director of the California Department of Toxic Substances Control
- B.A. from University of Redlands and Masters from Claremont University

## Mark Yung, Executive Chairman

- Executive Chairman of ESW since 2011
- Board member of Polymer Plainfield
- Previously, a SVP at Citigroup and ABN AMRO and an investment professional at JPMorgan Partners
- B.A. from Cornell University and a M.B.A. from INSEAD

## Praveen Nair, CFO and CAO

- Joined in May 2005
- Previously, Senior Manager in the B.D. and Migrations Unit at e-Serve International Ltd, a Citigroup company
- B. Com. and Masters in Finance from College of Materials Management, Jabalpur, India

## Virendra Kumar, CCO

- Joined in 2009
- Previously Emission Operations Leader at Cummins, design and production engineer at Escort JCB, project manager at Indian Institute of Technology Delhi
- B.S. from University of Rajasthan, Masters degree from Indian Institute of Technology Delhi

