ESW Group®

Oregon Diesel Workgroup Meeting

June 27, 2016

SUMMARY

- Retrofits are a proven tool to achieve immediate Diesel PM reduction
- Oregon can draw on the CARB experience and avoid mistakes
  - CARB verification is most rigorous, has been proven and forces BACT
  - Focus on public fleets and those operating in populated areas (refuse, municipal fleets etc.) initially
  - Incentives are key as are adequate implementation dates and industry outreach and education
- Outreach and enforcement are important

CLEAN AIR STRATEGY: NEW AND IN-USE

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- New engines have very low PM emissions but:
  - Heavy Duty Fleet turnover is slow
  - Oregon has become a dumping ground for old California vehicles
- DPF retrofits applied to older engines generate an immediate benefit
  - DPF retrofit reduces PM emissions by 90% or more
  - DPF retrofit can be cost effective and easy to implement
  - DPF technology exists for old and high-emitting engines
  - Infrastructure for DPFs is already in place

RETROFIT DPFs COME IN MANY VARIETIES

ESW Group®

- Products exist for every application
  - Passive DPFs for heavy operation
  - Active DPFs for low-speed operation

FLEET TURNOVER IS SLOW….

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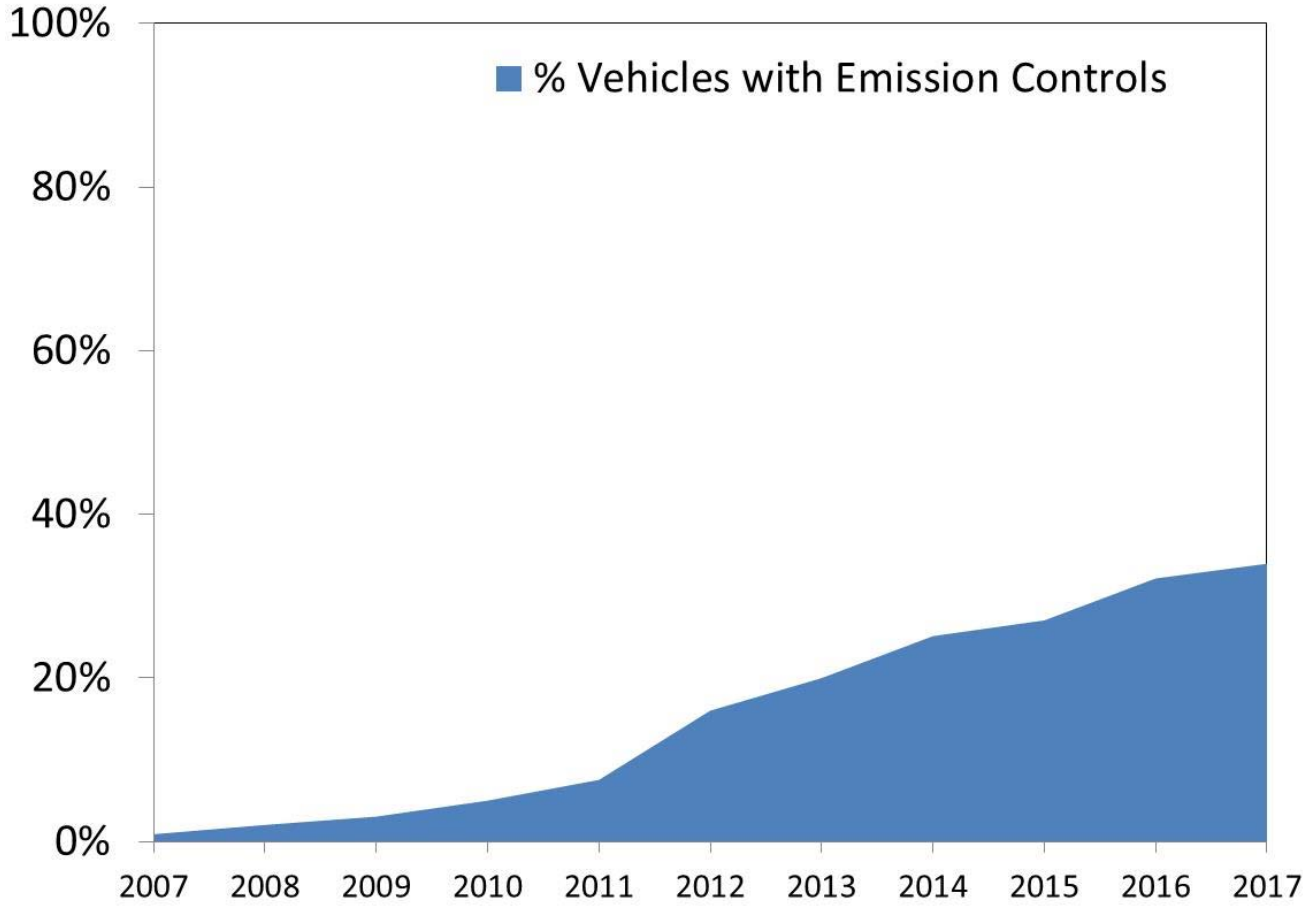
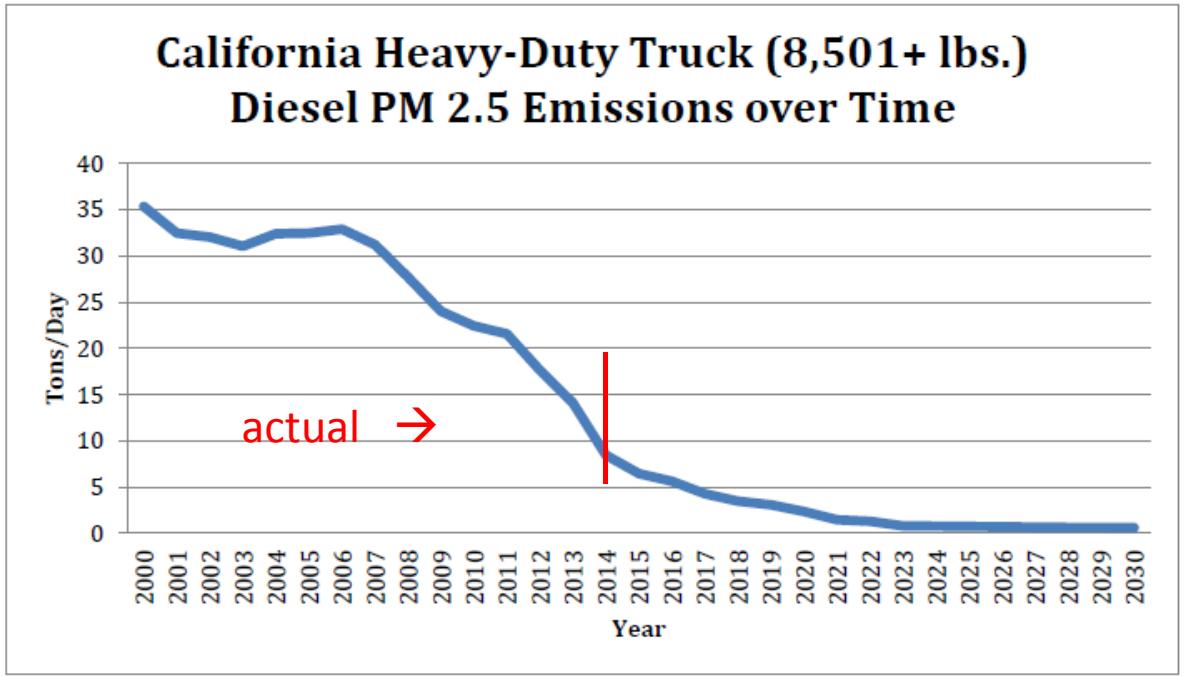
US Medium- and Heavy Duty Vehicles with Emissions Controls



Source: Frost & Sullivan analysis, March 2012.

CALIFORNIA'S EXPERIENCE

- CARB has had success with two pronged strategy
  - New engine regulations
  - In-use rules require retrofits, retirement and replacement



Draft Supporting Information For Technology Assessments: Truck And Bus Sector Description, CARB, April 2016

BUILDING ON CALIFORNIA EXPERIENCE

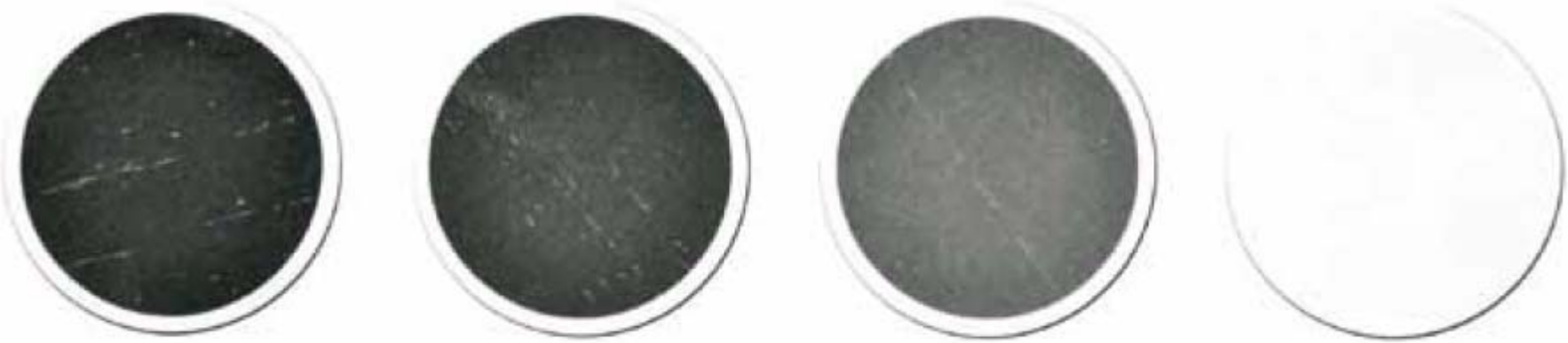
- Focus on vehicles that work in populated areas
  - Transit buses and refuse collection vehicles
  - Municipal fleets
  - Ports
- Major clean up of school buses
  - Accelerated by state funding
- Fleet flexibility
  - With clear start dates for fleet operators
- Incentives
  - Double credits for early adoption
  - Funding to accelerate emission reductions

WHAT HAS NOT WORKED WELL IN CALIFORNIA

- Changing deadlines cause uncertainty for fleets and emission control manufacturers
- Failure to coordinate with Cal-OSHA on off-road rule
- Inadequate outreach and education
- Spotty enforcement
  - Many fleets ignored the Clean Diesel regulation
- Limited incentives

FOCUS ON COMPLETE PM CONTROL

- Regulation should focus on controlling all diesel PM, from ultrafine particulates (< 100 nm) to PM10
  - DPFs have been proven to be most effective in capturing ultrafine particulate
  - DOCs do not control black carbon or ultrafine PM
  - Biodiesel does not reduce ultrafine PM



No retrofit system
Uncontrolled Diesel Exhaust

Retrofitted with
Diesel Oxidation Catalyst (DOC)
(Level 1)

Retrofitted with
Partial Filter
(Level 2)

Retrofitted with
Diesel Particulate Filter (DPF)
(Level 3)

DPF VS. DOC

DPF	DOC
Captures PM whenever the engine is running	Reduces PM only when catalyst temperature is in the active range
Collects PM of all sizes with high efficiency, including ultrafines	Relatively low efficiency across all sizes
Removes all types of PM: carbon particles, composite particles, lube oil (including lube oil ash) and other inorganic material	Mainly removes soluble organic component, little effect on carbon particles, no effect on inorganic material

OREGON CAN BENEFIT FROM CARB EXPERIENCE

- CARB verification
  - Is robust with strict performance standards
  - Protects the end user
- CARB verified systems have
  - proven themselves in thousands of applications
  - have track records
- Retrofit systems have matured
- Retrofit cost has decreased
  - HD truck: ~$ 10k for passive and $10-16k for active system
- Inspection and maintenance is important

CLEAN DIESEL REQUIRES MONITORING

- Clean Diesel regulations don't mean much if the filters are broken!
- Many 2007+ vehicles operate with broken DPFs!
- Many maintenance shops have not adapted to Clean Diesel
- Education and enforcement is important

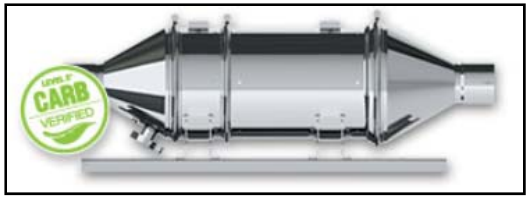
ESW GROUP OVERVIEW

- ESW Group is a US company with about 50 employees
- Over 20,000 retrofit systems sold since 2004
- Headquarters, manufacturing and testing in Montgomeryville, PA. Additional facilities in Toronto, San Diego, Los Angeles and San Francisco area.
- ESW's emission test laboratory is capable of EPA and CARB certification and verification; fully CFR compliant
- ESW is a VERT member

Diesel emission control is our core business.

LEADING LEVEL III+ CARB VERIFIED RETROFIT PRODUCT LINE

ESW Group®

- Largest portfolio of CARB verified retrofit products for on-road and off-road engines originally certified without DPF's
  - 5 on-road CARB verified DPF retrofits
  - 3 off-road CARB verified DPF Retrofits

- With over 20,000 systems in the retrofit market, ESW is the leading diesel emission control manufacturer for on-road and off-road heavy duty diesel engines in the US. www.eswgroup.com