SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

ICF International

# Truck Emission Reduction Strategies

FREIGHTWORKS
SOUTHERN CALIFORNIA DELIVERS THE GOODS

# Presentation overview

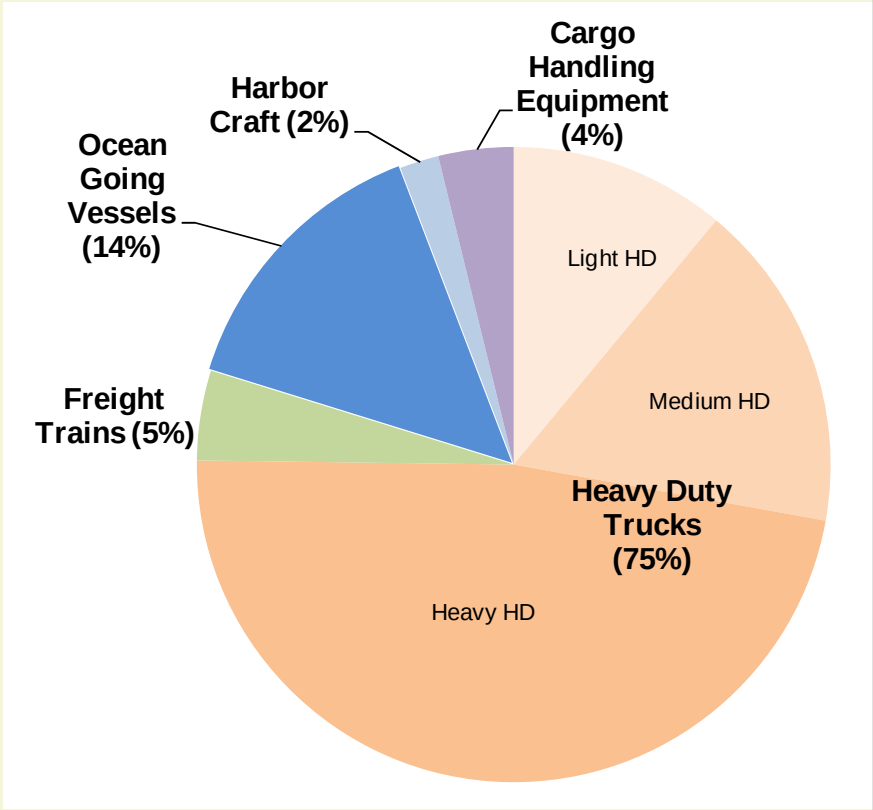
- Baseline emissions
- Emission reduction strategies
- Policy issues

# Zero-Emission Technology Strategy

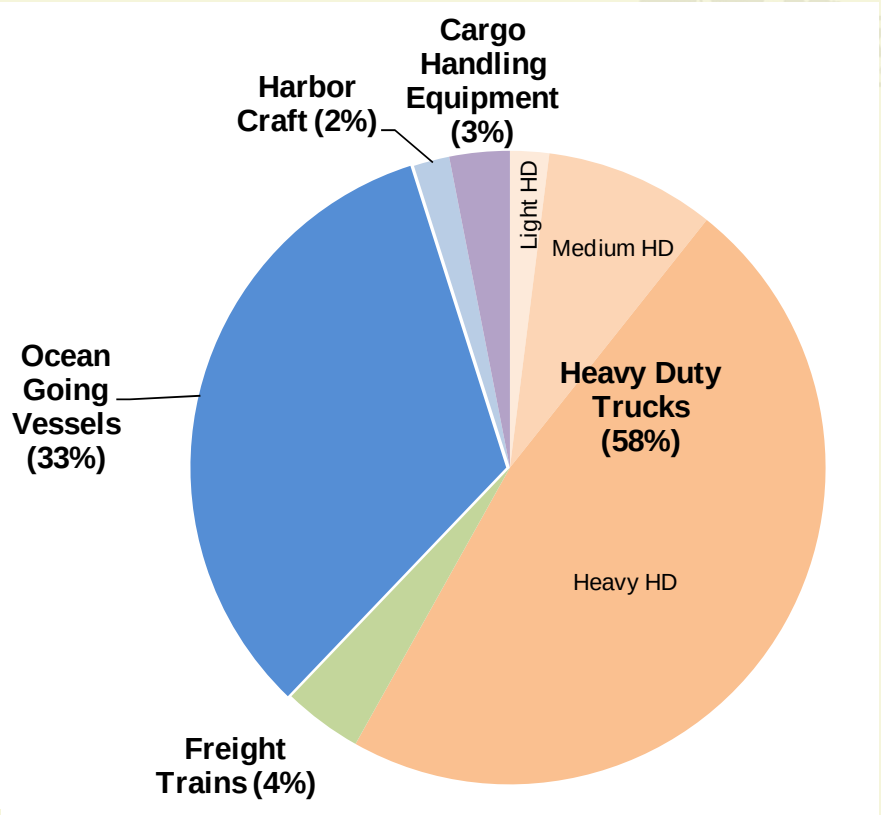
- Two-pronged approach
  - An aggressive program to bring more clean fuel / hybrid trucks into service represents the best near-term strategy
  - A regional freight corridor program represents an opportunity to commercialize zero-emission technologies and build incentives into an existing program (e.g., the RTP)

# Current goods movement emissions

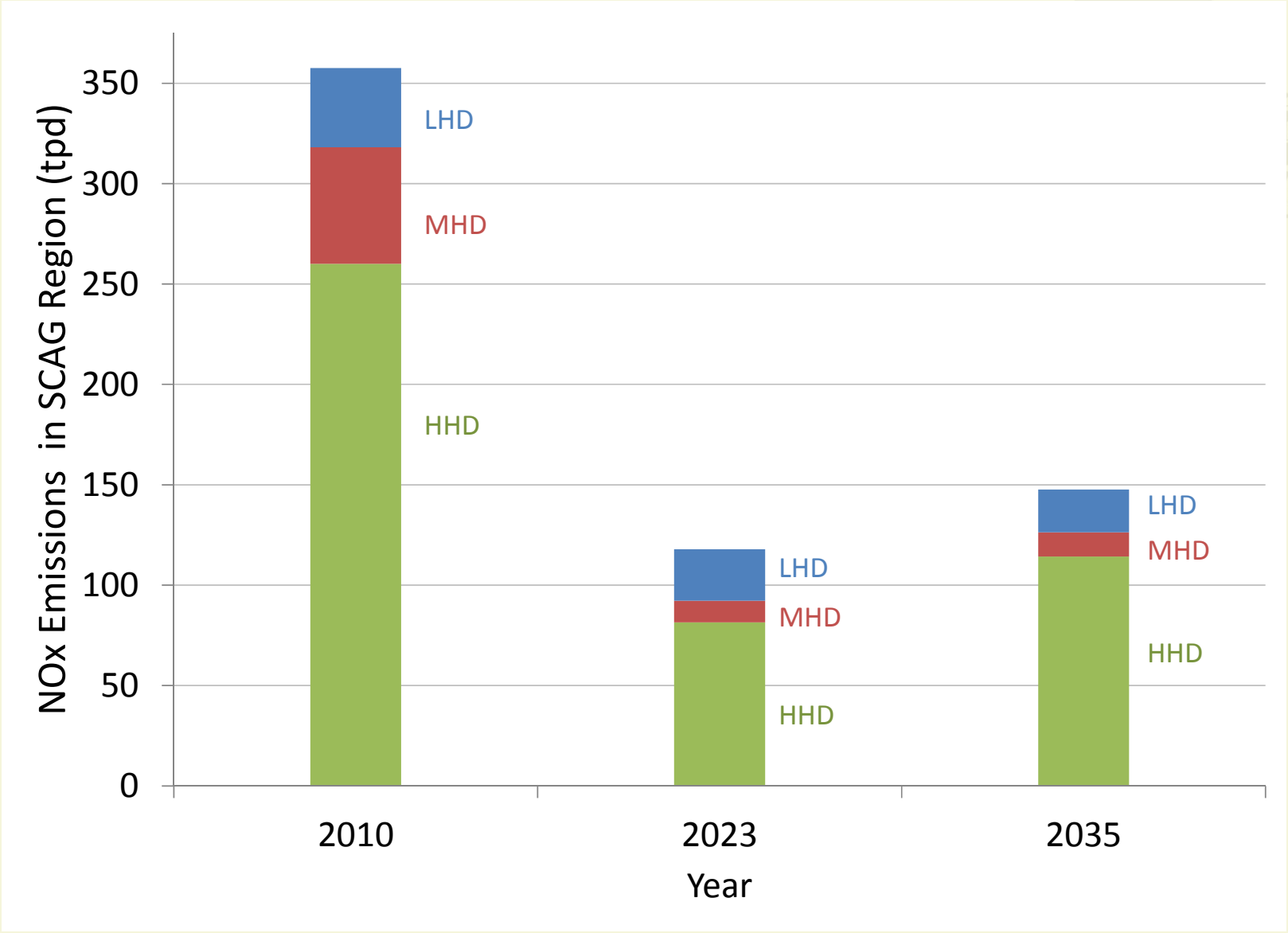
## NOx Emissions



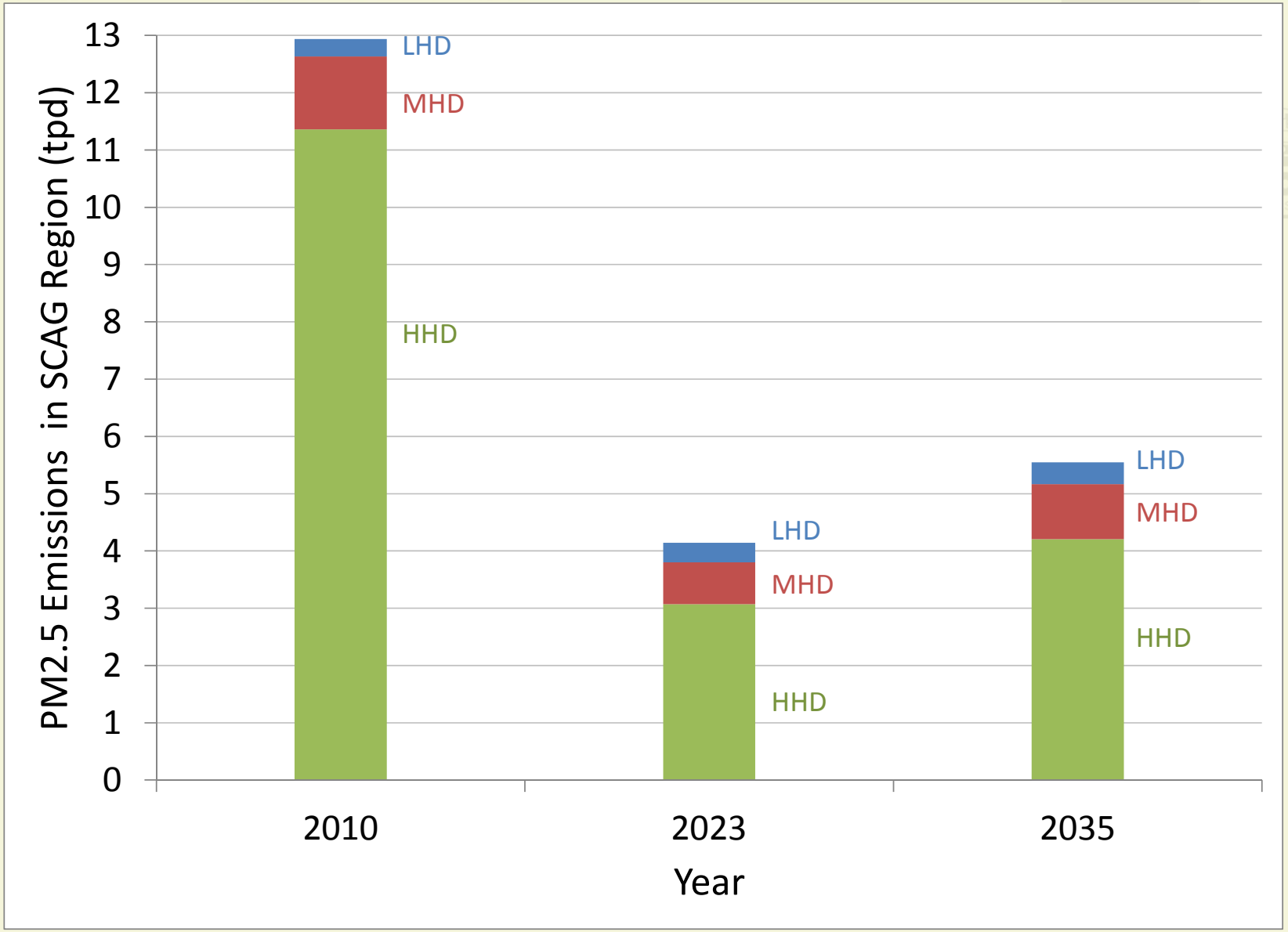

## PM2.5 Emissions



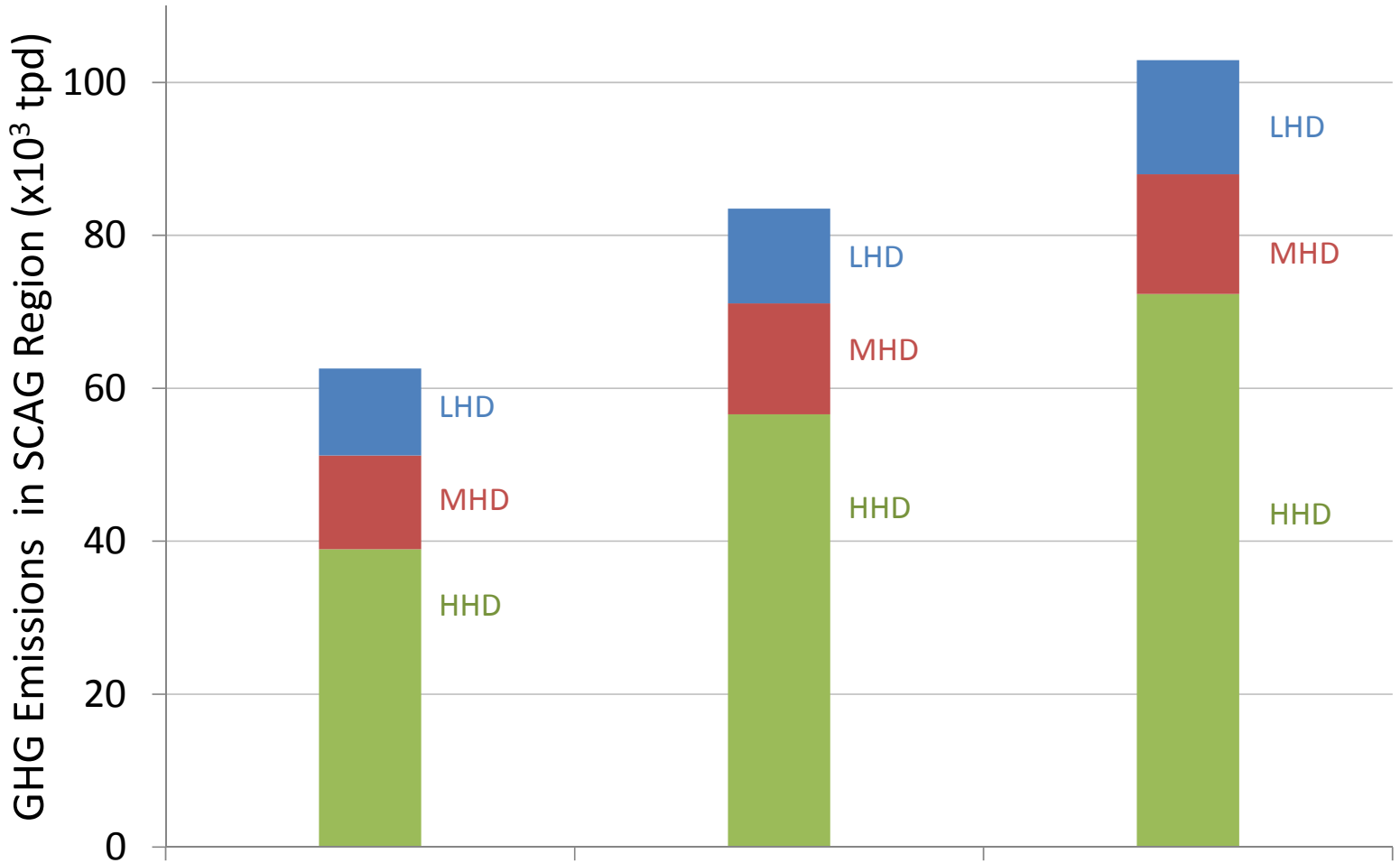
# Heavy duty trucks – baseline NOx



# Heavy duty trucks – baseline PM2.5

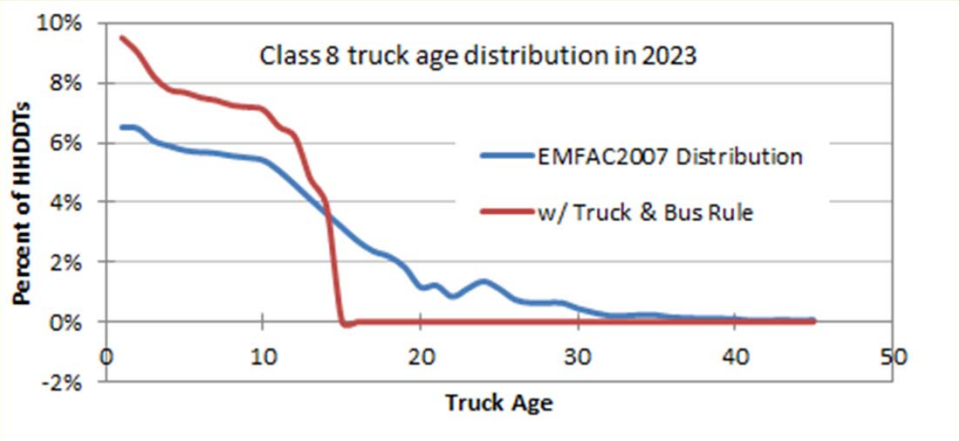


# Heavy duty trucks – baseline GHGs



# Near-term: Impact of ARB's In-Use Truck & Bus Rule

- By 2023, nearly all HDVs will be model year 2010 or newer




- Accelerating turnover will produce no significant emissions benefits
- So … further emission reductions must come from introduction of advanced technology HDVs

# Truck advanced technology options

- Advanced natural gas engines
- Hybrid technologies
- Plug-in hybrid technologies
- Battery electric technologies

# Natural gas engines

- Available today for most applications
- Emissions reductions per truck

| Class 3 Gasoline | | | Class 8b Diesel | | |
|---|---|---|---|---|---|
| NOx | PM | GHGs | NOx | PM | GHGs |
| 20-30% | 0% | 21-38% | 35-50% | 10-30% | 20-37% |

- Incremental cost per truck
  - Class 3: $15-20K
  - Class 8: $35-45K
- Fueling infrastructure needed

# Hybrid technologies

- Available today for most single-unit trucks
- Limited availability for Class 8; more in next few years
- Emissions reductions per truck

| Class 3 Gasoline | | | Class 8b Diesel | | |
|---|---|---|---|---|---|
| NOx | PM | GHGs | NOx | PM | GHGs |
| 11-21% | 21-31% | 20-35% | 31-41% | 4-24% | 5-20% |

- Incremental costs per truck
  - Class 3: $10-15K; potential to decrease 50% by 2035
  - Class 8: $55-60K; potential to decrease 50% by 2035

# Plug-in hybrid technologies

- Demonstration stage
- Emissions reductions per truck

| Class 3 Gasoline | | | Class 8b Diesel | | |
|---|---|---|---|---|---|
| NOx | PM | GHGs | NOx | PM | GHGs |
| 68-78% | 43-58% | 42-52% | 28-58% | 9-33% | 10-25% |

- Incremental costs per truck
  - Class 3: $20-30K; potential to decrease 50% by 2035
  - Class 8: $70-100K; potential to decrease 50% by 2035
- Charging infrastructure needed
- Could potentially use wayside power

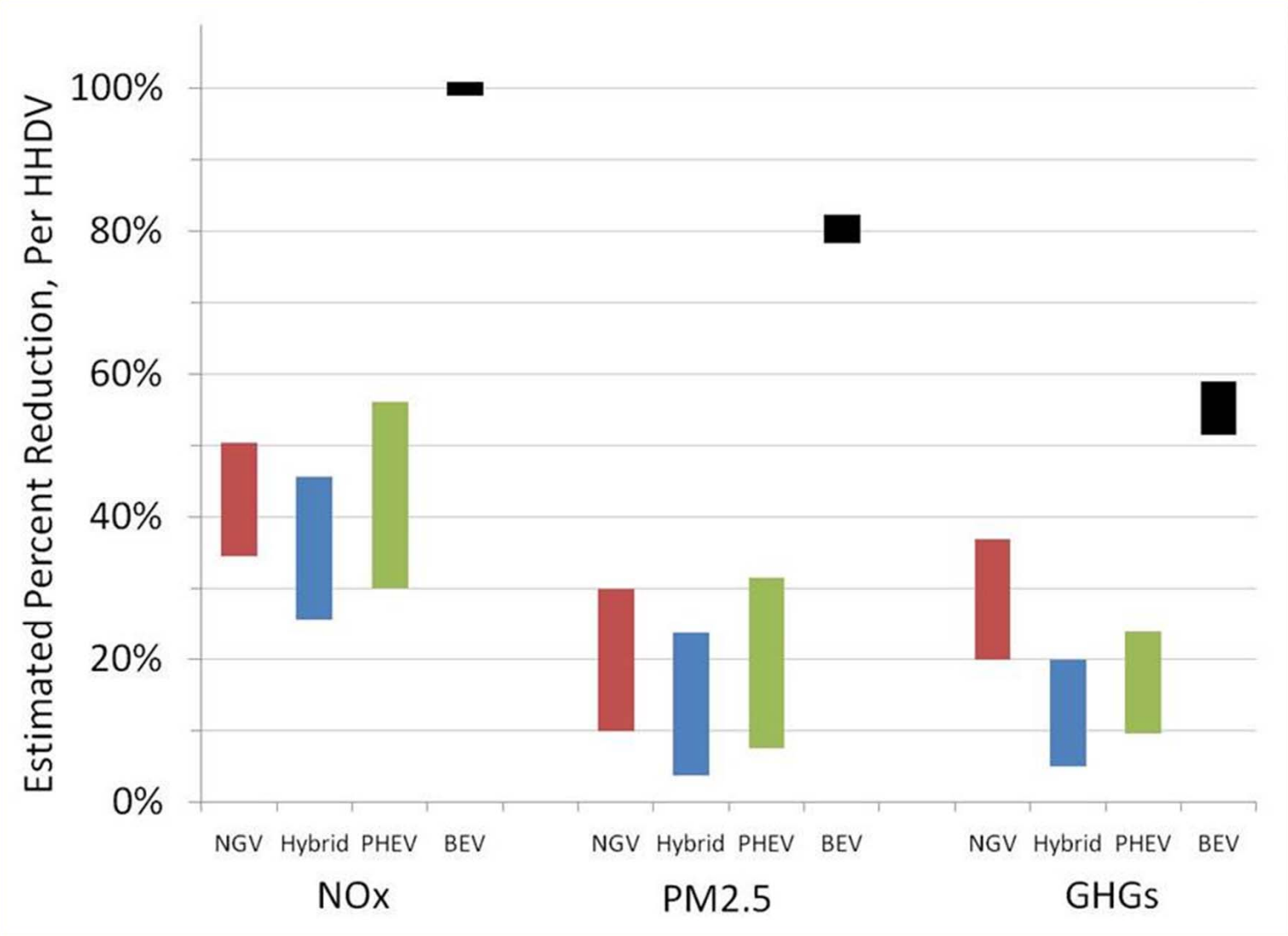
# Battery electric technologies

- Demonstration stage
- Emissions reductions per truck

| Class 3 Gasoline | | | Class 8b Diesel | | |
|---|---|---|---|---|---|
| NOx | PM | GHGs | NOx | PM | GHGs |
| 100% | 58-66% | 52-60% | 100% | 76-84% | 51-59% |

- Incremental costs per truck
  - Class 3: $30-50K; potential to decrease 50% by 2035
  - Class 8: $100-135K; potential to decrease 50% by 2035
- Charging infrastructure needed
- Could potentially use wayside power

# Emission reduction (per HHDV)



# Deployment scenarios

- Assume technology deployed in first year available for each weight class
- Assume cost is incremental purchase price of vehicle

# Deployment scenario - 2023

- Example: if 20% of new vehicle purchases are advanced technology
- Results for 2023:

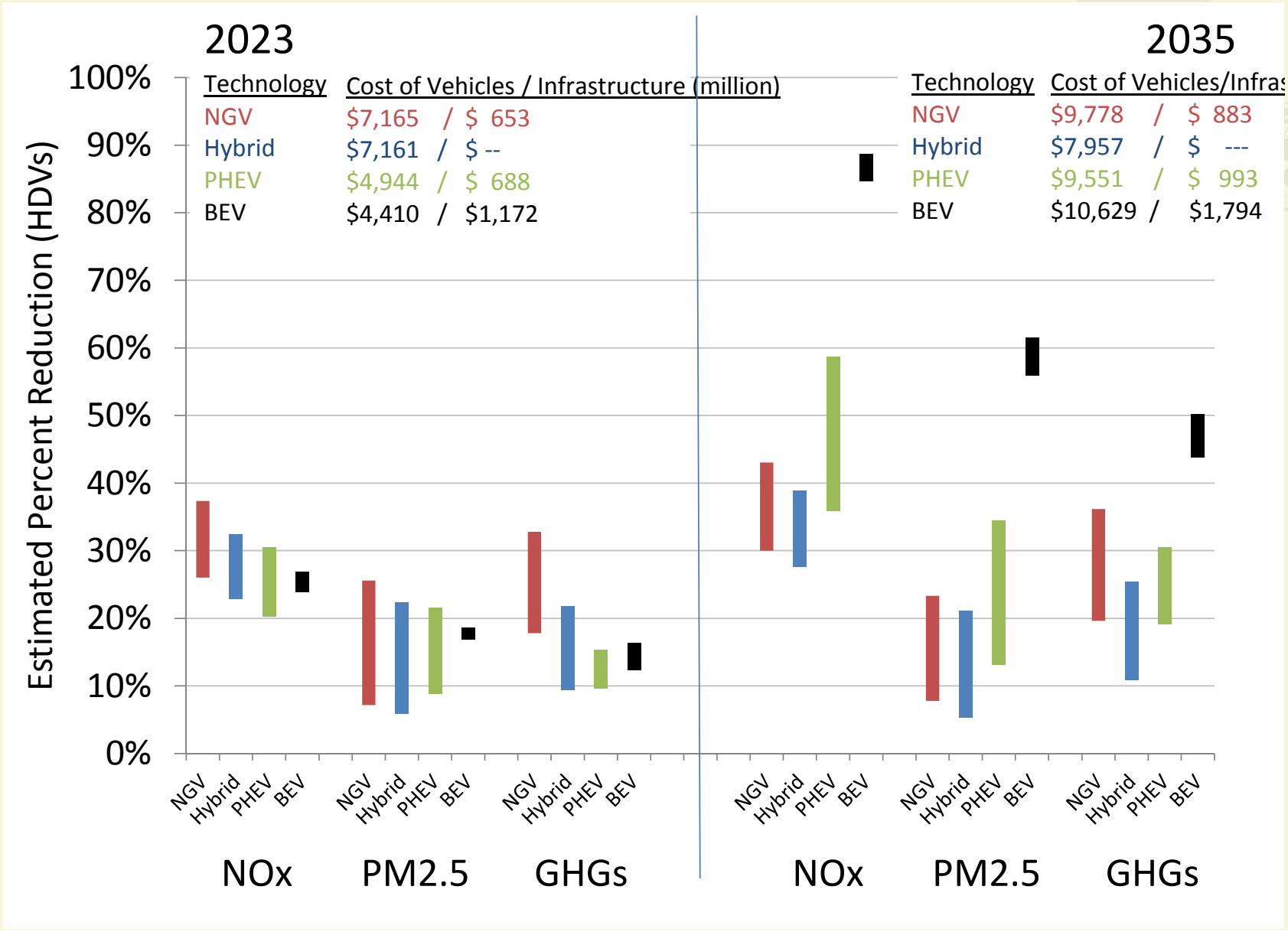
| Technology | Assumed first year of commercial availability | NOx | | | PM2.5 | | | Capital Cost (Millions) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Baseline (tpd) | Reduction (tpd) | % of Baseline | Baseline (tpd) | Reduction (tpd) | % of Baseline | Vehicles | Infrastr. |
| Natural Gas | 2012 | 76.2 | 4.8 | 6% | 2.6 | 0.09 | 3% | $1,433 | $131 |
| Hybrid Electric | 2012-14 | | 4.2 | 6% | | 0.07 | 3% | $1,432 | $0 |
| Plug-In Hybrid | 2016-20 | | 3.9 | 5% | | 0.08 | 3% | $989 | $138 |
| Battery Electric | 2017-23 | | 3.6 | 5% | | 0.09 | 4% | $882 | $234 |

# Deployment scenario - 2035

- Example: if 20% of new vehicle purchases are advanced technology
- Results for 2035:

| Technology | Assumed first year of commercial availability | NOx | | | PM2.5 | | | Capital Cost (Millions) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Baseline (tpd) | Reduction (tpd) | % of Baseline | Baseline (tpd) | Reduction (tpd) | % of Baseline | Vehicles | Infrastr. |
| Natural Gas | 2012 | 88.0 | 6.4 | 8% | 3.3 | 0.10 | 4% | $1,956 | $177 |
| Hybrid Electric | 2012-14 | | 5.9 | 8% | | 0.09 | 3% | $1,591 | $0 |
| Plug-In Hybrid | 2016-20 | | 8.3 | 11% | | 0.16 | 6% | $1,910 | $199 |
| Battery Electric | 2017-23 | | 14.9 | 20% | | 0.39 | 15% | $2,126 | $359 |

# Deployment scenario – 100% of new purchases are advanced technology



# Potential mechanisms to accelerate clean truck deployment

- New emission standards
  - Outside control of SCAG and regional partners
- Vehicle purchase subsidies
  - Buy down incremental cost; like Carl Moyer
- Access control
  - Highway segments and/or major terminals (e.g., ports)
  - Need to couple with vehicle incentives
- Clean truck technology infrastructure
  - Wayside power
  - Charging / fueling infrastructure

# Operational & maintenance strategies

- Maximize use of on-dock rail
  - Actively pursued by ports
- Expand use of near-dock rail
  - SCIG and ICTF expansion
- Railroad grade separation
  - Safety and mobility benefits
- Railroad capacity expansion
  - Minimize train delay/idling

# Operational & maintenance strategies cont.

- Truck idle reduction
  - Expand enforcement of ARB rule
  - Use permits for new/expanded warehouses
- New truck I&M program
  - Concern about SCR systems
- System management
  - Bottleneck relief
  - Incident management for trucks

# Truck strategies – Policy implications

- Freight corridor with access restrictions and/or wayside power:
  - Could potentially accelerate low/zero emission truck deployment
  - Will affect only a portion of regional truck VMT
- Significant regional HDV emission reductions will require vehicle purchase incentives
- Investments in clean truck infrastructure should maximize flexibility to avoid stranded capital