

Fuel and emission standards for the City fleet

City of Madison
The Natural Step
July 17, 2007

Overall Project Status

- Staff is currently researching/evaluating data collection equipment to obtain data on tailpipe emissions.



- Development of methods to reduce fuel use and emission reductions.

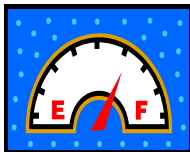
Team Members

- Bill Vandebrook, Fleet Services
- Andrew Statz, Mayor's Office
- Ann Gullickson, Metro
- Bruce Nelson, Fleet Service
- Tim Fruit, Comptroller's Office
- Chris Kelley, Streets Division



Four System Conditions

- **SYSTEM CONDITION 1.**
- Reduces dependence upon fossil fuels, extracted underground metals and minerals?
- Reduced fuel consumption



- **SYSTEM CONDITION 3.**
- Reduces dependence on activities that harm life-sustaining ecosystems?
- Reduced environmental impact due to drilling and emissions





Potential Impacts

- Environmental-improved air quality
- Social- improved air quality
- Fiscal-reduced fuel use, improved air quality



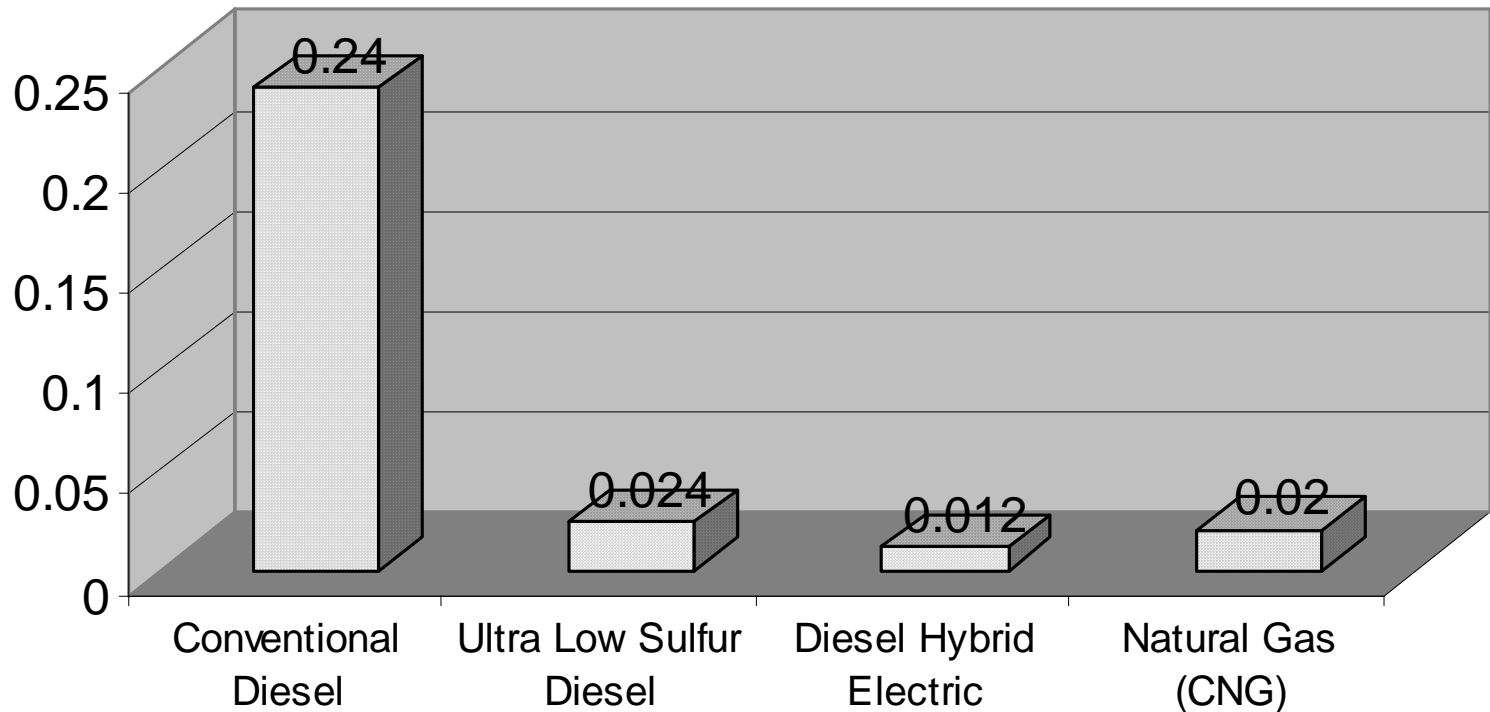


Metro Transit

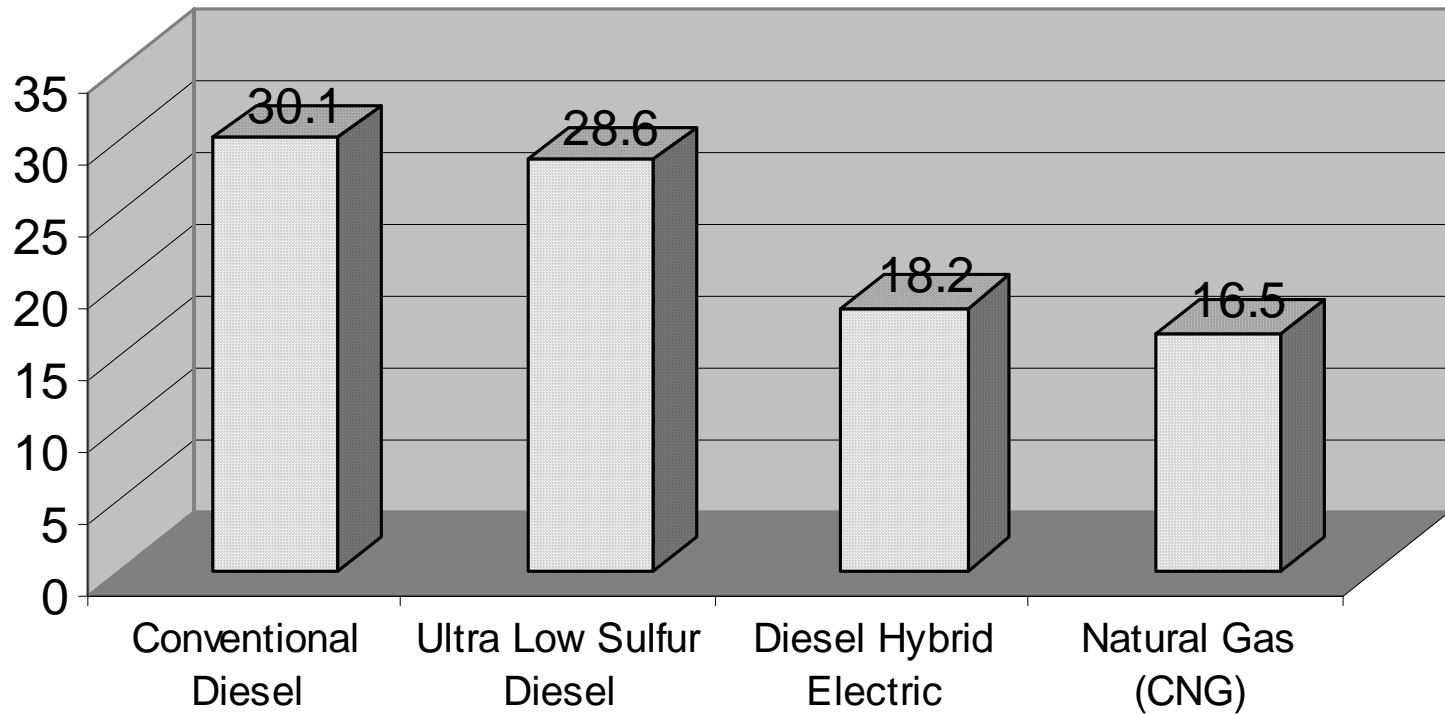
| | Gasoline | Diesel #1 | Diesel #2 | ULSD | Diesel Totals |
|-------------|-----------------|------------------|------------------|-------------|----------------------|
| 2004 | 10,828.7 | 158,436.0 | 1,099,984.2 | | 1,258,420.2 |
| 2005 | 9,909.9 | 56,297.0 | 724,373.3 | 512,742.0 | 1,293,412.3 |
| 2006 | 10,475.9 | | 3,005.3 | 1,320,112.0 | 1,323,117.3 |

Transit Buses

Particulate Matter Emissions, grams/mile

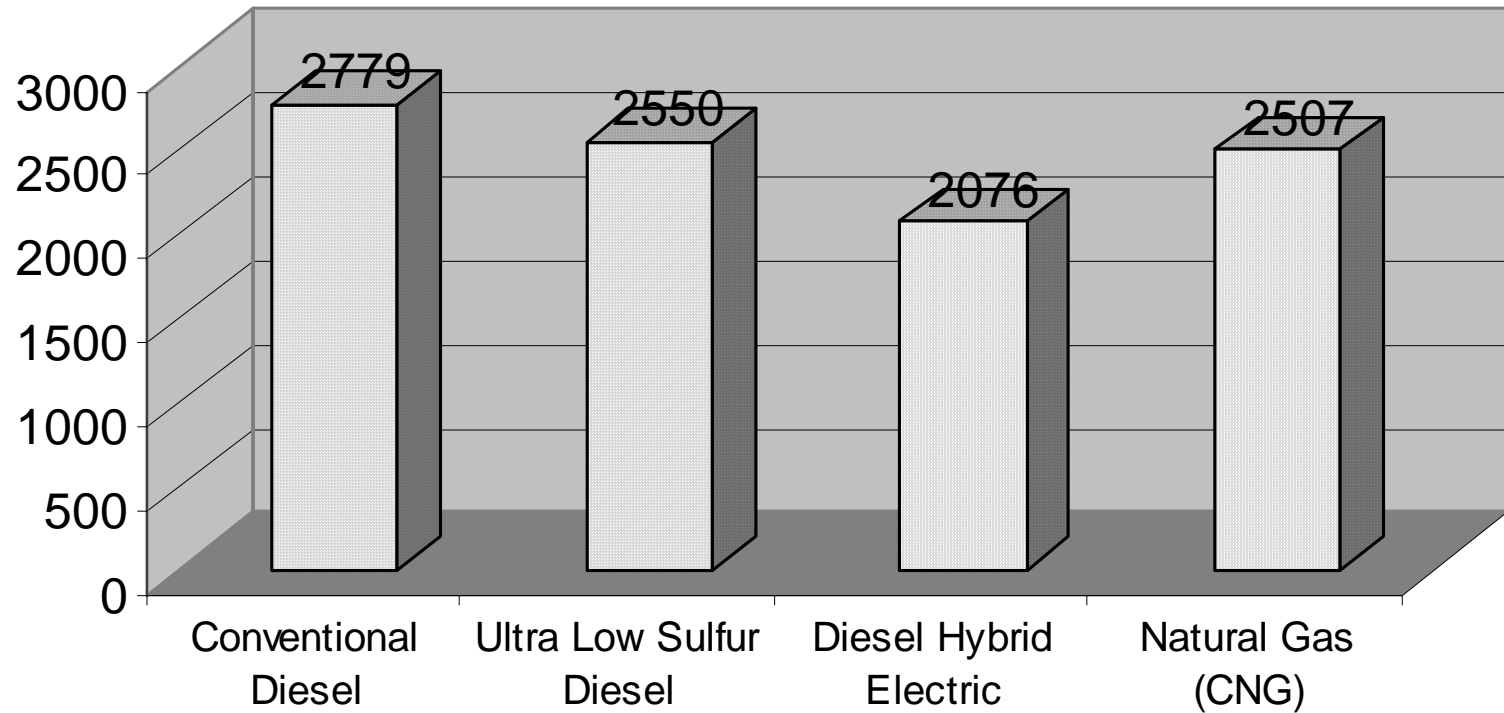


Transit Buses NOx Emissions, grams/mile



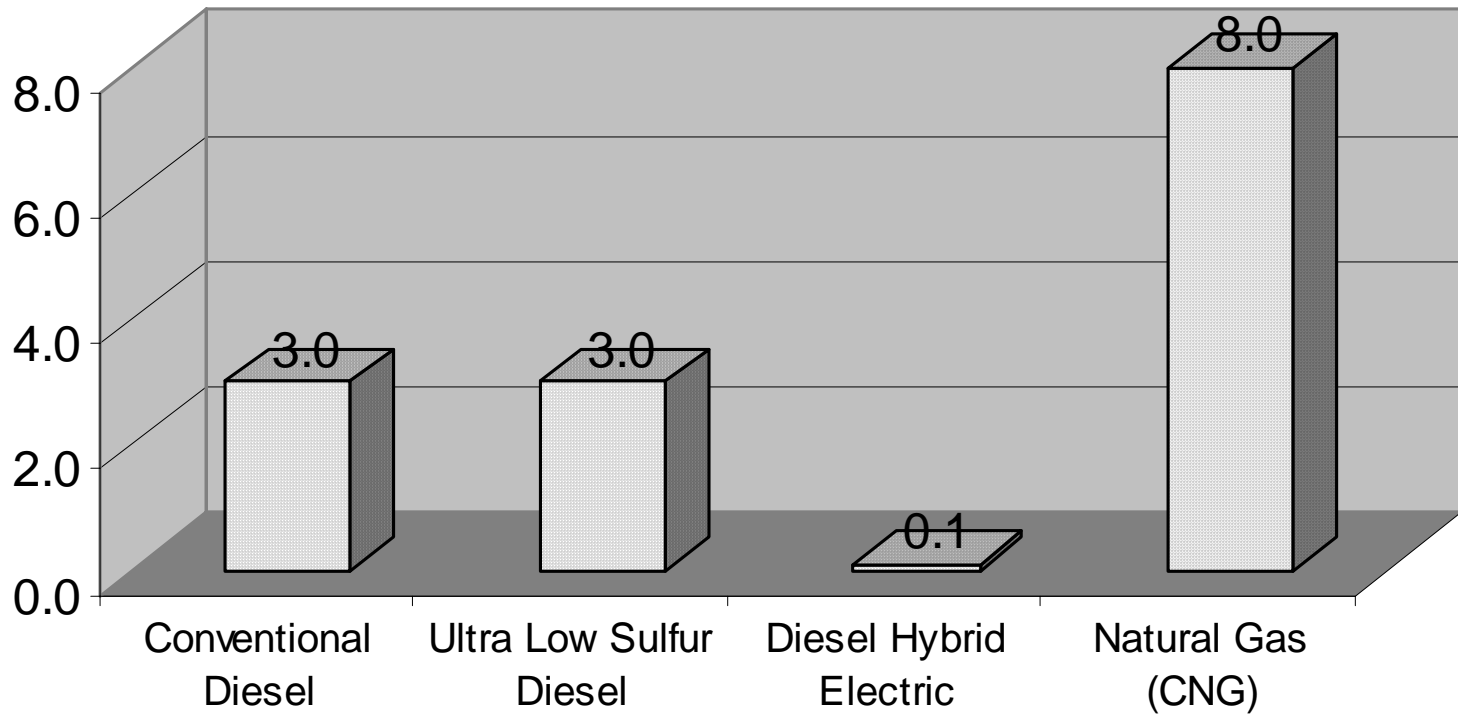
Transit Buses

Carbon Monoxide (CO) Emissions, grams/mile



Transit Buses

Carbon Dioxide (CO₂) Emissions, grams/mile

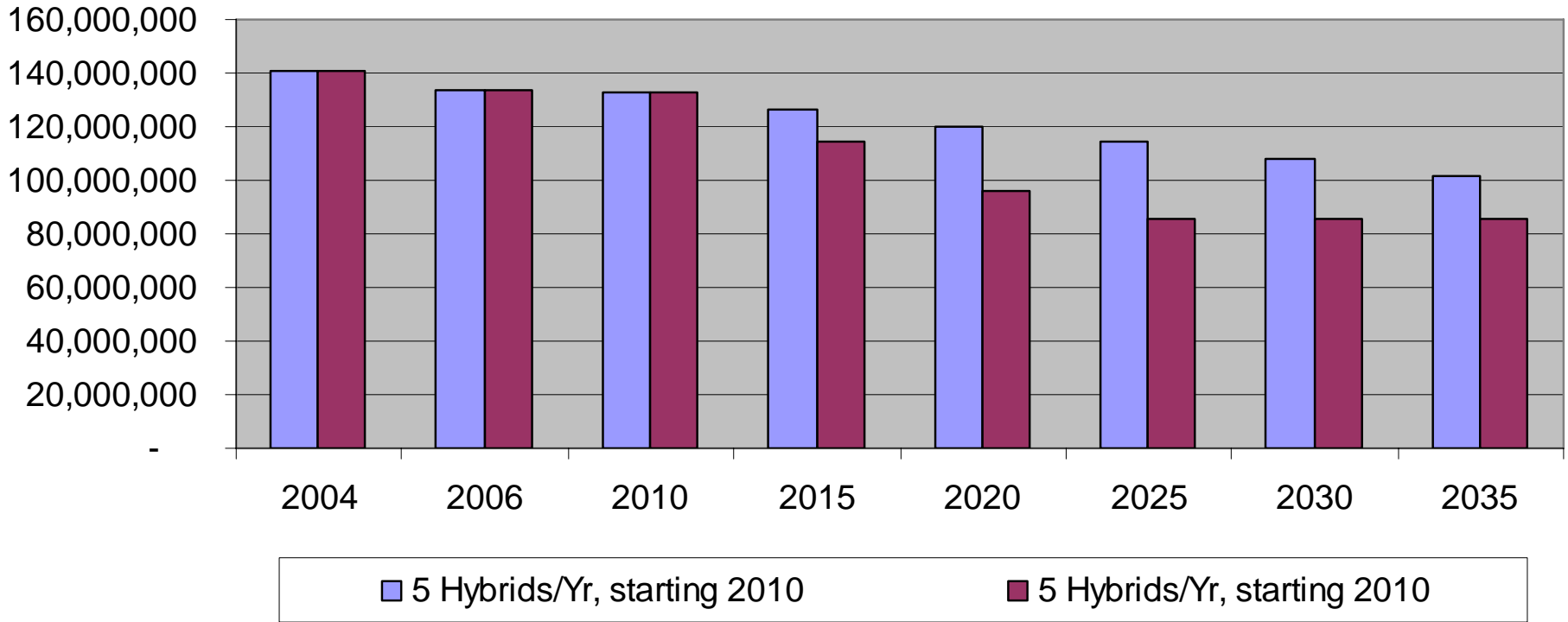


| | ULSD | Hybrid |
|-------------------------------|------------|------------|
| PM | 570 | 285 |
| Nox | 678,706 | 432,928 |
| CO2 | 71,193 | 2,373 |
| CO | 60,513,959 | 49,256,055 |
| Assumes equal mileage per bus | | |

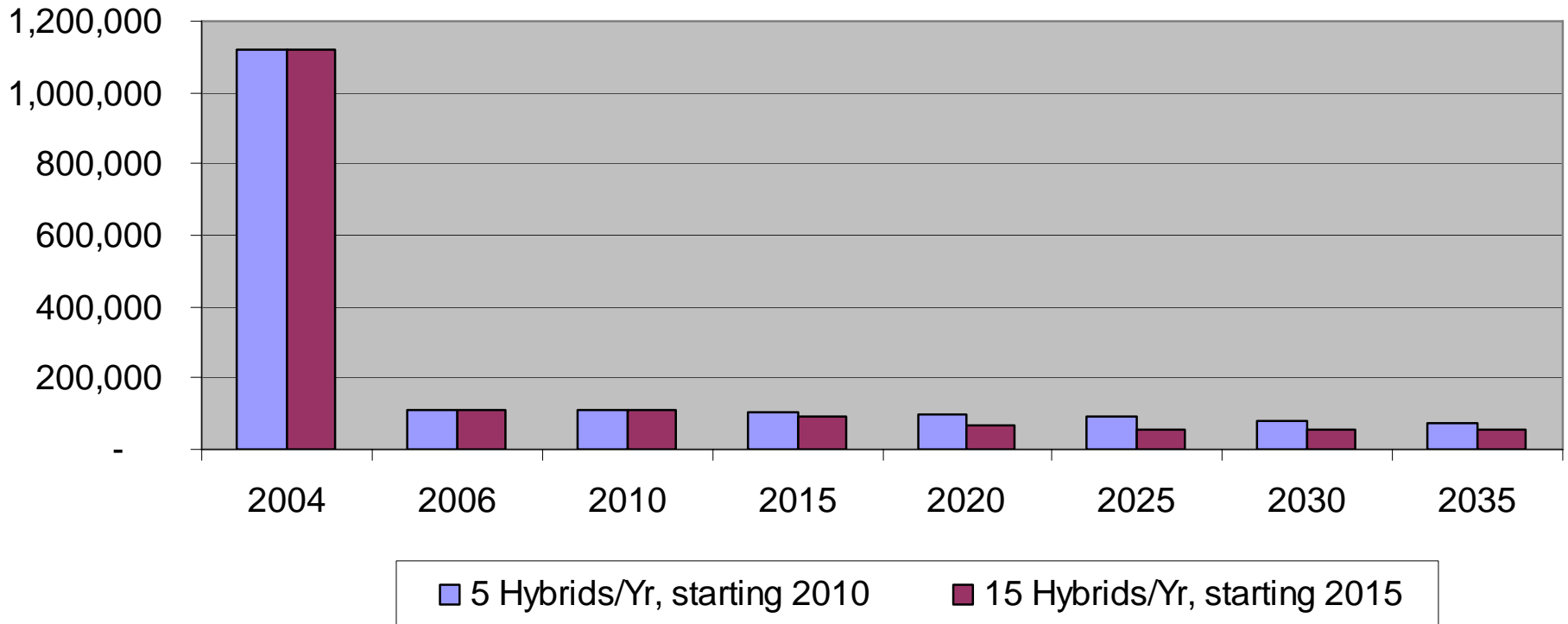
Annual Emissions (Grams)

| | 2004 | 2006 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|------------------------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Scenario #1 | Conventional | ULSD | 5 Hybrids | 30 Hybrids | 55 Hybrids | 80 Hybrids | 105 Hybrids | 130 Hybrids |
| 5 Hybrids/Yr, starting 2010 | Diesel | | 192 Diesel | 167 Diesel | 142 Diesel | 117 Diesel | 92 Diesel | 67 Diesel |
| Scenario #2 | | | 5 Hybrids | 80 Hybrids | 155 Hybrids | 197 Hybrids | 197 Hybrids | 197 Hybrids |
| 15 Hybrids/Yr, starting 2015 | | | 192 Diesel | 117 Diesel | 42 Diesel | 0 Diesel | 0 Diesel | 0 Diesel |
| Scenario #1 | | | 1,424 | 8,543 | 15,662 | 22,782 | 29,901 | 37,020 |
| | | | 109,352 | 95,114 | 80,875 | 66,637 | 52,398 | 38,159 |
| | Total PM | 1,122,000 | 112,200 | 110,776 | 103,657 | 96,538 | 89,418 | 82,299 |
| Scenario #2 | | | 1,424 | 22,782 | 44,140 | 56,100 | 56,100 | 56,100 |
| | | | 109,352 | 66,637 | 23,921 | - | - | - |
| | Total PM | 1,122,000 | 112,200 | 110,776 | 89,418 | 68,060 | 56,100 | 56,100 |
| Scenario #1 | | | 2,164,642 | 12,987,854 | 23,811,066 | 34,634,278 | 45,457,490 | 56,280,702 |
| | | | 130,311,472 | 113,343,832 | 96,376,193 | 79,408,553 | 62,440,914 | 45,473,274 |
| | Total NOx | 140,717,500 | 133,705,000 | 132,476,114 | 126,331,687 | 120,187,259 | 114,042,832 | 107,898,404 |
| Scenario #2 | | | 2,164,642 | 34,634,278 | 67,103,914 | 85,286,910 | 85,286,910 | 85,286,910 |
| | | | 130,311,472 | 79,408,553 | 28,505,635 | - | - | - |
| | Total NOx | 140,717,500 | 133,705,000 | 132,476,114 | 114,042,832 | 95,609,549 | 85,286,910 | 85,286,910 |
| Scenario #1 | | | 11,865 | 71,193 | 130,520 | 189,848 | 249,175 | 308,503 |
| | | | 13,669,036 | 11,889,213 | 10,109,391 | 8,329,569 | 6,549,746 | 4,769,924 |
| | CO2 | 14,025,000 | 14,025,000 | 13,680,901 | 11,960,406 | 10,239,911 | 8,519,416 | 6,798,921 |
| Scenario #2 | | | 11,865 | 189,848 | 367,830 | 467,500 | 467,500 | 467,500 |
| | | | 13,669,036 | 11,889,213 | 2,990,102 | - | - | - |
| | CO2 | 14,025,000 | 14,025,000 | 13,680,901 | 12,079,061 | 3,357,931 | 467,500 | 467,500 |
| Scenario #1 | | | 246,280,274 | 1,477,681,642 | 2,709,083,011 | 3,940,484,380 | 5,171,885,748 | 6,403,287,117 |
| | | | 11,618,680,203 | 10,105,831,218 | 8,592,982,234 | 7,080,133,249 | 5,567,284,264 | 4,054,435,279 |
| | CO | 12,991,825,000 | 11,921,250,000 | 11,864,960,477 | 11,583,512,861 | 11,302,065,245 | 11,020,617,628 | 10,739,170,012 |
| Scenario #2 | | | 246,280,274 | 3,940,484,380 | 7,634,688,486 | 9,703,442,785 | 9,703,442,785 | 9,703,442,785 |
| | | | 11,618,680,203 | 7,080,133,249 | 2,541,586,294 | - | - | - |
| | CO | 12,991,825,000 | 11,921,250,000 | 11,864,960,477 | 11,020,617,628 | 10,176,274,780 | 9,703,442,785 | 9,703,442,785 |

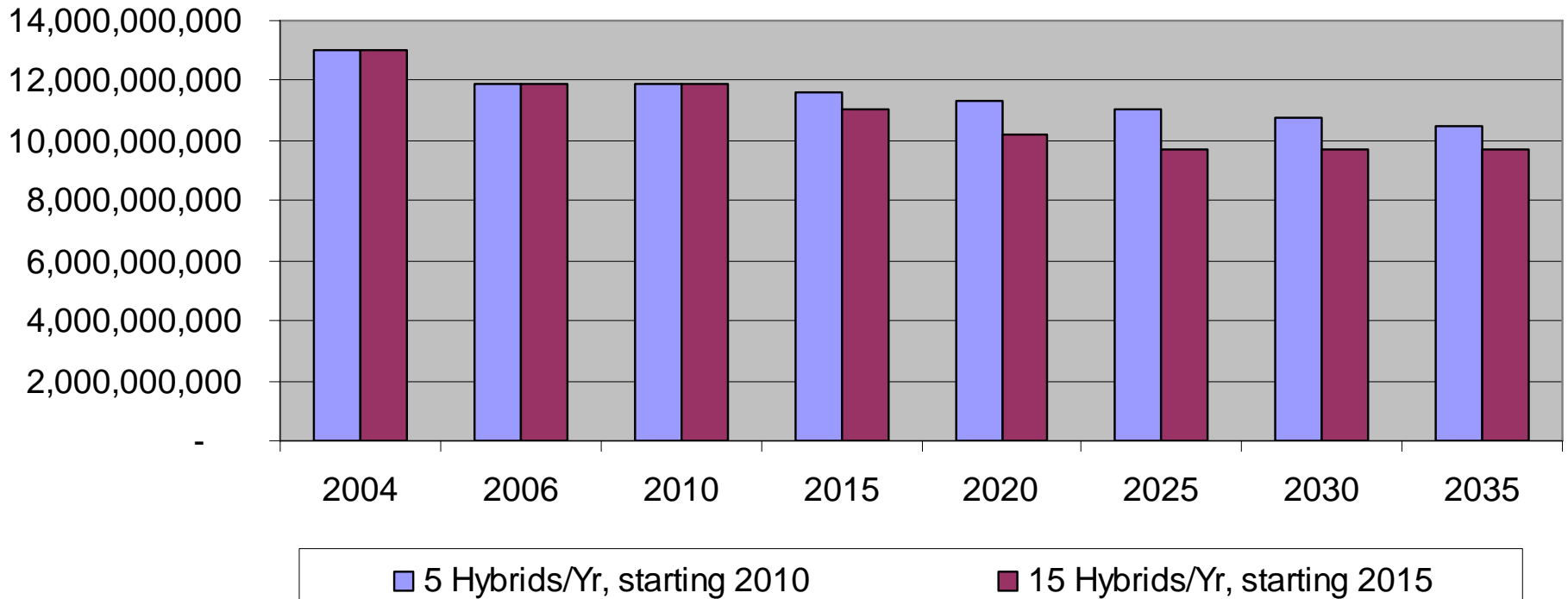
Annual Emissions, NOx



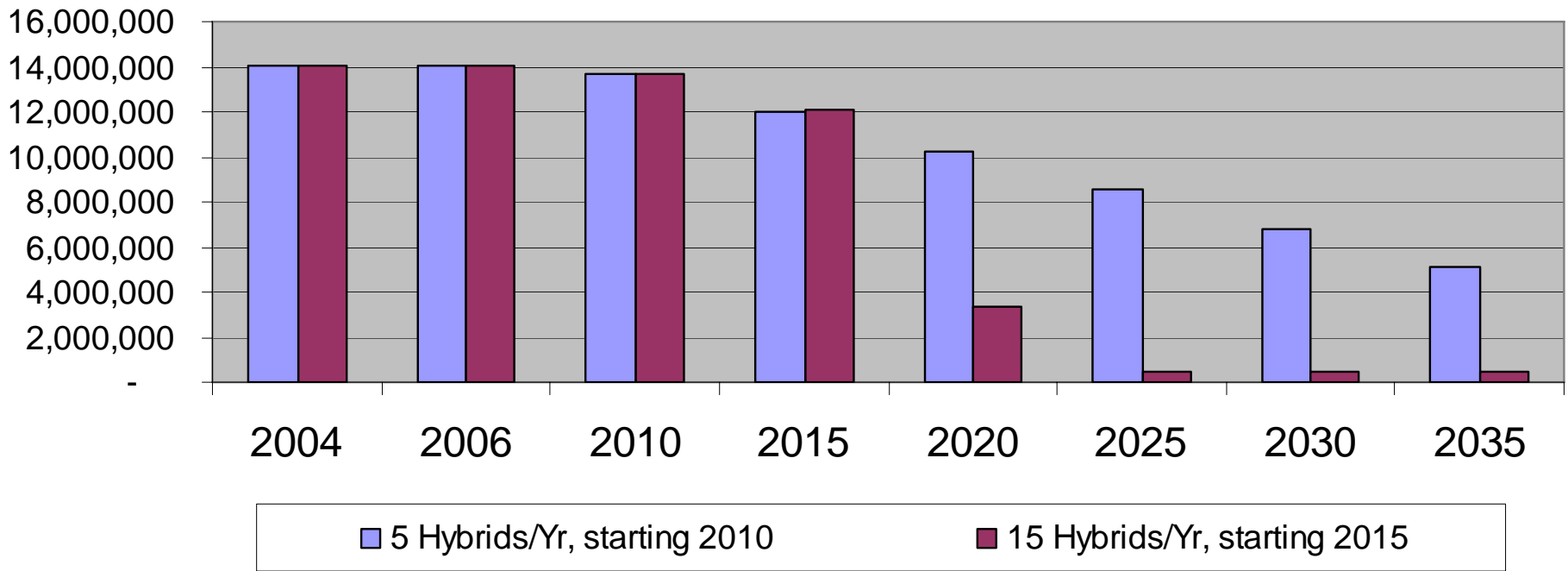
Annual Emission, Particulate Matter

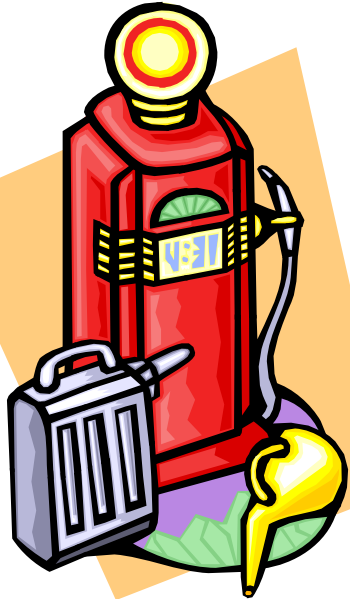


Annual Emissions, Carbon Monoxide



Annual Emissions, Carbon Dioxide





| YEAR | N/L Fuel | Diesel | Total | Total Cost | Ave. Per Gallon |
|------|----------|---------|-----------|------------|-----------------|
| 1974 | 914,561 | 145,000 | 1,059,561 | \$347,871 | \$0.33 |
| 1975 | 898,689 | 150,000 | 1,048,689 | \$394,843 | \$0.38 |
| 1976 | 855,266 | 153,571 | 1,008,837 | \$416,198 | \$0.41 |
| 1977 | 814,045 | 153,454 | 967,499 | \$443,523 | \$0.46 |
| 1978 | 801,645 | 147,388 | 949,033 | \$424,924 | \$0.45 |
| 1979 | 787,715 | 153,126 | 940,033 | \$646,864 | \$0.69 |
| 1980 | 731,967 | 171,041 | 903,008 | \$903,994 | \$1.00 |
| 1981 | 622,745 | 175,345 | 838,090 | \$947,042 | \$1.13 |
| 1982 | 676,644 | 201,253 | 877,897 | \$919,958 | \$1.05 |



Fleet Service Fuel Use/Cost

| YEAR | N/L | cost | Diesel | cost | Total Fuel | Total Cost | Ave. per gal. |
|------|---------|-----------|---------|-------------|------------|-------------|---------------|
| 2003 | 394,772 | \$493,423 | 550,911 | \$686,094 | 945,683 | \$1,179,518 | \$1.25 |
| 2004 | 380,306 | \$528,226 | 599,577 | \$881,708 | 979,883 | \$1,409,934 | \$1.44 |
| 2005 | 388,522 | \$672,918 | 610,524 | \$1,044,860 | 999,046 | \$1,717,779 | \$1.72 |
| 2006 | 378,992 | \$930,359 | 778,881 | \$1,937,279 | 1,157,873 | \$2,867,638 | \$2.48 |

All Measurement in PPM

| NO2 | NOX | CO | NO | |
|------------|------------|-----------|-----------|----------------------------------|
| 0.1 | 1 | 1 | 0 | 2007 Crown Victoria (CVPI) |
| 68.9 | 375 | 161 | 306 | 2001 Internation Dump/Plow Truck |
| 17.9 | 141 | 86 | 123 | 2003 Freightliner Vactor |

Lessons Learned

- What have you learned to date?
 1. Dedicated group
- What has been easy to accomplish?
 1. Metro has good information on fleet profile
- What has been hard?
 1. Establishing baseline on diverse fleet
 2. Obtaining test equipment for emission testing
 3. Installation of automated fuel system

What's Next?

- What's next?
 - Emission testing standards
 - Fleet fuel economy standards
- What is needed to move forward?
 - Testing equipment acquisition/training
- How might your project evolve? Will it lead to or feed into other projects?
 - We see this as long term statistical process, that may lead to various fleet wide initiatives
- Will your project or recommendations require a budget provision?
 - Very possible, depending on the technology advancements for fleet vehicle replacement