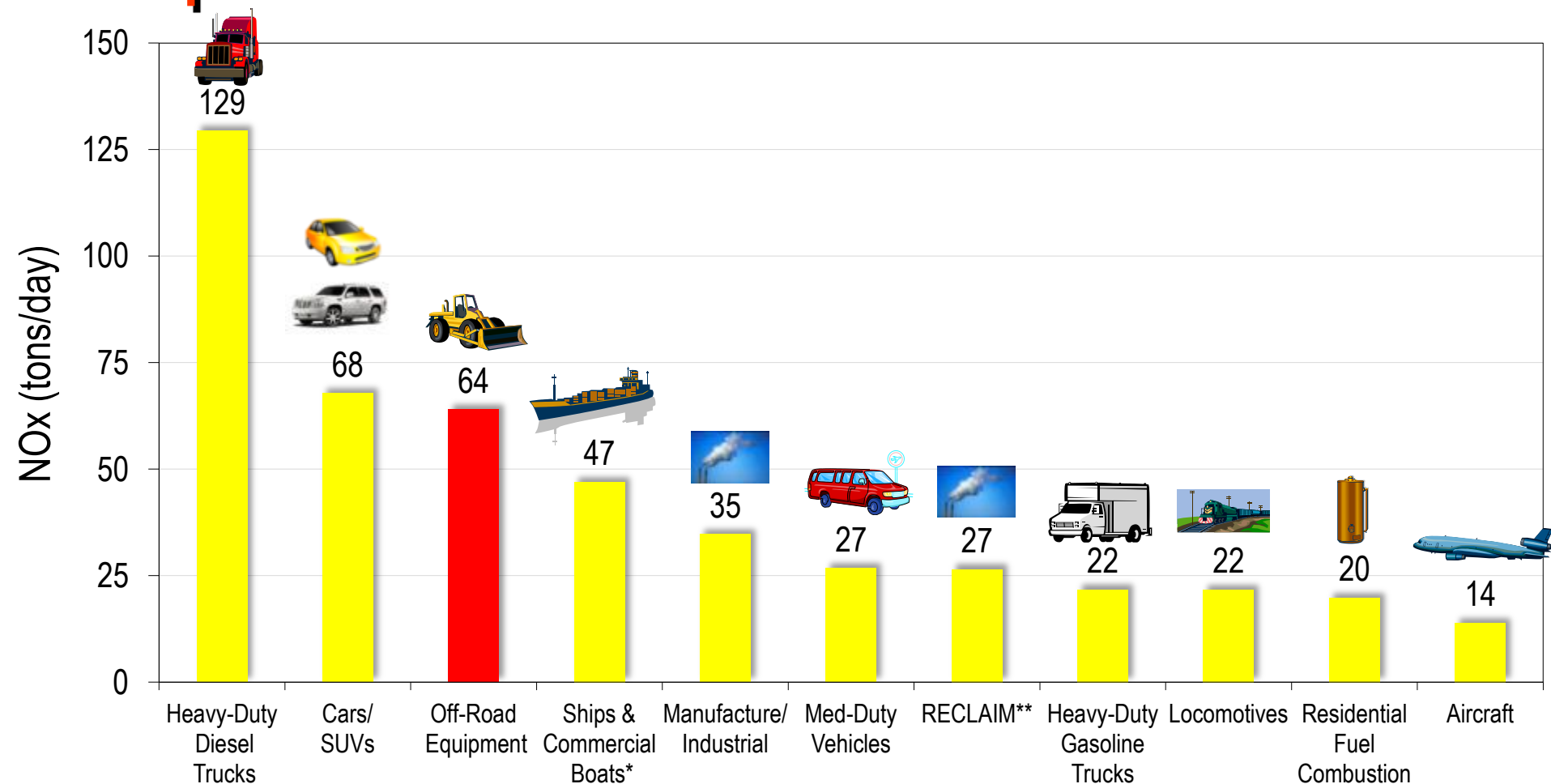




Off-Road Equipment

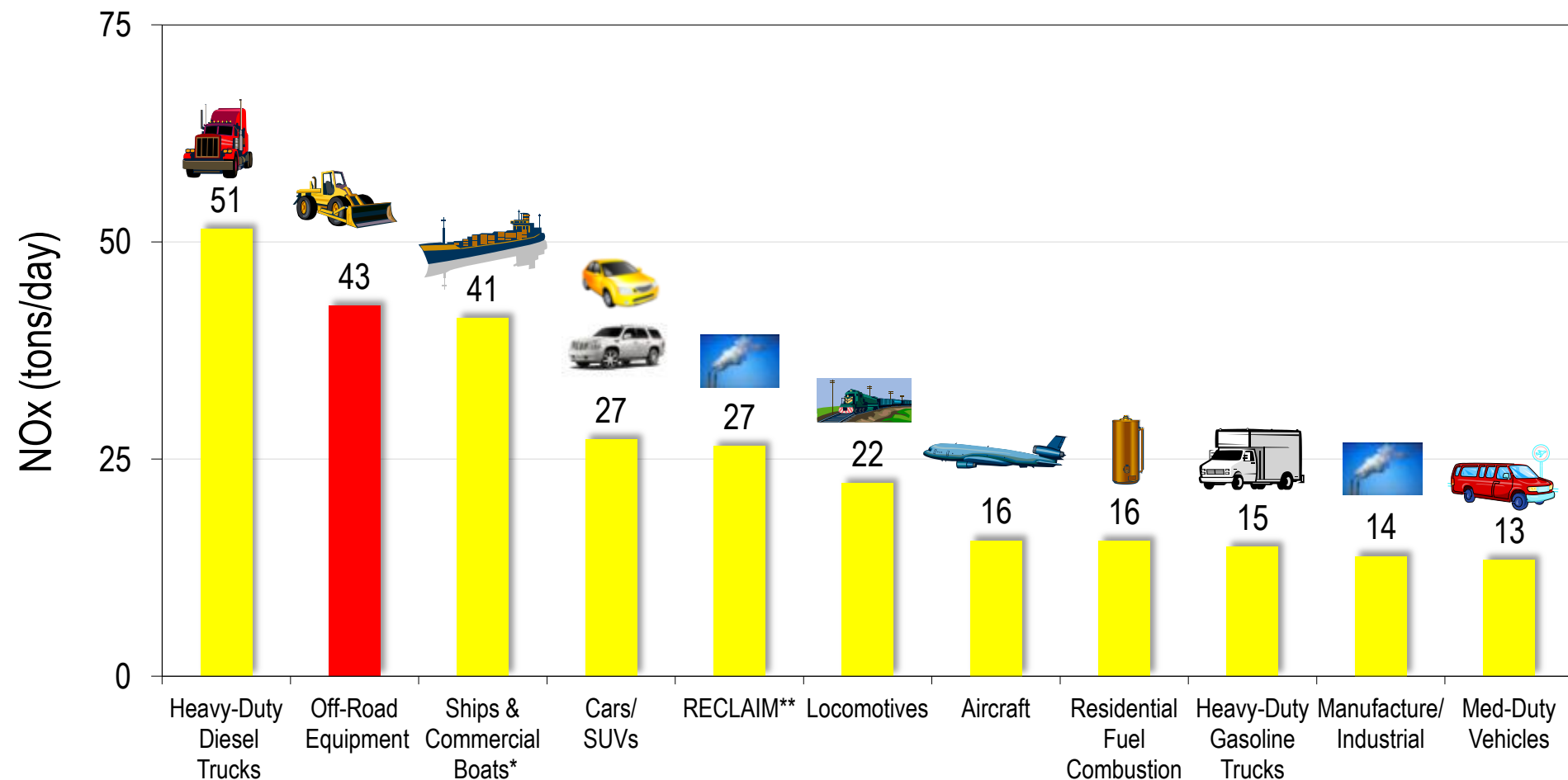
Top NO_x Emissions Sources in 2014



* Ocean-going vessels = 35 tons/day

**RECLAIM: 320 largest stationary sources, including all refineries and power plants

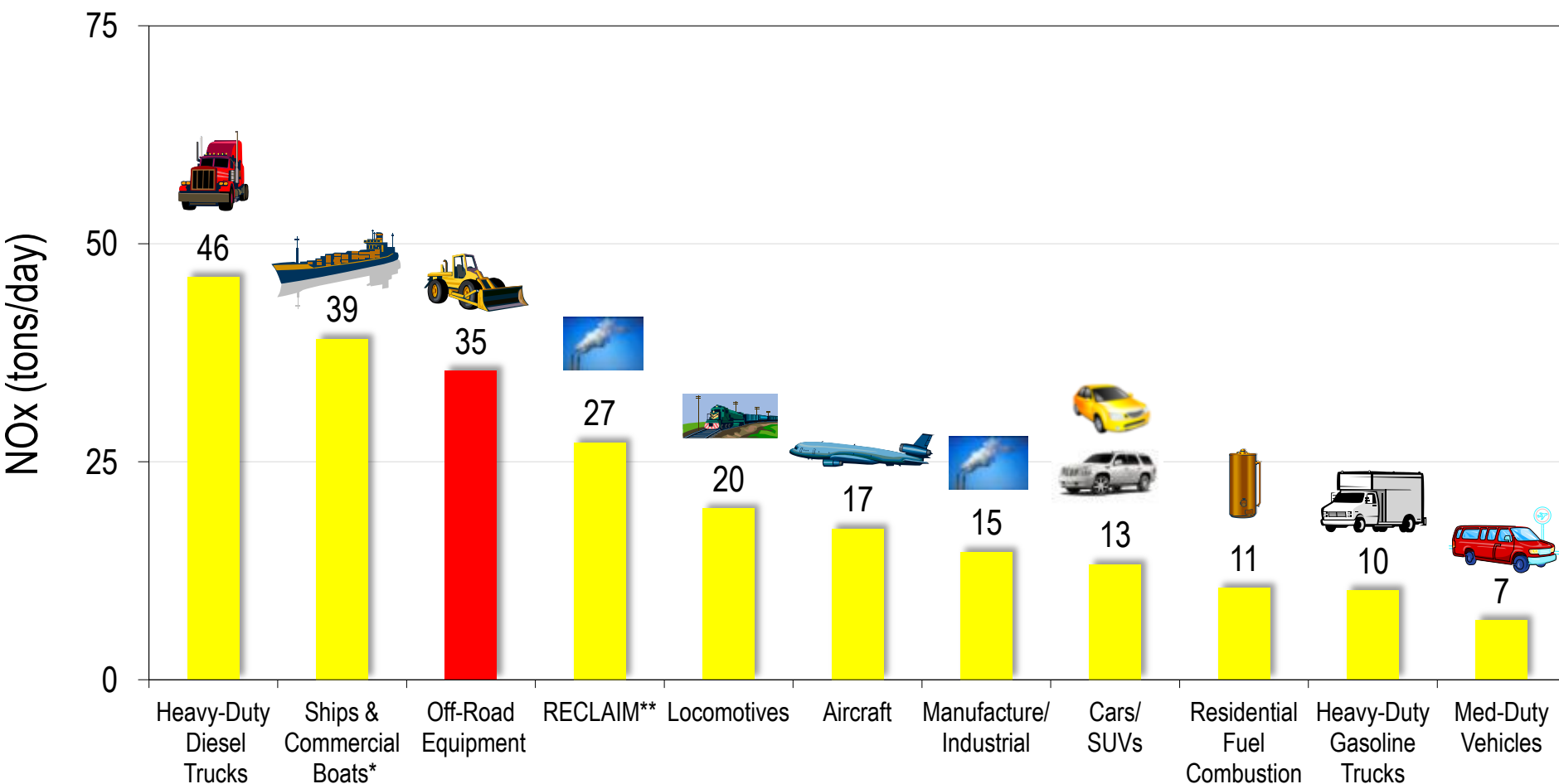
Top NOx Emissions Sources in 2023



* Ocean-going vessels = 32 tons/day

**RECLAIM: 320 largest stationary sources, including all refineries and power plants

Top NO_x Emissions Sources in 2032



* Ocean-going vessels = 29 tons/day

**RECLAIM: 320 largest stationary sources, including all refineries and power plants

Key Challenges Moving Forward

- Zero- and Near-Zero Emission Technology Opportunities with Smaller Industrial Equipment, Cargo Handling Equipment, and Ground Service Equipment
- Long Remaining Useful Life
- Economic Concerns with Replacement Value of Recently Acquired Equipment



Category	Equipment		2023 NOx Emissions (TPD)
Cargo Handling Equipment	Yard Trucks, Container Handlers, Forklifts, Cranes, Loaders,	  	2.2
Commercial	Compressors, Generator Sets, Pumps, Pressure Washers, Welders	 	6.8
Industrial	Aerial Lifts, Forklifts, Sweepers, Material Handling Equipment	  	7.6

Category	Equipment		2023 NOx Emissions (TPD)
Transport Refrigeration Unit (TRU)	Truck, Trailer, Container, Railcars	 	4.1
Construction and Mining	Dozers, Loaders, Scrapers, Excavators	  	15.1

Potential Zero- and Near-Zero Technologies

Technology	Application
Cleaner Combustion Engines	Equipment Types where Additional Emissions Controls are Feasible
Alternative Fuels	Equipment at Fixed Sites or Returning to Equipment Yards at Night
Hybrid Systems	Equipment with Energy Recovery Duty Cycles or High Percentage of Idle/Low Power Operations

Potential Zero- and Near-Zero Technologies

Technology	Application
Plug-In Hybrid Electric	Equipment with Energy Recovery Duty Cycles or High Percentage of Idle/Low Power Operations with Access to Grid Power
Fuel Cell	Equipment at Fixed Sites or Returning to Equipment Yards at Night
All Electric - Grid and Battery	Equipment with High Percentage of Standby or Low Load Time at Site with Grid Power

Status of Technology Development

Technology	Status
Cleaner Combustion Engines	Prototype On-Road Diesel and Natural Gas Engines in Development. Goal - 90% Lower NOx than Current Standard in Process
Natural Gas	Commercially Available for Some Applications. On-Road Engine Development of 90% Lower NOx than Current Standard in Process
Hybrid Systems	Commercially Available for Selected Applications
Plug-In Hybrid Electric	On-Road Heavy Duty Truck Demonstrations in Process
Fuel Cell	Forklifts Commercially Available and Other Equipment in Process (On-Road Heavy Duty Trucks, Buses, TRUs, GSE)
Battery Electric	Industrial Equipment Commercialized. Other Equipment Demonstrations in Process (On-Road and Off-Road Trucks, TRU)