

# PORTABLE GENERATORS AND CARBON MONOXIDE POISONING

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*This presentation was prepared by CPSC staff, has not been reviewed or approved by, and may not reflect the views of, the Commission.*

**U.S. Consumer Product  
Safety Commission**



# U. S. Consumer Product Safety Commission

- Independent, federal agency
- Established in 1973
- 5 Commissioners
- Over 500 staff
- Headquarters in Bethesda, MD
- Laboratory in Rockville, MD



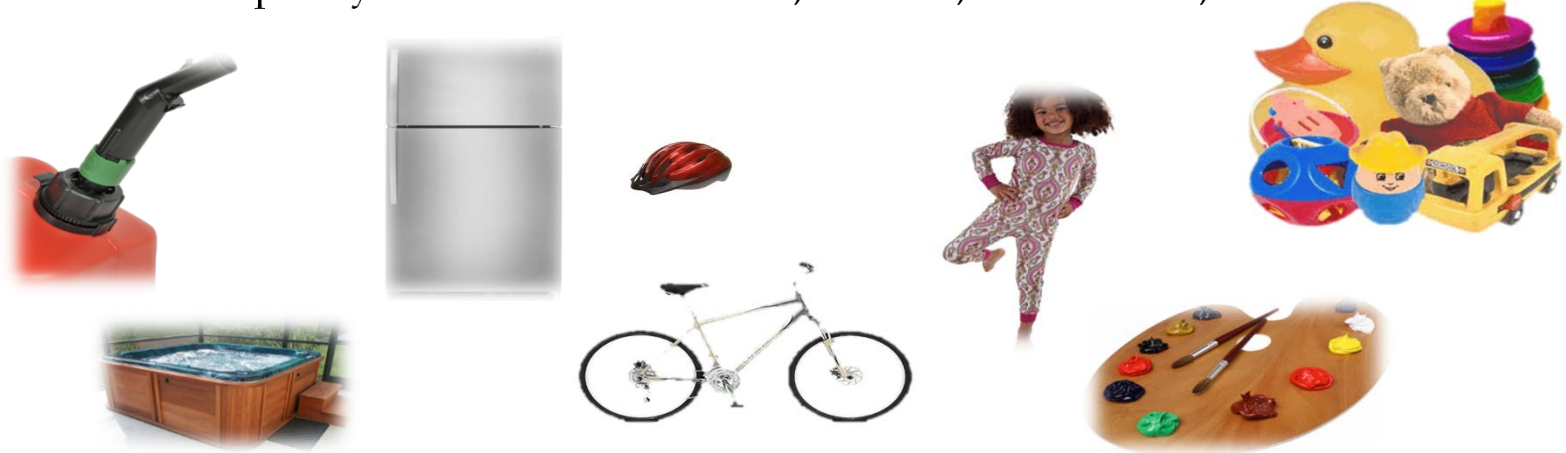
## CPSC's Mission:

Protecting the public against unreasonable risks of injury from consumer products through education, safety standards activities, regulation, and enforcement.

# What Do We Regulate?

## Consumer Products

“...any article, or component part thereof, produced or distributed (i) for sale to a consumer for use in or around a permanent or temporary household or residence, a school, in recreation, or otherwise, or (ii) for the personal use, consumption or enjoyment of a consumer in or around a permanent or temporary household or residence, a school, in recreation, or otherwise...”<sup>1</sup>



<sup>1</sup>Section 3(a)(5) of the Consumer Product Safety Act, 15 U.S.C. § 2052(a)(5)

# What Do We Not Regulate?



- Tobacco products (FDA)
- Drugs, cosmetics, food (FDA, USDA)
- Motor vehicles for road use (NHTSA), aircraft (FAA), boats and watercraft (USCG)
- Pesticides (EPA), medical devices (FDA), workplace products (OSHA and others)

# Generator CO Poisoning Hazard

5kW generator



=

~450 cars



Typical engine powering a 5kW generator emits a weighted average CO rate of nominally 1500g/hr

Idling mid-sized late 1990s model cars emit 2.4–5.4 g/hr of CO

Sources:

1. <http://www3.epa.gov/otaq/certdata.htm#smallsi>

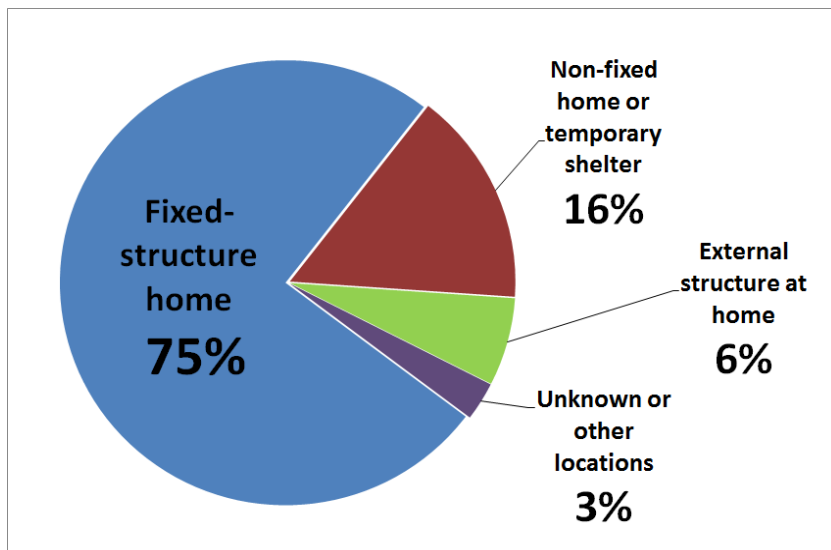
2. Frey, H., et al., On-Road Measurement of Vehicle Tailpipe Emissions Using a Portable Instrument, *Journal of the Air & Waste Management Association*, Vol. 53, August 2003.

## Generator-Related CO Death Counts and CO Injury Estimates, 2004-2012

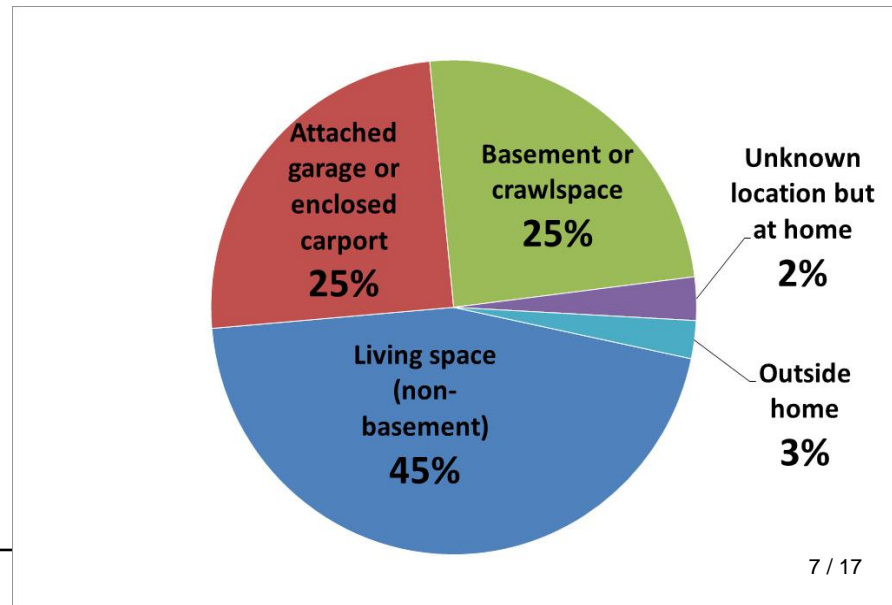
- 659 CO deaths (average 73 deaths/year)
- More than 25,000 estimated medically-treated CO Injuries (about 3,000 injuries per year)
- 25% of fatal incidents involved multiple fatalities, so these incidents account for 44% of all the deaths.

# Hazard Patterns

## Sites Where Generators Were Used that Caused Fatalities



## Specific location of generator in incidents that occurred in fixed-structure homes



## Staff Investigations of Reducing Portable Generators' CO Emission Rates

- CPSC prototype generator demonstration program
- EPA demonstration on engines to lower HC+NO<sub>x</sub>
- Staff testing of EFI generators



# CPSC Prototype Generator Demonstration Program

Prototype Development and Durability:	University of Alabama
End-of-Life Emission Testing:	Intertek Carnot Emission Services
Scenario Testing :	National Institute for Standards and Technology

## Prototype configuration:

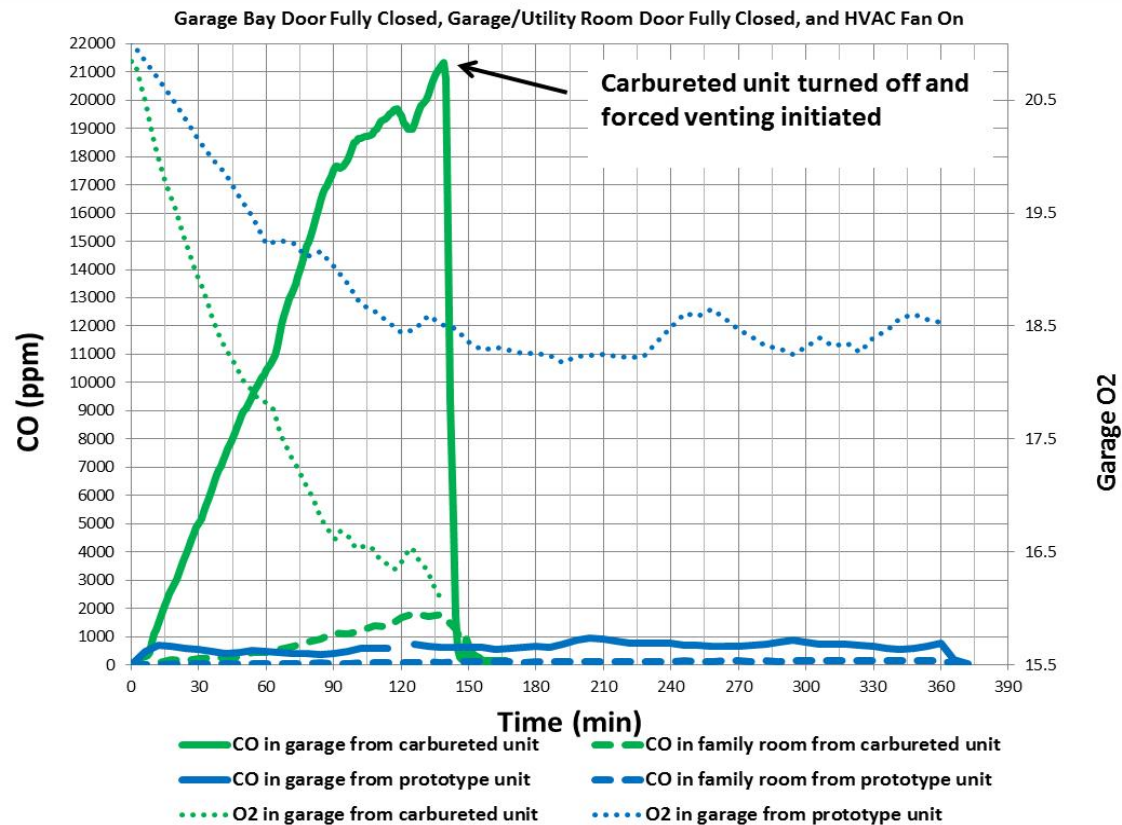
- Modified 8.2 kW Class II engine with 500-hour rated useful life, certified to EPA Phase 2 standard
- Adapted EMS with closed loop EFI
- Calibrated for stoichiometric AFR at all loads
- Integrated 3-way catalyst, primarily to target NOx reduction, into shrouded muffler

## Hazard Characterization of Common Incident Scenario: Generator operation in SFH attached garage (NIST)



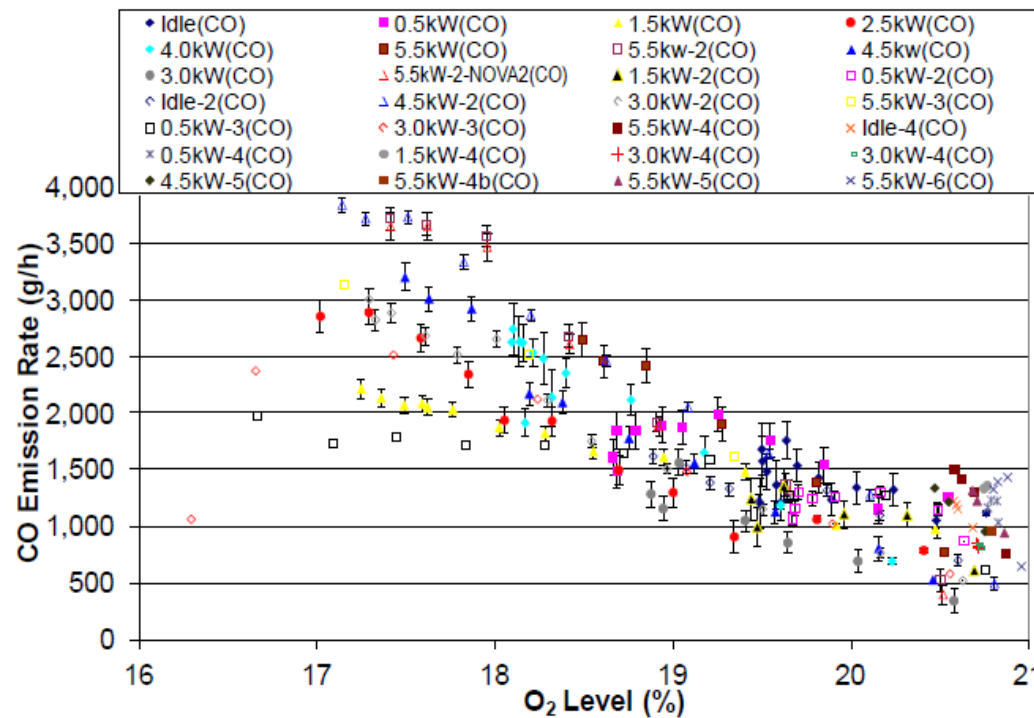
Source: S. J. Emmerich, A. K. Persily, and L. Wang, *Modeling and Measuring the Effects of Portable Gasoline Powered Generator Exhaust on Indoor Carbon Monoxide Level* (NIST Technical Note 1781), Feb 2013.

# Garage and Family Room CO Concentration Profiles from Unmodified Carbureted 5 kW Unit and Prototype 5 kW Unit



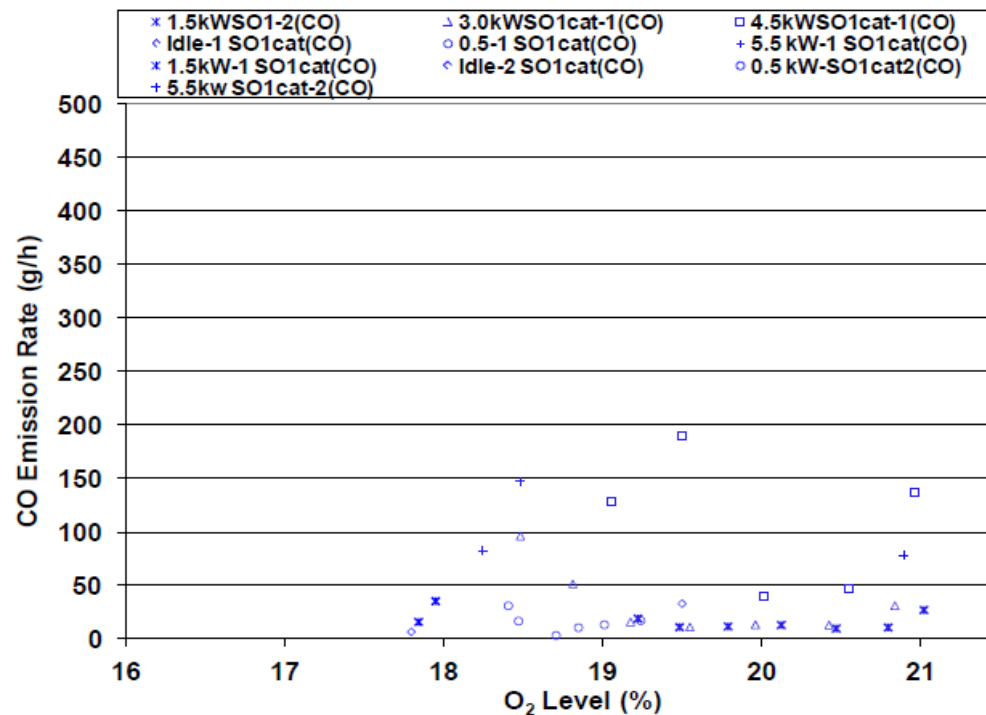
# Generators' CO Emission Rates in Enclosed Space

## CO Emission Rates of Unmodified Carbureted Generator



# Generators' CO Emission Rates in Enclosed Space

## CO Emission Rates of Prototype Generator



## Conclusions from CPSC's Demonstration Program

- Prototype used same commercially available EMS being currently used in marketplace on small SI engines and on small scooters and motorcycles.
- Prototype met Phase 3 EPA exhaust emission standard for HC+NOx and reduced the CO emission rate by 93% - 97%.
- Weighted CO emission rate of carbureted unit increased 3-fold when oxygen in intake air is 17%. Prototype generator did not appear to increase CO rate in reduced oxygen.

# CPSC Generator Categories

Generator Category	Engine
Handheld	$\leq 80cc$
Class 1	$>80cc$ to $<225cc$
Class 2 single cylinder	$\geq 225cc$ , up to 25kW maximum engine power and 1 cylinder
Class 2 twin cylinder	$\geq 225cc$ , up to 25kW maximum engine power and 2 cylinders

## Proposed Performance Standard by Generator Category

Generator Category	Draft Proposed CO Emission Rate Limit, g/hr
Handheld	75
Class 1	75
Class 2 single cylinder	150
Class 2 twin cylinder	300

Rates are weighted CO emission rates calculated based on six specified loads applied to generator operating in atmosphere with normal oxygen content



# Current Status of NPR

- Staff delivered NPR package to Commission on 10/5/2016:  
<https://www.cpsc.gov/s3fs-public/ProposedRuleSafetyStandardforPortableGenerators.pdf>  
(cut and paste this link into your browser window)
- Staff briefed Commission on the NPR package on 10/19/2016:  
<https://www.cpsc.gov/newsroom/video/portable-generators-notice-of-proposed-rulemaking>
- Commission held decisional meeting on 11/2/2016 and voted (4-1) to approve the NPR :  
<https://www.cpsc.gov/content/commission-meeting-minutes-decisional-matter-proposed-rule-portable-generators> and <https://www.cpsc.gov/Newsroom/Video/commission-meeting-decisional-matter-portable-generators>
- Notice will soon be published in Federal Register, officially starting 75-day comment period on NPR.
- Contact me if you want to be notified of latest status on NPR:

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