

# CPSC Activities to Address CO Poisoning Hazard of Portable Generators

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

# Overview

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- What Is the CPSC?
- Generators: Why CPSC Is Concerned
- CPSC Activities to Address Generator CO Hazard
  - Participation in Development of UL 2201
  - Technology Demonstration of Low CO Emission Prototype using Existing Emission Control Technology
  - Investigations of Shutoff Strategies
- Strategy: Limiting Engine's CO Emission Rate
- Q & A

# U.S. Consumer Product Safety Commission

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- Independent federal agency
- Created in 1972
- Responsible for consumer product safety including imported consumer products
- Five Commissioners, appointed by the President and confirmed by the Senate

# CPSC Mission

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

# CPSC – Addressing Hazards

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- Hazard identification
  - collection and analysis of injury and death data
  - research on emerging and potential product hazards
- Hazard reduction
  - developing voluntary consensus safety standards with industry
  - adopting and enforcing mandatory standards
- Enforcement
  - market and import surveillance, testing and certification
  - recall of products; arranging for their repair or replacement
- Outreach
  - informing and educating consumers, manufacturers, other stakeholders and responding to their inquiries

# Four Types of Safety Concerns

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- Product fails to comply with a *mandatory safety standard or ban* under the Acts
- Product fails to comply with *voluntary standards* relied upon by the Commission
- Product *contains a defect* which could create a “*substantial product hazard*”
- Product creates an “*unreasonable risk*” of serious injury or death

# What Is a Consumer Product?

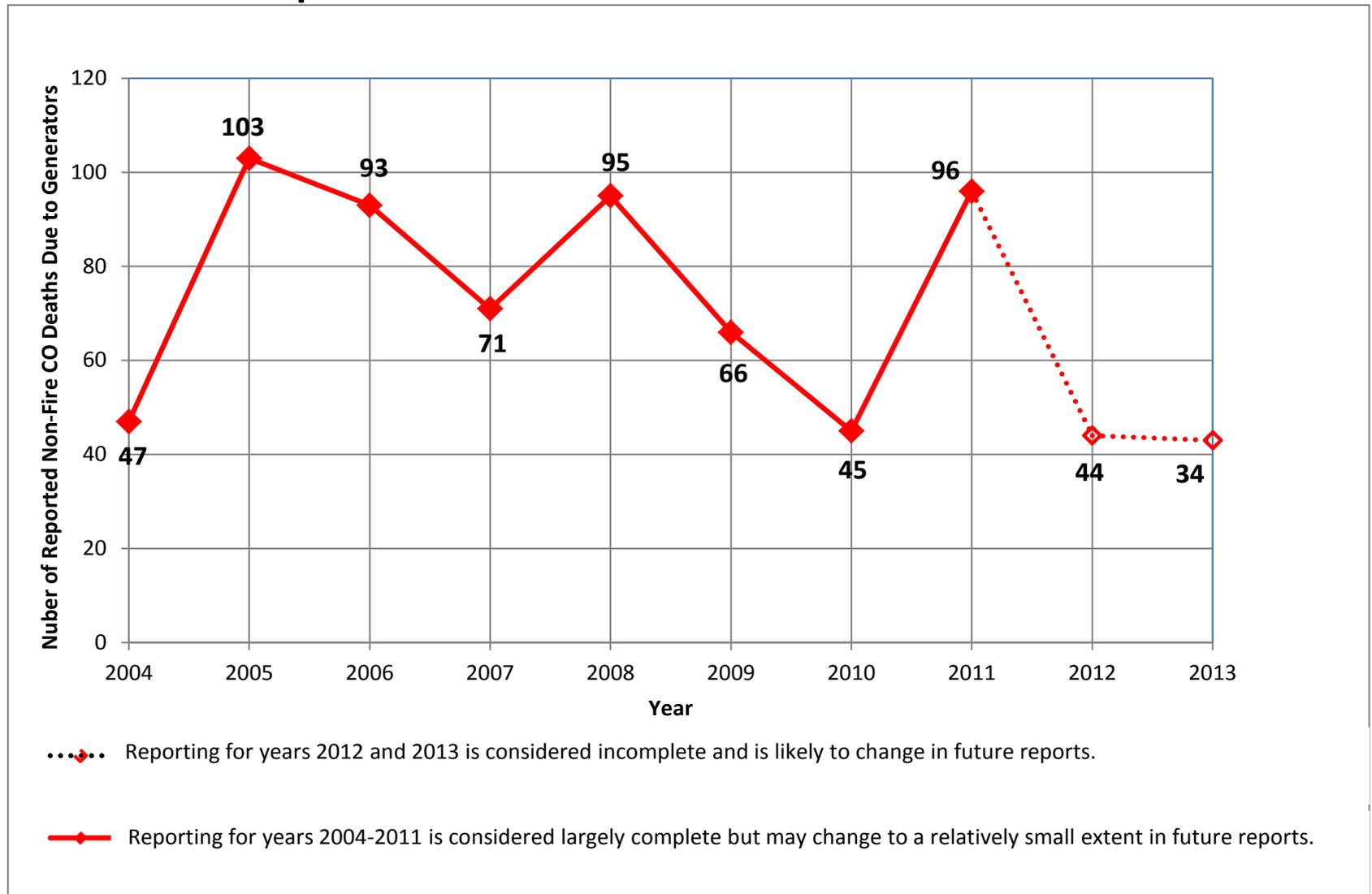
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- Jurisdiction over thousands of different types of consumer products under the Consumer Product Safety Act
- Excludes use in the workplace and products covered by other federal agencies, such as:
  - Cars and related equipment (NHTSA)
  - Boats (Coast Guard)
  - Airplanes (FAA)
  - Food, drugs, medical devices, cosmetics, tobacco products (FDA)
  - Firearms (ATF)
  - Pesticides (EPA)
  - Tobacco Products (ATF)

# Why CPSC Is Concerned About Generators

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## Number of Reported CO Deaths Associated with Portable Generators

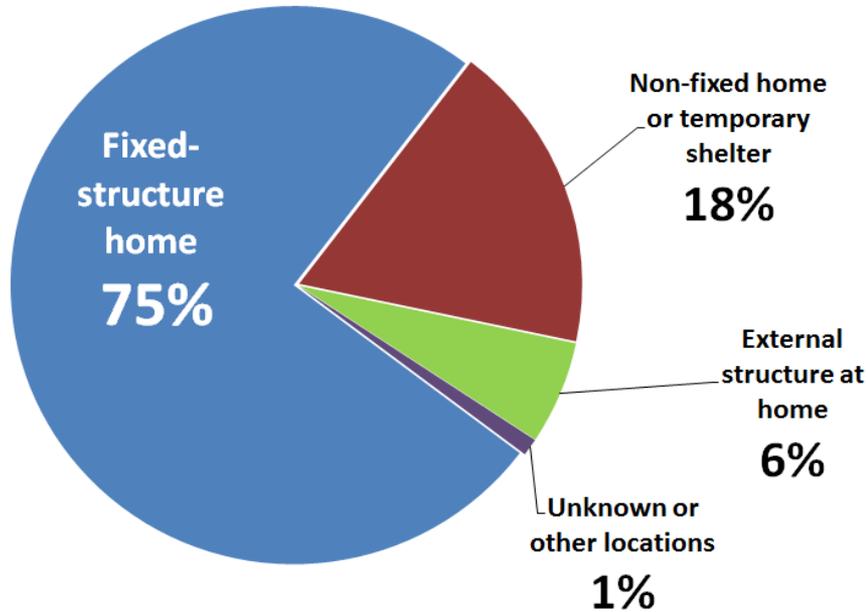


Source: Hnatov, Matthew, *Incidents, Deaths, and In-Depth Investigations Associated with Non-Fire Carbon Monoxide from Engine-Driven Generators and Other Engine-Driven Tools, 2004-2013*, U.S. Consumer Product Safety Commission, Bethesda, MD, June 2014. (Docket Identification CPSC-2006-0057-0023, available online at [www.regulations.gov](http://www.regulations.gov)).

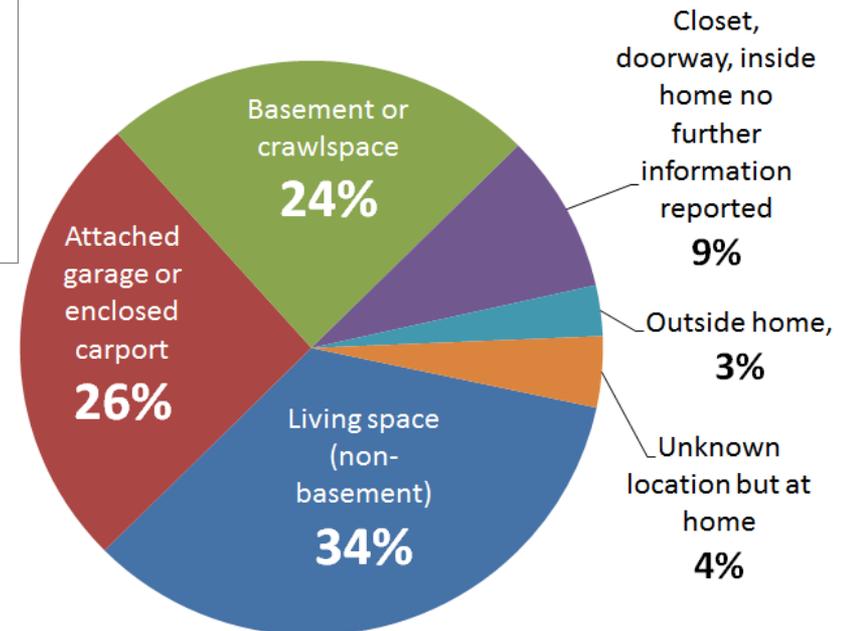
# Some of Our Hazard Analysis...

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## Location where incident occurred



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



# CPSC Activities to Address CO Hazard with Portable Generators

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- 2003: Began participation as non-voting member on STP for UL 2201
- 2004: Hosted roundtable
- 2006: Staff report “Review of Portable Generator Safety”
- 2006: Briefed Commission: most reliable way to reduce the CO poisoning risk is to reduce CO emission rate
- 2006: Commission voted to approve ANPR

# CPSC Activities to Address CO Hazard with Portable Generators

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- 2007: FR for mandatory label, effective May 2007
- Ongoing: Reports supporting ANPR; see Docket ID CPSC-2006-0057 on [www.regulations.gov](http://www.regulations.gov) or CPSC website [www.cpsc.gov](http://www.cpsc.gov)
- 2014: Staff sent letter to UL with recommendations based on research findings to address hazard in UL 2201:
  - A performance requirement that sets a limit on the engine's exhaust CO emission rate
  - A test method for measuring generator's CO emission rate
  - Requested formation of task group to develop recommendations into proposal
    - 36 stakeholders, including CPSC staff, volunteered for task group
    - Task group holds teleconference meetings every 4-6 weeks
    - If task group successful, STP for UL 2201 will determine if proposal is included in UL 2201

# Mandatory Label

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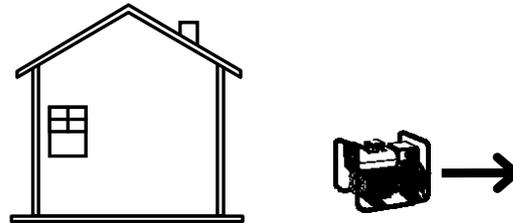
**⚠ DANGER**

**Using a generator indoors CAN KILL YOU IN MINUTES.**

**Generator exhaust contains carbon monoxide. This is a poison you cannot see or smell.**



**NEVER use inside a home or garage, EVEN IF doors and windows are open.**

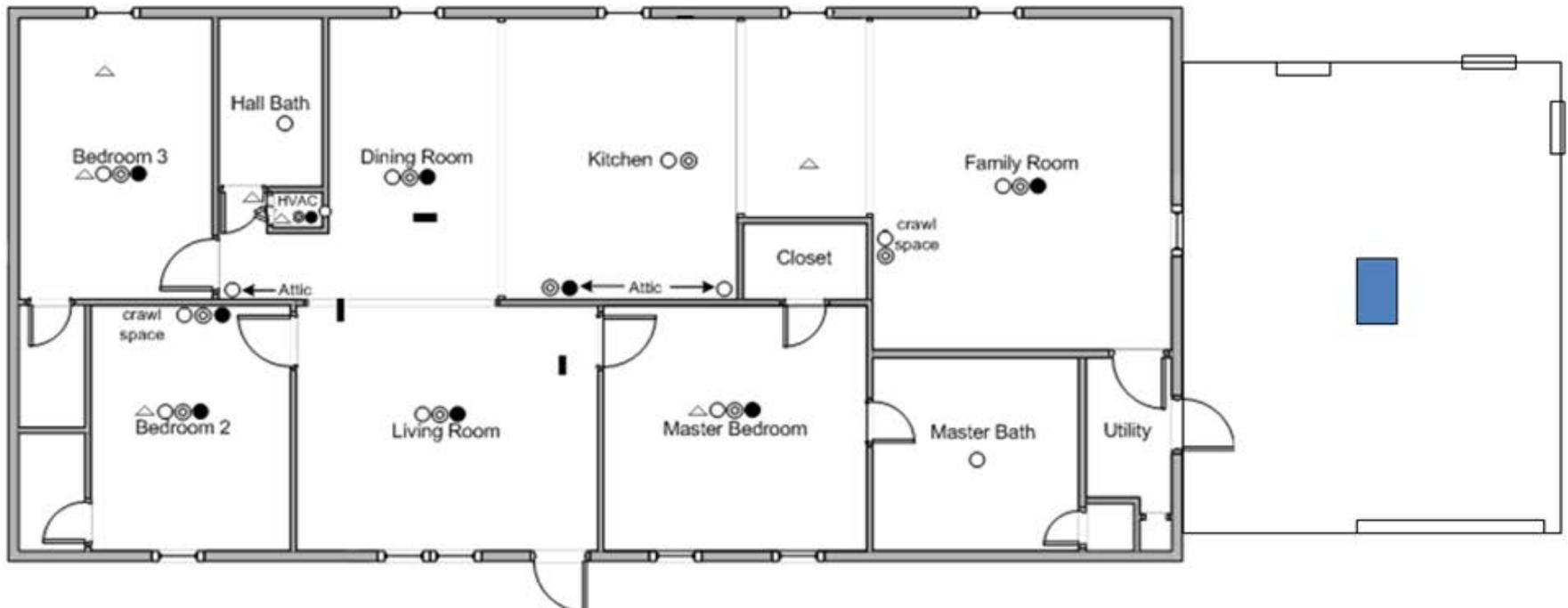


**Only use OUTSIDE and far away from windows, doors, and vents.**

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

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National Institute of Standards and Technology (NIST)



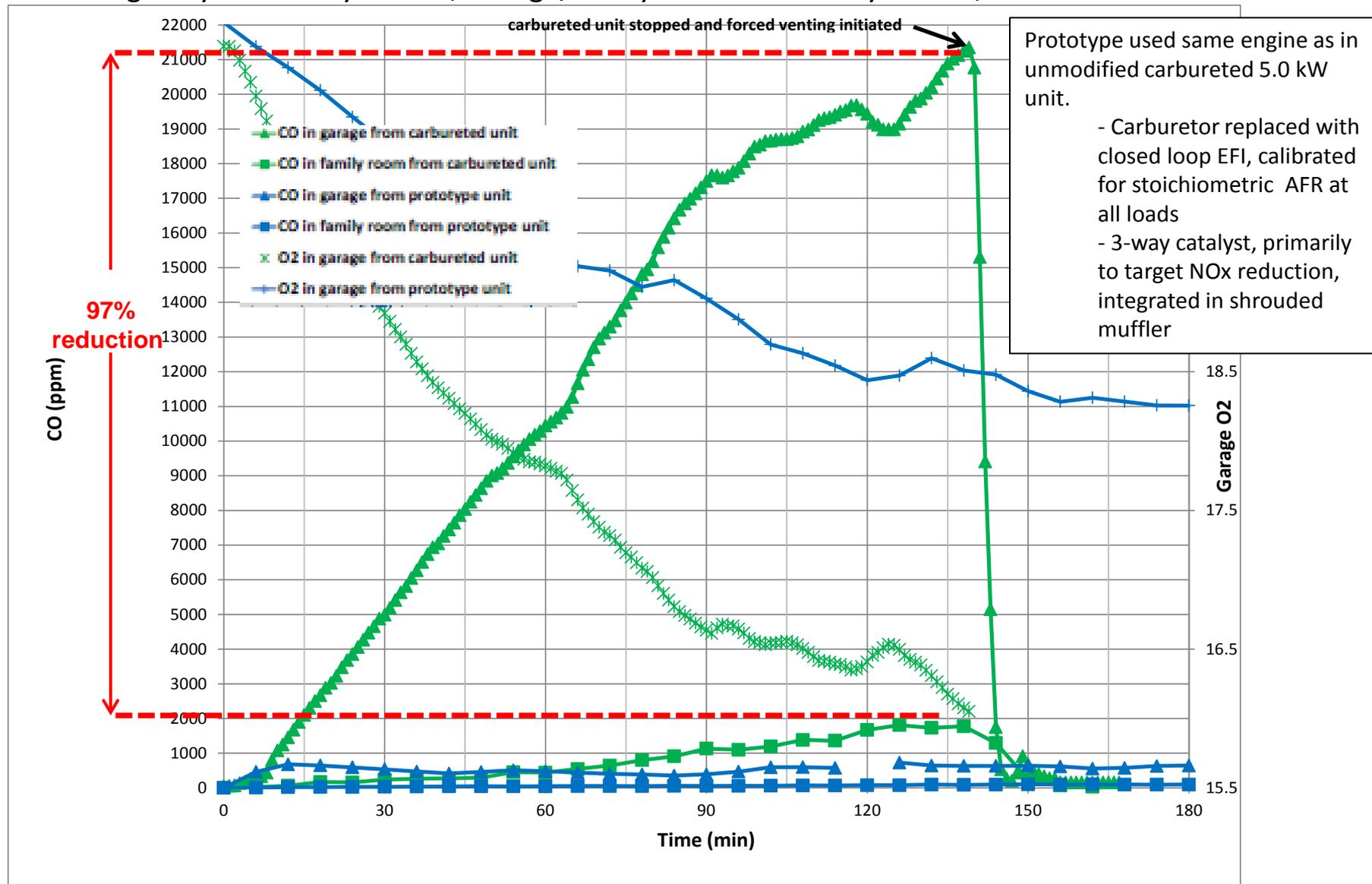
# Garage and Family Room CO Concentration Profiles

## from Unmodified, Carbureted 5 kW unit and Prototype 5 kW Unit

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6-mode hourly load profile applied to generator

Garage Bay Door Fully Closed, Garage/Utility Room Door Fully Closed, and HVAC Fan On



# Generators' CO Emission Rates

Calculated from chamber (shed) tests

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## **Carbureted 5 kW unit (Unmod Gen X )**

~1200-1500 g/hr CO emission rate near ambient (20.9% O<sub>2</sub>) with 5.5 kW applied

~500-1000 g/hr CO emission rate near ambient (20.9% O<sub>2</sub>) with 3.0 kW applied

CO emission rate increases by ~100 g/hr for each 0.1% decrease in O<sub>2</sub> until O<sub>2</sub> drops to ~17% - 18%

## **Closed Loop Fuel Injected 5 kW unit with catalyst (Gen SO1; same model engine as on unmod Gen X)**

40-50 g/hr CO\* with 5.5 kW applied

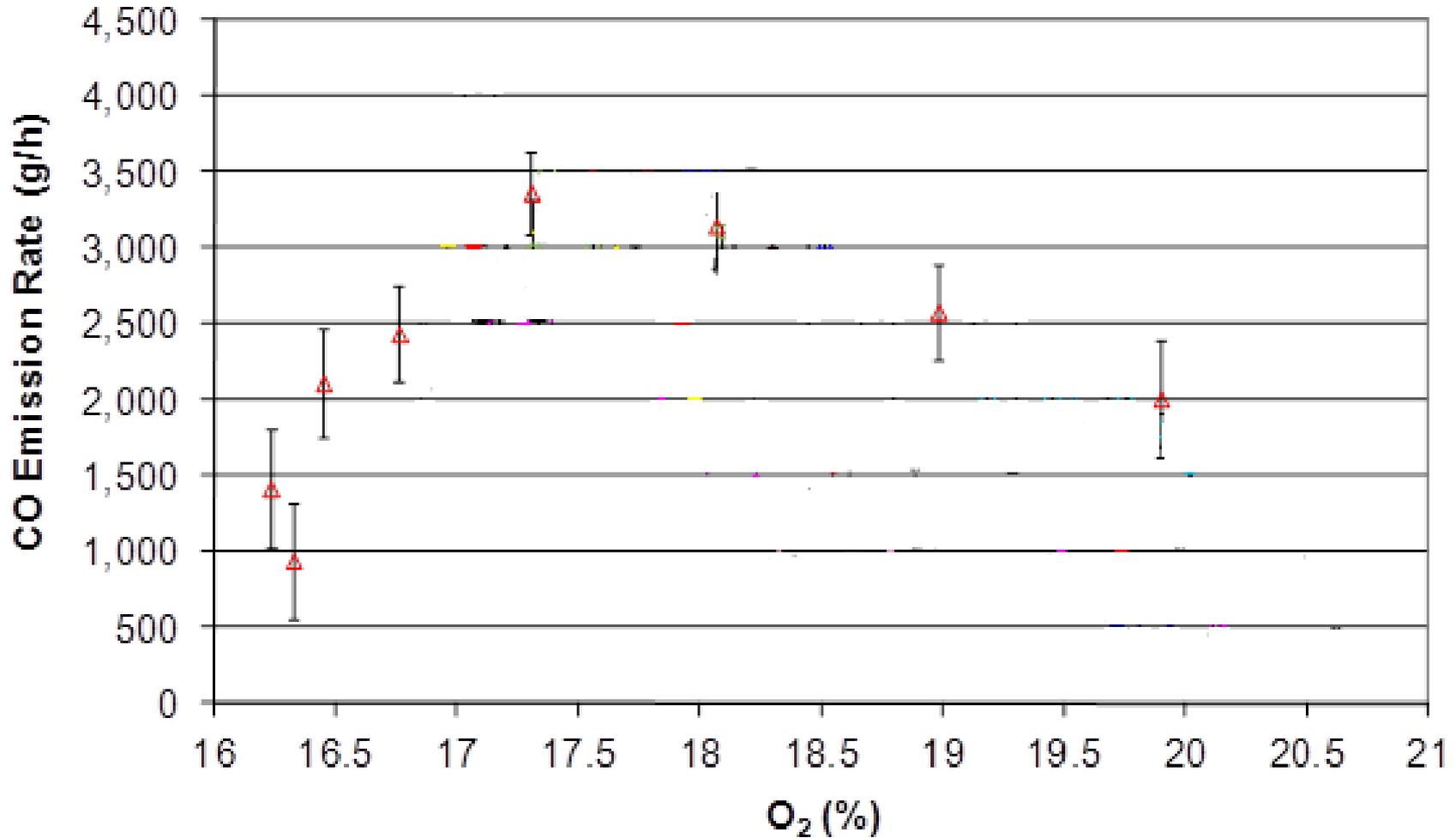
< 30 g/hr CO\* with 3.0 kW applied

Emission rates do not appear to increase as O<sub>2</sub> level decreases

\* (with some exceptions, when AFR was off-design)

# Effect of Oxygen Level on CO Emission Rate on Carbureted 5 kW Generator

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# Putting the Carbureted Generator's CO Emission Rates in Perspective...

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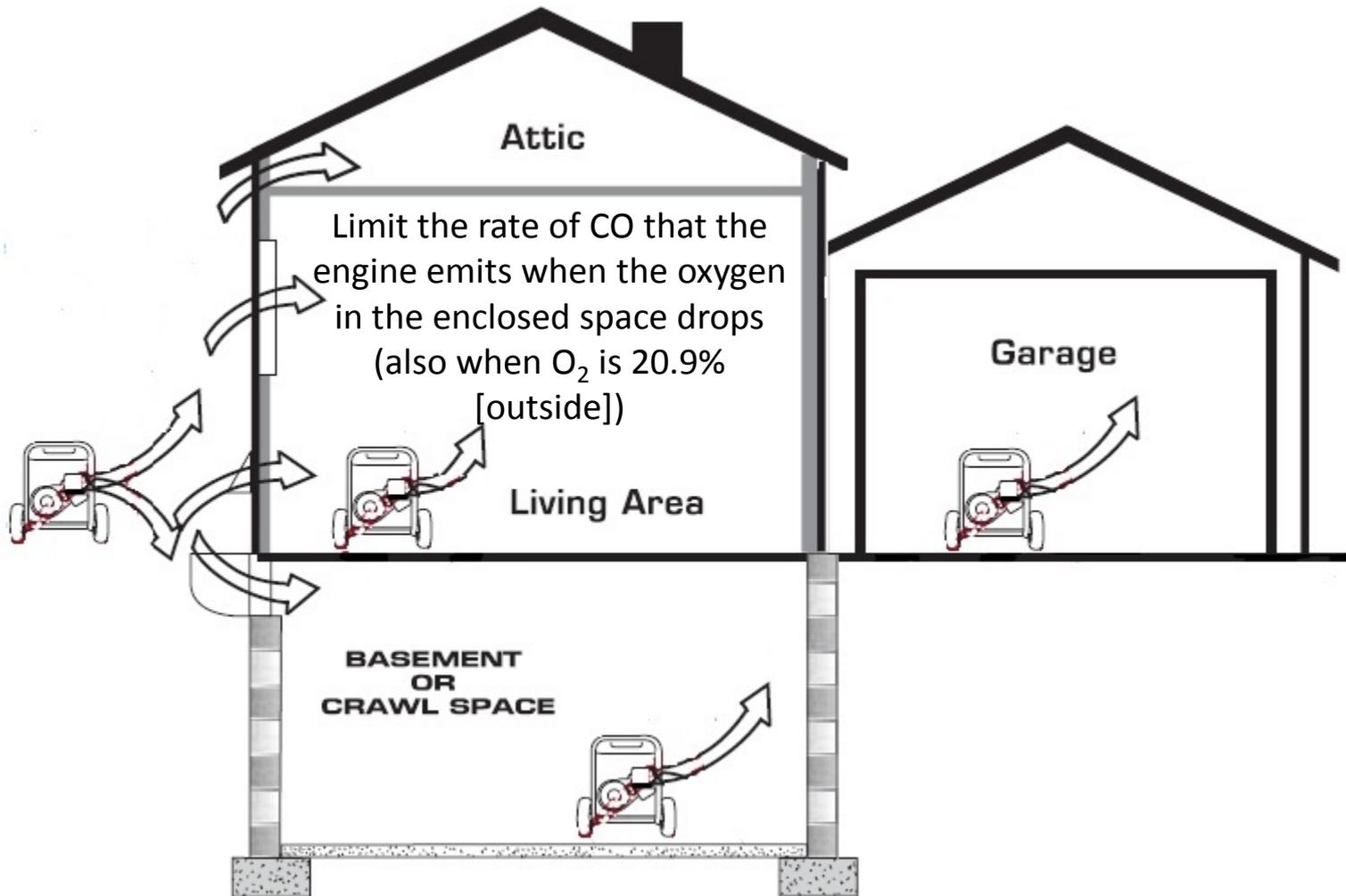
- The carbureted generator's CO emission rate at ambient oxygen with partial load applied was nominally 500 g/hr.
- At approximately 17.5 percent oxygen with near rated load applied, the generator's CO emission rate was nominally 3750 g/hr.
- In contrast, the measured CO emission rate of an 1996 Oldsmobile Cutlass while idling was 0.66 mg/sec (2.37 g/hr).\*

*The CO emission rates of the carbureted 5 kW generator while operating in an enclosed space ranged from **200 to 1500 times** that of an idling 1996 Oldsmobile Cutlass.*

\*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. (available online at <http://www.tandfonline.com/doi/pdf/10.1080/10473289.2003.10466245>)

# Staff Recommendation To UL Is A Performance Requirement That Puts A Limit On The Exhaust CO Emission Rate While A Generator Is Operating Continuously, Regardless Of Whether It Is Operated In An Enclosed Space Or Outdoors

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# Shutoff Concepts Investigated by CPSC Staff

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- CO sensing system mounted on generator
- Remotely located CO sensing system that communicates with generator; relies on user to place sensing unit in proper location
- GPS system mounted on generator; relies on poor signal strength to infer generator is located indoors
- Programmed engine control unit (ECU) on prototype; relies on electronic fuel injection (EFI) system sensors to infer indoor operation

# Limiting Engine's CO Emission Rate Used by EPA to Address Risk of Acute CO Poisoning Hazard

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- In 2002, EPA adopted a 4.4 g/kW-hr CO emission standard for large SI engines that power equipment designed for use in enclosed spaces.
- In 2008, EPA adopted a 5.0 g/kW-hr CO emission standard specifically for engines that power marine generators.
  - EPA limit for all other small SI engines is 610 g/kW-hr
- Although not intentionally done to reduce CO poisoning hazard, introduction of catalytic converters on cars in 1975, which reduced CO emissions by 76%, resulted in 81% reduction in vehicle-related CO deaths and injuries.

# Questions?

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- All documents located at:  
[www.regulations.gov](http://www.regulations.gov) under docket CPSC-2006-0057

And

<http://www.cpsc.gov/en/Research--Statistics/Carbon-Monoxide/Portable-Generator-Technical-Reports/>

- For further info:

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