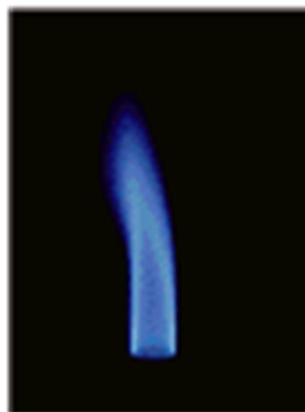


**Track: Natural Gas Basics  
Unit 8: Natural Gas Safety**

Eric Burgis, Energy Solutions Center

**Presentation Outline**

- About Natural Gas
- Gas Leaks
- Digging Safety
- Pipe Safety
- Carbon Monoxide
- Hot Water Safety
- Emergency Preparedness
- General Safety



© Energy Solutions Center Inc. – All Rights Reserved

2

## About Natural Gas

### Natural Gas Safety

- Natural gas is used by 45% of U.S. and 55% of Canadian households as their main heating source
- Natural gas is clean, efficient and relatively safe
- However, there are potential dangers associated with natural gas usage
  - Combustible
  - Colorless
  - Tasteless
  - Odorless



Source: 2020 Residential Energy Consumption Survey, Table Hc6.1  
<https://www.eia.gov/consumption/residential/data/2020/hc/pdf/Hc6.1.pdf>

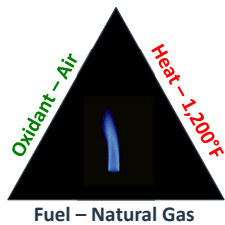
Source: Natural Resources Canada – Energy Fact Book 2022-2023  
[https://publications.gc.ca/collections/collection\\_2022/mcan-nrcan/m136-1-2022-eng.pdf](https://publications.gc.ca/collections/collection_2022/mcan-nrcan/m136-1-2022-eng.pdf)

© Energy Solutions Center Inc. – All Rights Reserved

4

## Natural Gas Combustion

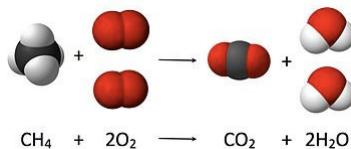
- Natural gas is not flammable by itself
- Requires fuel, air, and ignition source
- All must be in an appropriate mixture shown simply by the Combustion Triangle



© Energy Solutions Center Inc. – All Rights Reserved

5

## The Combustion Equation



- Must be in the proper ratios for the reaction to occur
- This is referred to as Stoichiometric combustion



© Energy Solutions Center Inc. – All Rights Reserved

6

### Combustion Zone



- Gas or vapor will ignite only within a specific range of fuel/Oxygen mixtures
- Too little or too much gas will not ignite
- These conditions are defined as the Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL)
- Any amount of gas between the two limits is explosive

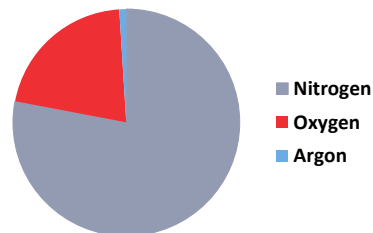


© Energy Solutions Center Inc. – All Rights Reserved

7

### Issues in Combustion

- Most gas equipment uses “air” for the oxidant
- Air is composed of Oxygen, Nitrogen and Argon
- The chemical composition of the air in our atmosphere is:
  - Nitrogen (78%)
  - Oxygen (about 21%)
  - Argon (almost 1%)



© Energy Solutions Center Inc. – All Rights Reserved

8

## Issues in Combustion

- When combusting with “air” the nitrogen and argon are not consumed but instead heated and pass through the process into the exhaust stream performing no work
- Any combustion at high temperatures in atmospheric air can create small amounts of several nitrogen oxides, commonly referred to as NOx
  - NOx is 300 times more potent than CO2 and depletes our ozone layer



© Energy Solutions Center Inc. – All Rights Reserved

9

## Gas Leaks

## Natural Gas Leaks

- While rare, natural gas line leaks can be extremely dangerous
- The most telling sign of a natural gas leak is the familiar rotten egg odor of natural gas
- This odorant called Mercaptan is added to the natural gas so it can be detected in the event of a leak



[This Photo](#) by Unknown Author is licensed under [CC BY](#)



© Energy Solutions Center Inc. – All Rights Reserved

11

## How to Recognize a Leak

- Look for signs of a leak such as dead vegetation, bubbles in a flooded area or dirt blowing from the ground
- Listen for a hissing or roaring sound



[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)



© Energy Solutions Center Inc. – All Rights Reserved

12

## Gas Utility Responsibility

- Technicians have specialty equipment that can detect very small leaks
- Utility crew will check main lines, service line and meter location for leaks
- If a leak is detected in the gas service to the home or building, this service may be shut off to make repairs



<https://www.ueitest.com/ECommerce/product/cd100a/cd100a>

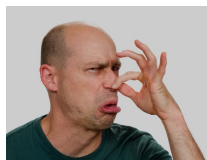


© Energy Solutions Center Inc. – All Rights Reserved

13

## Know the 3 R's

- **R**ecognize



- **R**eact



- **R**eport



These Photos by Unknown Authors is licensed under [CC BY-SA-NC](#)



© Energy Solutions Center Inc. – All Rights Reserved

14

## What if you Suspect a Leak

- If you detect a strong gas odor, follow these tips:
  - Do not attempt to locate the leak
  - Do not turn any electrical appliances on or off
  - Do not smoke or use any open flames
  - Leave the house and, from a safe distance, call the utility company and 911
  - When digging outside, if a natural gas line is damaged, call the utility immediately



© Energy Solutions Center Inc. – All Rights Reserved

15

## Digging Safety



## Digging Safety

- Call 811 before you dig so that you know where gas lines are buried to prevent risk of injury
- If you hit a natural gas line while digging – leave the area and call 911 – do not attempt to make repairs yourself



© Energy Solutions Center Inc. – All Rights Reserved

17

## Digging Safety

- Be careful when excavation and respect markings from 811
  - Use trained operators and spotters when digging
  - Leave site safe at end of day – Protective fencing, warning barriers or covering plates
- Implement traffic control measures when digging in a street
  - Coordinate with city, state for traffic control
  - Use signs, cones, or flaggers as necessary



© Energy Solutions Center Inc. – All Rights Reserved

18

## Call 811

- It's the law – Call 811 before you dig
  - Applies to homeowners, landscapers, contractors
- Call at least 3 days prior to digging
- The local One Call Center will notify utilities
- Utilities will mark areas so you know what is below ground
- Service is free
- Line locators will mark the location of lines











© Energy Solutions Center Inc. – All Rights Reserved

19

## Know the Colors

- Red Flag – Electric
- Orange Flag – Cable or Phone
- Blue Flag – Water
- Green Flag – Sewage
- Yellow Flag – Natural Gas

Know what's below.  
811 before you dig.**COLOR CODE FOR UTILITY MARKINGS**

	ELECTRIC
	GAS-OIL-STEAM
	TELEPHONE & CABLE TV
	WATER
	SEWER
	RECLAIMED WATER
	TEMPORARY SURVEY MARKINGS
	PROPOSED CONSTRUCTION

**When in Doubt – Check it Out**

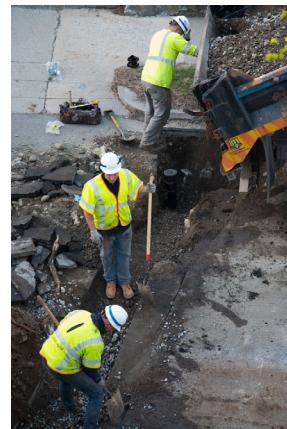
© Energy Solutions Center Inc. – All Rights Reserved

20

## Pipe Safety

### Utility Replacement Programs

- Utilities routinely perform detailed safety inspections on their pipelines, fittings and connections
- Required system integrity programs to manage Transmission and Distribution systems
  - Elimination of cast iron piping
  - Replacement of all bare steel pipes
  - Maintenance of pressure regulators
  - Quality Assurance monitoring



[This Photo](#) by Unknown Author is licensed under [CC BY-SA-NC](#)

## Internal Piping Safety

- Perform leak surveys
- Follow installation standards to insure consistency and quality of workmanship
- Use the correct materials and tools for the job
  - Black iron pipe
  - CSST
  - Copper tubing
- Test, Test and Retest of pressure for leaks on new piping.



[This Photo](#) by Unknown Author is licensed under [CC BY-NC-ND](#)



© Energy Solutions Center Inc. – All Rights Reserved

23

## Carbon Monoxide

## Carbon Monoxide (CO)

- The chemical properties of natural gas make it a clean fuel source
- However, it can be potentially dangerous for consumers if their natural gas appliances are not properly maintained
- One of the dangers of poorly maintained or improperly used appliances is carbon monoxide poisoning – if a faulty furnace does not burn natural gas properly (or is not vented properly) carbon monoxide can begin to build in the home



© Energy Solutions Center Inc. – All Rights Reserved

25

## Carbon Monoxide

- Cannot see, hear, taste or smell CO
- Often called the invisible killer
- Created when fuels (such as gasoline, wood, coal, natural gas, propane, oil, and methane) burn incompletely
- In the home, heating and cooking equipment that burn fuel are potential sources of carbon monoxide
- Vehicles or generators running in an attached garage can also produce dangerous levels of carbon monoxide



© Energy Solutions Center Inc. – All Rights Reserved

26

### Estimated Non-Fire Carbon Monoxide Poisoning Deaths by Associated Fuel-Burning Consumer Product

	2009	2010	2011	2012	2013	2014	2105	2016	2017	2018	2019
<b>Total</b>	<b>148</b>	<b>159</b>	<b>163</b>	<b>137</b>	<b>146</b>	<b>164</b>	<b>172</b>	<b>178</b>	<b>188</b>	<b>210</b>	<b>250</b>
All Heating	41	58	49	46	43	64	37	50	41	64	69
Gas Furnaces	10	15	6	15	5	6	6	15	6	21	13
Gas Water Heaters	1	2	4	*	*	*	*	1	4	1	7
Gas Range	2	2	3	*	2	*	3	6	*	2	3
Engine-Driven	76	56	73	64	68	62	92	80	104	100	118

\*no data reported

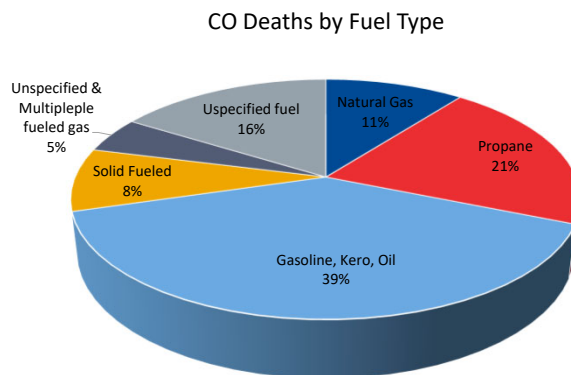
Non-Fire CO Deaths with Consumer Products 2019 Annual Estimates | March 2023 | cpsc.gov  
<https://www.cpsc.gov/s3fs-public/NonFireCarbonMonoxideDeathsAssociatedwiththeUseofConsumerProducts2019AnnualEstimates.pdf?VersionId=90WCZoH61aVUvTgDt0o16LLKZf1EeH3E>



© Energy Solutions Center Inc. – All Rights Reserved

27

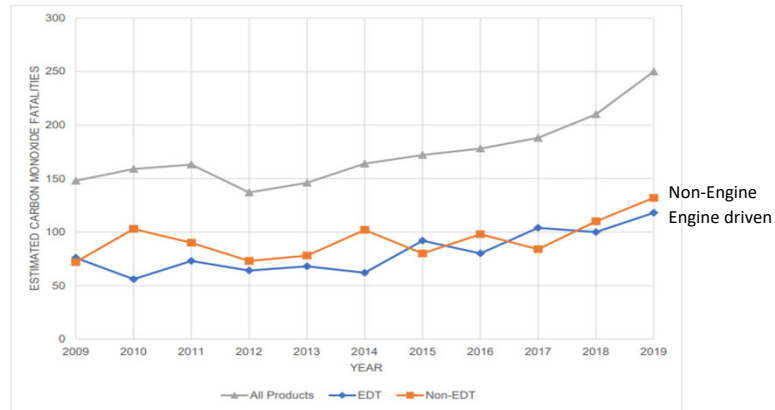
### Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Consumer Products by Fuel Type



Non-Fire CO Deaths with Consumer Products 2019 Annual Estimates | March 2023 | cpsc.gov for 2019  
<https://www.cpsc.gov/s3fs-public/NonFireCarbonMonoxideDeathsAssociatedwiththeUseofConsumerProducts2019AnnualEstimates.pdf?VersionId=90WCZoH61aVUvTgDt0o16LLKZf1EeH3E>



## Comparison of Trends in Consumer Product-Related Carbon Monoxide Deaths, 2009 to 2019



Source: U.S. Consumer Product Safety Commission/EPHA, CPSC Death Certificate File, CPSC Injury or Potential Injury Incident File, CPSC In-Depth Investigation File, 2009–2019.



## Carbon Monoxide

### ■ Signs of CO Poisoning (within 1-2 minutes)

1. Dizziness
2. Nausea
3. Headaches
4. Collapse

### ■ Test your CO Detector monthly



This Photo by Unknown Author is licensed under CC BY-NC



## Carbon Monoxide Safety Tips

- CO alarms should be installed in a central location outside each sleeping area and on every level of the home
- Follow the manufacturer's instructions for placement and mounting height
- Choose a CO alarm that has the label of a recognized testing laboratory
- If the audible trouble signal sounds, check for low batteries.
- Test your CO Detector monthly
- If the CO alarm sounds, immediately move to a fresh air location outdoors or by an open window or door. Make sure everyone inside the home is accounted for. Call for help from a fresh air location and stay there until emergency personnel arrive



© Energy Solutions Center Inc. – All Rights Reserved

31

## Hot Water Safety



### Hot Water Safety

- Make sure your water heater is set to a safe temperature for home use
- Hot liquids can cause life-threatening burn injuries
- Scalds are the number-one cause of burn injury to children under age 4
- Hot tap water accounts for 17% of all childhood scald hospitalizations
- When tap water reaches 140°F, it can cause a third degree (full thickness) burn in just five seconds

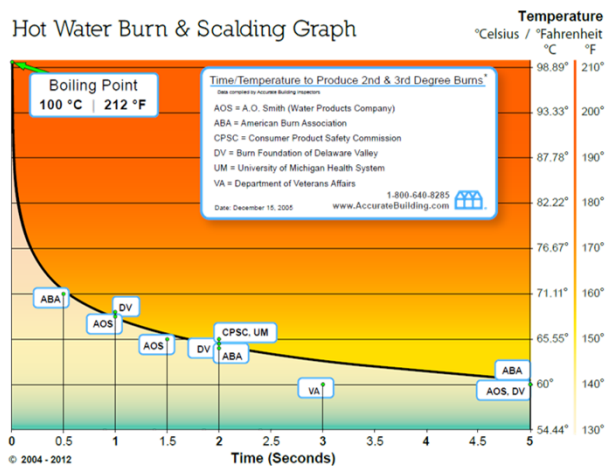
<http://www.burnfoundation.org/programs/resource.cfm?c=1&a=3>



© Energy Solutions Center Inc. – All Rights Reserved

33

### Time/Temp to Produce 2<sup>nd</sup> & 3<sup>rd</sup> Degree Burns



[http://www.accuratebuilding.com/services/legal/charts/hot\\_water\\_burn\\_scalding\\_graph.html](http://www.accuratebuilding.com/services/legal/charts/hot_water_burn_scalding_graph.html)



© Energy Solutions Center Inc.

No portion of this material may be reproduced without the expressed written consent of the Energy Solutions Center Inc.

## Set Appropriate Temperatures

- Set per manufacturer recommendations



© Energy Solutions Center Inc. – All Rights Reserved

35

## Emergency Preparedness

## Lightning Safety Tips

- Plan in advance your evacuation and safety measures
- When you first see lightning or hear thunder, activate your emergency plan
- Now is the time to go to a building or a vehicle
- Lightning often precedes rain, so don't wait for the rain to begin before suspending activities



© Energy Solutions Center Inc. – All Rights Reserved

37

## Indoor Safety Tips

- Even though your home is a safe shelter during a lightning storm, you may still be at risk
- About one-third of lightning-strike injuries occur indoors



© Energy Solutions Center Inc. – All Rights Reserved

38

## Indoor Tips

- Here are some tips to keep safe & reduce your risk of being struck by lightning while indoors during a storm
  - **Avoid water** – Don't bathe, shower, wash dishes, or have any other contact with water
  - **Avoid electronic equipment** – Don't use your computers, laptops, game systems, washers, dryers, stoves, or anything connected to an electrical outlet
  - **Avoid windows, doors, porches and concrete** – Lightning can travel through any metal wires or bars in concrete walls or flooring



© Energy Solutions Center Inc. – All Rights Reserved

39

## What to Do if the Lights Go Out

- Don't panic – check to see if neighbors have power
- If you're home is the only one without power, see whether a main fuse is blown or a circuit breaker is tripped – use a flashlight



© Energy Solutions Center Inc. – All Rights Reserved

40

## Will the Gas Appliances Work

- A natural gas, propane or electric heating system will not operate while the power is out
  - Here are a couple tips to follow during an outage:
  - Never use a gas oven or range to heat your home
  - If inadequately ventilated, a kerosene heater or wood burner also can cause deadly carbon monoxide gas
  - Wear layers of clothing and use several layers of blankets



© Energy Solutions Center Inc. – All Rights Reserved

41

## Will the Gas Appliances Work

- Gas ranges with a pilot light will work for cooking during an outage
- A conventional tank style gas water heater will continue to operate and provide hot water to your home
- High efficiency and tankless water heaters require electricity to operate fans and controls so these will not operate during an outage



© Energy Solutions Center Inc. – All Rights Reserved

42

## Natural Gas Standby Generators

### Natural Gas Generators

#### ■ Standby Generator Advantages

- Fast, automatic delivery of emergency power, after power failure
- Units conduct self diagnosis every week and display alerts about its status
- Fuel autonomy to provide power for as long as you need it
- Allow you to normally operate your home or business including use of internet, heating and air conditioning, TV, etc.
- They can be sized to turn on your entire house or building or just the critical portion that is most important

## Natural Gas Generators (Continued)

### ■ Standby Generator Advantages

- Automatically disconnects your house or building from the utility lines when power fails – protecting you and your electronic devices from violent power surges, spikes, and brownouts
- When power returns, generator does not transfer to the utility until the voltage has stabilized, protecting from dangerous voltage fluctuation when power is first turned on
- They are permanently installed – no need to run extension cords and set up your unit in the middle of a storm or other natural disaster



© Energy Solutions Center Inc. – All Rights Reserved

45

## Natural Gas Generators (Continued)

### ■ Standby Generator Advantages

- Safe operation during storms or other disasters
- No need to improvise a backup energy solution during an actual emergency
- Afford you piece of mind by ensuring that your loved ones, and the things important to you are well protected during times of emergencies
- Allow you to remain at home and in familial surroundings during a storm or extended power outage, rather than fleeing to a hotel which may not be available as they too may be out of power, or full



© Energy Solutions Center Inc. – All Rights Reserved

46

## General Safety

### General Safety Tips

- Have all natural gas lines located before making any home renovation
- Keep meter, regulators and exhaust vents clear
- Don't attempt to repair or replace appliances by yourself
- Make sure your appliances carry CSA & UL approvals





## Fireplace Safety

- Hot glass and frame take up to 1 hour to cool
- Use a barrier (gate) or screen around stove or fireplace with children
- Put remote control out of reach



© Energy Solutions Center Inc. – All Rights Reserved

49

## Dryer Safety

- Clean your lint trap after every use of the dryer



[These Photo](#) by Unknown Authors are licensed under [CC BY-SA](#)



© Energy Solutions Center Inc. – All Rights Reserved

50

## Check the Color of the Flame on Your Stove

**Wrong**



**Right**



© Energy Solutions Center Inc. – All Rights Reserved

51

## Install a CO Detector

- Follow the recommended installation specifications when installing a CO detector



[This Photo](#) by Unknown Author is licensed under [CC BY-NC](#)



© Energy Solutions Center Inc. – All Rights Reserved

52

### Have Chimneys Inspected Annually by a Trained Professional



[www.ctsweep.com](http://www.ctsweep.com)



© Energy Solutions Center Inc. – All Rights Reserved

53

### Clear Clutter from Around Appliances



© Energy Solutions Center Inc. – All Rights Reserved

54

# Thank You

Consider taking the on-line test while  
course material is fresh in your mind



400 North Capitol Street, 4th Floor  
Washington, DC 20001  
[escenter.org](http://escenter.org)