

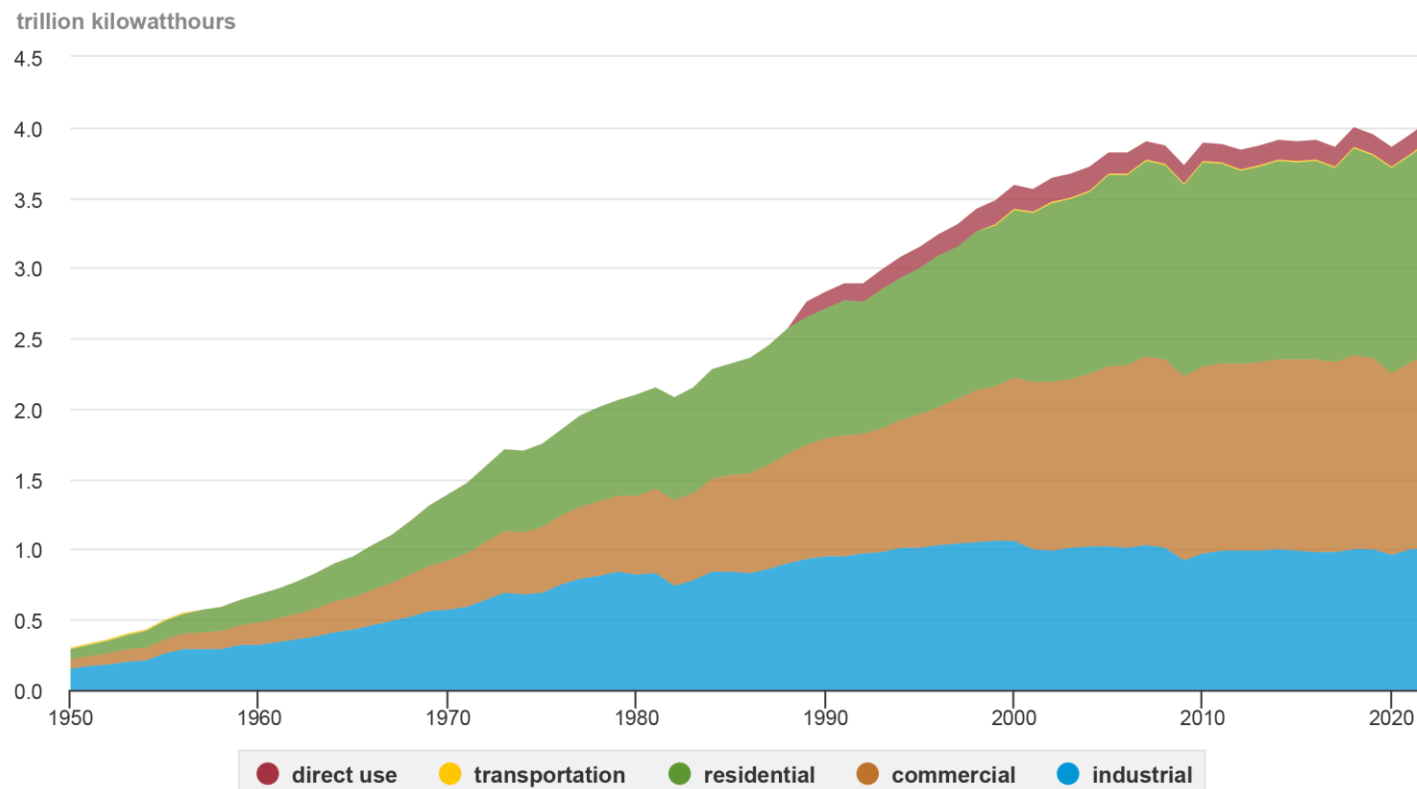
Electrical Safety in the Workplace

Brett Brenner – Electrical Safety Foundation
Daniel Majano – Electrical Safety Foundation

Electrification is on the Rise

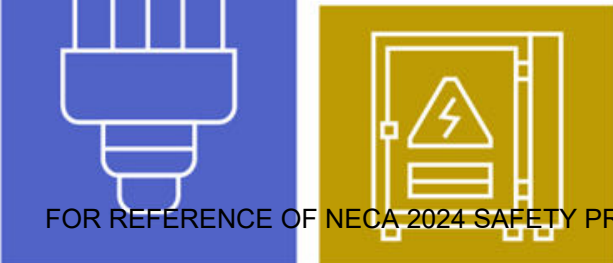
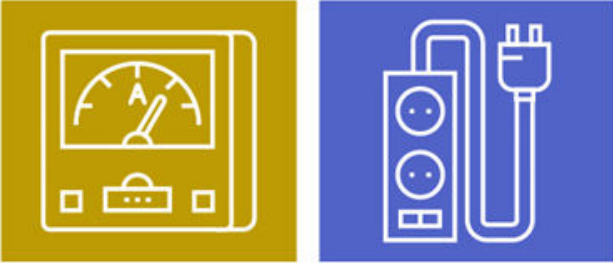
According to the U.S. Energy Information Administration, the United States used a total of 4.07 trillion kilowatt hours of electricity in 2022, which is 14 times higher than electricity use in 1950.

U.S. electricity retail sales to major end-use sectors and electricity direct use by all sectors, 1950-2022

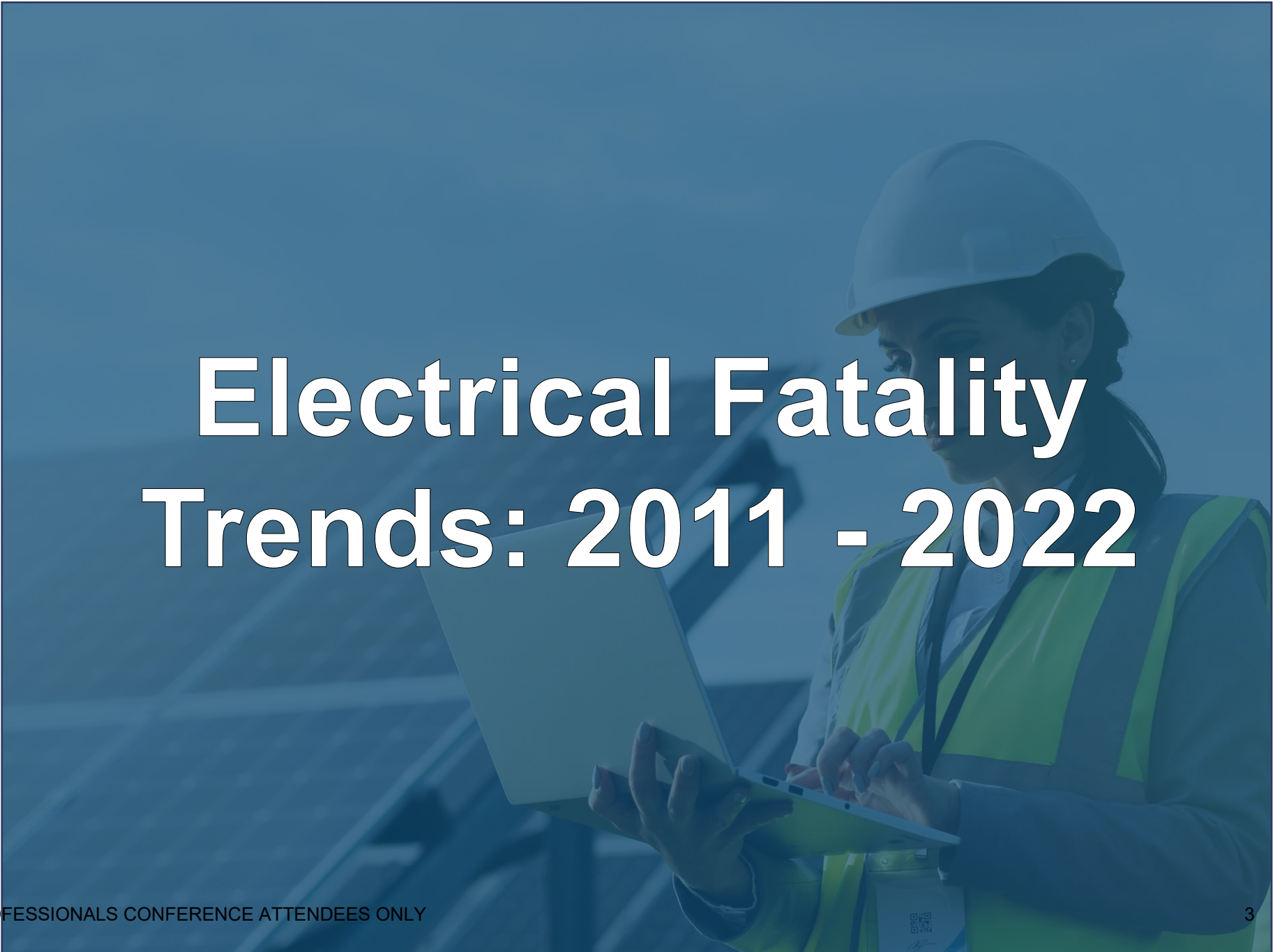


Data source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 7.6, March 2023, preliminary data for 2022





Electrical Fatality Trends: 2011 - 2022



Data Sources

- **Occupational Safety and Health Administration
Accident Investigation Summaries (OSHA 170 form)**
 - Provides the most details about the fatalities. Summaries must undergo a process for screening personal information and adding keywords that may cause some additional delay in posting.
- **Bureau of Labor Statistics: Census of Fatal Occupational Injuries (CFOI)**
 - “The Census of Fatal Occupational Injuries is the most complete count of fatal work injuries in the United States.”

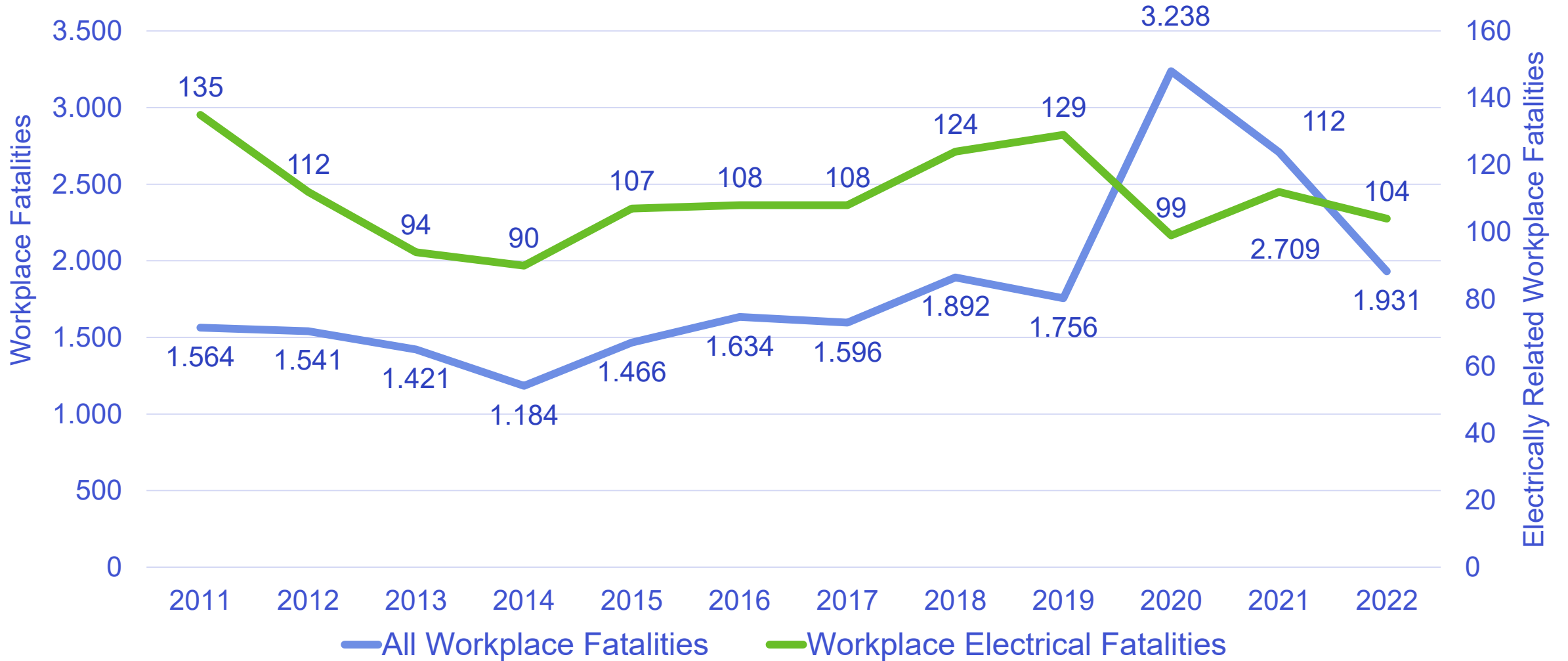


Electrical Fatalities in the Workplace

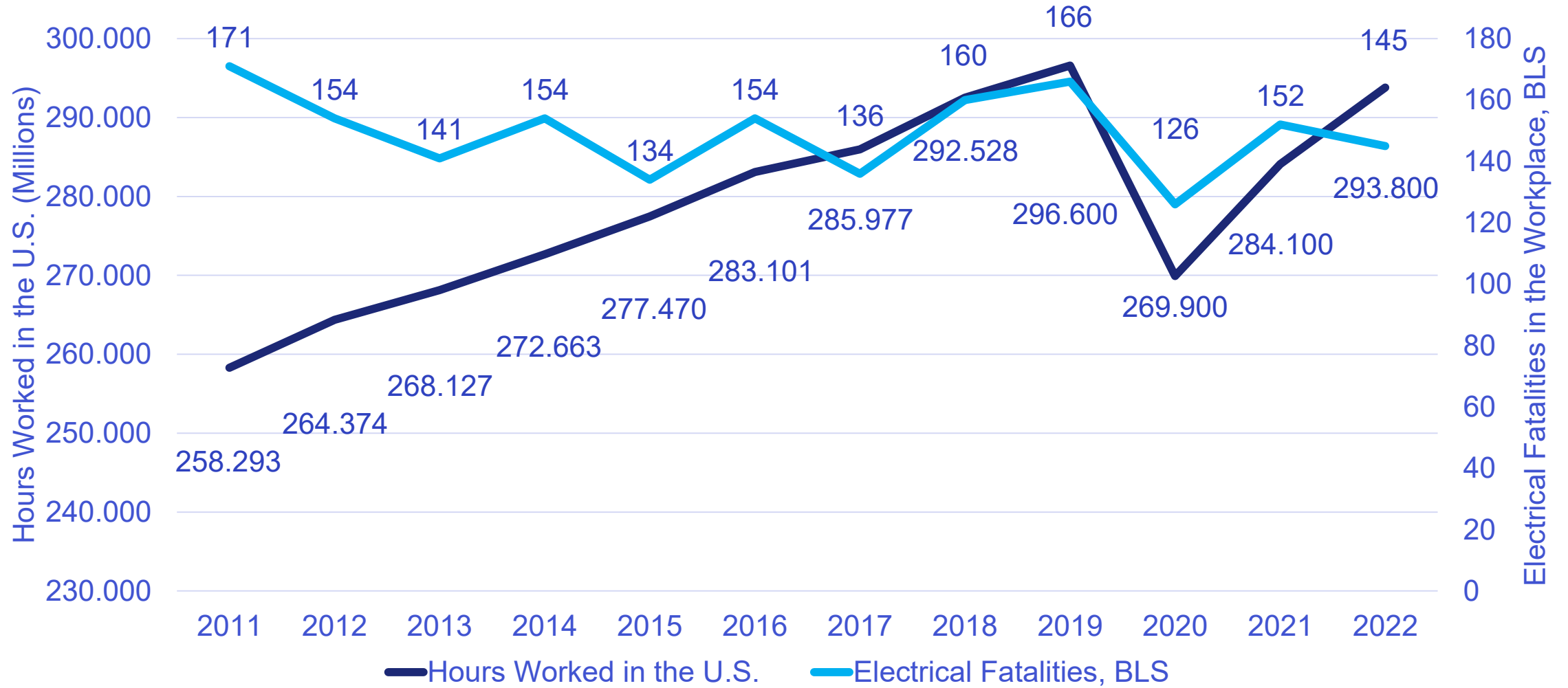
- Contact with or exposure to electricity continues to be one of the leading causes of workplace fatalities and injuries
- 1,322 workplace electrical fatalities between 2011 – 2021
- 6% of all workplace fatalities are caused by electricity
- 70% of fatalities occur in non-electrical occupations



Workplace Fatalities and Electrical Workplace Fatalities Reported in OSHA 170 Form, 2011 - 2022



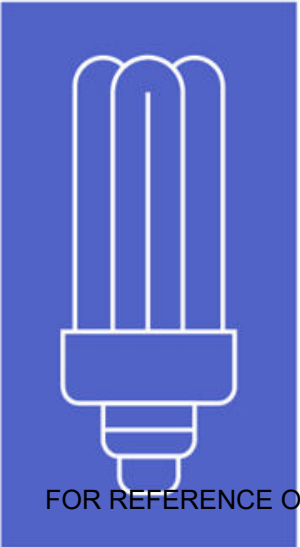
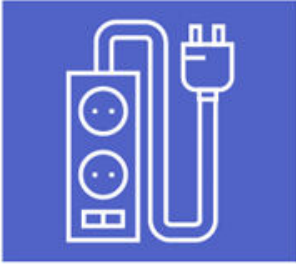
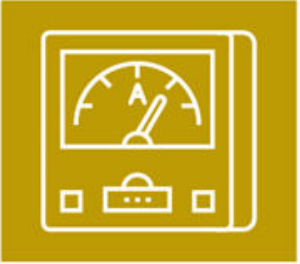
Bureau of Labor Statistics: Electrical Fatalities v. Hours Worked in the United States, All Industries



Electrical Fatalities in the Workplace

- Electrical fatalities continue to stay consistent year over year
 - 8% drop in electrical fatalities from 2021 to 2022
 - There is an average change of -1.5% in electrical fatalities year over year
- Electrical fatalities account for 6% of all workplace fatalities
- Non-electrical occupations account for 70% of workplace electrical fatalities
- Leading fatality causes:
 - Working on or near energized equipment or parts: 48%
 - Overhead power line contact: 41%





Occupations Involved in Electrical Fatalities

Occupations Involved in Electrical Fatalities

OSHA 170 form categorizes occupations into one of 573 recognized occupations, including occupations listed as “not applicable,” “occupation not reported,” or “occupation not listed.”

- A total of 118 occupations were involved in electrical fatalities
- 30% of fatalities were in electrical occupations
- 70% of fatalities were in non-electrical occupations
- Non-electrical occupation fatalities decreased an average of 1.6%
- Electrical occupation fatalities **increased** an average of 1.5%
- Ten occupations account for 60% of all electrical fatalities in the workplace, with three being electrical occupations



Occupations Involved in Electrical Fatalities

ELECTRICAL OCCUPATIONS

Electrical and electronic engineers

Electrical and electronic equipment assemblers

Electrical and electronic technicians

Electric power installers and repairers

Electricians

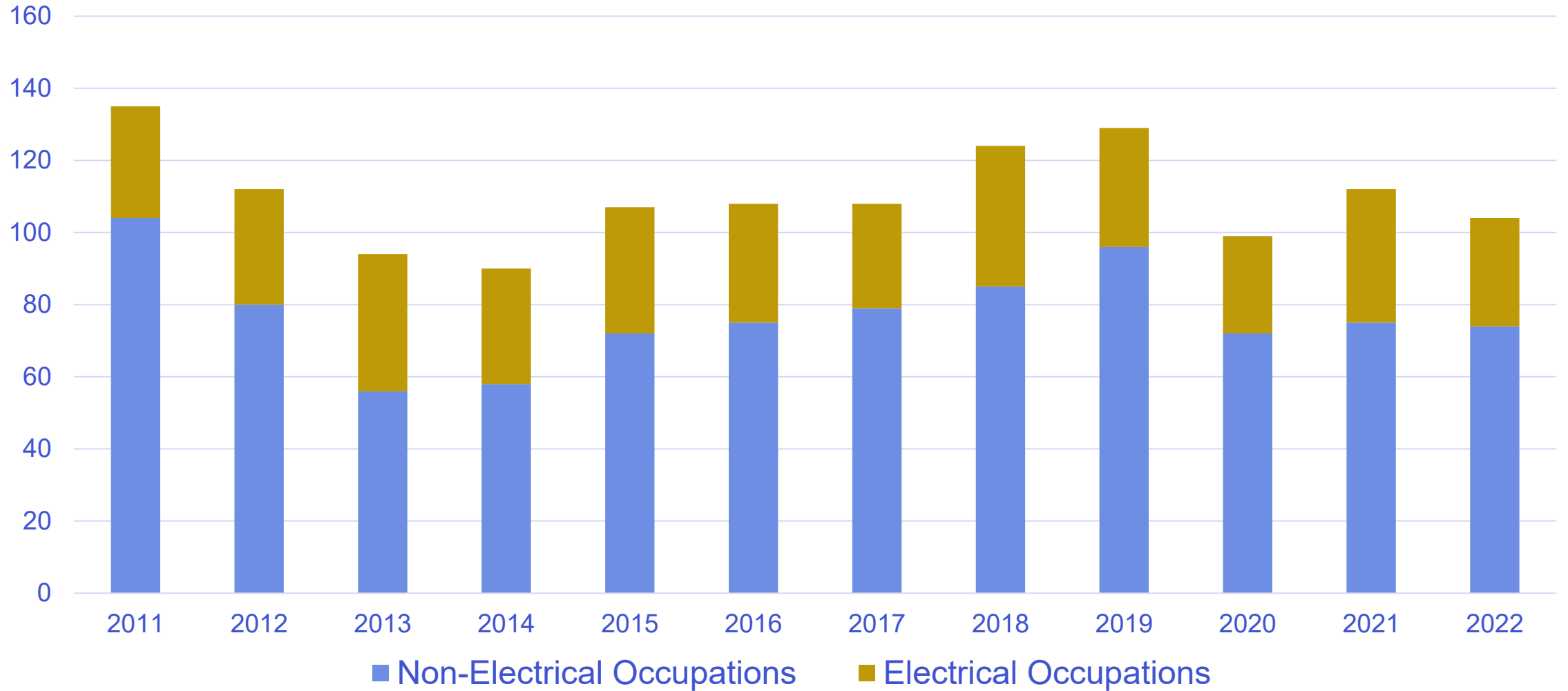
Electricians' apprentices

Electronic repairers, communications, and industrial equipment

Supervisors in above fields



OSHA: Electrical Occupation v. Non-Electrical Occupation Electrical Fatalities 2011 - 2022



Occupations Involved in Electrical Fatalities

Occupation	Fatalities
Electricians	195
Construction laborers	119
Laborers, except const.	117
Occupation not reported	117
Electrical power installers and repairers	109
Tree trimming occupations	94
HVAC and refrig. mechanics	42
Electricians' apprentices	37
Truck drivers; heavy	35
Roofers	29
Painters, const. and maintenance	28

Occupation	Fatalities
Installers and repairers	26
Telecomm: line installers & repairers	23
Electrical and electronic engineers	22
Machinery maintenance occ.	22
Carpenters	19
Technicians, n.e.c	13
Electrical and electronic technicians	13
Welders and cutters	13
Helpers, construction trades	12
Construction trade, n.e.c	11
Farm workers	11



WORKPLACE SAFETY

KNOW WHEN TO SAY WHEN – KNOW WHEN TO STOP WORK

While qualified electrical line workers and electricians are often willing to go above and beyond the call, some jobs require specific knowledge and experience. That's why it's important to stop and reassess a situation if there is ever doubt about a job's task or a procedure's requirement. As qualified electrical workers, it is our jobs to ensure all trades are aware of danger related to unqualified electrical work.

ALWAYS ASK YOURSELF:

- 1** Have I been properly trained to safely complete this job task?
- 2** Have I worked on this task before, and do I have the right training and experience?
- 3** Do I have the proper tools for this job?
- 4** Is the hierarchy of risk controls being followed to ensure that preventive and protective risk controls are being implemented?
- 5** Has a proper risk assessment been performed?
- 6** Are all conductors and circuit parts in an electrically safe working condition?
- 7** Are these parts properly guarded to reduce the likelihood of electrical contact or arcing faults?
- 8** Are all applicable procedures and job planning procedures completed?
- 9** Am I confident about completing this job without risk or putting others at risk?

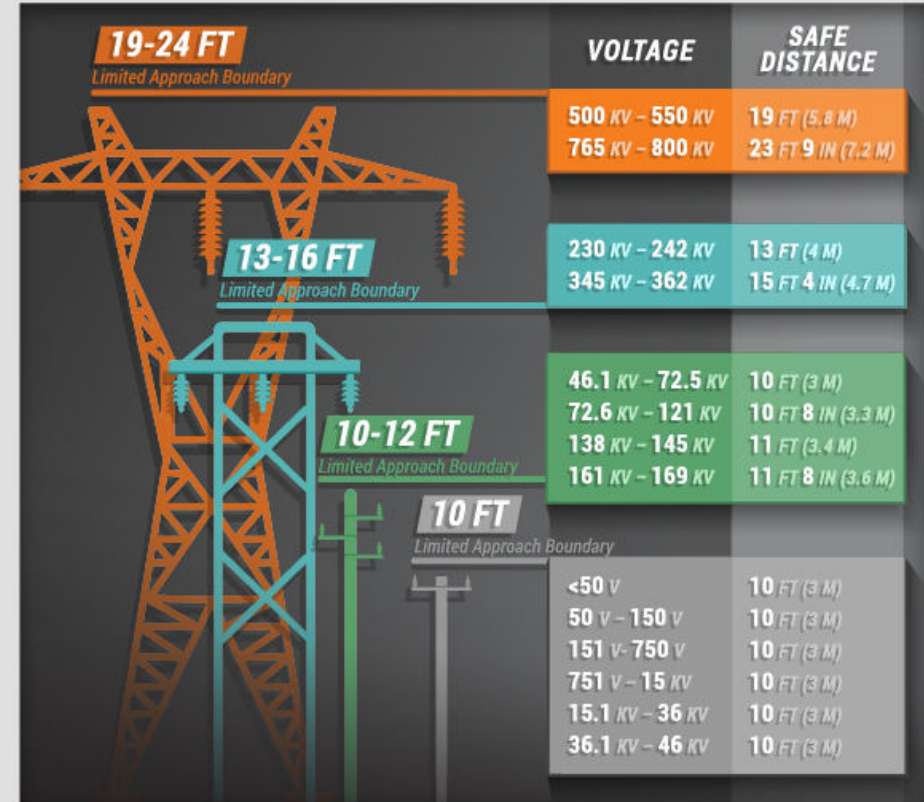
KNOW WHEN TO SAY WHEN – IT CAN SAVE YOUR LIFE, AND THE LIVES OF THOSE WORKING WITH YOU.

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ALWAYS LOOK UP ALWAYS

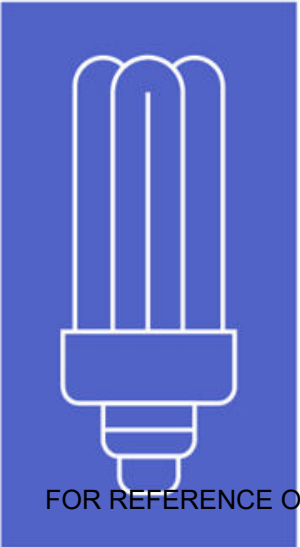
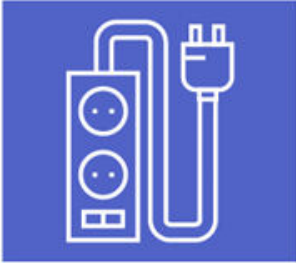
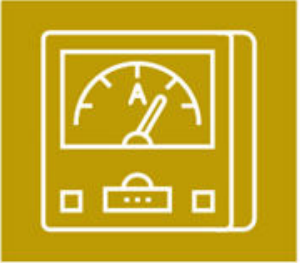
It's no surprise that a construction job site can be an incredibly dangerous workplace. With so many safety protocols and procedures to follow, it can seem overwhelming. But the truth is, most accidents involving electricity, are caused by non-electrical workers inadvertently contacting power lines.

KEEP THE FOLLOWING DISTANCE FROM OVERHEAD POWER LINES:



SO WHEN YOU ARE ON THE JOB SITE REMEMBER TO ALWAYS LOOK UP. ALWAYS. IT COULD SAVE YOUR LIFE AND THE LIVES OF THOSE AROUND YOU.

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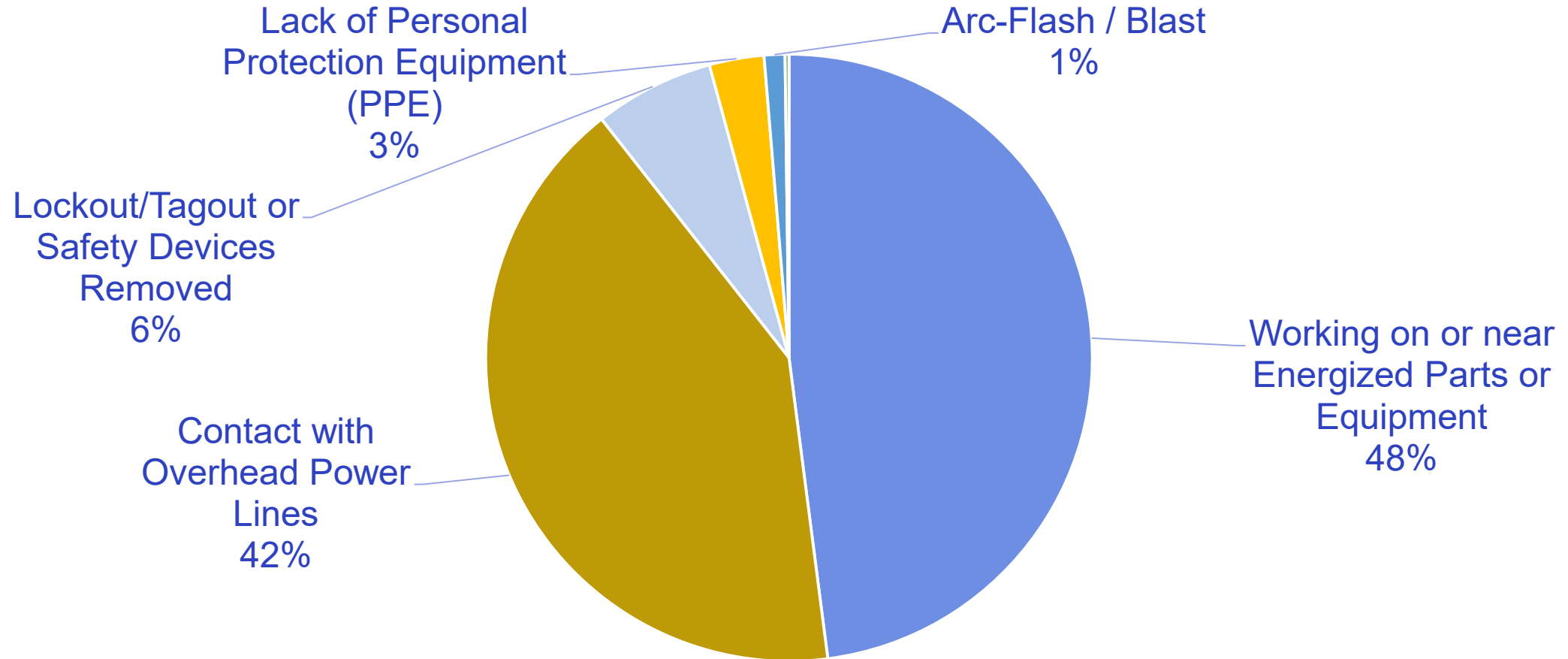
Causes of Electrical Fatalities

Causes of Electrical Fatalities

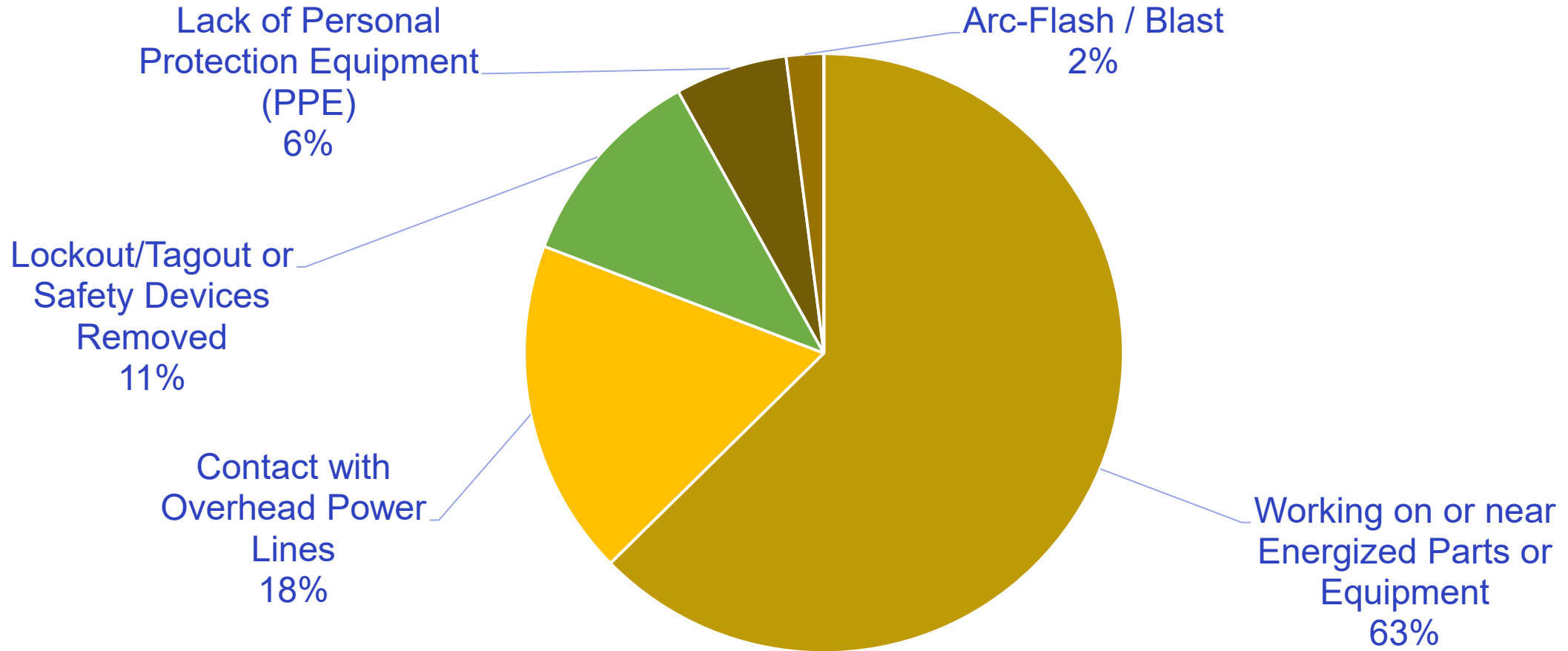
- a) **Working on or near energized conductors / energized parts:** The fatal injury occurred due to contact with energized conductors or equipment. This occurred from the equipment being worked on or nearby equipment or wires, excluding overhead power lines.
- b) **Contact with overhead power lines:** The fatal injury occurred from contact with overhead power lines. This excludes contact with other energized equipment or wires. This also includes arcing events caused by overhead power lines.
- c) **Lockout / tagout procedure failure or safety controls removed:** The fatal injury narrative mentions the removal of safety devices or a failure of a lockout / tagout procedure.
- d) **Lack of personal protection equipment (PPE):** The narrative mentions the lack of personal protective equipment when the fatal injury occurred.
- e) **Arc flash / blast:** The fatal injury occurred due to a reported arc-flash or blast.



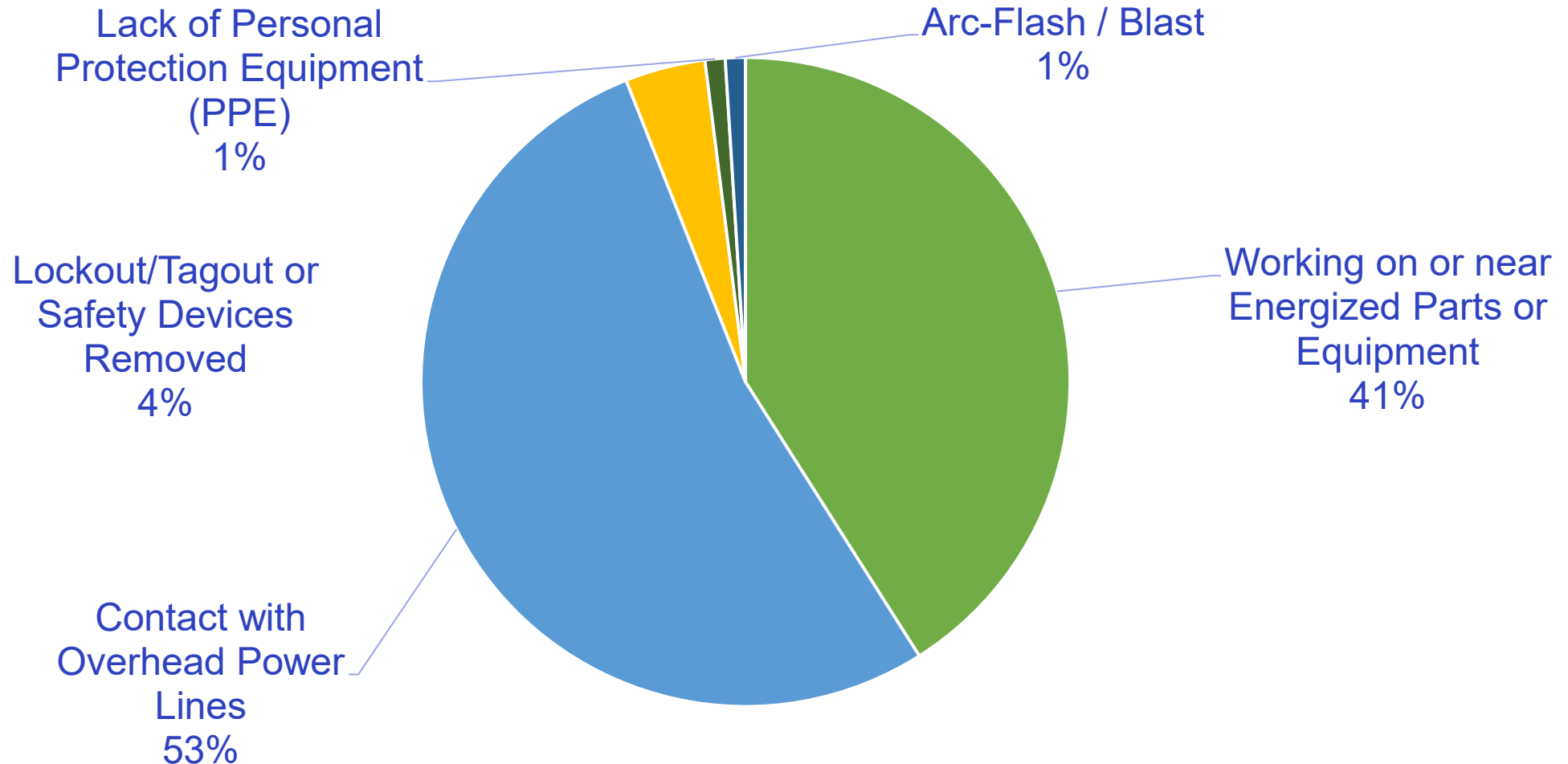
Causes of Electrical Fatalities: All Occupations



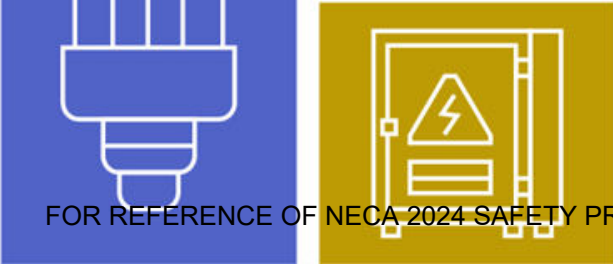
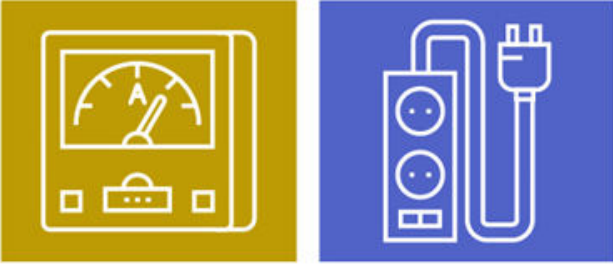
Causes of Electrical Fatalities: Electrical Occupations



Causes of Electrical Fatalities: Non-Electrical Occupations

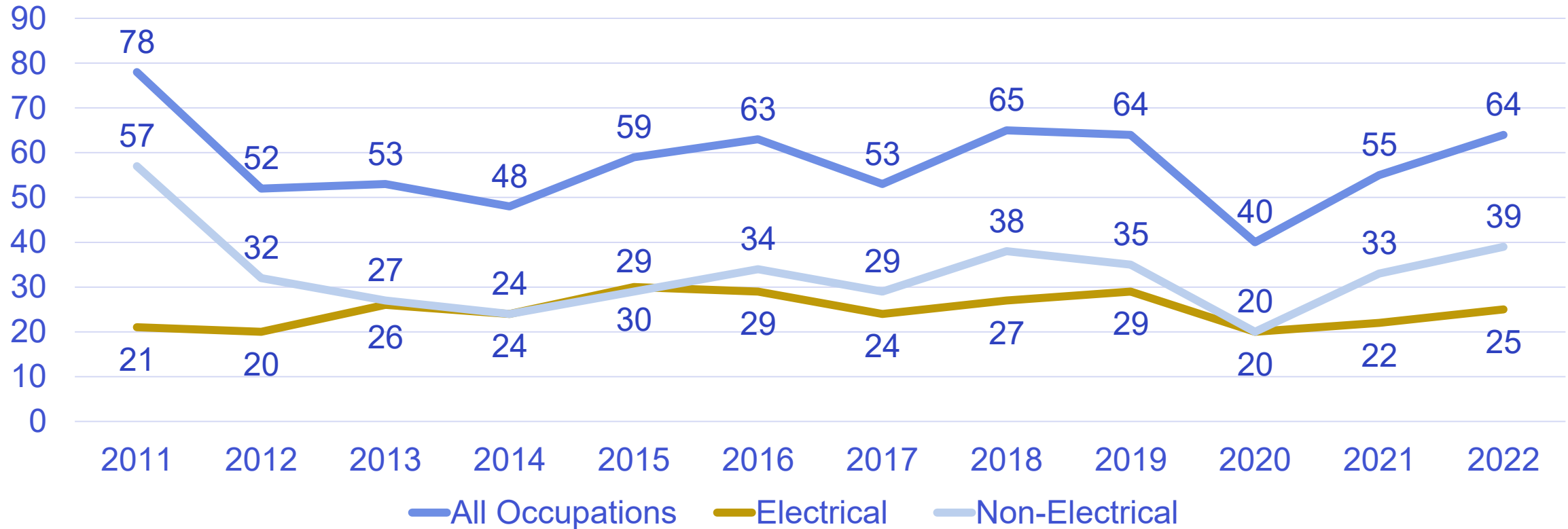






Working on or Near Energized Wires and Equipment

Working on or Near Energized Parts / Equipment



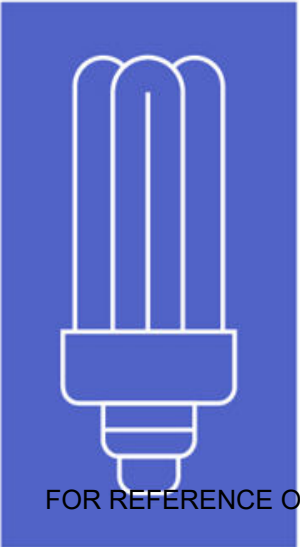
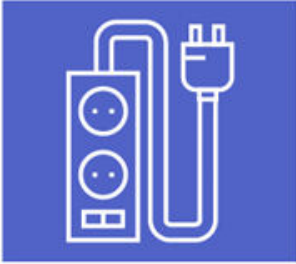
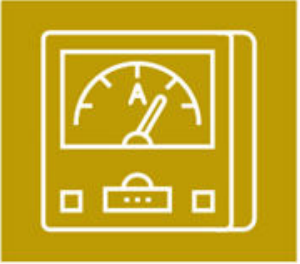
Average of a 1% increase year over year in working on or near energized parts or equipment fatalities

Working on or Near Energized Parts / Equipment

Occupations With 10 or More Fatalities Caused by Working on or Near Energized Parts

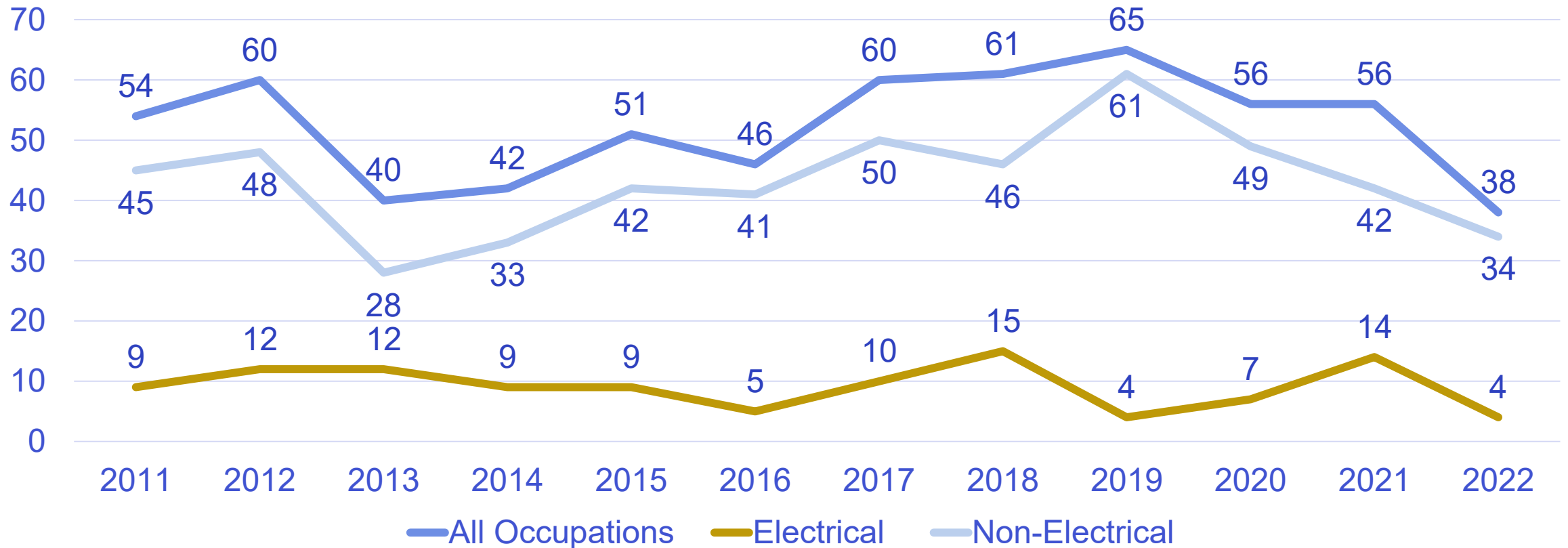
Occupation	Fatalities	Occupation	Fatalities
Electricians	175	Machinery maintenance occupations	20
Electrical power installers & repairers	45	Electrical and electronic engineers	18
Laborers, except construction	44	Installers and repairers	16
Construction laborers	41	Tree trimming occupations	14
Heating, air conditioning, and refrigeration mechanics	38	Electrical and electronic technicians	13
Electricians' apprentices	33	Welders and cutters	13





Overhead Power Line Contact

Overhead Power Line Contact



Average change of -1.18% overhead power line fatalities year over year



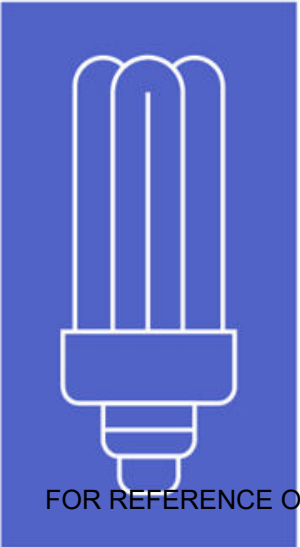
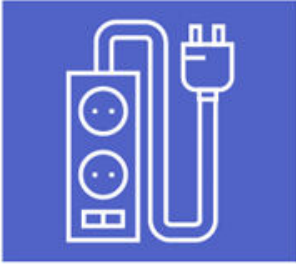
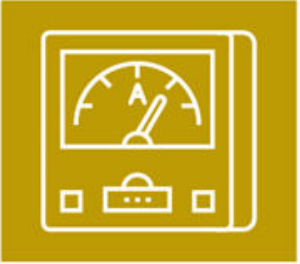
Overhead Power Line Contact

Occupations With 10 or More Fatalities Caused by Overhead Power Line Contact

Occupation	Fatalities	Occupation	Fatalities
Tree trimming occupations	86	Roofers	25
Electrical power installers & repairers	77	Painters, construction & maintenance	25
Laborers, except construction	75	Telecomm: line installers & repairers	21
Construction laborers	59	Electricians	18
Truck drivers, heavy	26	Carpenters	12



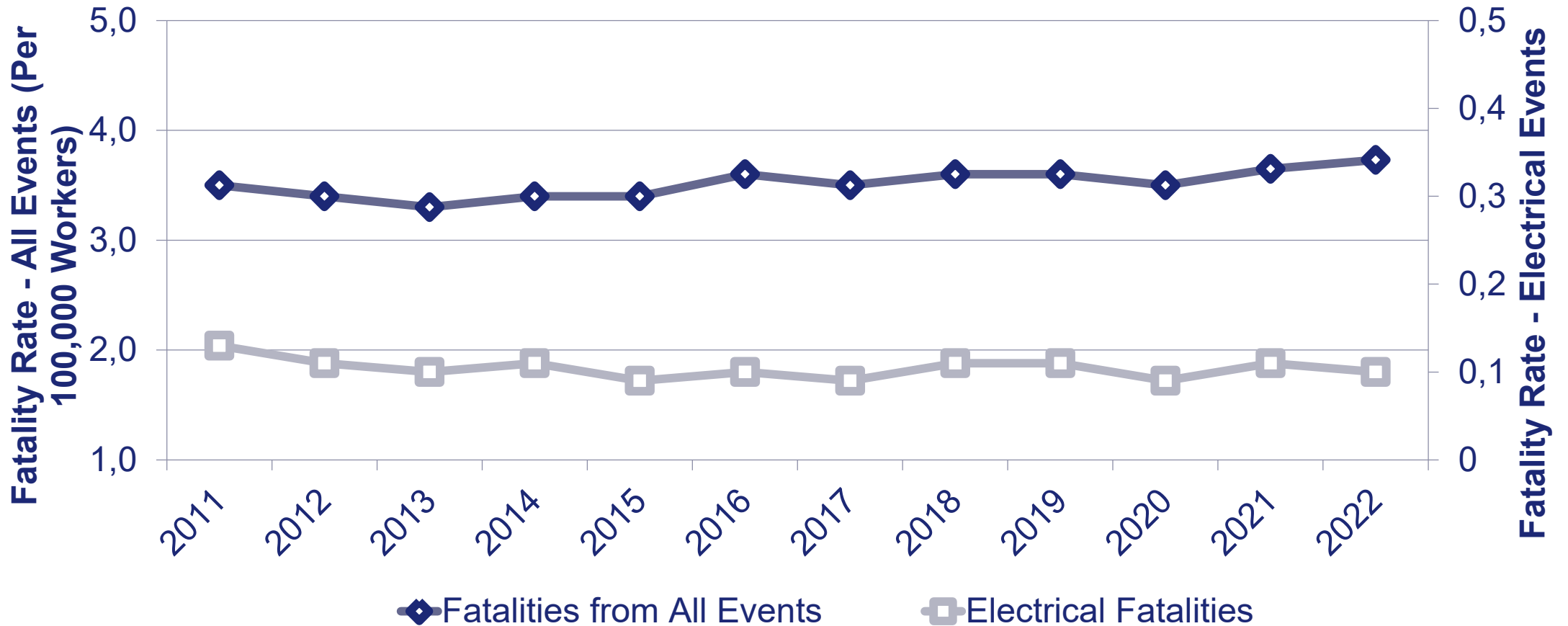




Bureau of Labor Statistics: Electrical Fatality Rates

Electrical Fatality Rates

Fatality Rates for All Events vs. Electrical Events,
All Ownerships, 2011 - 2022



Electrical Fatality Rates

Industries:

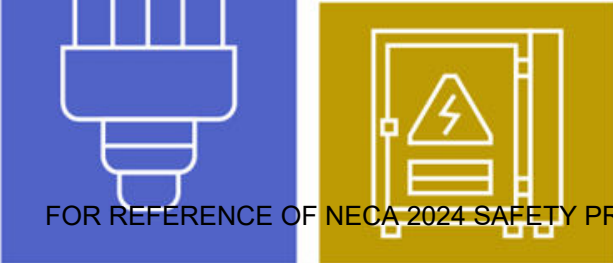
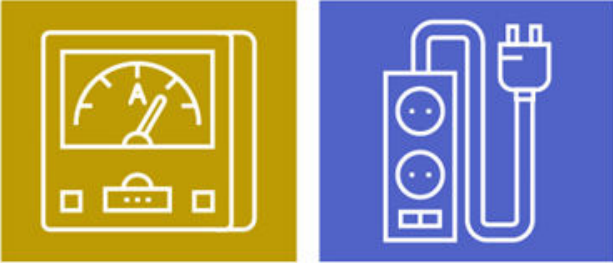
The construction industry had the highest number of electrical fatalities at 789 fatalities between 2011 and 2022.

- Professional and Business Services: 212 fatalities
- Trade, Transportation, and Utilities: 139 fatalities
- Natural Resources and Mining: 138 fatalities
- Manufacturing: 120 fatalities

Fatality rates:

- Electrical fatality rates per 100,000 workers have remained consistent while overall fatality rates have increased.
- Hispanic or Latino workers have the highest rate of electrical fatalities, and this rate is increasing.
- Construction and Extraction occupations, Installation, Maintenance, and Repair occupations, and Building and Grounds Cleaning and Maintenance occupations have the highest rate of electrical fatalities.





Emerging Technology Safety: Electric Vehicles

Electric Vehicle Supply Equipment Safety

Electric vehicles (EV) and EV supply equipment (EVSE) are safe as long as:

- All EV chargers are installed by qualified workers
- EV chargers are properly maintained and used
- Only approved adapters and chargers are used
- EVs and chargers are not modified



Electric Vehicle Charging Safety

Stay safe while charging your electric vehicle

Visually inspect the charging cable before use. Never use a damaged charger

Follow the manufacturer's instructions on how to charge

Never use an extension cord or multiplug adapter when charging electric vehicles

Only use manufacturer provided or approved charging cables.

Never alter or modify your electric vehicle or its battery

Properly store chargers when not in use to prevent damage

Cover chargers to manufacturer's specifications to avoid water damage

Ensure you have proper GFCI protection to protect against electric shocks

Be aware of your surroundings. Do not accidentally come in contact with chargers when driving or parking

Make sure your charging equipment has been certified by a Nationally Recognized Testing Laboratory

All electric vehicle chargers should be installed by a qualified electrician

Please **share** this **free** resource to save lives

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CONNECTED to SAFETY

Understanding Electric Vehicles

Are you thinking about purchasing, or have you recently purchased an **electric vehicle**? Learn about the different charging options you have and how to **charge your electric vehicle safely**.

HOME CHARGING EVSE

Electric Vehicle Supply Equipment

Before using a charger, ensure the equipment has been listed by a **Nationally Recognized Testing Laboratory (NRTL)**.

Have a **qualified electrician** inspect your home to ensure your electrical system can handle charging.

Ensure both the **charger** and **charging cord** do not have **damage** before use.

LEVEL 1 EVSE CHARGING

Provides charging through a **standard household plug**. 2-5 miles of range per hour.

Ensure your charger or receptacle has **GFCI protection** to prevent accidental shocks and electrocution.

Ensure you are using a **dedicated circuit** to charge your vehicle. The circuit should not provide power to any other appliance.

Use a **manufacturer provided** charging cord.

LEVEL 2 EVSE CHARGING

Provides charging through **specialized 240v charging equipment**. 10 - 60 miles of range per hour.

Must be installed by a **qualified electrician**.

May require an **electrical service upgrade** to install.

Only use **outdoor rated** charging stations outdoors.

Ensure the charging station **cannot come in contact** with the electric vehicle.

Keep the **charging cable off the floor** to avoid tripping hazards and maintain the life of the cord.

WARNING

- Electric vehicles have **high voltage** batteries
- All maintenance should be **completed by the manufacturer**
- Avoid contact with **high-voltage orange cables**

LEVEL 3 EVSE CHARGING

Fastest charging option. **Not available** for residential installation.

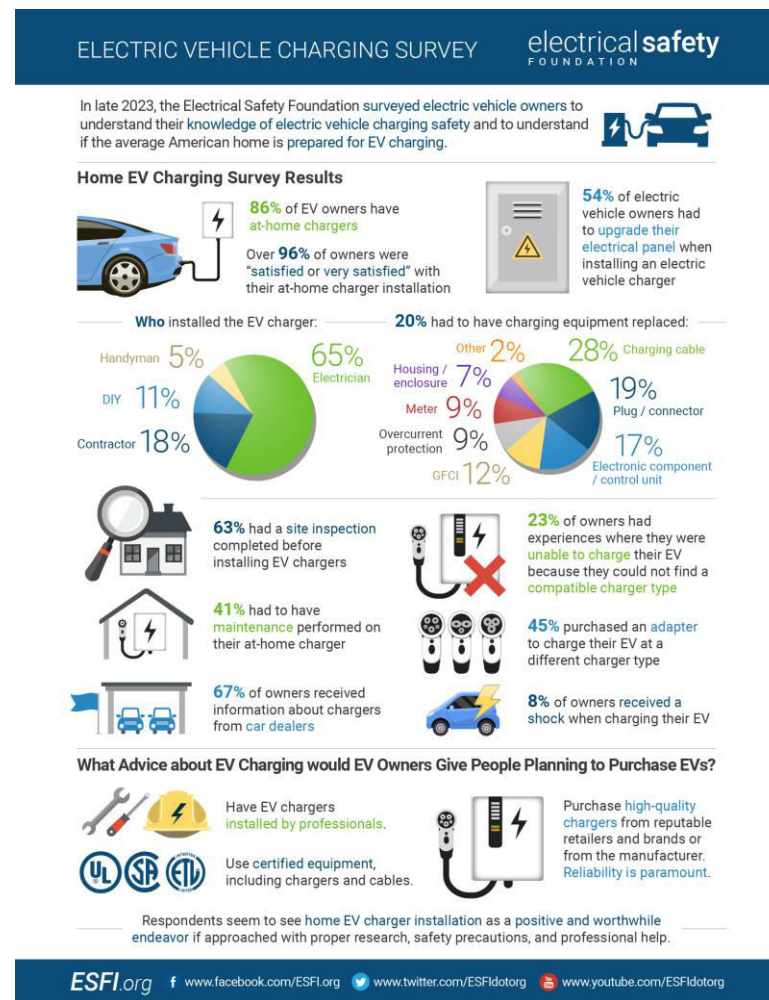
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Electric Vehicle Supply Equipment Safety

- **85%** of EV owners have at-home chargers
 - **Over 95%** of owners were “satisfied or very satisfied” with their at-home charger installation
 - **65%** had the chargers installed by an electrician
- **65%** of electric vehicle owners had to upgrade their electrical panel when installing an electric vehicle charger
- **63%** had a site inspection completed before installing an EV charger
- **41%** had to have maintenance performed on their at-home charger



Electric Vehicle Supply Equipment Safety

2023 ELECTRIC VEHICLE CHARGING SURVEY

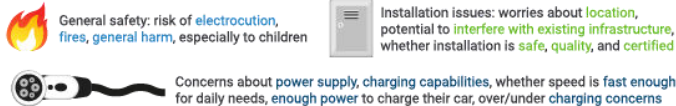


In late 2023, the Electrical Safety Foundation surveyed electric vehicle supply equipment installers, building owners, and electric vehicle owners to understand their knowledge of electric vehicle charging safety and to understand how prepared each group was for EV charging.

Electric Vehicle Supply Equipment (EVSE) Installers



56% of Customers Express Concern about EVSE



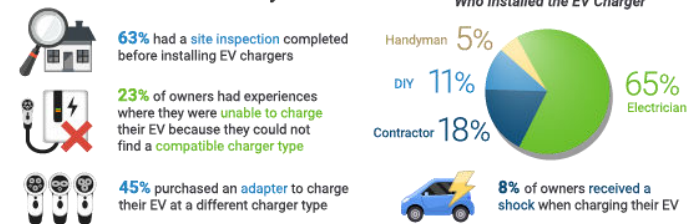
Building Owners EVSE



When asked how they expect the number of EVSE installations in their buildings would change over the next two months:



Electric Vehicle Owner Survey



EV Installers:

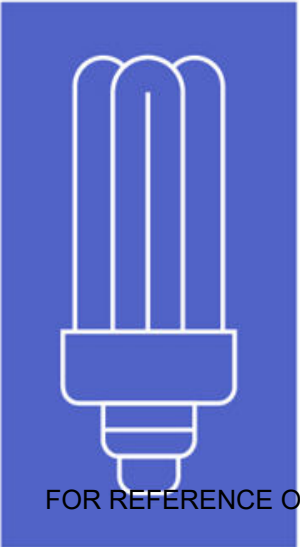
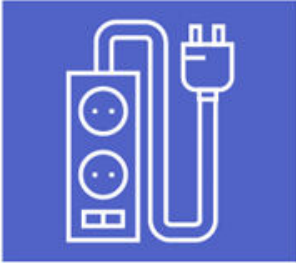
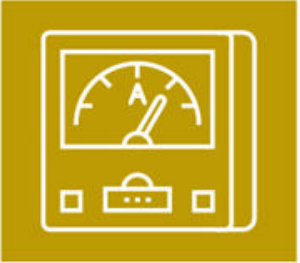
- 82% of installers believe EVSE installation should require specific certification
- 76% of installers received specific EVSE training
- 56% of customers expressed concern about EVSE

Building Owners EVSE:

- 91% of building owners had a site inspection conducted before installing EVSE
- 57% of building owners had to have maintenance conducted on their EVSE

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Emerging Technology Safety: Lithium-ion Battery Safety

Lithium-ion Battery Safety

Background:

- Lithium-ion batteries can be found in all types of everyday electronics, including e-mobility devices, electric vehicles, cell phones, laptops, toothbrushes and more.
- Lithium-ion batteries, when sourced and used correctly, are safe.
- Improper sourcing, charging, or disposing of lithium-ion batteries may lead to fires, injuries, or even death.

Statistics

- Over 25,000 incident reports to the CPSC related to lithium-ion batteries.
- 10 deaths and 226 injuries in NYC alone between 2021 – 2022.
- More than 5,000 fires a year at recycling facilities are caused by lithium-ion batteries.



Lithium-ion Battery Safety

ELECTRIC BIKE & ELECTRIC SCOOTER SAFETY

Learn how to charge your lithium-ion powered devices safely

electricalsafety
FOUNDATION

Electric bikes and scooters, powered by lithium-ion batteries, enhance our lives, but with such convenience comes responsibility. In many cities, lithium-ion batteries have become one of the leading causes of fires and fire deaths. Learn how to charge your devices safely.

Where to Buy Devices and Equipment



Purchase from a trusted retailer who stands behind their products.



Purchase devices that have a manufacturer's warranty.



Purchase devices that have been tested and listed by a Nationally Recognized Testing Laboratory and have one or more of these symbols.

What to do Once You Get Your New Device



Always review the device's manual before using.



Always use manufacturer provided gear.



Always purchase additional batteries from reputable retailers. Uncertified batteries can be a fire hazard.

Where to Charge and Where to Store



Always charge and plug directly into a wall outlet.



Charge in a flat, dry area away from children and sunlight.



Never charge near doors or entryways – if a fire occurs, it can block your exit.



Never leave a charging battery unattended. Unplug as soon as it is done charging, and never charge overnight.

Signs of a Problem



If you notice an odd odor, discoloration, or hear something unusual from your device, it could be a sign of danger. Move the device from anything flammable and call 911.

Take CHARGE of Battery Safety

Choose certified products

Handle lithium-ion devices with care

Always stay alert for warning signs

Recycle devices and batteries properly

Get out quickly if there's a fire

Educate others on safe practices

Where to purchase:

- From a trusted retailer
- Purchase only tested and listed devices
- What to do when you get a new device:
 - Always read the device's manual before using
 - Always use manufacturer-provided or authorized gear

How to charge the device:

- Always plug directly into the wall
- Never charge near doors or entryways
- Never leave a charging battery unattended

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Lithium-ion Battery Safety: Consumer

Infographics:

- How to Store and Charge Batteries
- How to Identify a Battery Problem
- How to Recycle


Videos:


- How to Store and Charge Batteries
- Where to Purchase Batteries
- How to Identify a Battery Problem
- How to Recycle (coming in spring 2024)


LITHIUM-ION BATTERY SAFETY
HOW TO STORE & CHARGE BATTERIES


electrical safety
FOUNDATION


Lithium-ion batteries are in all types of devices we use every day. These batteries can be found in cell phones, tablets, laptops, electric bikes and scooters, toothbrushes, and backup batteries. When purchased and used correctly, lithium-ion batteries can provide a valuable service, but there is a risk of fire and injury if uncertified batteries or chargers are used.


- 

Purchase batteries and chargers that are listed by a Nationally Recognized Testing Laboratory. These marks are found on batteries and chargers and show that they have been tested and are safe.
- 

Always follow the manufacturer's instructions, including instructions on how to charge.
- 

Only use manufacturer-approved batteries and chargers.
- 

Stop charging once the device is fully charged.
- 



Keep devices away from items that can catch fire, including bedding and couches. Never charge on surfaces that can catch fire.
- 

Never charge devices near doors or hallways that may block exits.

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Lithium-ion Battery Safety: First Responder





LITHIUM-ION BATTERY SAFETY  **FIRST RESPONDER SAFETY** 

HOW TO EXTINGUISH LITHIUM-ION BATTERY FIRES
Lithium-ion battery fires have unique threats, which include reignition and explosion, if they are not extinguished properly. Hazardous energy may still exist even after the battery or device is shut down.









Electrolyte Spills




-  Identify chemistry involved to know the response.
-  Reference any **pre-plan** info if available.
-  Interview any **knowledgeable** staff.
-  **PPE** and **SCBA** offer limited protection.
-  **Dike area around spread** – clean up needs to be completed by **qualified personnel**.

Overheated Batteries

-  Overheating can be evident by **bulging** or other deformities.
-  **Air monitoring** and **ventilation** should be ongoing.
-  If you can see the battery, monitor them with a **thermal imager** for changes to temperature.
-  When batteries are shut off, **they should cool**, but it may take time. If temperatures do not go down or go up, there **may be a fire**.

Battery / Energy Storage System Fires

-  Ensure full **PPE** and **SCBA** are being used in firefighting operations.
-  Review **safety data sheets** or **pre-plans** to know battery chemistry and hazards.
-  Secure the **water supply**.
-  **Evacuate** the area affected by fire.
-  Consider **turning off HVAC** but keep dedicated exhaust for energy storage systems.
-  Attempt to **extinguish the fire**. Apply water directly to cells, if possible, to remove heat. If direct water application isn't possible, apply water to protect exposures.
-  After the fire, **monitor for flammable or toxic gases**. Always monitor for pockets of stranded gas. Never attempt to overhaul a damaged energy storage system.
-  **Continue temperature monitoring**. It may take hours or days to cool. Continue monitoring for explosive and toxic off-gassing and reignition, if possible.

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Train the Trainer Program (Summer 2024):

An online virtual awareness program to educate first responders (fire, EMS, police) on how to identify battery fires and the unique dangers associated with them.

Infographics:

- How to Identify a Battery Fire
- How to Extinguish a Battery Fire

Lithium-ion Battery Safety: Transportation

Train the Trainer Program (Summer 2024):

An online virtual awareness program to educate transporters (tow trucks, waste management, recyclers) on how to identify battery-powered devices and how to transport and handle them correctly to avoid fires.

Infographics:

- Electric Vehicle Transportation
- Importance of Proper Recycling

LITHIUM-ION BATTERY SAFETY
DAMAGED EV VEHICLE BATTERIES

electrical safety FOUNDATION

ELECTRIC VEHICLE BATTERY IDENTIFICATION & TRANSPORTATION, AFTER DAMAGE
Automotive batteries (12v, hybrid, and EV batteries) pose a risk if **not properly prepared and transported, using all necessary standard operating procedures**. This danger can be higher if the battery systems in the vehicles have been **compromised from an accident**. Lithium-ion batteries contain high-energy and present electrical, chemical, and thermal hazards.

Before Vehicle Collection

- 1** **Identify the type of car:** gas powered, hybrid electric, plug-in hybrid, or fully electric. The VIN can be used to identify the type of car. If the car cannot be identified, assume it's electric.
- 2** Hybrid electric (HEV) and electric vehicles (EV) should be marked with "HAZARDOUS VOLTAGE" warnings.
- 3** Transportation drivers and loader operators should be **trained of the potential dangers** with HEV / EV batteries.
- 4** HEV / EV specific **personal protective equipment (PPE)** should be available to all involved in the collection and intake of the vehicle.
- 5** **Qualified personnel** should assess the type of damage the vehicle has and identify any vehicle at high risk of having a compromised battery compartment.

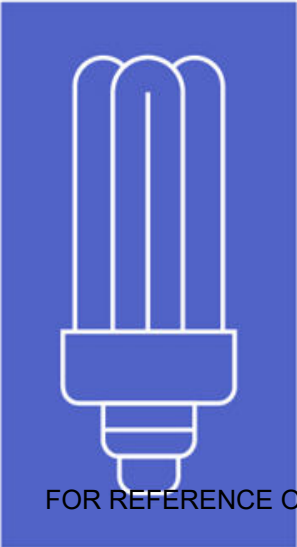
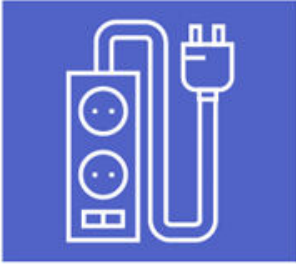
During Vehicle Collection

- 1** **Proper PPE must be worn**, and qualified personnel must be present.
- 2** HEV / EV "HAZARDOUS VOLTAGE" warning signs must be applied to multiple sides of the vehicle.
- 3** Qualified personnel should **assess possible damage to batteries prior to loading the vehicle**, and the transportation team should look for physical damage and symptoms (fire, discoloration of voltage cables).

Vehicle On-Site and Check-In

- 1** Follow vehicle manufacturer's process to make the vehicle electrically-safe.
- 2** Remove hazardous voltage battery master disconnect service plug and zip tie it to the steering wheel.
- 3** HEV / EV should be placed in a segregated area awaiting final dismantling.
- 4** Removed high voltage batteries must be **safely stored** to prevent risk of thermal events.

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Conclusion



Conclusion

- Electrification is on the rise
 - Emerging areas of electrical safety: solar, energy storage systems, lithium-ion batteries, electric vehicles / electric vehicle supply equipment
- All electrical work should be completed by qualified workers
 - 70% of workplace electrical fatalities occur in non-electrical occupations
- Leading electrical fatality causes:
 - Working on or near energized equipment or parts: 48%
 - Overhead power line contact: 41%
- The construction industry has the highest rate of electrical fatalities



Conclusion

How to prevent electrical fatalities:

- Unexpected contact with electricity could be prevented by reminding qualified workers to always test before they touch or to check to see if parts are energized before work is completed.
- Overhead power line fatalities could be prevented by educating all workers on the dangers of overhead power line contact and reminding workers to always be aware of their surroundings, and to always look up in all ways when working on any job site.
- Non-electrical workers should be trained on how to understand normal operating conditions and recognize damaged wiring. Safety devices, such as permanently installed safety devices, could also prevent injuries by notifying workers of present voltage.



Thank you!

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Please Complete the Online Evaluation



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