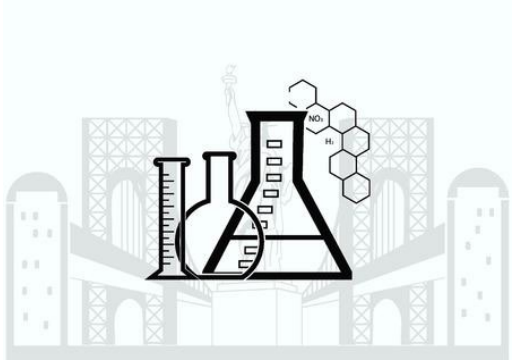
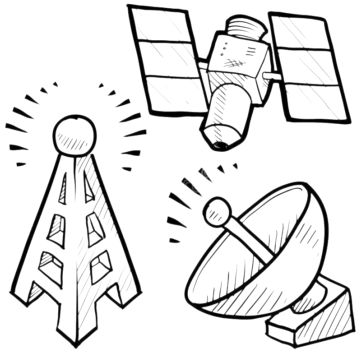




Chemical Sector

Chemical plants are not equipped to deal with long periods of freezing temperatures. In the past plants have shut down in Texas in 2021, 2018, 2011 due to prolong cold temperatures.

Impacts to transportation can have cascading consequences for the sector as key shipments can be delayed.

Extremely low temperatures can affect the physical properties of liquids and gasses, such as freeze points, viscosity and moisture content.

During prevalent winter storm years, deicing use increases. Deicing chemicals for pavement include sodium chloride, calcium chloride, magnesium chloride, and potassium chloride.

Weaker trees from the drought/heat this past summer may result in more downed branches causing increased and prolonged power outages which can impact chemical plants.

Commercial Facilities Sector

Facilities during freeze events can experience higher rates of frozen/burst pipe issues.

Icing and heavy snowfall can damage roofs and premature heating causing sudden dense semi-melted snow falling from rooftops.

Unknown snow loads for roof strength may result in stronger blizzard events this year leading to roof collapse in some areas.

Facilities along river systems which are lower flowing may see waterways go through freeze-thaw cycles at a greater rate, increasing embankment subsidence damages.

Increased energy costs due to widespread freezes and more sites than usual attempting to run heating could impact local grid systems.

Parking lots, garages, and building foundations do not handle freeze-thaw cycles well and may see cracking this year due to the stronger swings in event temperatures.

Communications Sector

Subzero temperatures can affect the performance of electronic equipment, leading to system malfunctions or damage.

Accumulated snow or ice can cause physical damage to antennas, towers, and cables.

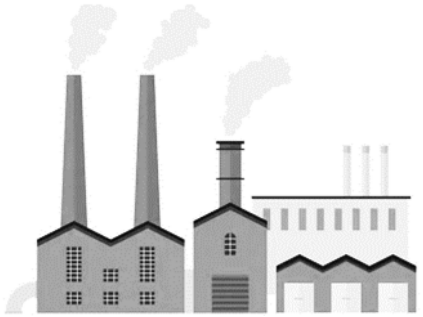
Winter storms often result in power outages, leaving communication systems without the necessary energy sources.

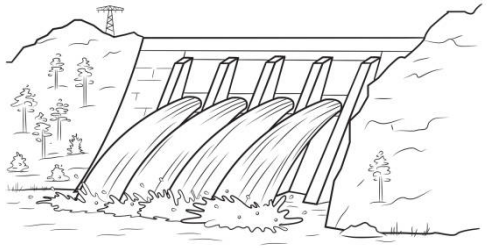
Heavy snowfall or blizzards can hamper signal transmission, hindering communication capabilities and moisture intrusion can impact cable connections.

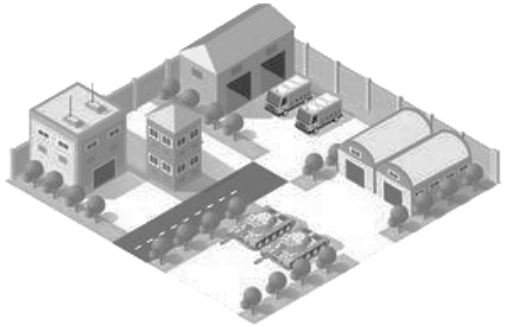
Sites which do not often check their fuel types and amounts in backup generators may find their redundancies do not work when needed.

Nor’easters can cause significant damage to coastal systems on par with tropical cyclones.

Larger winter systems can impact multiple areas simultaneously, delaying restoration.







Critical Manufacturing Sector

During winter, coal dust is suspended in the atmosphere what with the air being dryer than usual, increasing the hazard of coal mine explosions.

Winter brings about low barometric pressures, helping methane spread easily into active areas heightening the risk of an explosion.

Frozen river systems which were more shallow than usual may reduce water intake capabilities for manufacturing sites requiring water for operations and may delay barge shipments.

Cold stress on workers commuting and working on sites may result in impairment or fatalities.

Construction may see larger delays due to winter storms and repairs from more frequent storm systems may drive supply/demand pricing to increase.

More dense air and longer periods between storm systems may result in stagnant air.

Dams Sector

Increased overtopping events are possible from the past years of increased sediment rates along river systems and in reservoirs along with aquifer compaction reducing capacity.

Piping events may increase from the freeze-thaw cycles impacting earthen dams' structural integrity, resulting in increased failure rates.

Erosion and scour from flood flow can damage earthen channels and canals such as irrigation canals and drainage ditches.

Over 85% of all US dams will be more than 50 years old by 2030. An analysis of recorded USA's dam failures suggests that over 75% of the failures occurred after 50 years of age.

The number of freeze-thaw cycles that the concrete is exposed to, even in cold climates, is more damaging to durability than the absolute lowest temperature. Dams built prior to 1950 are likely not aerated and may crack.

Defense Industrial Base Sector

Winter storms can damage facilities and privatized homes across military installations.

Winter storms in 2021 cause more than $72 million in damages to Air Force Installations across the nation and damaged nearly 700 Army facilities.

More than 15 military bases saw delays or closures to base operations during winter storms in 2021.

Key transportation routes which see impacts from winter storms can delay necessary supply chains.

Downed trees from damaging winds or icing can cause power outages on installations but larger winter storms can cause prolonged outages.

Icing on external equipment can cause serious damage and increased need for deicing.

Emergency Services Sector

Emergency responders which have faced higher activations from the summer heatwaves and wildfire responses may be over-taxed.

Watermains and pipelines can burst in the winter resulting in water outages during and after winter storms.

Residential sites and worksites see higher rates of structure fires associated with improper use of heating equipment such as space heaters, ovens, grills, fireplaces, and others.

Recent drying periods exacerbated by the summer heat may have lowered aquifer levels resulting in weaker trees and weaker soils which can both collapse under the weight of frozen precipitation, requiring emergency aid.

Frequency of emergency response needs have been attributed to suicidal ideation in the field.

Robberies and homicides have risen by 31% during winter events against other seasons.

Energy Sector

Winter storms producing more precipitation per event can result in frozen generators,

A quarter of an inch of ice can add 500 pounds of weight to trees, when branches fall, they can damage critical power sources like generators or powerlines, resulting in a sudden loss of electricity regardless of damage location.

During prolonged power outages, insulated homes may see internal temperatures drop below safe levels resulting harm to occupants.

Cracked water, oil, and gas pipelines, frozen substances causing pressure buildup and expansion damage, and soil shifts at the base of supporting structures can result in damage or pressure loss.

NERC warned that over half the US is at an elevated risk of blackouts this winter due to increased demand, regional power generation shortfalls and potential fuel delivery challenges in the event of prolonged cold weather events.

Financial Services Sector

Winter spending associated with the holidays, end of year bonus spending, and job changes through the winter period can cause investment shifts and short-burst economic growth.

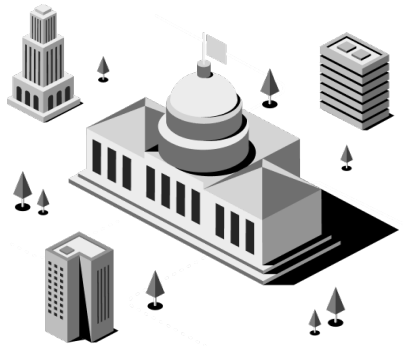
Physical banking sites may see that frozen precipitation can inhibit use of equipment or degrade machines like ATMs along external walls.

Insecurity across the energy market following an abnormally hot year as many countries now face significant pitfalls in heating capabilities.

Uninsured property losses could spillover to banks via higher loan losses with knock on effects to bank income and capital.

Banks may close during severe winter weather events making certain aspects inaccessible.

Increased rates of car accidents due to frozen roadways, freezing fog, freezing rain damage, or debris along roadways cause insurance loss.



Food and Agricultural Sector

The 2021 Winter Storm caused at least $600 million in agricultural losses across Texas, mainly to citrus, livestock, and vegetables.

Changes in when snowpack forms, how much sticks through the winters, and when melting begins and ends could have significant impacts on the agricultural outputs from 2024.

Winter storm damages to meat plants can cause suspended operations and premature death of livestock resulting in supply chain loss.

Wheat crops are reportedly still at an all-time low in many countries which could worsen this winter due to significant freeze events.

Double-bloom periods from increased warming between winter storm events could cause damage or decay to various vegetation.

Premature blooming in the spring may shift harvest periods and result in crops sitting for longer periods in transit facing degradation.

Government Facilities Sector

Security personnel require access to heated areas which may result in shorter intervals outdoors leaving sites less secure this year.

Snow can obscure visual security from staff and cameras and hinders drone operations resulting in more blind spots.

Icing can damage critical security equipment or impair batteries resulting in damage to or loss of external facing systems.

Structural collapse, such as roof failure, under the weight of frozen precipitation accumulation can cause damage, disruption to operations, and even loss of life.

Damaged concrete and steel supports, foundations, and pipelines/railways as the expansion and contraction of the material can cause movement in the structures.

Damage from rain and snowmelt events or dislodged ice dams can cause river floods.

Healthcare and Public Health Sector

Snow and ice may contribute to more falls and injuries both for personnel and for the public.

Cold homes, frozen walkways, icy roadways, and fuel poverty can cause additional threats.

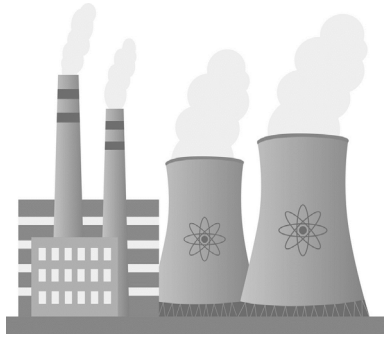
Carbon monoxide poisoning increases in the winter, increasing mortality rates associated with winter storm and freezing events.

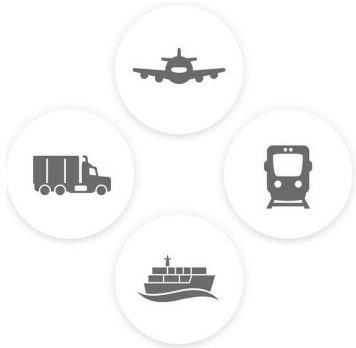
Heart attacks from shoveling snow, respiratory disease surges, hypothermia, etc. can strain emergency responders as warming between winter events may cause less preparation.

Access to critical community services such as public transportation, childcare, healthcare providers and schools may be limited.

Icing on roadways and heavy snowfall may result in supply chain delays in the region and diminished access to critical sites for rural communities.

Freezing fog events may increase car crashes.





Information Technology Sector

During winter, prolonged temperatures below 32 degrees can stiffen underground cables and may lead to snapping which results in outages.

Weather phenomena like rain and snow can directly interfere with wireless signals.

Power outages can impact the fiber used for connectivity from each cell site to the switching facilities, which can be exacerbated when multiple regions face larger winter storms.

Prolonged outages from downed or damaged lines can cause sites to miss crucial patches and updates, leaving systems vulnerable.

Frozen roadways and walkways can make commutes hazardous for IT workers resulting in decreased on-site presence.

Supply chain delays due to winter storms can result in critical equipment and supply shortages with cascading delays for access.

Sudden outages can damage computers.

Nuclear Reactors Sector

Most power plant outages during major freezes were caused by problems with freezing, fuel supply, and mechanical and electrical issues which can places increased need on nuclear.

Water intake can be threatened by prolonged freezing when low flowing river systems ice over which can damage pipes or diminish flow.

Pipelines which carry water to and from the nuclear site can see damages from soils which see greater rates of freeze-thaw cycles and may weaken or collapse, causing shifts in the pipeline foundations or water freezes during transport and can expand inside the pipe, resulting in bursts or cracks.

On-site water treatment facilities may face impacts from sudden freezes as concrete-cement mixtures face water incursion in pores.

Increased energy needs and impacts to transportation from frozen precipitation could result in reduced staffing capabilities for events.

Transportation Systems Sector

Runways and roadways face black ice, potholes, and fog-freezing fog visibility limiters.

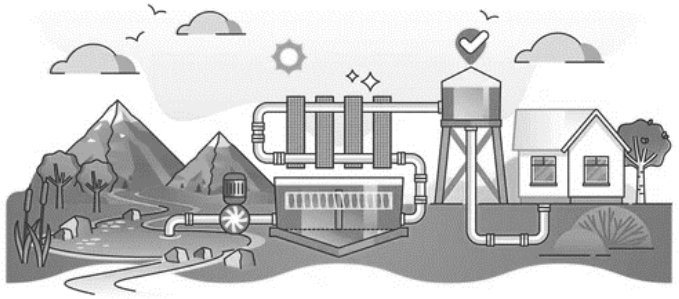
Railways extreme cold can cause rails to split or crack and heavy snowfall can result in canceled train movement.

Trains also face ice buildup on brake shoes which makes it take a lot longer to stop the train during cold weather.

Ports temporarily suspend operations, even at key terminals, due to abnormal sub-freezing temperatures or significant ice development.

Warehouse storage movements and trucking capabilities are reduced during bad weather and when coupled with shipping delays on barges due to frozen waterways or storms can result in prolonged supply chain impacts.

Overhead powerlines can be damaged by freezing precipitation weight which can reduce output and impact metro systems.



Water and Wastewater Sector

Increased demand and freezing temperatures often yield water main breaks at a higher rate during the winter which can stress city and state water systems.

Pipes in homes and businesses can also face increased rates of leaks and bursts due to the temperature drops and frozen water expansion.

Abnormally low outside temperatures for extended periods can freeze your water intake pipe impacting flow and cooling systems.

Water pumps and sensors can freeze over during winter storms resulting in no water access from wells or rural water systems.

Freezes impact bacteria in the water system which can change effluent quality and can experience poor BOD reduction.

Nitrification and biochemical reactions are decreased during extreme cold shifts which can reduce biogas production.

Impacts to Society

Winter death statistics related to ice and snow:

- About 70% occur in automobiles.
- About 25% are people caught in the storm.
- Majority are males over 40 years old.

Winter death statistics for exposure to cold:

- 50% are people over 60 years old.
- Over 75% are males.
- About 20% occur in the home.

Heavy snowfall and blizzards can trap motorists in their vehicles or homes with no alternatives to walk to warming shelters.

Storm effects, like severely cold temperatures, heavy snow, and coastal flooding, can result in coastal impacts at higher rates this year.

Winter storms which persist for multiple days can have a direct impact on the economy of the region and result in food/medicine shortages.

Additional Winter Resources

FEMA's Ready campaign:

https://www.ready.gov/winter-weather

National Weather Service:

https://www.weather.gov/wrn/winter_safety

CDC Winter Impacts:

https://www.cdc.gov/disasters/winter/index.html

NWS Winter Storm Preparations:

https://www.weather.gov/safety/winter-before

Red Cross Winter Storm Safety:

https://www.redcross.org/get-help/how-to-prepare-for-emergencies/types-of-emergencies/winter-storm.html