Place API info/website links to sources here

USNRC.org:
https://www.nrc.gov/waste/llw-disposal/licensing/locations.html
This site gives a general overview of the US waste plants certified with dealing with waste but not listing radioactive areas or onsite storage
Congressional Research Service
https://sgp.fas.org/crs/nuke/IF11201.pdf This is a congressional report informing congress of nuclear waste storage and disposal, listing areas in the US that are affected.
World Nuclear Waste Report 2019 presented for Focus Europe
https://www.boell.de/sites/default/files/2019-11/World_Nuclear_Waste_Report_2019_summary.pdf This will need to be broken down into more readable and understanding.
IAEA
https://www.iaea.org/newscenter/news/new-iaea-spent-fuel-and-radioactive-waste-database-facilitates-national-data-reporting-and-sharing This one will be huge, its a comprehensive report and updated database of spent fuel rods and nuclear waste called SRIS, we should try to get access to this.

https://www.eia.gov/energyexplained/nuclear/nuclear-power-and-the-environment.php This is information on the radioactive waste supplied by the U.S. Energy Information Administration

https://cen.acs.org/environment/pollution/nuclear-waste-pilesscientists-seek-best/98/i12 Storage solution ideas for nuclear waste pile up. Infoms us on how it all started and what are some long-term solutions in how to fight this problem

https://www.forbes.com/sites/jeffmcmahon/2019/05/31/new-map-shows-expanse-of-u-s-nuclear-waste-sites/?sh=167e6af4c2cf Expansion of nuclear waste sites within the US

https://www.epa.gov/radtown/radioactively-contaminated-sites A list of contaminated sites from the US Environmental Protection Agency.

API for gathering pictures on google maps/world to create a timelapse from the 50s to now:

1) https://newsinitiative.withgoogle.com/resources/lessons/google-historical-imagery-google-earth-maps-and-timelapse/ Historical imagery from Google World Pro
2) https://developers.google.com/maps/apis-by-platform Google Maps Platform API

Energy Information Agency: information on the affects of nuclear waste on surrounding communities: https://www.eia.gov/energyexplained/nuclear/nuclear-power-and-the-environment.php

FACT 1: Till this day there is no repository that can dispose High-Level-Waste in the United States.
FACT2: Commercial SNF (Spent-Nuclear-Fuel) is benign stored safely in pools and dry casks at reactor sites. However, when the nuclear reactors shutdown and are decommisioned, the SNF has nowhere to go.
FACT3: SNF is rather dangerously radioactive when first emitted and has the potential to release a poisonous chemical called plutonium into the environment. Exposure to radioactive waste can cause cancerous frowths in humans and genetic damage; or mutation to animals and plants.

Environment Impact: 1-5
Human Impact: 1-5
Cost Impact: 1-5
Political Impact/Societal Impact(did this even cause new legislation or change public perception): 1-5
Defenses in place/broken(containment): 1-5

0: Meaning no impact

1: Some impact but relatively harmless

2: Small impact but required some remedy

3: Decent impact showing this area required expensive or dangerous remedy but in the end could be fixed

4: This area was such an issue that there were concerns over if it was possible to fix or repair the impact

5: We are still actively trying to repair the damage, we may forever live with these scars on our planet

Then descriptions
Then comparisons (if you notice one that was completed before we were asked to do comparisons please let me know or fill it it)

List of Nuclear events surveyed

1. Kyshtym disaster
2. The Windscale fire
3. SL-1
4. Chernobyl
5. Calvert Cliff Units 1 and 2
6. Sosnovy Bor leak
7. Marcoule Nuclear Site- Specifically dealing with waste
8. Fukushima
9. Dounreay explosion- This event and all below are specifically about radiation waste/misuse
10. Church Rock uranium mill spill
11. Lycoming, Nine Mile Point spill
12. San José, Costa Rica- Cobalt radiation therapy device failure
13. J-PARC radioactive isotope leakage
14. Instituto Oncológico Nacional

Kyshtym disaster: 44/50

- ☐ Environmental Impact: 4/5
- ☐ Human Impact: 5/5
- ☐ Cost Impact: 4/5
- ☐ Societal Impact: 5/5
- ☐ Containment Impact: 4/5

The Kyshtym disaster was a catastrophic nuclear accident that occurred in 1957 at a nuclear reprocessing plant in the town of Ozyorsk, Russia (then part of the Soviet Union). The accident, which was caused by a failure in the plant's cooling system, resulted in the release of a large amount of radioactive material into the atmosphere, contaminating a wide area around the plant and leading to the evacuation of thousands of people. The exact number of casualties is not known, but it is estimated that several hundred people may have died as a result of the disaster. The accident is considered to be one of the worst nuclear disasters in history and is ranked as a Level 6 on the International Nuclear Event Scale, the same level as the Fukushima nuclear disaster in Japan.

However, other energy sources can still have significant safety and environmental risks, such as oil spills in the case of offshore drilling, or air pollution from the burning of coal.

Then you would follow up with a description of the event and relevant information for why it earned that statistic here.

Below the description attempt to give a comparison as to how similar issues might arise from other energy sources(I.E. “If this was a hydroelectric system, damages would have cost much more as repairs would be more difficult and extensive.)

The Windscale fire: 22/50

- ☐ Environmental Impact: 3/5

- ☐ Human Impact: 1/5
- ☐ Cost Impact: 2/5
- ☐ Societal Impact: 3/5
- ☐ Containment Impact: 2/5

During routine operations a fuel rod caught fire due to a breach in the rod. This set more channels alight and forced those at windscale to increase the fans, increasing oxygen in the fire. This was also released due to there being inefficient filters for the air release as it was expected to only release steam. This was also made worse due to an attempt made to flood the reactor, causing more radioactive steam to be released.

This could be compared to a large chemical dump opening up or breaking into the local environment, many people and animals exhibited increased cancer and health defects from this event. Though luckily no direct deaths.

SL-1: 24/50

- ☐ Environmental Impact: 2/5
- ☐ Human Impact: 4/5
- ☐ Cost Impact: 3/5
- ☐ Societal Impact: 1/5
- ☐ Containment Impact: 2/5

SL-1, also known as the Stationary Low-Power Reactor Number One, was a U.S. Army experimental nuclear power reactor that experienced a catastrophic accident in 1961, resulting in the deaths of three operators. The explosion ruptured the reactor's core, releasing radioactive materials into the containment

building. The SL-1 accident was the first and only fatal reactor accident in the history of the U.S. commercial nuclear power industry.

In contrast, Hydroelectric dams can fail if they are not properly engineered or if they are overburdened by heavy rainfall or snowmelt.

Chernobyl: 48/50

- ☐ Environmental Impact: 5/5
- ☐ Human Impact: 5/5
- ☐ Cost Impact: 5/5
- ☐ Societal Impact: 5/5
- ☐ Containment Impact: 4/5

The Chernobyl disaster is quite famous so I wont go into detail about it but I will explain my 1 point off. The one point off in containment is due to the fact that while containment was breached, there were known defects or tolerances in procedure. So there is no 5 as it would've had to break good containment AND still be the disaster it was to get that point.

I can compare Chernobyl to Katrina's effect on the Gulf's oil production in terms of cost as Katrina took out 113 oil platforms, spilling oil, breaking pipelines, causing a wreck to the environment and costs. Total estimated cost of Katrina: 187 Billion Chernobyl: 230 Billion

Calvert Cliff Units 1 and 2: 12/50

- ☐ Environmental Impact: 2/5
- ☐ Human Impact: 0/5
- ☐ Cost Impact: 2/5
- ☐ Societal Impact: 1/5
- ☐ Containment Impact: ⅛

The Calvert Cliffs Nuclear Power Plant is a nuclear power plant located on the western shore of the Chesapeake Bay near Lusby, Calvert County, Maryland. the watertight integrity of the service water pump rooms on both units could be impaired if there was a pipe break or a flood. This undesirable condition occurred because check valves had not been installed in the floor drain system which carries water by gravity to the turbine condenser pit in the turbine building.

This can be compared to Wind Turbines as they are resistant to floods and do not utilize water pumps within their systems, making it a safer option within the area.

Sosnovy Bor leak: 14/50

- ☐ Environmental Impact: 2/5
- ☐ Human Impact: 3/5
- ☐ Cost Impact: 1/5
- ☐ Societal Impact: 0/5
- ☐ Containment Impact: 1/5

Degradation of some equipment led to a fire and a subsequent release of radiation for one month. The reason the human impact was so high is due to

civilians in the nearby towns not being told of the leak, leading to increased exposure.

In terms of comparisons I would relate this to Hinkley groundwater contamination event as it was similar circumstances. People were being affected by chemical dumping and not being told.

Marcoule Nuclear Site: 10/50

- ☐ Environmental Impact: 1/5
- ☐ Human Impact: 1/5
- ☐ Cost Impact: 1/5
- ☐ Societal Impact: 1/5
- ☐ Containment Impact: 1/5

In 2011, there was a fire at the Marcoule Nuclear Site in southern France. The fire occurred in the plutonium processing building of the site, and caused significant damage to the facility. There were no reported injuries or radioactive releases as a result of the incident.

The extraction of natural gas typically involves drilling into underground reserves of the gas and then extracting it using specialized equipment. This process can have a number of environmental impacts, depending on the specific methods used and the location of the reserves. For example, the drilling process can result in the release of pollutants into the air and water, and can also have impacts on local ecosystems and wildlife. In addition, the extraction of natural gas often involves the use of hydraulic fracturing, or fracking, which involves injecting water, sand, and chemicals into the ground at high pressure to break up the rock and release the gas.

Fukushima: 32/50

- ☐ Environmental Impact: 3/5
- ☐ Human Impact: 2/5
- ☐ Cost Impact: 4/5
- ☐ Societal Impact: 3/5
- ☐ Containment Impact: 4/5

A tsunami was able to sufficiently damage the generators for the water pumps at the Fukushima Daiichi plant due to increased safety measures being ignored during construction. This lack of water caused a meltdown. The reason they were ignored is due to the safety measures only being needed AFTER the plant was constructed and planned to expand, forcing the plant to decide between getting the expansions (that would require more safety measures) or getting the safety measures but not having a need for them yet.

While I don't have much for comparison I would like to state the impressive work by the Japanese government to evacuate people as this prevented MANY deaths. Total injuries and fatalities came to only 19 people.

Dounreay explosion: 22/50

- ☐ Environmental Impact: 3/5
- ☐ Human Impact: 1/5
- ☐ Cost Impact: 2/5
- ☐ Societal Impact: 3/5
- ☐ Containment Impact: 2/5

The Dounreay explosion was a nuclear accident that occurred at the Dounreay Nuclear Power Development

Establishment in Scotland in 1977. The explosion occurred in the core of a fast breeder reactor, and resulted in the release of radioactive material into the atmosphere. While there were no injuries or deaths as a result of the accident, it caused significant damage to the reactor and resulted in the release of radioactive material into the environment.

One major concern is the environmental impact of burning oil to generate electricity. This process releases greenhouse gasses, such as carbon dioxide and methane, into the atmosphere, contributing to climate change. In addition, the burning of oil can release other pollutants into the air, such as nitrogen oxides and sulfur dioxide, which can have negative effects on human health and the environment.

Church Rock uranium mill spill: 18/50

- ☐ Environmental Impact: 3/5
- ☐ Human Impact: 1/5
- ☐ Cost Impact: 3/5
- ☐ Societal Impact: 0/5
- ☐ Containment Impact: 2/5

Due to a dam failure solid fuel waste was dumped into the Puerco river in New Mexico. The water was found to be outputting 7000 times the allowable level of radiation for a water source.

This is comparable to the BP spill as most of the impact was cost and environmental.

Lycoming, Nine Mile Point spill: 22/50

- ☐ Environmental Impact: 2/5
- ☐ Human Impact: 2/5
- ☐ Cost Impact: 2/5
- ☐ Societal Impact: 2/5
- ☐ Containment Impact: 3/5

In July 1981, rainwater flooded the Radwaste Processing Building at Nine Mile Point nuclear plant containing highly radioactive waste. The water caused the metal drums to tip over, spilling their highly radioactive contents all around.

in comparison to fracking, The process involves injecting water, sand, and chemicals into the ground at high pressure to break up rock and release the gas or oil. This can result in the release of pollutants into the air and water, and can potentially contaminate nearby groundwater sources. In addition, the disposal of the wastewater generated by fracking can also be a challenge, as it can be contaminated with the chemicals used in the process.

San José, Costa Rica: 14/50

- ☐ Environmental Impact: 0/5
- ☐ Human Impact: 3/5
- ☐ Cost Impact: 1/5
- ☐ Societal Impact: 1/5
- ☐ Containment Impact: 2/5

Due to a failure in calibration a teletherapy device output drastically higher than expected radiation. This led to 16 deaths and 114 exposed.

This is comparable to the San Bruno Pipeline explosion that destroyed a city block and killed 8 injuring about 70 people.

J-PARC radioactive isotope leakage: 16/50

- ☐ Environmental Impact: 1/5
- ☐ Human Impact: 2/5
- ☐ Cost Impact: 2/5
- ☐ Societal Impact: 1/5
- ☐ Containment Impact: 2/5

The incident occurred when a container of radioactive material was accidentally dropped, causing a small amount of radioactive material to leak out. The incident resulted in the exposure of four workers to radiation, but there were no injuries or long-term health effects as a result. The incident prompted the Japanese government to conduct an investigation and tighten safety regulations at J-PARC and other nuclear facilities in the country.

In comparison to: Hydraulic Dams. The construction of large dams can have significant impacts on the local ecosystem, including the displacement of wildlife and the alteration of natural water flow patterns. In addition, the reservoirs created by hydroelectric dams can release greenhouse gases, such as methane, into the atmosphere, which can contribute to climate change.

Instituto Oncológico Nacional: 18/50

- ☐ Environmental Impact: 0/5
- ☐ Human Impact: 2/5
- ☐ Cost Impact: 1/5
- ☐ Societal Impact: 1/5
- ☐ Containment Impact: 5/5

Due to a radiologist bypassing data entry protocols for a TPS machine at the institute, Severe and in some cases lethal amounts of radiation were given to approximately 30 patients.

Another elaboration instead of comparison here, The reason this is a 5 point containment event is because this event would have been impossible if protocol was followed, some of the best safety nets and measures were in place and were still violated.