

- Stringent regulations for landfill placement now consider factors such as topography, hydrology, geology, and precipitation levels
- **Geologic Disposal:** Injecting or placing waste beneath Earth's surface
  - Liquid waste from industry, mining, and oil and gas production injected into deep wells
- Waste can be stored in secured concrete **containment buildings:** air-lock doors, liquid collection drains, negative air-pressure and dust control
- No permanent disposal strategy for radioactive waste from nuclear fuel
- **Challenges of Isolation:**
  - 1) Leachate will escape from sanitary landfills as synthetic liners degrade, releasing hazardous pollutants like heavy metals + VOCs
  - 2) Release significant level of greenhouse gasses, and are largest human-generated source of methane
- **2) Incineration:** technology of controlled combustion at high temperatures with pollution controls in place (burning waste)
  - **Reduces volume + provides heat,** results in uncontrolled fires/air pollution
  - 3/4 of incinerators use mass burn technologies: combust solid waste first then perform secondary combustion of resulting gasses
  - **Refuse-derived fuel** uses dehydrated waste pellets, where non-combustibles (glass/metal) are removed to increase efficiency
  - **Incineration Pollution Control System:** NO Removal System → Scrubbers Remove Air Pollutants → Particulate Removal → Pollution Control Tests
- **3) Conversion:** disposal strategy where waste is converted into something else useful, most often generating electricity
  - **Waste-to-energy** sites
  - **Bioreactor landfill:** disposal strategy using injected water + air to accelerate decomposition, reduce volume of waste, and reduce methane production due to aeration
  - **Remediation:** converts hazardous waste to less hazardous substances
    - **Bioremediation** uses microorganisms and enzymes
    - **Mycoremediation** uses fungi
    - **Phytoremediation** uses plants to reduce toxic substances like pesticides and polychlorinated biphenyls (PCBs)

## Recycling:

- **Recycling:** Strategy of redefining "waste" as "resources" for new products, diverting materials from waste stream
  - Saves energy and reduces impacts from creating products from scratch but does require processing
- **Primary Recycling (closed-loop recycling):** converts waste materials into same sort of product from which they came
  - Most efficient
- **Secondary Recycling (open-loop recycling):** converts waste material from one product into different sort of product