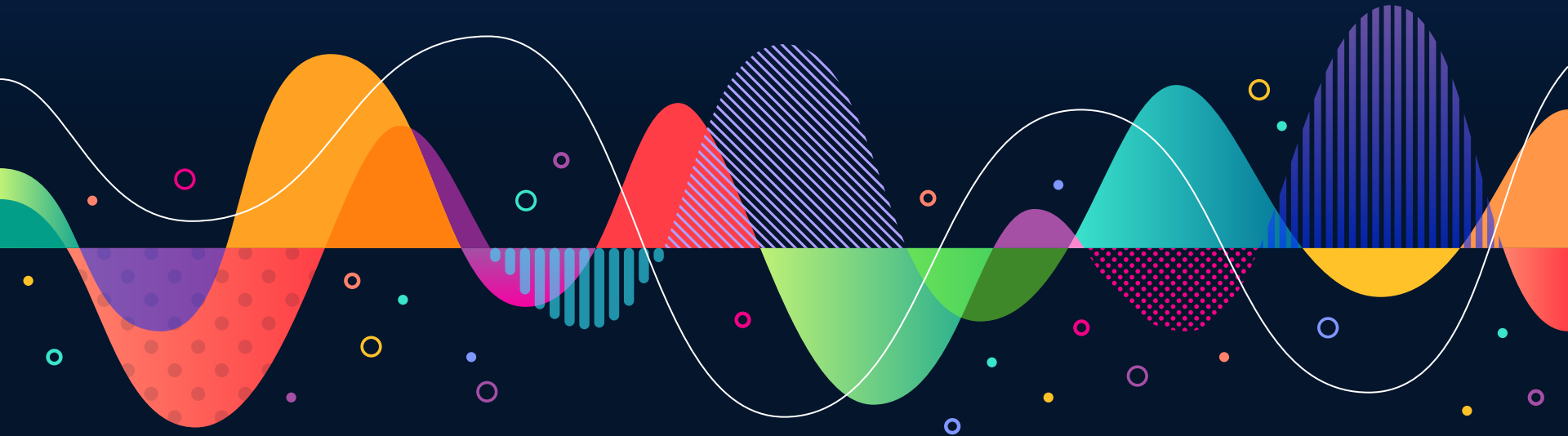


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# CdSe Solar Cell Fabrication: Ethics



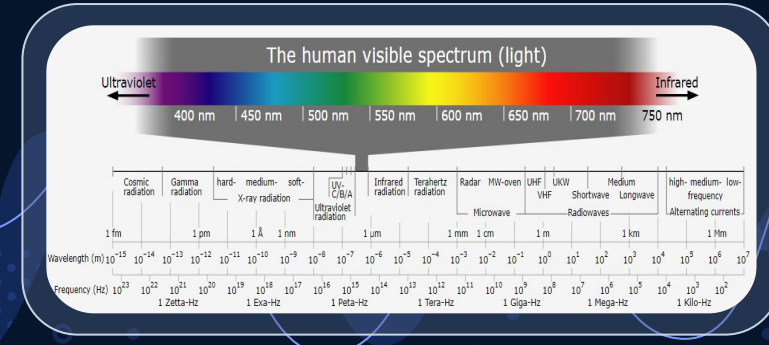
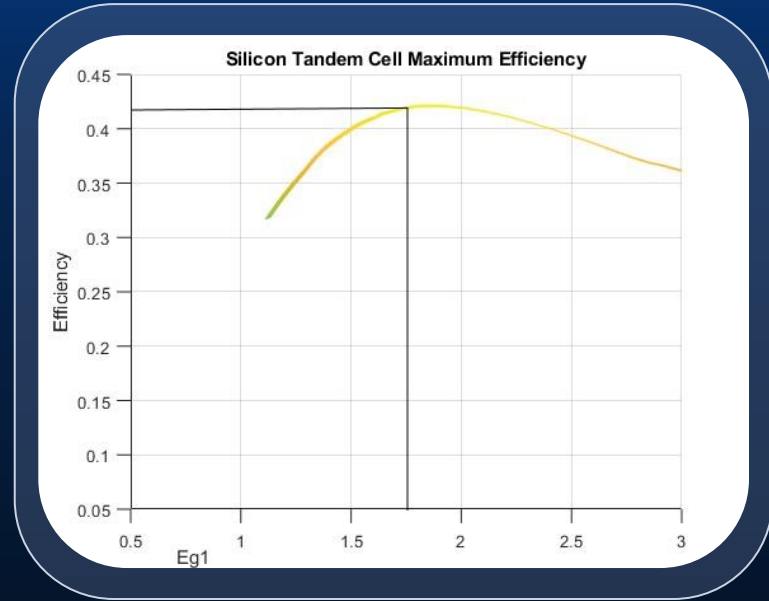
# Project Overview

- Our project is to develop a CdSe solar cell.
- Typical solar cells are a semiconductor made of Silicon, and convert light into electricity.
- Commercial silicon cells are approaching their theoretical efficiency limit.
- The only way to increase efficiency past this point is to add a second solar panel on top made of a different material.



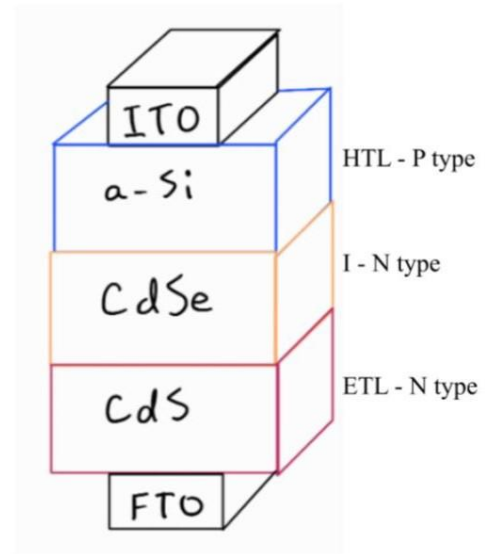
# Project Overview

- Stacked cells are referred to as a Tandem Solar cell.
- CdSe absorbs higher energy light more efficiently than Silicon.
- This is all determined by the “Band gap energy” of the material.
  - Silicon |  $E_g = 1.12 \text{ eV}$
  - CdSe |  $E_g = 1.74 \text{ eV}$
- End goal of 1% cell efficiency of our manufactured CdSe cell
- Viability Report concerning CdSe material, cell design and economics



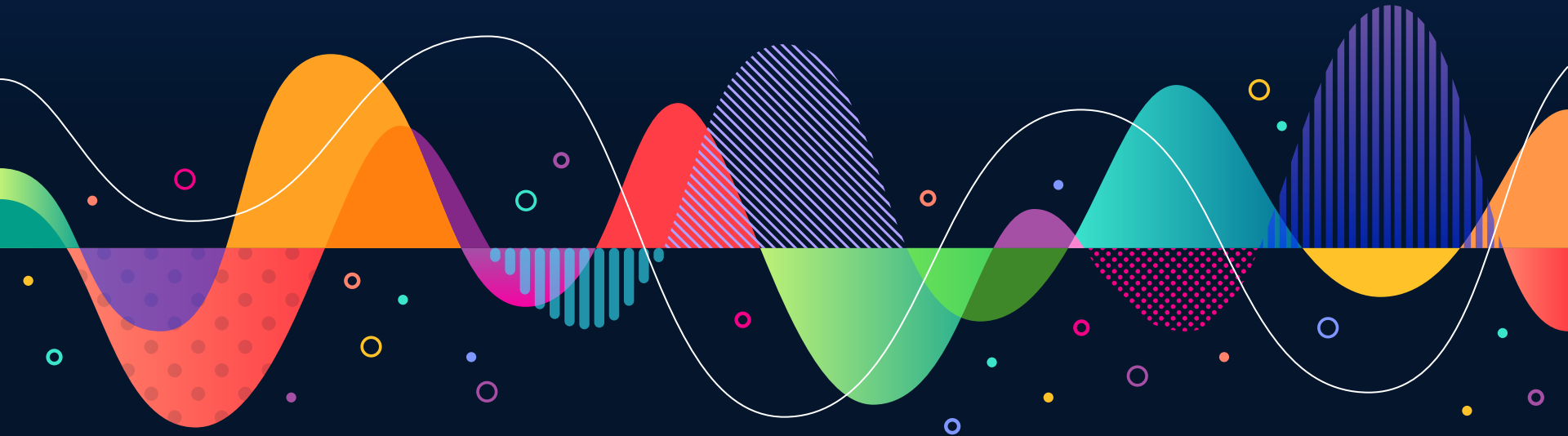
# Design

- P-i-N heterojunction configuration
- The design has 3 different semiconductor materials.
- The CdSe layer is where all the generation of electrical energy occurs.
- The other layers are HTL and ETL, and help move energy throughout the material more efficiently.



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# Ethics




# Sustainability Considerations

- 60% of electricity in U.S is generated from non-renewables
  - Predominantly natural gas and coal, which heavily contribute to CO<sub>2</sub> emissions.
  - Alternatives must become more viable to combat climate change.
- 3.9% generated from solar cells
  - Low usage driven by tradeoffs between solar cell efficiency and manufacturing costs
  - Solar contribution to the grid will increase with cell efficiency



# Sustainability Considerations

- 
- Current industry solar panels operate at 15-25% efficiency
    - More efficient cells can potentially reduce cost per KWh
  - A CdSe-Si tandem cell could reach 30-35% efficiency in commercial use
    - Land usage is a large cost for solar farms
      - This can be reduced with CdSe tandem cells
    - Tradeoff between efficiency and panel cost is decreased, leading to increased scalability of solar farms.
  - Increased scalability entices more investment into renewable energy.

# Health, Safety, and Well Being Considerations

## Cadmium Selenide (CdSe) Overview

- Slight solubility in water (can still be suspended)
  - Carcinogenic
- Lattice breaks down over time within the cell
  - Cd and Se and not soluble in water by themselves
    - Both carcinogenic
- Environmentally hazardous
- Generally Safe
  - Only a concern when ingested or inhaled
    - Toxicity: 300 mg/kg - ingested | 2500 ppm - inhalation
    - Remains in body for many years



Cd



Se



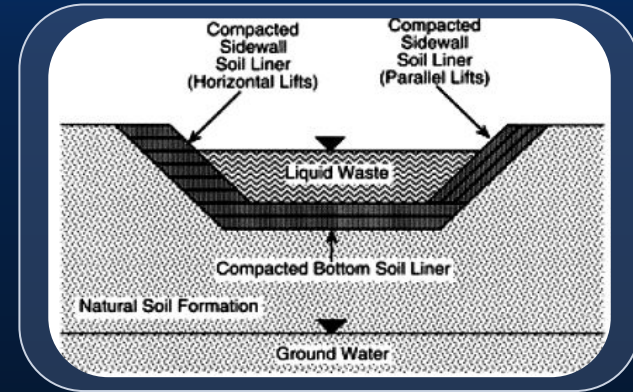
# Health, Safety, and Well Being Considerations

## Concerns

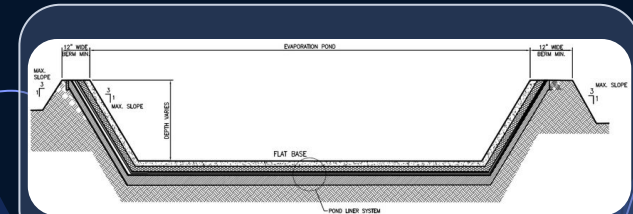
- Leakage into groundwater after installation
  - Due to cracked panels + Rain/Snow
- Cells being not fully sealed from elements
  - Can negatively affect people installing the cells
- Mishandeling of cell

## Plausible Mitigation

- Generally solar panels are waterproof and stable.
- Groundwater separator
  - Clay barrier + synthetic barrier with evaporation ponds
- Proper handling procedures



Clay Barrier



Evaporation Pond

# Health, Safety, and Well Being Considerations

## Sources

- Cadmium is a byproduct of zinc mining (Sphalerite)
- Selenium is a byproduct of copper mining (Berzelianite)

## Questionable mining practices

- Both process devastated ecosystems near the mining and processing sites
  - Often pollutes waterways

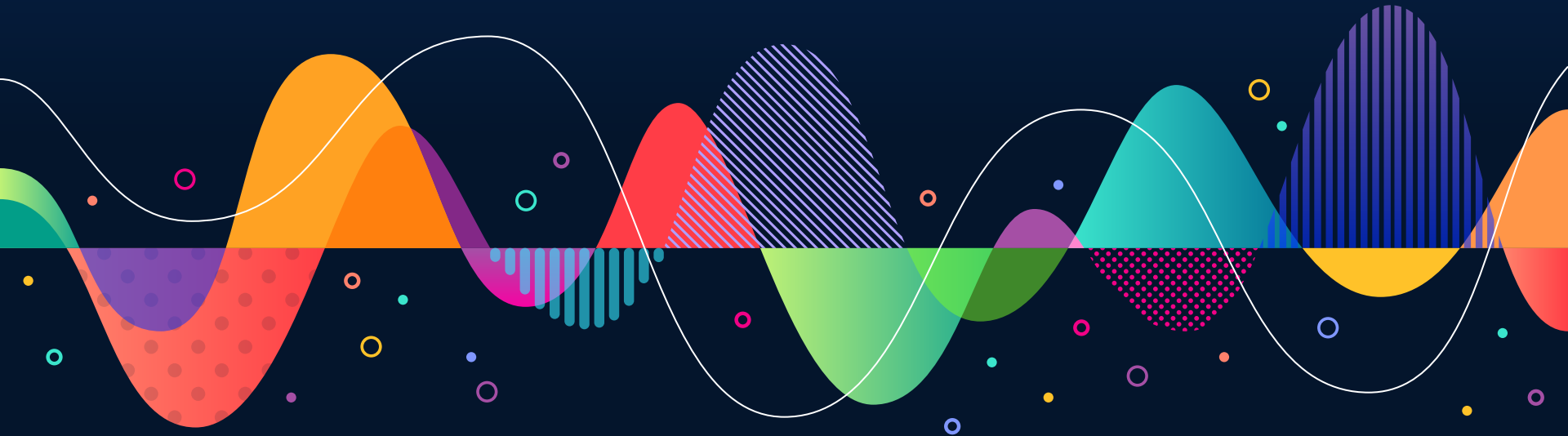


Sphalerite



Berzelianite

# Questions?



# Sources & Links



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