Types of Hydrogen

Types of HYDROGEN

- GRAY
- BLUE
- GREEN
- TURQUOISE
- PINK
- WHITE
- YELLOW

Gray Hydrogen

- **Production Method**:
  - Produced primarily from natural gas using Steam Methane Reforming (SMR).
  - SMR process: CH_4 (methane) + H_2O (steam) → CO (carbon monoxide) + $3H_2$ (hydrogen).
  - Followed by Water-Gas Shift Reaction: CO + H_2O → CO_2 (carbon dioxide) + H_2.
- **Environmental Impact**:
  - High CO_2 emissions.
  - Significant contributor to greenhouse gas emissions.
- **Use Cases**:
  - Widely used in the chemical industry, for refining petroleum, and for producing ammonia for fertilizers.

Blue Hydrogen

- **Production Method**:
  - Also produced from natural gas using SMR, but incorporates Carbon Capture and Storage (CCS) to capture CO_2 emissions.
  - Similar initial process to gray hydrogen.
- **Environmental Impact**:
  - Lower CO_2 emissions compared to gray hydrogen.
  - CCS technology captures up to 90% of the CO_2 emissions.
- **Use Cases**:
  - Similar to gray hydrogen but with reduced environmental footprint.

Green Hydrogen

- **Production Method**:
  - Produced through the electrolysis of water using renewable energy sources like wind, solar, or hydropower.
  - Electrolysis process: $2H_2O$ (water) → $2H_2$ (hydrogen) + O_2 (oxygen).
- **Environmental Impact**:
  - Zero carbon emissions if renewable energy is used.
  - Considered the most sustainable and environmentally friendly option.
- **Use Cases**:
  - Energy storage, fuel for transportation, industrial processes, and heating.

Turquoise Hydrogen

- **Production Method**:
  - Produced via methane pyrolysis, splitting methane into hydrogen and solid carbon.
  - Pyrolysis process: CH_4 (methane) → C (solid carbon) + $2H_2$ (hydrogen).
- **Environmental Impact**:
  - Avoids CO_2 emissions as carbon is captured in solid form.
  - Solid carbon can be used in various industries.
- **Use Cases**:
  - Industrial applications, reducing carbon footprint in hydrogen production.

Pink Hydrogen

- **Production Method**:
  - Produced through the electrolysis of water using electricity derived from nuclear power.
  - Electrolysis process is the same as green hydrogen but powered by nuclear energy.
- **Environmental Impact**:
  - Low carbon emissions due to the use of nuclear energy, which is a low-carbon energy source.
- **Use Cases**:
  - Similar to green hydrogen, with the advantage of a stable and continuous power supply from nuclear energy.

White Hydrogen

- **Production Method**:
  - Refers to naturally occurring geological hydrogen found in underground deposits.
  - Extracted through mining or drilling.
- **Environmental Impact**:
  - Still in early stages of exploration and development.
  - Environmental impact depends on extraction methods.
- **Use Cases**:
- Potential future source of hydrogen, currently under research.

Yellow Hydrogen

- **Production Method**:
  - Produced through electrolysis of water using grid electricity.
  - Grid electricity can be a mix of renewable and non-renewable sources.
- **Environmental Impact**:
  - Carbon footprint varies depending on the energy mix of the grid.
  - Can range from low to high emissions based on electricity source.
- **Use Cases**:
  - Versatile, used in similar applications to green hydrogen but with varying environmental impacts.