**Summary of South Korea Project**

Optimize South Korea's overseas hydrogen (H₂) supply chain (2025–2040) using MILP to minimize costs while meeting decarbonization targets.

**Types of Data Used**

**1. Hydrogen Demand Data**

* **Source**: South Korea’s national hydrogen roadmap (2019).
* **Details**: Projected hydrogen demand for 2018, 2030, and 2040, including breakdowns by hydrogen type (grey, blue, green, byproduct).
* **Purpose**: To set the targets and constraints for how much hydrogen needs to be supplied/imported in each year.

**2. Production Capacity Data (Exporting Countries)**

* **Natural Gas Capacity**: For blue hydrogen (SMR with CCS), data on natural gas production and export volumes from candidate countries (e.g., Qatar, Russia).
* **Renewable Energy Capacity**: For green hydrogen (water electrolysis), data on solar and wind generation capacities in exporting countries (e.g., UAE, India, Australia, Chile, Indonesia).
* **Purpose**: To determine how much hydrogen each country could potentially export.

**3. Resource Price Data**

* **Natural Gas Prices**: 10-year historical data for candidate exporters.
* **Renewable Electricity Prices**: 10-year historical data for solar PV and wind in each exporter country.
* **Purpose**: To estimate the cost of hydrogen production in each exporting country.

**4. Transportation and Conversion Data**

* **Distances**: Shipping distances between exporters and South Korea.
* **Carrier Options**: Data on costs and technical feasibility for different carriers (liquefied hydrogen, ammonia, methylcyclohexane).
* **Conversion Costs**: Costs for converting hydrogen into each carrier form and reconversion at the destination.
* **Purpose**: To model the end-to-end supply chain cost and feasibility.

**5. Carbon Emissions Data**

* **Capture Rates**: For blue hydrogen, data on CO₂ capture efficiency (e.g., 90% for SMR-CCS).
* **Grid Emissions**: Emission factors for electricity used in green hydrogen production.
* **Purpose**: To ensure supply chains meet decarbonization targets.

**6. Policy and Scenario Data**

* **Carbon Tax**: Assumed or scenario-based carbon price (e.g., $50/ton CO₂).
* **Subsidies/Regulations**: Any relevant policy incentives or constraints.

**Predictions Made by the Model**

* **Optimal Mix of Hydrogen Supply**: How much hydrogen should be imported from each country, using which carrier, and by which production method (blue or green), for each year.
* **Total and Unit Supply Chain Costs**: The cost per kilogram of hydrogen delivered to South Korea, including production, conversion, transportation, and reconversion.
* **Carbon Emissions**: Total and per-unit emissions for each supply chain configuration.
* **Impact of Policy Scenarios**: How costs and supply mix change under different carbon tax or subsidy scenarios.
* **Future Trends**: Projections of when green hydrogen becomes more cost-competitive than blue hydrogen, based on declining renewable energy costs.

**Summary Table:**

| **Data Type** | **Used For** | **Example Source / Value** |
| --- | --- | --- |
| Hydrogen demand | Setting supply targets/constraints | SK H2 Roadmap: 5.26 MMT/yr by 2040 |
| Production capacity | Exporter selection, feasibility | Gas exports, solar/wind GW |
| Resource prices | Production cost estimation | $/MMBtu gas, $/MWh solar/wind |
| Transport/conversion | Supply chain cost modeling | $/kg/1000km for LH2, NH3, MCH |
| Carbon emissions | Decarbonization constraint | 90% capture (blue H2), grid factors |
| Policy scenarios | Sensitivity/risk analysis | Carbon tax, subsidy assumptions |

**Optimization of India’s Green Hydrogen Supply Chain: A Mixed-Integer Linear Programming Approach**

India is poised to become a major player in the global green hydrogen economy, driven by its abundant renewable energy resources and ambitious climate targets. However, the establishment of an efficient, cost-effective, and environmentally sustainable hydrogen supply chain presents significant challenges, including infrastructure limitations, water scarcity, and the need for robust risk assessment.

This project aims to design and optimize India’s green hydrogen supply chain by employing mixed-integer linear programming (MILP) to balance **carbon emissions and levelized costs across cross-regional and international networks**. The methodology involves comprehensive **demand analysis**, identification of **strategic export partnerships**, collection of **techno-economic and environmental parameters**, and scenario-based risk assessment.

The outcomes of this project will include a **set of optimized supply chain strategies for meeting India’s future green hydrogen demand at the lowest possible cost and carbon footprint**. The project will **deliver detailed forecasts of hydrogen demand across key sectors**, as well as projections of renewable energy prices that drive hydrogen production economics. Using these inputs, the mixed-integer linear programming model will identify the most cost-effective supply configurations for different time horizons, highlighting when and how green hydrogen can become competitive in India. Additionally, the results will provide actionable recommendations for policy, investment, and infrastructure development, supporting India’s transition to a sustainable hydrogen economy while accounting for uncertainties in demand and resource pricing.

**DATA USED**

* 1. **For predicting future resource prices**
     + Natural gas price
     + Renewable electricity
  2. **For predicting future production capacity for India**
     + Amount of natural gas exported to India
     + Total renewable energy capacity