

Main Inputs

1. Innovative value-chain configurations

- Objective function values, e.g., Life Cycle GHG emissions, Cost of natural resource use, Circularity, etc.

2. Technology Readiness Level (TRL) of each innovation, 1-10

3. R&D Cost estimate per unit TRL increase (USD/ Δ TRL)

4. Stochastic model to predict TRL evolution

- e.g., for Continuous time markov chains (CTMCs): Transition probabilities between and sojourn time in each TRL state

5. Integrated Assessment Model

- Decarbonization of power systems with time
- RCP Scenario

Objective function

Minimize

sum of:

1. Value-chain operating cost (**OPEX**) of Resource-Use
2. **R&D Cost** for investment in innovations
3. Cost of **Cumulative CO₂ emissions**

Constraints

1. **Multi-period planning**
2. **Evolution of TRL (stochastic)**
3. Changing background emissions through **IAM model**
4. Net-Zero Emissions and Circularity **Targets**
5. Cap on **cumulative emissions**

Main Outputs

1. Optimized plan/ **roadmap** to
 - A. **Invest** in Innovations
 - B. **Adopt** optimal value-chains
 - C. **Distribute** demand between favorable value-chains
2. **Plan** for cost-optimal decisions
3. **Cumulative Emissions** and Circularity **profiles**
4. **Optimal futuristic synergies** among innovations and evolving climate action