TECHNISCHE UNIVERSITÄT DRESDEN

Global Hydrogen Infrastructure Transport Model in 2050

A model-based analysis of green hydrogen trade

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Concept

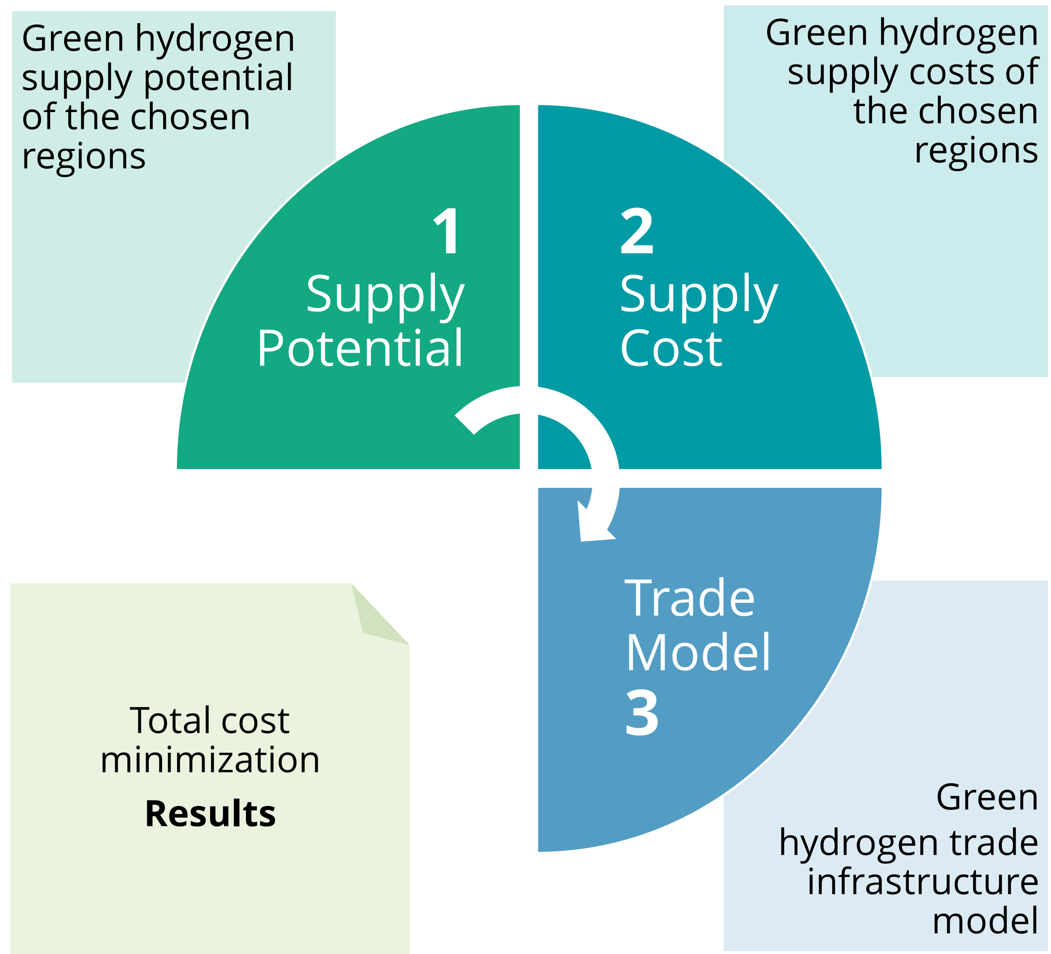
The impact of the climate crisis is felt in all areas, and with the Paris Agreement, governments aim to keep global warming below 1.5 °C. This situation has pushed the governments to seek clean energy, expand energy resource diversity and meet the increasing energy demand with an affordable energy supply. [1]

Green hydrogen, the hydrogen produced from renewable energy, may play a crucial role in a future renewable energy-based energy system by connecting intermittent wind and solar power generation to traditional energy-consuming sectors.

The development of the new hydrogen economy, policy, and industry is still in its infancy to construct a reasonable policy, rational parameters are necessary. At this stage, energy system and transport models are utilized to generate reasonable parameters.

Energy transport infrastructure modeling is one of the most important instruments for establishing macro-level energy and environmental policies and scenarios. These models can be used to examine the economic, environmental, and social repercussions of currently existing or projected energy and environmental policies.

This project aims to develop an outline of the global green hydrogen transport infrastructure in 2050 using a cost minimization linear programming model, analyze regional and global hydrogen policies and strategies and different transport options.



Methods

Firstly, it is aimed to estimate the green hydrogen supply potential of the chosen regions. The hydrogen supply potential depends on many variables such as renewable energy potential, water stress level, infrastructure potential, economic power, hydrogen strategies.

$$SupplyCapacity = EligableLandArea * CapacityFactor * InfrastructurePotential * (1 - WaterStress) * HydrogenPolicyRatio$$

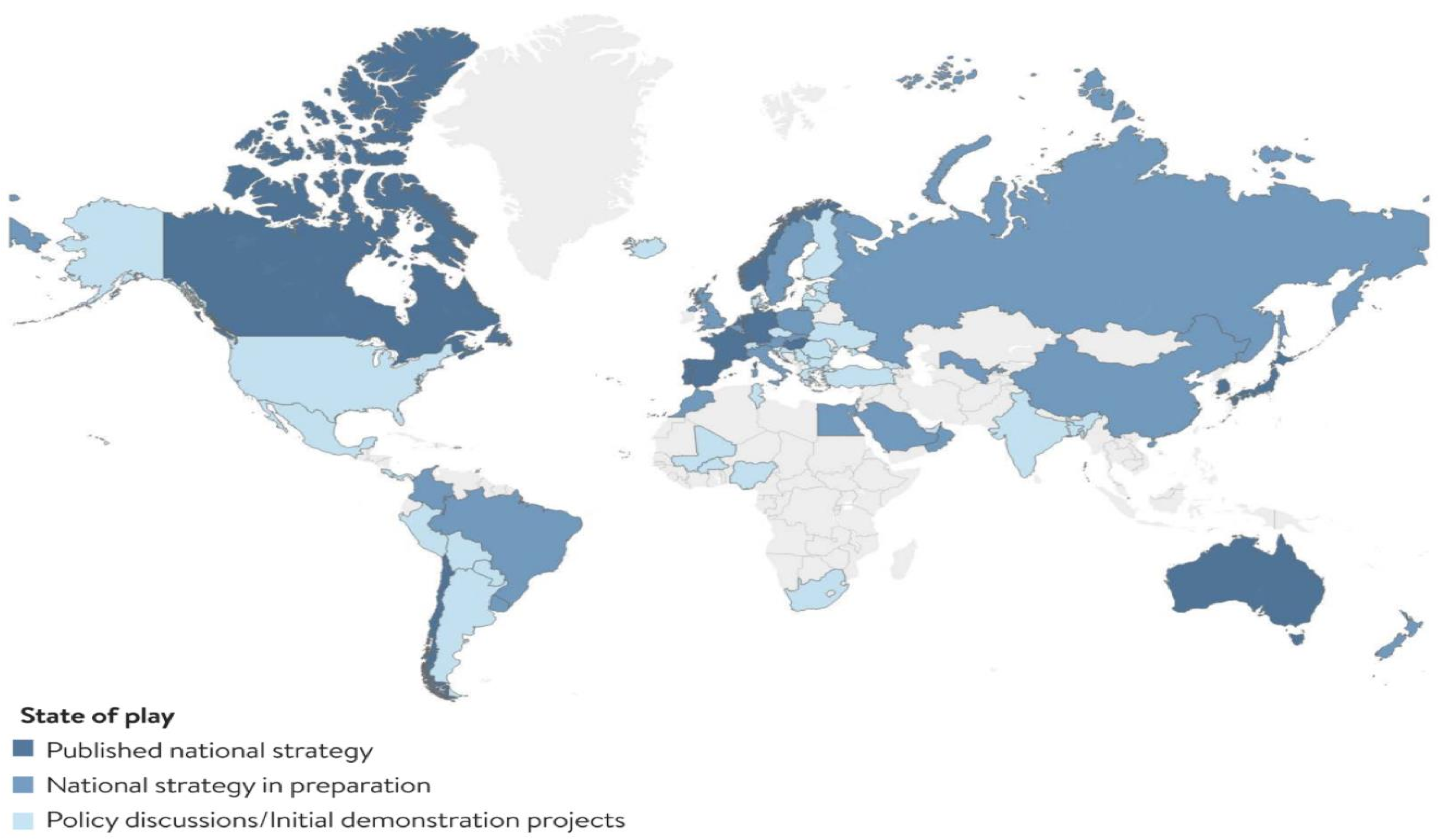
In the second part, the objective is to estimate the green hydrogen supply costs of the selected regions with the technology learning rates. Literature studies on learning rates for electrolyser, wind and solar energy are considered.

$$Cost_t = Cost_0 * \left(\frac{CumulativeProduction_t}{CumulativeProduction_0}\right)^{EmpiricalLearningParameter}$$

Finally, the linear programming method is applied to represent the global hydrogen infrastructure system in 2050. The objective of the problem is to minimize the total cost which is given by the production cost, trade cost and storage cost.

$$MINIMIZE\ TotalCost$$

Hydrogen Policies



Conclusion

Green hydrogen has the potential to be the pillar of energy transition.

The transport method, pipeline or shipping, plays an important role in the competitiveness of hydrogen.

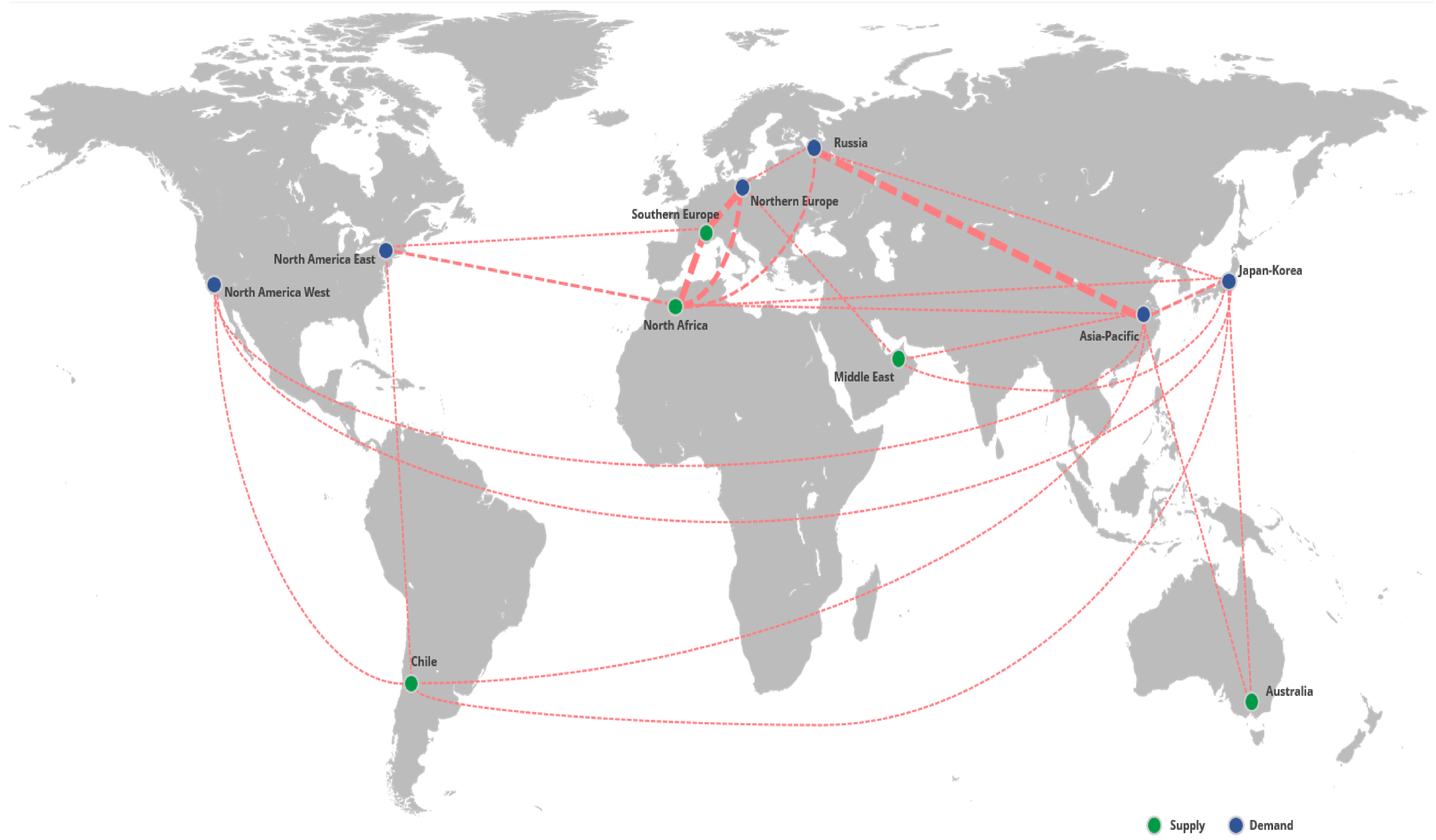
Solar power is the decisive force of the primary exporters: Australia, Chile, North Africa, and the Middle East.

The most advantageous region in terms of location is North Africa, which is connected to Europe, one of the highest demand regions, by pipeline and supplies hydrogen to other major demand regions by shipping.

The Middle East needs pipeline networks with Europe to be competitive with North Africa in the European market. insert images - large and proportional

Lower renewable costs are not enough for Australia and Chile, where regions need network agreements to compete in the Pacific market.

Results



Literature:

1 *Paris Agreement to the United Nations Framework Convention on Climate Change, Dec. 12, 2015, T.I.A.S. No. 16-1104.*

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