# TÜRKİYE GREEN HYDROGEN FUTURE | 2023


Executive Summary

Launch Slides

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# About IICEC

*Sabancı University Istanbul International Center for Energy and Climate (IICEC) was established as a future-oriented, independent research and policy center to conduct objective and quality research on energy and climate issues.*

*IICEC contributes to a cleaner and more secure energy future with its national, regional, and global studies on the energy and climate agenda and within the success triangle model that supports government-industry-academia collaborations.*

*Being a part of one of the most distinguished universities in the region, IICEC carries out analytical studies with a strategic and holistic perspective on the Turkish energy sector while also encouraging the exchange and development of ideas by providing a unique platform that brings together key stakeholders in the fields of energy and climate. "Turkey Energy Outlook", published by IICEC as a first-of-its-kind study in Türkiye in 2020, supports an efficient, secure, competitive, technology-oriented, and sustainable future of the energy sector with solid recommendations.*

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# Executive Summary

# IICEC Türkiye Green Hydrogen Future 2023

# Executive Summary

## Why the "Türkiye Green Hydrogen Future" ?

Recent developments in global energy – the first global energy crisis in 2022, ongoing geopolitical developments, the emerging needs for flexible electricity systems that can enable strong growth in electrification, and the bolstering of clean energy technologies and supply chains – have transformed the energy security paradigm into a multifaceted one. While the 1.5°C and net-zero targets remain vital in the fight against climate change, strengthening secure and clean energy options for energy transitions around the world constitutes one of the most important elements of a sustainable future. Recent levels of investment in clean energy have significantly outpaced those for fossil fuels, auguring a new period for the global energy sector in which the share of clean energy will increase rapidly. Diversification and localization of clean energy and climate technologies in addition to energy supply portfolios have become a central priority in the advancement of new industrial strategies for sustainable competitiveness of national economies. Geopolitical developments further reinforce these energy, climate and industrial trends.

Interest and investment in clean hydrogen has also been accelerating in recent years due to macro energy, climate, industrial and technological dynamics; and geopolitical developments. Clean hydrogen possesses potential to become widespread, especially in sectors that are difficult to decarbonize through clean electrification, such as heavy industry and long-haul transportation, and can be produced from various primary energy sources, from fossil fuels to renewables and nuclear energy, and through different technologies. Hydrogen can also be stored, transported, and used in different forms.

All these aspects suggest that green hydrogen can serve both as a fuel and a flexible energy carrier and can help build more secure, cleaner, and more sustainable energy supply-and-demand balances. Supportive financing and innovative business models, especially those implemented by major economies, aim to improve the economics and competitiveness of green hydrogen in its initial growth phases, to nurture the sustainable growth of green hydrogen supply chains and, at the same time, to forge a growth model that is compatible with the net-zero pathway, especially during the post-2030 period. Moreover, technological development and the drive to reduce costs are expected to provide significant improvements in the competitiveness of green hydrogen in the coming years globally. The growth in green hydrogen is also expected to play an important role in Türkiye's future energy balances.

## Türkiye's Potential and Strengths

Türkiye is one of the largest energy markets in Europe and among the most dynamic in the world. The country features rising energy demand and high growth potential in the energy sector, supported by a young population and rising levels of industrialization, urbanization, and mobility. Türkiye's announcement of the 2053 net-zero emission target, together with its developing energy strategies that focus on supply security, competitiveness, and localization, will be central to building a more secure and cleaner energy future over the next thirty years.

Technology-oriented development and versatile growth opportunities can simultaneously support Türkiye to reduce its imported fossil fuel intensity and energy-import bill, diversify its energy resources and technologies, assure security of supply, and initiate an inclusive transformation towards its net-zero targets. Among the energy policies, market development, and investment priorities, the rapid expansion of clean electrification and the realization of the high potential in renewable energy and energy efficiency have become more prominent. Developing the hydrogen ecosystem is also being strengthened within the framework of global and regional trends as well as national development, energy, climate, and industrial policies, and emerging initiatives in industry. Türkiye's dynamic energy market, the imperative to meet increasing demand, and the strong potential in renewable energy all provide important reasons for Türkiye to develop green hydrogen production and its related technologies.

In this regard, the "12th Development Plan" (2023), "Türkiye's National Energy Plan" (2022), and "Türkiye's Hydrogen Technologies Strategy and Road Map" (2023) present important targets and perspectives, especially in green hydrogen production and consumption in sectors that are difficult to decarbonize, and the development of relevant infrastructure and technologies. The country's proximity to European markets, which have robust demand for green hydrogen and clear import needs, also brings new opportunities within the perspective of becoming an energy trade center and exporter of green hydrogen in the future, with priority given to domestic consumption. The priorities within Türkiye's policy documents also support this vision.

## Summary of the IICEC Model and Analyses

Türkiye Green Hydrogen Future 2023 is based on the Türkiye Energy Outlook published by IICEC, a first-of-its-kind study in Türkiye, the IICEC Energy Model and a detailed inventory of Türkiye's energy economy. Employing a database covering the entire energy supply and demand chains, the holistic modeling framework reflects the global and regional energy and climate dynamics, critical priorities, and trends in Türkiye's current national development, energy, industrial, and climate policies, as well as the needs, expectations, and advances in energy markets and technologies.

This pioneering study is carried out with a detailed analytical approach and a long-term perspective. A growth and development perspective in green hydrogen out to 2050-2053 is presented together with multiple economic, energy, and climate benefits in terms of resource diversification and energy-supply security, including reducing imported fossil fuel consumption and the energy import bill, lowering $CO_2$ emissions, supporting clean energy transition goals, and incorporating the net-zero emissions perspective. In addition, the study evaluates other critical gains such as localization in relevant hydrogen technologies in the priority areas that are determined by Türkiye.

The IICEC model and analysis for green hydrogen production are based on the electrolyzer installation targets that were outlined in the "Türkiye Hydrogen Technologies Strategy and Road Map": 2 GW in 2030, 5 GW in 2035, and 70 GW in 2053. In this context, techno-economic analyses were carried out that took into consideration the following dynamics: the development pace of technologies and demand sectors, capacity utilization rates in production and consumption, the economics of hydrogen production, and other relevant factors.

The analyses reflect the target of rapid growth in electrolyzer capacity, especially in the period after 2035 that reaches 50-70 GW[1] between 2050 and 2053, showing that green hydrogen production increases approximately two-fold every five years starting from 2030. It is forecast that Türkiye's green hydrogen production reaches 0.6 Mt (million tons) in 2035 and 5.5 Mt[2] in 2050.

With present technologies, the current cost of producing green hydrogen from grid electricity is in the range of 8.5-9 $/kg[3] , which is fivefold-to-sixfold the current natural gas cost in terms of energy equivalent. The most critical element for the competitiveness of green hydrogen production will be the evolution of electricity costs. Targeted cost levels of 2.4 $/kg in 2035 and 1.2 $/kg in 2053 require electricity costs of 30$/MWh and 10-15$/MWh, respectively. At current natural gas price levels, green hydrogen will reach a break-even point with gray hydrogen around 2030 and with natural gas around 2040. Competitiveness may occur sooner if carbon costs rise more rapidly or fossil fuel prices remain higher in the future.

The study also analyzes the possible development of hydrogen demand in sectors that are difficult to decarbonize within the framework of relevant sectoral dynamics. With the effects of transformation in the refinery and fertilizer sectors, which are currently gray hydrogen consumers, and the EU Carbon Border Adjustment Mechanism (CBAM), especially in the post-2030 period, the industrial sectors with high fossil fuel intensity that are also critical for Türkiye's export competitiveness, especially steel, will constitute the first significant volumes of demand. As a result of dynamics such as the harmonization of the automotive industry with global and European developments, Türkiye's position in logistics, and clean energy trends in mobility, the demand in road, aviation, and marine transport is also expected to accelerate, especially after 2030-2035. Approximately 90% of Türkiye's total green hydrogen demand of 3.8 Mt in the 2050-2053 period is seen in industry and transportation[4].

Green hydrogen consumption increases to 0.7% of Türkiye's energy demand in transportation in 2035 and 11% in 2050, while it will be 1% of its industrial energy demand in 2035 and 8% in 2050. Green hydrogen corresponds to 0.7% of Türkiye's total final energy consumption in 2035, 1% in 2040, and 6% in 2050[5]. According to IICEC's analysis, the contribution of clean electrification, direct use of renewable energy, and green hydrogen to total final energy demand may increase to 70-75% by the 2050-2053 period, up from 10-15% in recent years[6]. The growth and development perspective in green hydrogen production and consumption shows that Türkiye can also become an exporter of green hydrogen, with priority given to meeting the demand of potential domestic consumer sectors, with hydrogen equivalent exports of 0.2 Mt forecast by 2035 and 1.7 Mt by 2050.

In this growth path, which is also compatible with the export vision in "Türkiye's Hydrogen Technologies Strategy and Road Map," approximately 30% of the cumulative production by 2050 can be utilized as exports to Europe, the majority of which is ammonia. Developments in pipelines may also diversify exports in the medium and long term. Through export development, Türkiye will be able to gain a 3% share on average in the EU's total green hydrogen imports until 2050 (8% in 2050).

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[1] 1.5% share in global electrolyzer capacity in 2050 in the IEA Net Zero Emissions (NZE) Scenario.

[2] 1.6% share in global green hydrogen production in 2050 in the IEA NZE Scenario.

[3] Levelized cost of hydrogen.

[4] IICEC analysis reflects on blending to gas grid targets, clean electrification and roll-out of efficient heat pumps. The use of hydrogen in buildings is rather limited. Hydrogen can contribute significantly to future electricity dynamics as a storage option to support system flexibility for increasing electrification and rising variable renewable generation.

[5] The world average in 2050 is 3% in the IEA APS and 8% in the IEA NZE.

[6] Electrical energy is expected to represent half of final energy consumption (approximately 20% today).

The green hydrogen development pathway presented in this study requires the development of approximately 15 GW of additional renewable energy installed capacity by 2035 and over 90 GW by 2050. The electricity input to ensure green hydrogen production corresponds to 6% of Türkiye's total gross electricity production in 2035 and approximately 20% in 2050. Hydrogen storage is expected to become an important option to support the increasing flexibility requirements of the electricity sector for supply security and strong growth in variable renewable energy in the medium and long term. Therefore, to achieve maximum economic benefit from the development of green hydrogen, short-, medium-, and long-term growth targets and supply-security priorities in the electricity system must be considered alongside the development of integrated planning approaches and road maps for electricity and hydrogen production. Factors such as the potential for pink hydrogen production from innovative nuclear technologies, blue hydrogen production based on the development of carbon technologies integrated with domestic fossil fuel resources, and uncertainties regarding demand growth, similar to observed globally, may also affect the evolution of the green hydrogen supply-demand balance in the medium and long term.

Electricity-intensive green hydrogen production is also water-intensive, which makes the use of seawater essential in supporting sustainable production. The total water requirement to support electrolyzer targets in the period until 2050 is 1.5 billion $m^3$, the majority of which is seawater[7]. At the same time, the security of supply chains for critical minerals – the fundamental inputs for electrolyzer production, installations, and other technologies – will be a vital planning component for large-scale and sustainable growth in green hydrogen. In developing the value chain for green hydrogen within a holistic system perspective, safety should be a top priority.

## Multidimensional Benefits for Energy, Climate, and Technology-Driven Industrial Development

Türkiye will be able to accrue multidimensional energy and climate benefits through the green hydrogen development pathway presented in this study, especially after 2030-2035. Until 2050, a total of 81.0 Mt of oil equivalent of savings in fossil fuel consumption can be achieved by substituting green hydrogen for petroleum products, natural gas, and coal, which is equivalent to the country's current annual fossil fuel consumption at final energy use. This savings corresponds to an average annual decrease of 0.8 billion 2022$ in the energy import bill until 2050, which reaches 3.1 billion 2022$ of savings in 2050[8] In the same period, a reduction of 287.2 Mt of $CO_2$-equivalent is achieved in greenhouse gas emissions in hard-to-abate sectors, with growth in green hydrogen supporting the net-zero target. (Currently, the emission inventory of hard-to-abate sectors is 79.5 Mt $CO_2$-eq.) In the period until 2050, the equivalent economic gain is calculated as 1.4 billion 2022$, with 4.8 billion 2022$ in 2050[9]. Therefore, an annual average of 2.2 billion 2022$ of economic benefit can be achieved in these two areas. The economic benefit that can be gained by exporting to the EU is calculated as an annual average of 1.3 billion 2022$, reaching 4.4 billion 2022$ in 2050. Exports to the EU, corresponding to 30% of production, will account for approximately 40% of the total economic benefit throughout the period until 2050.

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[7] If all use is from groundwater resources, equivalent to 6% of current groundwater consumption.

[8] With the IEA STEPS Scenario commodity price series. 0.6 billion 2022$ with the IEA APS Scenario price series. In its analysis, IICEC considers the perspective of rising domestic production of oil and natural gas, with fossil fuel import rates decreasing by two-thirds. 1.1 billion 2022$ with continuing import rates in fossil fuels.

[9] With the IEA STEPS Scenario carbon price series. 1.8 billion 2022$ with the IEA APS Scenario price series.

IICEC's analysis determined that an average annual investment of approximately 3.0 billion 2022$ will be required, with approximately half of it focused on electricity production until 2050. This includes 1.6 billion 2022$ for electricity production, 0.8 billion 2022$ for electrolyzer installations, and 0.6 billion 2022$ for other infrastructure. Expected technological advances provide improvements in electrolyzer costs in the period until 2050. The speed and optimization of development in infrastructure, which is one of the most important uncertainties in the value chain, are critical in terms of total cost.

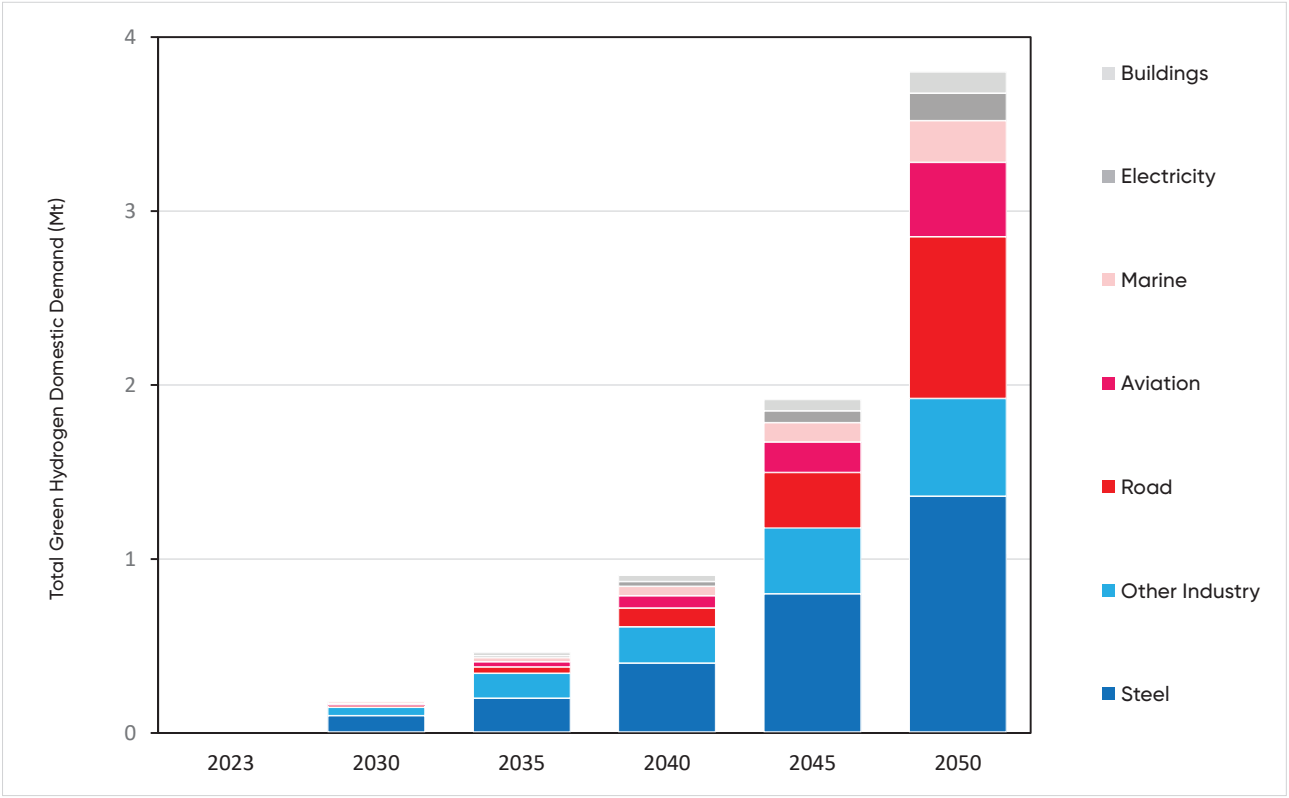
In the period until 2050, 3.5 billion 2022$ of energy import, emission, and green hydrogen-export benefits are realized in return for an annual average investment of 3.0 billion 2022$. This translates to a cumulative 77.2 billion 2022$ in investments until 2050 and 91.7 billion 2022$ in benefits (5.2 billion 2022$ in investments and 12.3 billion 2022$ in benefits in 2050). The cumulative benefit-cost multiplier is 1.2 until 2050 and reaches 2.4 annually by 2050, with the cumulative benefits exceeding costs around 2045. These analyses are largely consistent with the timing of green hydrogen becoming fully cost-competitive with traditional, fossil fuel-based alternatives.

An important contribution of green hydrogen is supporting energy security through the localization and diversification of energy supply. With the development of the ecosystem, critical gains in areas such as the localization of technologies will increase the benefit-cost multiplier and accelerate the returns on investment from a macro perspective. Developing and implementing support mechanisms like good practice examples in different regions at the initial development stages will strengthen predictability and multiply benefits within a long-term perspective.

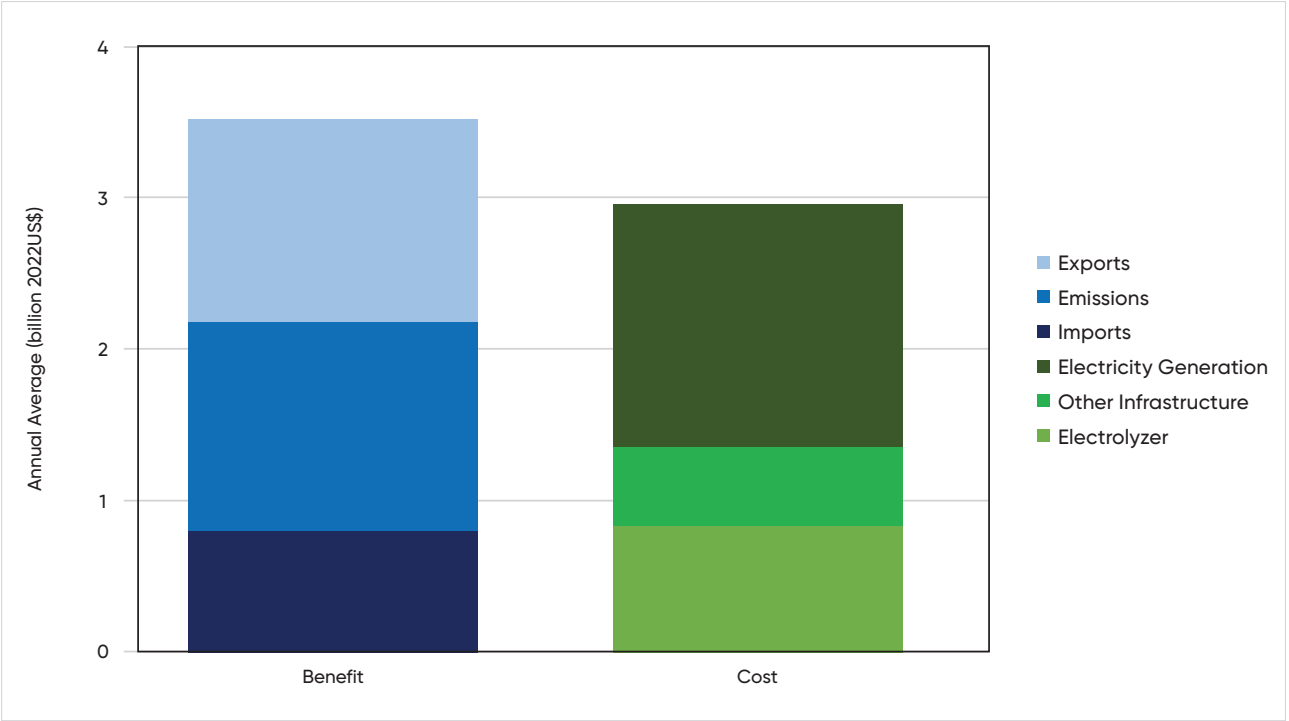
In addition to different price series regarding the development of medium- and long-term energy and carbon prices, the study also examines various factors regarding the benefit and cost dimensions of supply and demand, considering important uncertainties such as the change in fossil fuel-import dependency, the regional development of hydrogen and ammonia prices, and the speed of development of demand and infrastructure. Sensitivity analyses were also performed around this question. For example, with a 20% increase in infrastructure costs, the benefit-cost multiplier decreases by approximately 5%, while in the case of a 20% increase in hydrogen and ammonia export prices, the benefit-cost multiplier increases by 8%.

The growth in green hydrogen that can be achieved through integrated approaches to the development of the renewable energy and electricity sectors, compatible with development, energy, industry, and climate strategies and targets, can offer multidimensional contributions to a more secure and clean energy future with various technological advancements and benefits. All these benefits can be achieved through the government-industry-academia triangle of cooperation across several improvement areas: road maps supporting long-term goals; development of technical and regulatory infrastructures that place efficiency and safety at the center within a system perspective; market development and an investment environment supported by holistic planning; and R&D in future technologies together with localization and manufacturing capabilities, international collaboration, competent human resources, innovative business models, and greater sustainability.

## Development of Green Hydrogen Domestic Demand (2023-2050, Mt/y)




## Annual Average Benefit and Cost by Green Hydrogen Development (2023-2050, Billion 2022US$/y)



## IICEC Recommendations

**IICEC recommends the following to harness Türkiye's high potential and advantages in green hydrogen and its related technologies and thus provide multiple benefits for energy security, clean energy transition, competitiveness, localization, and technology-oriented industrial development:**

**1.** Determining road maps regarding the development perspectives within production, demand, and related infrastructures based on priority sectors and regions,

**2.** Developing technical and regulatory infrastructure, preparing and implementing long-term master plans that will ensure optimal resource use and maximum safety,

**3.** Establishing market and support mechanisms for efficient and predictable growth in the value chain, considering interactions with electricity, natural gas, carbon markets, and electricity-supply security,

**4.** Realizing opportunities in critical technologies, especially electrolyzers, storage, and fuel cells, and developing localization and manufacturing capabilities,

**5.** Strengthening international and regional cooperation, utilizing export opportunities to Europe with maximum benefits,

**6.** Implementing a broad sustainability perspective throughout the ecosystem, in areas such as wind and solar resources, water use, critical minerals, and relevant supply chains,

**7.** Developing qualified human resources and a talent pool and establishing a strong entrepreneurial ecosystem that will support sustainable growth and competitiveness objectives.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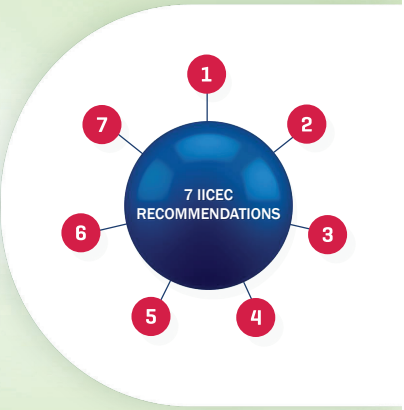
## Türkiye Green Hydrogen Future (TGHF) supports realization of high potential with multiple benefits by presenting solid recommendations.

### WHY TGHF?

- Energy, climate and industry dynamics, globally and regionally.
- National development, energy and climate targets of Türkiye.
- Türkiye's high potential in renewable energy and electrification and increasing energy demand in hard-to-abate sectors.
- Multi-dimensional opportunities to support a more secure and cleaner energy.
- An independent, participatory and exemplary study.

### HOW TGHF?

- Türkiye Energy Outlook developed by IICEC & a holistic energy model.
- Detailed inventory and analyses of the Turkish energy system and final demand sectors.
- Impacts of global and regional developments, related policy priorities in Türkiye, market development, and technological advancements.
- Independent research, qualitative analyses and perspectives.
- Stakeholder engagement built-upon Public-Private Sector-Academia success triangle.

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## Multi-faceted energy and climate benefits are assessed based on Türkiye's potential and strengths in green hydrogen.

### STRENGTHS & POTENTIAL

- Policy targets and strategies
- High renewable energy potential
- Demand increase in hard-to-decarbonize sectors
- Technology-oriented development priorities, emerging initiatives and cooperation areas in the ecosystem
- Proximity to European markets with high demand and import needs

### MULTI-DIMENSIONAL OPPORTUNITIES

- Diversification in energy supply & localization
- Greenhouse gas emission reductions
- Reductions in energy import bill
- Technological development & localization

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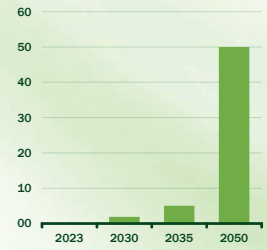
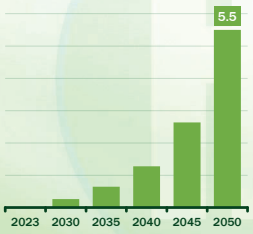
## Green hydrogen future perspective is presented based on the electrolyzer installation targets defined in the Türkiye National Energy Plan.

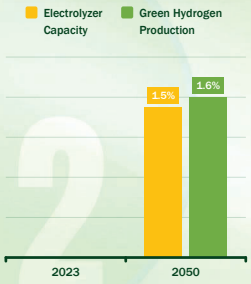
### Electrolyzer Capacity (GW)



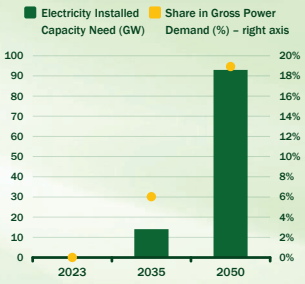

### Green Hydrogen Production (Mt)




### Global Share (2050, %)*




### Electricity Requirement (GW,%)




Türkiye's global share in capacity and generation increases to 2%, supported especially by fast growth after 2035;
Increasing need for electricity input strengthens the relationship among green hydrogen, renewable energy and electrification targets.

* According to the IEA NZE (Net Zero Emissions) Scenario 2050 global electrolyzer capacity and green hydrogen production perspective.

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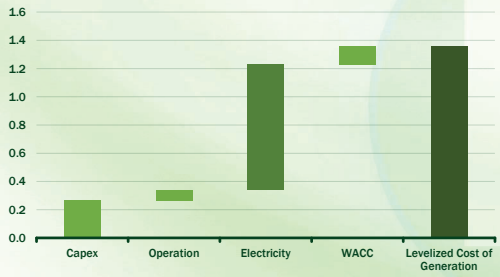
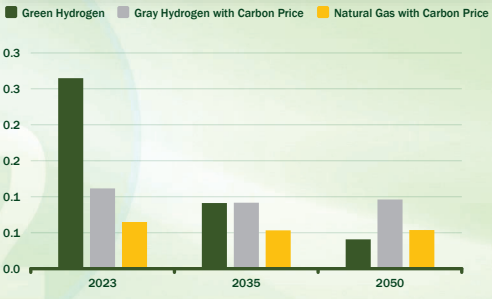
## The developments in the economics of production will be critical for both consumption pathways in various sectors and competitiveness with traditional alternatives.

### Levelized Cost of Green Hydrogen Production (2050, US$ / kg)




### Development of Green Hydrogen Economics and Competitiveness* (US$ / kWh)




Electricity input will continue to represent the largest component of the green hydrogen costs,
in addition to power prices, the evolution of fossil fuel and carbon prices will be key determinants in the competitiveness of generation.

* A development pathway that converges to the cost targets in the Türkiye Hydrogen Technologies Strategy and Road Map.
With IEA STEPS Scenario fossil fuel and carbon price series.

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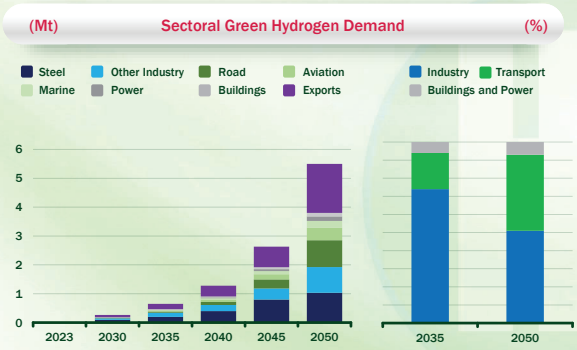
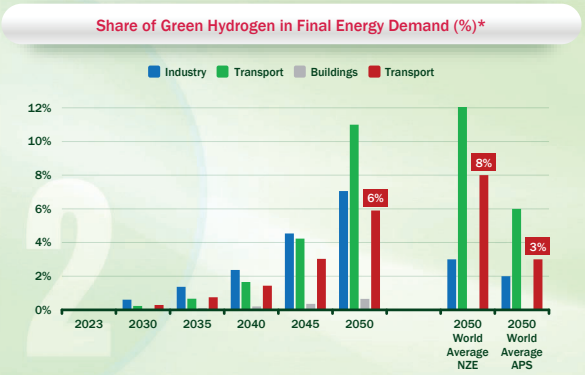
## Sectoral development of demand is analyzed based on sector-specific dynamics and prioritization of production in domestic consumption avenues.




Demand will develop in industrial sectors at early stages driven by conversion in existing uses and the impact of CBAM and will reach a more diversified structure in the future backed by drivers such as energy transition in transportation.

* IEA APS (Announced Pledges) Scenario and NZE (Net Zero Emissions) Scenario.

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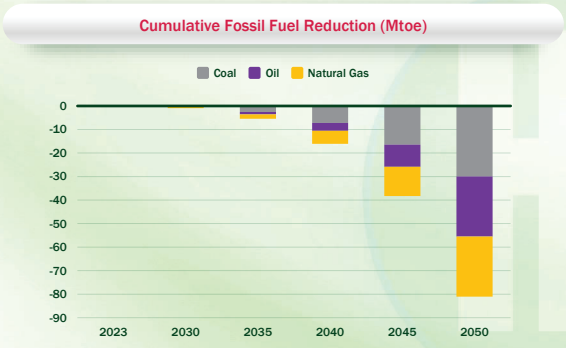
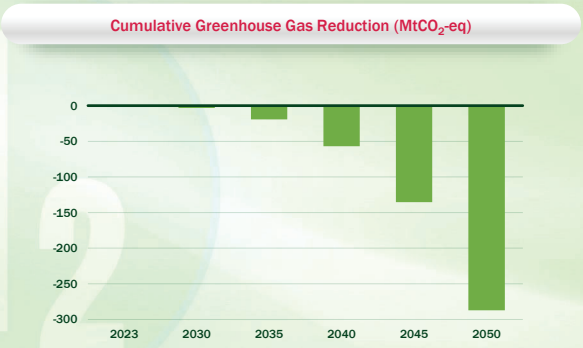
## Substituting fossil fuels with green hydrogen in hard-to-abate sectors presents multiple benefits for a more secure and cleaner energy future.

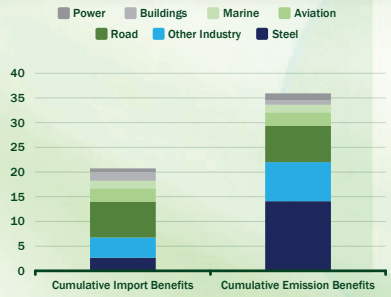


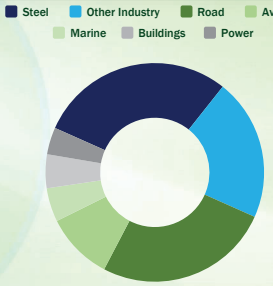

Energy savings equivalent to ~2 times the current energy consumption and emission reductions equivalent to ~3,5 times the current GHG emission inventory can be achieved across these sectors until 2050.

## Significant economic benefits can be achieved by reductions in fossil fuel consumption and emissions.

### Cumulative Import and Emissions Benefit* (billion 2022US$)




### Sectoral Breakdown of Cumulative Benefits (%)




Steel, other industries and road transportation represents nearly three-quarters of cumulative demand and 55 billion 2022US$ cumulative economic benefits.

* With the IEA STEPS (Stated Policies) Scenario price series. The analyses reflect the targets to ramp up localization rate in fossil fuel supplies.

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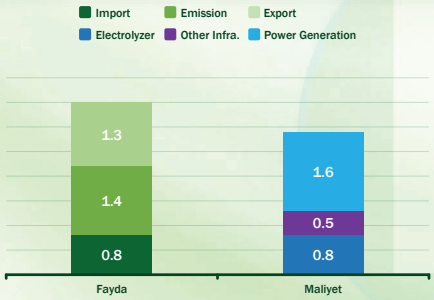
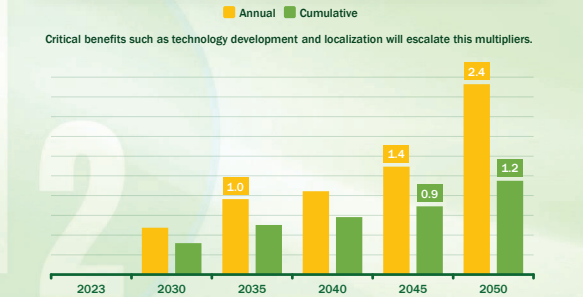
## Cost and benefit analyses show increasing gains over the medium-to-long term through the development of the holistic benefit-cost dynamics.

### Annual Average Cost and Benefit (billion 2022US$/year)*




### Development of the Benefit-Cost Multiplier




3.5 billion 2022USD$ of import, emissions and export benefits are achieved with 3.0 billion 2022US$ investment at annual average terms; cost-benefit multiplier exceeds 2.4 annually and 1.2 cumulatively post 2050.

* With the IEA STEPS (Stated Policies) Scenario price series. 3.7 billion 2022US$ with the IEA APS Scenario price series.

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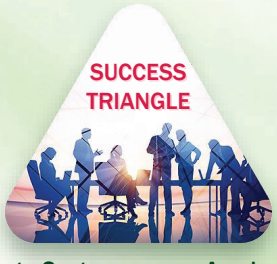
GREEN HYDROGEN FUTURE

## Türkiye Green Hydrogen Future presents critical development areas and opportunities to realize the high potential and multiple benefits.

Public




Private Sector Academia

- Policy Targets & Road Maps
- Infrastructures
- Markets
- Technologies & Localization
- International & Regional Cooperation
- Broad Sustainability
- Human Resources & Entrepreneurship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1. Determining road maps regarding the development perspectives within production, demand, and related infrastructures based on priority sectors and regions,
2. Developing technical and regulatory infrastructure, preparing and implementing long-term master plans that will ensure optimal resource use and maximum safety,
3. Establishing market and support mechanisms for efficient and predictable growth in the value chain, considering interactions with electricity, natural gas, carbon markets, and electricity-supply security,
4. Realizing opportunities in critical technologies, especially electrolyzers, storage, and fuel cells, and developing localization and manufacturing capabilities,
5. Strengthening international and regional cooperation, utilizing export opportunities to Europe with maximum benefits,
6. Implementing a broad sustainability perspective throughout the ecosystem, in areas such as wind and solar resources, water use, critical minerals, and relevant supply chains,
7. Developing qualified human resources and a talent pool and establishing a strong entrepreneurial ecosystem that will support sustainable growth and competitiveness objectives.

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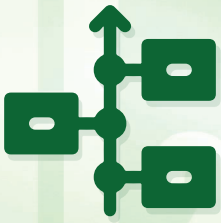
TÜRKİYE
GREEN HYDROGEN FUTURE

7 IICEC RECOMMENDATIONS

1 2 3 4 5 6 7



Determining road maps regarding the development perspectives within production, demand, and related infrastructures based on priority sectors and regions.

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TÜRKİYE
GREEN HYDROGEN FUTURE

7 IICEC RECOMMENDATIONS

1 2 3 4 5 6 7

Developing technical and regulatory infrastructure, preparing and implementing long-term master plans that will ensure optimal resource use and maximum safety.

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TÜRKİYE
GREEN HYDROGEN FUTURE

7 IICEC RECOMMENDATIONS

1 2 **3** 4 5 6 7


Establishing market and support mechanisms for efficient and predictable growth in the value chain, considering interactions with electricity, natural gas, carbon markets, and electricity-supply security.

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TÜRKİYE
GREEN HYDROGEN FUTURE

7 IICEC RECOMMENDATIONS

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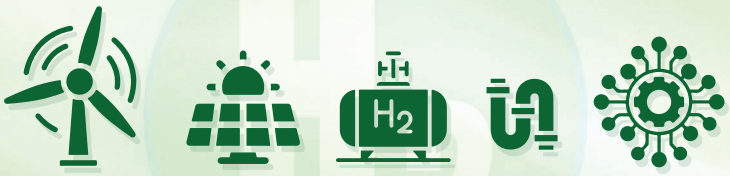


Realizing opportunities in critical technologies, especially electrolyzers, storage, and fuel cells, and developing localization and manufacturing capabilities.

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1 2 3 4 **5** 6 7

Strengthening international and regional cooperation,
utilizing export opportunities to Europe with maximum benefits.

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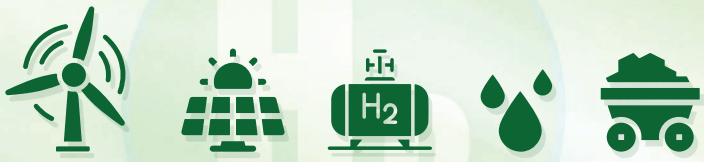
GREEN HYDROGEN FUTURE

7 IICEC RECOMMENDATIONS

1 2 3 4 5 **6** 7




Implementing a broad sustainability perspective throughout
the ecosystem, in areas such as wind and solar resources, water use,
critical minerals, and relevant supply chains.

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7 IICEC RECOMMENDATIONS

1 2 3 4 5 6 **7**

**Developing qualified human resources and a talent pool and establishing a strong entrepreneurial ecosystem that will support sustainable growth and competitiveness objectives.**

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7 IICEC RECOMMENDATIONS

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# THANK YOU

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## Notes

## Notes

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