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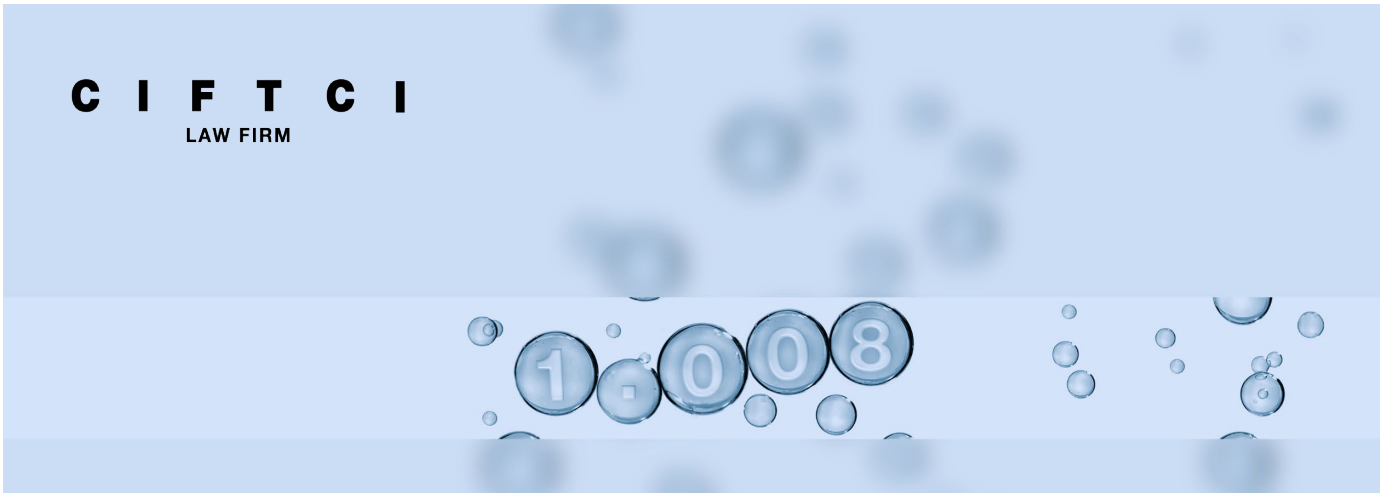

FOCUS ON HYDROGEN: ROADMAP TO A CO_2 NEUTRAL TURKEY

Turkey is one of the most dynamic regions in the world with respect to the generation of electricity from renewable sources. In just over a decade, Turkey has tripled its installed renewable generation capacity to around 45 gigawatts and invested nearly USD 40 billion in renewable energy projects. According to International Energy Agency (IEA), the country is expected to rank fifth in Europe in 2020 in terms of increase in renewable energy capacity. **Building on this momentum, will Turkey be ready to stay ahead of the pack in renewable energy leadership – this time with hydrogen?**

Key issues

- features of hydrogen
- reducing CO_2 emissions
- outlook for green energy

KEY FEATURES OF HYDROGEN

Hydrogen is the most abundant chemical element in the universe. As an energy carrier, it has remarkable potential. The energy stored in its molecule can be released in multiple ways, including through combustion or conversion of the chemical energy into electricity.

Using hydrogen in its pure form on Earth requires an extraction process, as the element is found only as a component of more complex substances, such as water. The different processes applied for its extraction and the source of energy they use serve to categorise hydrogen into:

- 'grey' hydrogen – extracted from fossil fuels
- 'blue' (or low-carbon) hydrogen – produced from fossil fuels with carbon capture technology
- 'green' (or renewable or clean) hydrogen – the product of electrolysis powered by renewable electricity, biogas processing or biochemical conversion of biomass.

There is no current specific categorisation for hydrogen produced from nuclear energy, but it is another production route to consider, especially in Turkey.

CURRENT MARKET AND GREEN HYDROGEN

Hydrogen is a critical resource in some industrial supply chains and it has the potential to reshape renewable energy storage, transportation and end-point usage across sectors. Given that hydrogen does not emit carbon at the point of use, if emissions can be eliminated from the production process, green hydrogen could become a vital technology in tackling climate and environmental challenges while accelerating the transition to renewable energy. Owing to its characteristics, hydrogen can be used in numerous sectors, including transportation (as fuel for electric vehicles or in the maritime and aviation industries), heating (blended with or replacing natural gas heating – power-to-gas projects), electricity (hydrogen produced from renewable sources is stored and then transformed back into power for future use – power-to-power projects), and various industrial processes (e.g., in the production of fertilisers, or in the steel industry).

Renewable hydrogen is globally on the rise as a viable alternative for fossil fuels and an energy storage reservoir for renewable energy. So far, only renewable hydrogen has been proposed to be labelled as 'clean' by the European Commission, but there is a recognition that to address hydrogen demand, while large-scale production of renewable hydrogen is increasing, renewable hydrogen is likely to be complemented in a transition phase by low-carbon hydrogen.

SNAPSHOT OF HYDROGEN IN TURKEY

Last year proved to be an extraordinary year for a number of reasons. On a positive note, one of these reasons appears to be that the hype around clean hydrogen was replaced by increasing hope that it is important in safeguarding the global environment. There are certainly a number of political signals and industry reactions which, together with technological advances in fuel cells and electrolysis, falling renewable energy and fuel cell prices, and stringent climate change requirements, would support such hope.

Market Opportunities

Green hydrogen can be distributed directly to end-point users, stored locally for future use, and transported regionally or as a global commodity. As an energy source, green hydrogen can be used to operate fuel cells for power generation, distributed through repurposed pipeline facilities and reconfigured into biofuels for transportation. In Turkey, green hydrogen could be used within existing renewable energy systems to store excess energy during peak generation periods, whilst supplying energy during low production periods. Green hydrogen production has the potential to be scaled up to meet new demands within a wide range of sectors, while also reducing the carbon footprint of existing operations. Hydrogen is already used in heavy industry in the production of metals, in the chemical formation of fertilisers, and in other refining processes.

Turkey's commercial maritime, heavy truck transport, air travel and public transit sectors could all be adapted to this new green energy source. Although Turkey currently lacks a framework legislation for regulating the associated licensing, production, transmission or distribution of hydrogen, Turkish authorities, in co-operation with universities, research institutions and private companies, have made promising statements on the role of hydrogen in the country's national energy targets.

In addition, Turkey has already been introducing some 'piecemeal' legislation that paves the way for more widespread hydrogen use in the future. For instance, the Regulation on Increasing the Efficiency and Use of Energy Resources published by the Ministry of Energy and Natural Resources (the "**MENR**") sets out that State institutions carrying out or supporting research and development projects connected with the use of hydrogen must prioritise economically viable projects concerning hydrogen production technologies based on renewable energy sources (such as hydro, wind, solar and geothermal energy). In addition, on 2 May 2019, the Ministry of Transport published the Regulation on Rules and Procedures Regarding Increasing the Energy Efficiency in Transportation, which lists hydrogen amongst the clean energy resources to be promoted by the Ministry of Transport in its projects as an alternative to fossil fuel.

Economic Feasibility

As with the development of the solar photovoltaic (PV) market, although the generation of green hydrogen is currently expensive, investment in green hydrogen-related technologies and strategic infrastructure may reduce the costs of production in subsequent years. Just 10 years ago photovoltaics began as an emerging technology with significant limitations, but it is now considered to be an essential method for generating electric power.

In respect of green hydrogen-related costs, the International Energy Agency forecasts that the cost of producing hydrogen from renewable electricity could fall by 30 per cent. by 2030. As with other emerging technologies, policy efforts (including tax policies and financial incentives), the regulatory environment, and public perspective of the industry will also be critical to its progress. International and national efforts to reduce carbon emissions should support the development of green hydrogen. Policy initiatives and pilot projects around the globe demonstrate concrete steps that can be taken to develop the technology and support the new industry in existing energy markets. This dynamism must also be matched by public attention upon the environmental and social considerations for particular locations and applications of green hydrogen technology.

Exploring New Ways to Make Use of Boron

Turkey has an impressive energy strategy to meet the continual rise in the country's demand for energy, including a commitment to produce at least 50 per cent. of power from renewables by 2023, marking the centennial anniversary of the Turkish Republic. Turkey's energy strategy aims in general to lessen the country's dependence on external resources, which includes exploring new ways of making use of boron.

Turkey has approximately 72.8 per cent. of the World's known reserves of boron, which belongs to a class of elements that can effectively store significant amounts of hydrogen. Under the experimental conditions so far conducted this element can release the energy, and so it is expected to be a major factor in the country's overall approach to the generation and storage of hydrogen. Due to Turkey's impressive boron reserves, its unique geographic position, being lying partly in Asia and partly in Europe, Turkey may become one of the regional hydrogen hubs in the near future, particularly in terms of the storage and conservation of hydrogen through innovative ways of using its boron reserves.

In a workshop organised for the use of hydrogen in the energy sector in January 2020, the Minister of Energy and Natural Resources of Turkey (the "**Minister**") described hydrogen as "the energy carrier of the future", which is expected to mirror Turkey's efforts to lower the consumption of oil, natural gas and other fossil fuels. In a subsequent press release, the Minister announced the country's short-term targets for the use of hydrogen as: increasing the overall generation of renewable energy; decarbonising the heating sector; generating hydrogen from local coal; and incentivising the use of boron for the storage and conservation of hydrogen.

Promising Renewable Energy Potential: Prospects for Blue Hydrogen

Located at the crossroads of East and West and surrounded by sea on three sides, Turkey has an extensive shoreline, vast landscape and mountains and a rich renewable energy potential. With a commitment on the energy strategy to lessen the country's dependence to external resources, Turkey has an impressive track record of realising large-scale energy projects in all renewable energy resources, including but not limited to wind, solar, hydro and geothermal.

There is a clear potential to procure necessary renewable energy input from newly constructed or contemplated onshore and offshore wind projects or large-scale solar plants or other renewable resources. There is an ongoing debate as to what extent such sources can be complemented by "blue" hydrogen produced from natural gas that is also expected to get a hold of CO_2 emissions. Turkey has so far proven to be enthusiastic to implement this plan initially in the heating sector, by generating hydrogen from local coal and exploring new ways to decarbonise the heating sector through blending hydrogen with methane on the gas distribution system.

Expected Developments

In January 2020, the MENR published a "white paper" in an effort to start formal discussions for determining Turkey's hydrogen road map. The white paper set out that, following a gradual consultation phase, the MENR will publish in early 2021 a "red paper" containing its views and recommendations for promoting the market, which is expected to be followed by a "green paper" setting out the implementation guidelines for Turkey's national hydrogen strategy.

BANKABILITY

The most common forms of green finance in Turkey have been green credit lines and loans made available by the IFIs. Two major players are the European Bank for Reconstruction and Development (EBRD) and the World Bank. The French Development Agency, AFD, the German Development Bank, KfW, and the European Investment Bank (EIB) are also active players in the Turkish green energy market, while some projects are financed or co-financed by the Asian Development Bank (ADB), the Islamic Development Bank (IsDB) and the Japan Bank for International Cooperation (JBIC) together with other multinational and local partners.

The expansion of the green hydrogen industry and the associated risks will require committed parties and a favourable environment. PPP schemes, offtake agreements between green hydrogen producers and distributors or end-users, as well as other usage, storage, conversion, or transportation arrangements, will all be critical to the feasibility and bankability of any project. Financing options may also be limited by the creditworthiness of the parties involved and the stability of the energy market. Technology risk will be an important factor to assess, and completion guarantees and fully wrapped EPCs might be expected.

Green hydrogen has the potential to fill a critical gap in global efforts to reduce carbon emissions, especially in Turkey where significant progress has already been made in the renewable energy sector. As a future source of energy for heavy industry, transportation, and electricity generation, amongst other uses, green hydrogen responds to many of the unaddressed opportunities within the existing renewable energy market. Current pilot projects around the globe are demonstrating the viability of the technology, but scaling up the industry will require an established regulatory environment and partners committed to the production of green hydrogen and the distribution of the energy. In terms of renewable power generation, the production and use of green hydrogen could result in a solution to the intermittency challenges seen across the region and may be an attractive alternative to diesel-based generation.

At a global level, it is expected that there will be importing states – such as Germany, Japan, South Korea, the USA and Singapore – and exporting countries like Morocco, Saudi Arabia, Turkey and Ukraine. As in other industries, importers and exporters will have different challenges and drivers. Given that various countries in the EMEA region are analysing the viability of green hydrogen, it is expected that certain countries may form alliances for the development of technical and scientific human capital, the exchange of best regulatory practices, the joint acquisition of equipment, and other regional initiatives. Green hydrogen has revolutionary potential, and current global development efforts will generate market-leading innovations.

CONCLUSION

Renewable and low-carbon hydrogen is a source of hope for both meeting carbon emission reduction targets and fostering industrial recovery after the COVID-19 crisis. However, as was the case at the outset of wind and solar power generation, the clean hydrogen industry needs support and time to become cost-effective and competitive compared with fossil-based hydrogen and other energy sources.

Support by public authorities, including financial support schemes and forward-looking legislation, are therefore needed to transform the hope for hydrogen into reality. The EU is currently at the forefront of the global carbon zero transition agenda, the European Commission's strategic long-term vision estimates that the share of hydrogen in Europe's energy mix will grow to 13-14 per cent. by 2050. Turkey, as the EU's sixth largest trading partner and a notable player in the global renewable arena, is also expected to build on this dynamism and roll out a clear national strategy for the use of hydrogen during the course of 2021. By joining this global trend, Turkey is not only expected to address local energy market needs but also build international market opportunities for investors.

CONTACTS

Sait Eryılmaz
Head of Turkish Banking & Finance Practice

T +90 212 339 0060
E sait.eryilmaz@ciftcilaw.com.tr

Ali Can Altıparmak
Associate

T +90 212 339 0062
E alican.altiparmak@ciftcilaw.com.tr

www.ciftcilaw.com.tr

CIFTCI Law Firm attorneys are registered with the Istanbul Bar.

Registered office: Kanyon Ofis Binasi Kat 10, Büyükdere Cad. No. 185, 34394 Levent, Istanbul, Turkey