SCENARIO MAKING WITHIN THE FRAMEWORK OF GECF GLOBAL GAS OUTLOOK: HYDROGEN SCENARIO

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Overview

Hydrogen is receiving much attention because of the many advantages that it can bring to the entire energy system. Hydrogen is a clean fuel and can be transformed practically into electricity at different scale level through fuel-cells or other power plants. It can play a significant role in the transport, residential, commercial, and industry sectors. There are also different ways to produce hydrogen that make the hydrogen economy even more interesting and at the same time challenging. The world's interest in the hydrogen economy has accelerated in recent years.

Hydrogen is well-suited for meeting future energy needs. It is considered the cleanest fuel and a way towards a decarbonised economy. However, the production, storage, distribution, and end-use of this fuel have not considerably developed to compete with other energy carriers.

In order to assess the impacts of prospective hydrogen penetration on the global energy landscape, the GECF Energy Economics and Forecasting Department (EEFD) has formulated the Hydrogen Scenario (HS). The Hydrogen Scenario builds upon ambitious yet realistic assumptions on the advancement of hydrogen through global energy supply chains and, ultimately, end-use sectors.

Methods

The Scenario is developed through energy modelling employing a very sophisticated tool that is used for energy modelling purpose in GECF Global Gas Outlook and named GECF Global Gas Model (GGM). This hybrid tool employs econometrics time-series and optimisation process iteratively. The modelling methodology is based on GGM architecture and follows its formulation and dynamics. The modelling time horizon is set to be from 2019 (the base year) through to 2050.

The transport sector is divided into road passenger transport, road freight transport, rail transport, aviation, and the marine sector. All of these sectors have the potential to develop hydrogen. In road passenger transport, the model considers three subsectors: automobiles, buses, and motorbikes. Hydrogen is very promising in heavy freight, where electrification is complicated by long-distance travel and the vast size requirements for electric batteries.

The industry also has significant potential for hydrogen consumption, especially the iron, steel and chemical sectors. Hydrogen is currently being used in some industry sectors as a feedstock, but the use of hydrogen for industrial high- and medium-grade heat is tremendously auspicious. Hydrogen will help to decarbonise the industry sector in high-grade heat that is roughly 25% of the total heat needed for the industry, where decarbonising from other ways like electrification and post-combustion carbon-capturing are entirely challenged.

In the shorter term, decarbonisation can be maintained by blending hydrogen with natural gas. Most countries that demand a considerable amount of high-grade industry heat also have an extensive gas network infrastructure that can be used for the blended fuel (enriched methane) or even pure hydrogen in the longer term. Therefore the application of enriched methane is also taken into account in the Hydrogen Scenario as a transition in the way of hydrogen economy development.

Results

The results of the Hydrogen Scenario suggest that natural gas can maintain its position in hydrogen production provided that CCS measures are employed. The results show that natural gas can contribute to around 52% of hydrogen production compared with 30% for electricity from renewable energies. CCUS is an inevitable part of these results, so moving to blue hydrogen presents an essential opportunity for gas producer and exporter countries to remain

competitive in hydrogen production in lieu of climate concerns. Green hydrogen will serve as a perfect complement to blue hydrogen produced from natural gas.

In the Hydrogen Scenario, more than 470 mt of hydrogen is annually demanded by all mentioned sectors by 2050, much more than the value of 160 mt of hydrogen forecasted in the Reference Case Scenario. Transportation will be the leading driver of this massive demand, followed by the industry and power sector. Industrial use of hydrogen, including as fuel or feedstock as well as residential and commercial sectors also have an essential role in hydrogen demand by 2050.

Hydrogen deployment will result in annual emission reductions of 3.5 $GtCO_2$ by 2050 compared with the Reference Case Scenario that translates to a cumulative total of more than 55$GtCO_2$ from 2019 to 2050.

The share of natural gas in primary energy consumption will increase to 29% by 2050 compared with 28% in the Reference Case Scenario, and a 6% increase from today's value.

Conclusions

Hydrogen will gain shares in the global energy system due to the varied benefits that it has to offer. The advantages include but are not limited to net zero-emission, the diverse application range in most end-use sectors (including electrification in high-grade industrial heat or heavy transport) and in off-grid or distributed generation, and enhancing energy security.

Natural gas can contribute significantly to hydrogen production when carbon-capturing measures are employed, especially pre-combustion capturing. Blue hydrogen, by its definition, includes carbon capturing and promises a very economical way to meet hydrogen demand.

The results of the Hydrogen Scenario admits that natural gas can play a significant role in the hydrogen economy development. Natural gas, along with the CCUS technologies, provides a very economical, competitive, reliable, and practicable option to produce hydrogen consistent with the sustainable development goals. Most type of greenhouse gas emissions, including CO_2, can be abated significantly through blue hydrogen production, while the costs will still be competitive.

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