PRESS INFORMATION BUREAU
(Research Unit)
Ministry of Information and Broadcasting
Government of India

National Hydrogen Mission

(Ministry of New & Renewable Energy)

March 21, 2022

"Of every effort being made by India today, the thing that is going to help India with a quantum leap in terms of climate is the field of Green Hydrogen. To achieve the goal of Green Hydrogen, I am announcing the National Hydrogen Mission today with this tricolour as a witness."

-Prime Minister Narendra Modi[1]
(75th Independence Day address from the Red Fort, 15 Aug 2021)

Introduction

In the Budget Speech 2021-22, Finance Minister Nirmala Sitharaman proposed to launch a National Hydrogen Mission for generating hydrogen from green power sources. She highlighted the Prime Minister's address at the 3rd RE-Invest Conference in November 2020, where he had announced plans to launch a comprehensive National Hydrogen Energy Mission.[2]

Hydrogen, like electricity, is an energy carrier that must be produced from another substance. Hydrogen can be produced—separated—from a variety of sources including water, fossil fuels, or biomass and used as a source of energy or fuel. Hydrogen has the highest energy content of

[1] https://pib.gov.in/PressReleasePage.aspx?PRID=1746062
[2] https://pib.gov.in/PressReleasePage.aspx?PRID=1696498

any common fuel by weight (about three times more than gasoline), but it has the lowest energy content by volume (about four times less than gasoline).[3]

National Hydrogen Mission: Aim[4]

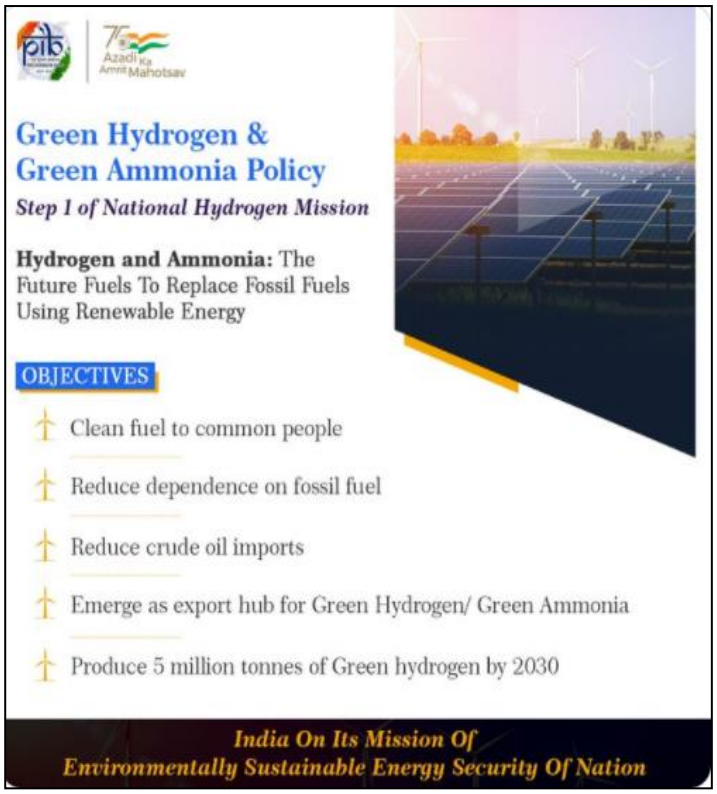
- The proposed National Hydrogen Energy Mission aims to lay down the vision, intent and direction for harnessing hydrogen energy by the Government of India.
- The aim is to develop India as a global hub for manufacturing of hydrogen and fuel cells technology across the value chain.
- The mission would put forward specific strategy for the short term (four years), and broad strokes principles for long term (10 years and beyond).
- It will provide necessary flexibility to capture benefits from the advances that are taking place in the technological landscape.
- The Government of India will facilitate demand creation in identified segments. Possible areas include suitable mandates for use of green hydrogen in industry such as fertilizer, steel, petrochemicals etc.
- Major activities envisaged under the mission include creating volumes and infrastructure; demonstrations in niche applications including transport and industry; goal-oriented research & development; facilitative policy support; and putting in place a robust framework for standards and regulations for hydrogen technologies.
- The mission aims to aid the government in meeting its climate targets and making India a green hydrogen hub. This will help in meeting the target of production of five million tonnes of Green hydrogen by 2030 and the related development of renewable energy capacity.[5]

Green Hydrogen & Green Ammonia Policy: A Key Step in National Hydrogen Mission

Hydrogen and Ammonia are envisaged to be the future of fuels and are envisaged to replace fossil fuels in the years to come. One of the major requirements of environmentally sustainable energy security of the nation is production of these fuels by using power from renewable energy sources. This is known as Green Hydrogen and Green Ammonia. [6]

[3] https://www.eia.gov/energyexplained/hydrogen/
[4] https://pib.gov.in/PressReleasePage.aspx?PRID=1696498
[5] https://pib.gov.in/PressReleasePage.aspx?PRID=1799067
[6] https://pib.gov.in/PressReleasePage.aspx?PRID=1799067

There is an increased consensus around the world that concerted steps need to be taken to reduce global warming to levels less than 2°C and if possible to cap it at 1.5°C higher than pre-industrial levels. Various countries have pledged their Nationally Determined Contributions in order to ensure energy transition and reduce emissions. Most large economies including India have committed to net zero targets.



Transitioning to Green Hydrogen and Green Ammonia is one of the major requirements for reduction of emissions. Government of India has had under consideration a number of policy measures in order to facilitate the transition from fossil fuel / fossil fuel-based feed stocks to Green Hydrogen / Green Ammonia both as energy carriers and as chemical feed stock for different sectors. In this regard, a Green Hydrogen policy has been framed by Ministry of Power for compliance and implementation by concerned stakeholders. Click here to read the Green Hydrogen Policy.

Hydrogen Energy[7]

Hydrogen is emerging as an important source of energy since it has zero carbon content and is a non-polluting source of energy in contrast to hydrocarbons that have net carbon content in the range of 75–85 per cent. Hydrogen energy is expected to reduce carbon emissions that are set to jump by 1.5 billion tons in 2021. **It has the highest energy content by weight and lowest energy content by volume.** As per International Renewable Energy Agency (IRENA), **Hydrogen shall make up six per cent of total energy consumption by 2050**. The Hydrogen Council Report, 2021 also mentions that, global investments on hydrogen will constitute around 1.4 per cent of the total global energy funding by 2030.

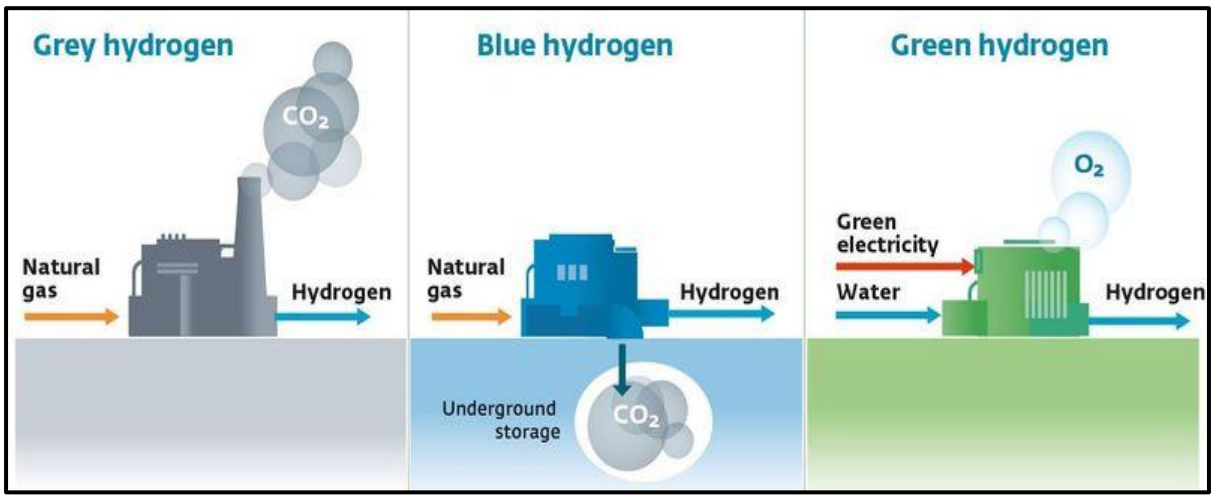
The current global demand for hydrogen is 70 million metric tons per year, more than 76 per cent of which is being produced from natural gas, 23 per cent comes from coal and the remaining is produced from electrolysis of water.

Grey Hydrogen, Blue Hydrogen, Green Hydrogen: A Comparison

Hydrogen is primarily used in petrochemicals and fertiliser industry and is produced largely from natural gas, thereby emitting enormous amounts of carbon dioxide**. Depending on the**

[7] https://idsa.in/issuebrief/india-national-hydrogenet c-mission-n-gcc-lpriya-270821#footnote7_fkm1xpe

nature of the method of its extraction, hydrogen is categorised into three categories, namely, grey, blue and green. There is a growing focus on increasing production of green and blue hydrogen due to its no carbon emission and use of carbon offset technology, respectively. Additionally, several leading organizations are exploring technologies which can convert bio and plastic waste into hydrogen, thereby providing a huge scope for investment in this technology which can combat India's twin problems of waste management and energy security.[8]



Where the hydrogen comes from is important. At the moment, it's mainly produced industrially from natural gas, which generates significant carbon emissions. That type is known as "grey" hydrogen. A cleaner version is "blue" hydrogen, for which the carbon emissions are captured and stored, or reused. The cleanest one of all is "green" hydrogen, which is generated by renewable energy sources without producing carbon emissions in the first place.[9]

India Advancing Towards a Cleaner Future: The Role of Hydrogen Energy

- **India has a huge edge in green hydrogen production** owing to its **favourable geographic conditions** and the **presence of abundant natural elements**.
- The Government has given **impetus in scaling up the gas pipeline infrastructure** across the length and breadth of the country and has **introduced reforms for the power grid**, including the introduction of smart grids. Such steps are being taken to effectively integrate renewable energy into the present energy mix.
- With appropriate capacity addition to renewable power generation, storage and transmission, producing green hydrogen in India can become cost-effective which will not only guarantee energy security but also ensure self-sufficiency gradually.[10]
- Setting the right priorities for hydrogen use will be essential for its rapid scale-up and long-term contribution to decarbonization efforts. Hydrogen is part of a much bigger energy transition picture, and its development and deployment strategies should not be considered in isolation.

[8] https://newsonair.com/2021/02/17/national-hydrogen-mission-advancing-towards-indias-cleaner-future/
[9] https://www.iea.org/commentaries/the-clean-hydrogen-future-has-already-begun
[10] https://newsonair.com/2021/02/17/national-hydrogen-mission-advancing-towards-indias-cleaner-future/

- A shift to large-scale use of hydrogen fuel can **help bolster India's geopolitical heft and support energy security.** More than 30 countries and regions have hydrogen strategies that include import or export plans, indicating that cross-border hydrogen trade is set to grow considerably.

Various uses of Hydrogen[11]

- Hydrogen use today is dominated by **industry**, namely: oil refining, ammonia production, methanol production and steel production. Virtually all of this hydrogen is supplied using fossil fuels, so there is significant potential for emissions reductions from clean hydrogen.
- In **transport**, the competitiveness of hydrogen fuel cell cars depends on fuel cell costs and refuelling stations while for trucks the priority is to reduce the delivered price of hydrogen. Shipping and aviation have limited low-carbon fuel options available and represent an opportunity for hydrogen-based fuels.
- In **buildings**, hydrogen could be blended into existing natural gas networks, with the highest potential in multifamily and commercial buildings, particularly in dense cities while longer-term prospects could include the direct use of hydrogen in hydrogen boilers or fuel cells.
- In **power generation**, hydrogen is one of the leading options for storing renewable energy, and hydrogen and ammonia can be used in gas turbines to increase power system flexibility. Ammonia could also be used in coal-fired power plants to reduce emissions.

Hydrogen: The Indian Context[12]

Hydrogen for integrating Renewable Energy

Hydrogen provides a means for storage of variable renewable energy for stabilizing its output. For long duration storage, running into several hours, converting excess available energy into hydrogen and utilizing it for grid support and other applications is seen to be a suitable alternative.

Hydrogen in Industry

In industry, hydrogen can potentially replace the coal and coke in iron and steel production. Steel manufacturing is one of the largest carbon emitters in the world, decarbonising this sector using hydrogen is expected to have significant impact on our climate goals.

Hydrogen has potential to reduce fossil fuel imports

[11] https://www.iea.org/reports/the-future-of-hydrogen
[12] https://mnre.gov.in/img/documents/uploads/file_f-1612941710983.pdf

At present, hydrogen produced from natural gas is widely utilized for production of nitrogenous fertilizers, and petrochemicals. Substituting this with green hydrogen could allow use of renewable energy in these important sectors and reduce import dependence.

- India's annual Ammonia consumption for fertilizer production is about 15 million tonnes, roughly 15 per cent of this demand (over 2 million tonnes per annum) is currently met from imports. Mandating even 1 per cent green ammonia share is likely to save about 0.4 million standard cubic feet per day of natural gas import.

- Use of hydrogen in steel industry could substitute imported coking coal. During 2018-19, the total demand of coking coal for the steel industry was 58.37 million tonne (MT). Out of this, 51.83 MT was met through imports.

Hydrogen-based Transport

Fuel cell electric vehicles (FCEVs) run on hydrogen fuel and have no harmful emissions. Battery Electric Vehicles (BEVs) may be suitable for light passenger vehicle segment for shorter driving range. For heavy duty vehicles with longer trip range, such as buses, trucks and other commercial vehicles, FCEVs are likely to become cost competitive in the coming years.

- While Battery Electric Vehicles (BEVs) are dependent on imported raw materials like lithium and cobalt for lithium-ion batteries, the hydrogen fuel cell supply chain can be wholly indigenized, making India **Aatmanirbhar in the clean transportation segment.**

India's Progress towards Green Hydrogen[13]

- Prime Minister Narendra Modi aims to **transform India into an energy independent nation by 2047** where green hydrogen will play an active role as an alternate fuel to petroleum/ fossil-based products.
- In 2020, India's hydrogen demand stood at 6 million tonnes (MT) per year. It is estimated that by 2030, the hydrogen costs will be down by 50 per cent.
- The **demand for hydrogen is expected to see a five-fold jump** to 28 MT by 2050 where **80 per cent of the demand is expected to be green** in nature.
- Some of the prominent industrial mammoths such as Reliance Industries Limited (RIL), Gas Authority of India Limited (GAIL), National Thermal Power Corporation (NTPC), Indian Oil Corporation (IOC) and Larsen and Toubro (L&T) plan to foray into the green hydrogen space. RIL plans to become a net-carbon zero firm by 2035 and invest nearly INR 750 billion over the next three years in RE.
- India has declared its ambition to become an exporter of hydrogen to Japan, South Korea, and Europe.[14]

[13] https://www.investindia.gov.in/siru/green-hydrogen-indias-sunrise-sector

[14] https://www.investindia.gov.in/team-india-blogs/indias-green-hydrogen-policy

- Various hydrogen powered vehicles have been developed and demonstrated under projects supported by Government of India. These include 6 Cell buses by Tata Motors Ltd., 50 hydrogen enriched CNG (H-CNG) buses in Delhi by Indian Oil Corporation Ltd. in collaboration with Govt. of NCT of Delhi, 2 hydrogen fueled Internal Combustion Engine buses (by IIT Delhi in collaboration with Mahindra & Mahindra).

Figure 20. Hydrogen fuelled 3-wheeler developed jointly by IIT Delhi and Mahindra & Mahindra in New Delhi

Figure 21. Total hydrogen S.I. engine genset using electronic fuel injection system

Figure 22. Hydrogen fuelled diesel Engine developed at IIT Delhi

Figure 23. Hydrogen fuelled three wheelers in Auto Expo 2012

Sources:

https://pib.gov.in/PressReleasePage.aspx?PRID=1746062
https://pib.gov.in/PressReleasePage.aspx?PRID=1696498
https://newsonair.com/2021/02/17/national-hydrogen-mission-advancing-towards-indias-cleaner-future/
https://pib.gov.in/PressReleasePage.aspx?PRID=1799067
http://164.100.94.214/sites/default/files/uploads/abridged-nherm.pdf
https://idsa.in/issuebrief/india-national-hydrogen-mission-n-gcc-lpriya-270821#footnote7_fkm1xpe
https://newsonair.com/2021/02/17/national-hydrogen-mission-advancing-towards-indias-cleaner-future/
https://www.iea.org/commentaries/the-clean-hydrogen-future-has-already-begun
https://newsonair.com/2021/02/17/national-hydrogen-mission-advancing-towards-indias-cleaner-future/
https://www.investindia.gov.in/team-india-blogs/indias-green-hydrogen-policy
https://www.iea.org/reports/the-future-of-hydrogen
https://mnre.gov.in/img/documents/uploads/file_f-1612941710983.pdf
https://www.investindia.gov.in/siru/green-hydrogen-indias-sunrise-sector

Further Reading:

https://www.teriin.org/sites/default/files/2020-06/Hydrogen-Policy-Brief.pdf

https://idsa.in/system/files/issuebrief/india-national-hydrogen-mission-n-gcc-lpriya.pdf

https://mnre.gov.in/img/documents/uploads/file_f-1612941710983.pdf

https://iea.blob.core.windows.net/assets/4719e321-6d3d-41a2-bd6b-461ad2f850a8/NetZeroby2050-ARoadmapfortheGlobalEnergySector.pdf

AG/HP/RC/TS/MK/TS