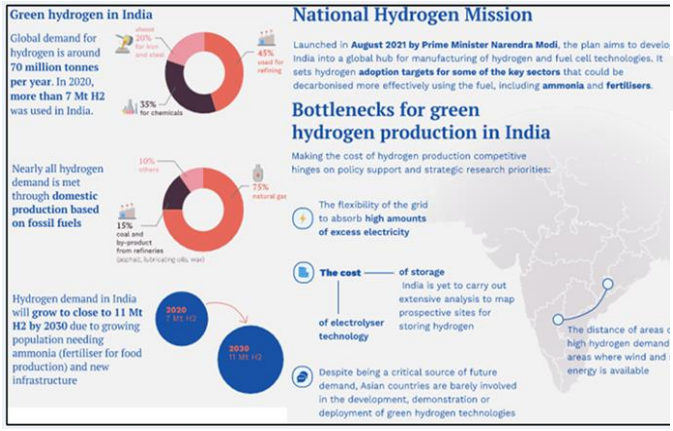
INDIA'S GREEN HYDROGEN CHALLENGE

Context

- The article examines challenges in the pathway to realise the vision of making India energy independent and decarbonising major sectors of the economy and the role of green hydrogen/National Hydrogen Mission in achieving this vision.

National Hydrogen Mission

- It aims to make India a global production and export hub of green hydrogen.
  - It envisages the production capacity of **low-cost green hydrogen** to touch **at least 5 MMT (million metric tonne) per annum by 2030**.
- It was launched (in 2023) by the Ministry of New and Renewable Energy (**MNRE**) with an initial outlay of $2.3 billion over the next five years.



Green Hydrogen

- It is the name given to hydrogen gas that has been **produced using renewable energy**, such as wind or solar power, which create no GHG emissions.
- **For example**, hydrogen is produced through water electrolysis and when the electricity used in the water electrolysis is produced from renewables, it is termed as green hydrogen.

Likely Outcomes of Green Hydrogen Mission

- **Adding renewable energy capacity** of about 125 GW (gigawatt) in the country
- Investments likely to the tune of $100 billion
- Creation of over 6 lakh green jobs
- Savings to the tune of $12.5 billion by **cutting fuel imports**
- Abatement of nearly 50 MMT of annual GHG emissions

Wide Ranging Benefits Related to Green Hydrogen Mission

- Creation of **export opportunities** for Green Hydrogen and its derivatives
- **Decarbonisation** of industrial, mobility and energy sectors
- **Reduction in dependence** on imported fossil fuels and feedstock
- Development of indigenous manufacturing capabilities
- Development of **cutting-edge technologies**

4Es Challenges Related to Green Hydrogen

- **Electrolyser challenge**: According to IEA (International Energy Agency), as of 2021 the global manufacturing capacity of electrolysers stands at 8 GW/year.
  - India would need about 60-100 GW of electrolyser capacity, which amounts to **almost 12 times the current global production capacity** to achieve its 2030 target.
  - India currently has launched projects to manufacture electrolysers, but the actual numbers as of today are **negligible**.
  - Also, **access to critical minerals** such as nickel, platinum group metals and rare earth metals such as lanthanum, yttrium and zirconium could hinder scaling up electrolyser manufacturing capability in India.
  - This is because these resources are **concentrated in countries** such as China, Democratic Republic of Congo (DRC), Australia, Indonesia, South Africa, Chile and Peru, and India has limited processing capabilities in these minerals.
- **Energy source challenge**: As per current estimates an efficient electrolysis system would require **39 kWh of electricity to produce 1 kg of hydrogen**.
  - As green hydrogen requires renewable energy as a source of electricity, but so far India has only achieved 119 GW of the 175 GW targeted capacity using solar, wind, bio-power and small hydro.
  - In addition to the **generation capacity**, the **transmission capacity** that includes a smooth facilitation of cross-border exchange of power between states is a **critical requirement**.
- **End use challenge**: Currently, most of the **demand for hydrogen** comes from the **chemical industry** to produce ammonia for fertilizers, followed by **refining** for hydro-cracking and the **desulphurisation** of fuels.

- It can be a **source of heat** for industry, such as steel, cement and aluminum production.
- In the **transport sector**, it can be used as **fuel** for heavy duty vehicles, aviation and shipping.
- Hence, the **conversion efficiency** from one form of energy carrier to another in the end use application will determine the scale of green hydrogen's applicability.

- **Endogenous resources challenge**: The production of one kg of hydrogen by electrolysis requires around nine litres of water. Thus, a requirement of approximately 50 billion litres of demineralised water supply.
- This is concerning as several parts of India are already **severely water-stressed**, demanding solutions to be found to cater to this additional water demand.
- While **desalination** has been suggested to address this challenge, this will have negative repercussions as follows:

- Increasing the physical footprint of the required infrastructure
- Add to competition for land use
- Impact biodiversity
- Create challenges and limitations in the location of electrolysers

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WHAT IS THE QUAD CYBER CHALLENGE?

The Quad has recently launched a public campaign, 'Quad Cyber Challenge' to improve cyber security across their nations.

About Quad Cyber Challenge:

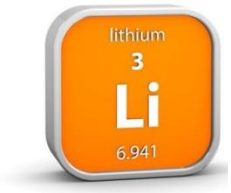
- Under the challenge, **QUAD has invited Internet users across the Indo-Pacific** and beyond to become part of the challenge and **practice "safe and responsible cyber habits**.
- The **challenge provides resources**, including **basic cybersecurity information** and **training for all users**, from corporations to educational institutions, small businesses and individuals.
- The action **in India is being coordinated by the office of the National Cyber Coordinator with the National Security Council Secretariat.**

What is QUAD?

- The Quad, officially the **Quadrilateral Security Dialogue**, is a **group of four countries: the United States, Australia, India, and Japan.**
- One of the **primary objectives** of the Quad is to work for a **free, open, prosperous and inclusive Indo-Pacific region.**
- The group **met for the first time in 2007** on the sidelines of the Association of Southeast Asian Nations (ASEAN).
- It is considered an **alliance of maritime democracies**, and the forum is maintained by **meetings, semi-regular summits, information exchanges** and military drills of all the member countries.

IMPORTANT FACTS ABOUT LITHIUM

India's Ministry of Mines recently announced that 5.9 million tonnes of lithium reserves have been found for the first time in the country in Jammu and Kashmir.



Key facts about Lithium:

- It is a **soft, silvery-white metal that heads group 1, the alkali metals group**, of the **periodic table** of the elements.
- **Features:**

- It has the **lowest density of all metals**.
- It is the **lightest of the solid elements**.
- It **reacts vigorously with water**.
- It has a **body-centered cubic crystal structure**.
- **Occurrence**:
- Lithium **does not occur as a metal in nature** but is found combined in small amounts in igneous rocks.
- Lithium is found in **brine deposits and as salts in mineral springs**. Its **concentration in seawater is 0.1 part per million** (ppm).
- **Major Reserves:** Lithium reserves are **concentrated in the lithium triangle** in South America – **Argentina, Bolivia & Chile**, with **50% of the deposits** concentrated in these regions.

- **Uses**:
- Lithium is important in **rechargeable batteries for mobile phones, laptops**, digital cameras, and **electric vehicles.**
- It is also used in some **non-rechargeable batteries** for things like heart pacemakers, toys, and clocks.
- Lithium metal is made into **alloys with aluminium and magnesium**, **improving their strength** and making them lighter.
- **Lithium oxide is used in special glasses and glass ceramics**.
- **Lithium stearate** is used as an all-purpose and **high-temperature lubricant.**
- **Lithium carbonate** is **used in drugs** to treat manic depression

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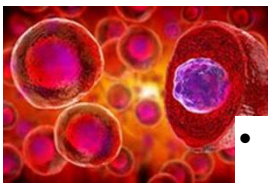
WHAT ARE STEM CELLS?

Kanpur's GSVM Medical College has claimed that that it is the first one in the country to cure blindness through stem cell transplants.



About Stem Cells:

- These are **cells with the potential to develop into many different types of cells** in the body.
- Under the right conditions in the body or a laboratory, **stem cells divide to form** more cells called **daughter cells.**
- These daughter cells become **either new stem cells or specialized cells** (differentiation) with a more specific function, such as blood cells, brain cells, heart muscle cells or bone cells.
- **No other cell in the body has the natural ability to generate new cell types**.
- They **serve as a repair system** for the body.
- Stem cells are **present inside different types of tissue**. Scientists have found stem cells in tissues, including the brain, bone marrow, blood, and blood vessels, etc.
- There are two types of stem cells.
- **Embryonic stem cells:**
- These stem cells **come from embryos that are 3 to 5 days old.**

- At this stage, an embryo is called a **blastocyst** and has about 150 cells.
- These are **pluripotent stem cells**, meaning they **can divide into more stem cells or can become any type of cell** in the body.
- This versatility allows embryonic stem cells to be **used to regenerate or repair diseased tissue** and organs.
- **Adult stem cells:**
- These stem cells are **found in small numbers in most adult tissues**, such **as bone marrow or fat**.
- Compared with embryonic stem cells, **adult stem cells have a more limited ability** to give rise to various cells of the body.

What is Induced pluripotent stem cells?

- These **are adult stem cells that have been changed in a lab to be more like embryonic stem cells.**
- These **cells behave in a similar way to embryonic stem cells**, so they could be **useful for developing a range of therapies.**

MODES OF LOSING INDIAN CITIZENSHIP

Over 16 lakh Indians have renounced their Indian citizenship since 2011, including 2,25,620 people last year, the highest during the period, while the lowest of 85,256 was in 2020, according to government data.

Modes of losing Indian Citizenship:

- The **Citizenship Act 1955** lays down the **three modes** by which an Indian citizen, whether a citizen at the commencement of the Constitution or subsequent to it, may lose their citizenship. These are,

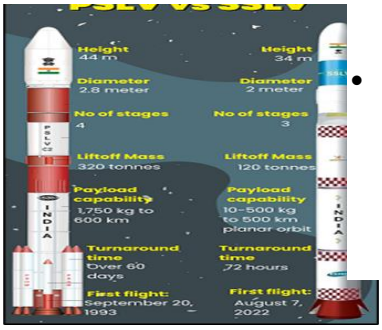
- **By Renunciation:**
- An **Indian Citizen of full age and capacity can renounce** his Indian citizenship **by making a declaration** to that effect and **having it registered.**

- But if such a declaration is made **during any war in which India is engaged**, the **registration shall be withheld** until the Central Government otherwise directs.
- When a **male person renounces** his citizenship, **every minor child of him ceases to be an Indian citizen.**
- **Such a child may**, however, **resume Indian citizenship** if he makes a declaration to that effect within a year of his **attaining full age, i.e. 18 years**.
- **By Termination:**
- If a citizen of India **voluntarily acquires citizenship of another country**, then the **citizenship of India gets terminated.**
- This provision **does not apply during times of war.**
- **If any question arises** as to whether, when, or how any person has acquired the citizenship of another country, it is to be **determined by such authority and in such manner as may be prescribed by the rules.**
- **By Deprivation:**
- It is a **compulsory termination of citizenship of India**.
- A citizen of India by naturalization, registration, domicile and residence may be **deprived of his citizenship by order of the Central Government** if it is **satisfied that:**
- The citizen has **obtained the citizenship by means of fraud**, false representation, or concealment of any material fact;
- The citizen has **shown disloyalty to the Constitution** of India;
- The citizen has **unlawfully traded or communicated with the enemy during a war**;
- The citizen has, **within five years after registration or neutralization, been imprisoned in any country** for two years;
- The **citizen has been ordinarily resident out of India for seven years**

ISRO'S SSLV-D2: THE MINI VEHICLE'S SECOND FLIGHT, WITH PROMISE ON BOARD

Why in News?

- **In its second development flight**, the Indian Space Research Organisation's (ISRO) smallest vehicle - Small Satellite Launch Vehicle (SSLV-D2), was launched from the Satish Dhawan Space Centre SHAR, Sriharikota, Andhra Pradesh.



- It will place the ISRO's earth observation satellite **EOS-07** and two co-passenger satellites - **Janus-1 and AzaadiSat2** - developed by start-ups, in a 450-km circular orbit around the Earth.

What is a Small Satellite Launch Vehicle (SSLV)?

- SSLV is a **3 stage Launch Vehicle** configured with -
  - **Three** Solid Propulsion Stages and
  - Liquid propulsion-based Velocity Trimming Module (VTM) as a **terminal**
- It is **2m in diameter and 34m in length** with a lift off weight of ~120 tonnes and is capable of launching **~500 kg satellite in 500 km planar orbit** from SHAR.
- **The key features of SSLV** are -
  - Low cost,
  - With low turn-around time,
  - Flexibility in accommodating multiple satellites,
  - Minimal launch infrastructure requirements (assembled by a small team in a week, compared to 6 months and 600 people for ISRO's workhorse PSLV), etc.
- The new vehicle was developed **to capture the emerging small** (nano-micro-mini) **satellite commercial market**, with launches offered on demand.
- The vehicle's first development flight (August 2022, EOS 02), **failed to place the satellites in precise orbit.**
  - **A new vehicle is declared operational** by the space agency after it completes two successful development flights.
  - The last vehicle to be declared operational was the **GSLV Mk III, now called LVM 3**, when it carried Chandrayaan-2 in 2019.

What's Onboard the SSLV-D2?

- **Janus-1** (weight 10.2 kg) **is a technology demonstrator satellite** built by US-based Antaris and its Indian partners XDLinks and Ananth Technologies.
  - It is **a cube satellite with five payloads on board** - two from Singapore, and one each from Kenya, Australia, and Indonesia.
- **AzaadiSat2** is a Cubesat weighing around 8 kg and carries 75 different payloads.
  - Girl students from rural regions across the country were provided guidance to build these payloads.
  - The payloads are integrated by the student team of "**Space Kidz India**".
- **EOS-07** is a 156.3 kg satellite designed, developed and realized by ISRO.
  - Its mission objective is **to design and develop payload instruments compatible with microsatellite buses** and new technologies for future operational satellites.
  - It would also **design and develop a microsatellite accommodating new technology payloads in a quick turn-around time**.