Dreamarks

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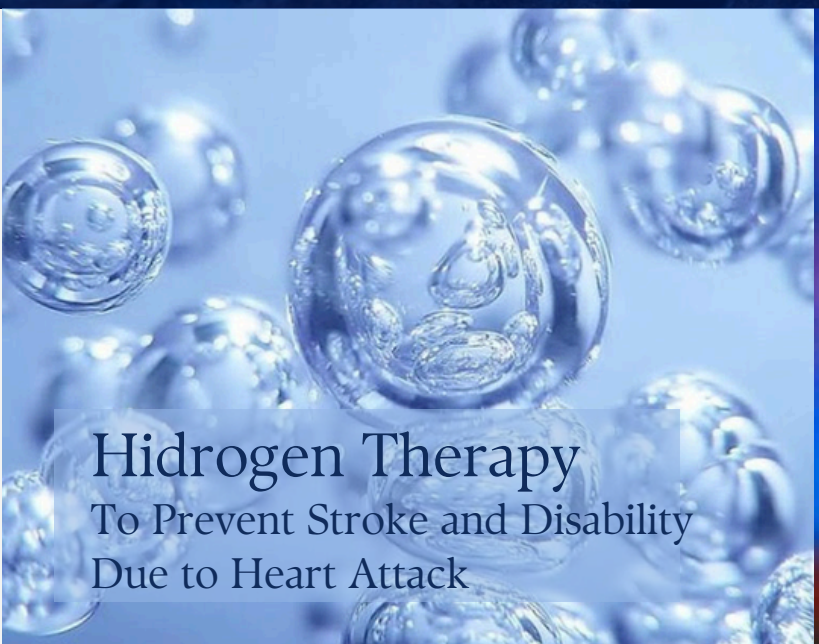
MAGAZINE

Various New Source of Electrical Energies

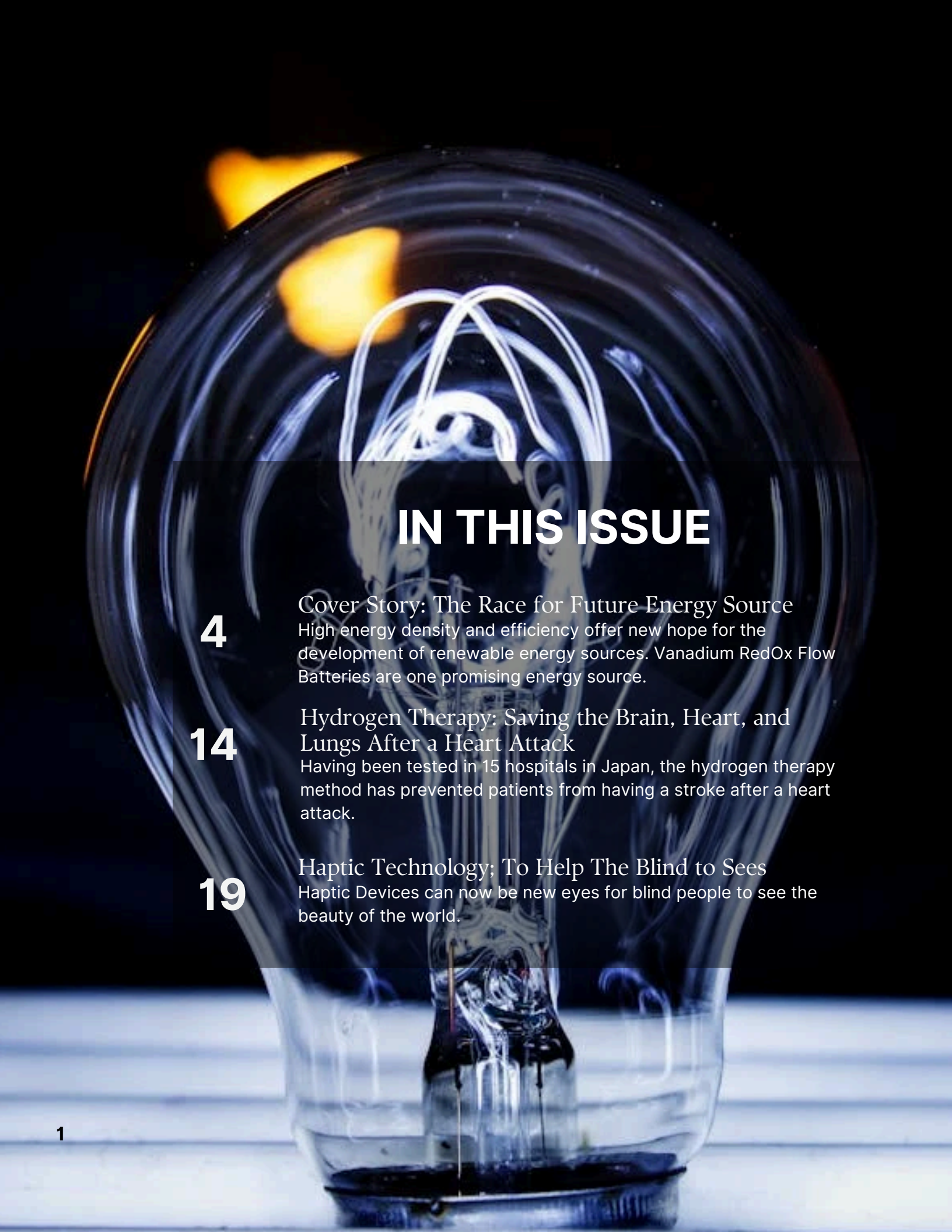
The Race of Inventions for Future Renewable Massive Energy Power House are Happening. From High Power Vanadium RedOx Flow Batteries, to the Inventions of Small Sodium Ion batteries, and the Green Hydrogen Factories that also functions as Solar Power House with 300MW PhotoVoltaic Energy Output.



Hidrogen Therapy

To Prevent Stroke and Disability Due to Heart Attack

Immersive Future of Haptic Technology



IN THIS ISSUE

Dreamarks Magazine

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The Humanistic Pursuit of Advancement

The development of science and technology today is aimed at expanding technology adoption and increasing its mass production, by assessing market needs and focusing on a variety of technologies to meet basic human needs before expanding into secondary and tertiary sectors.

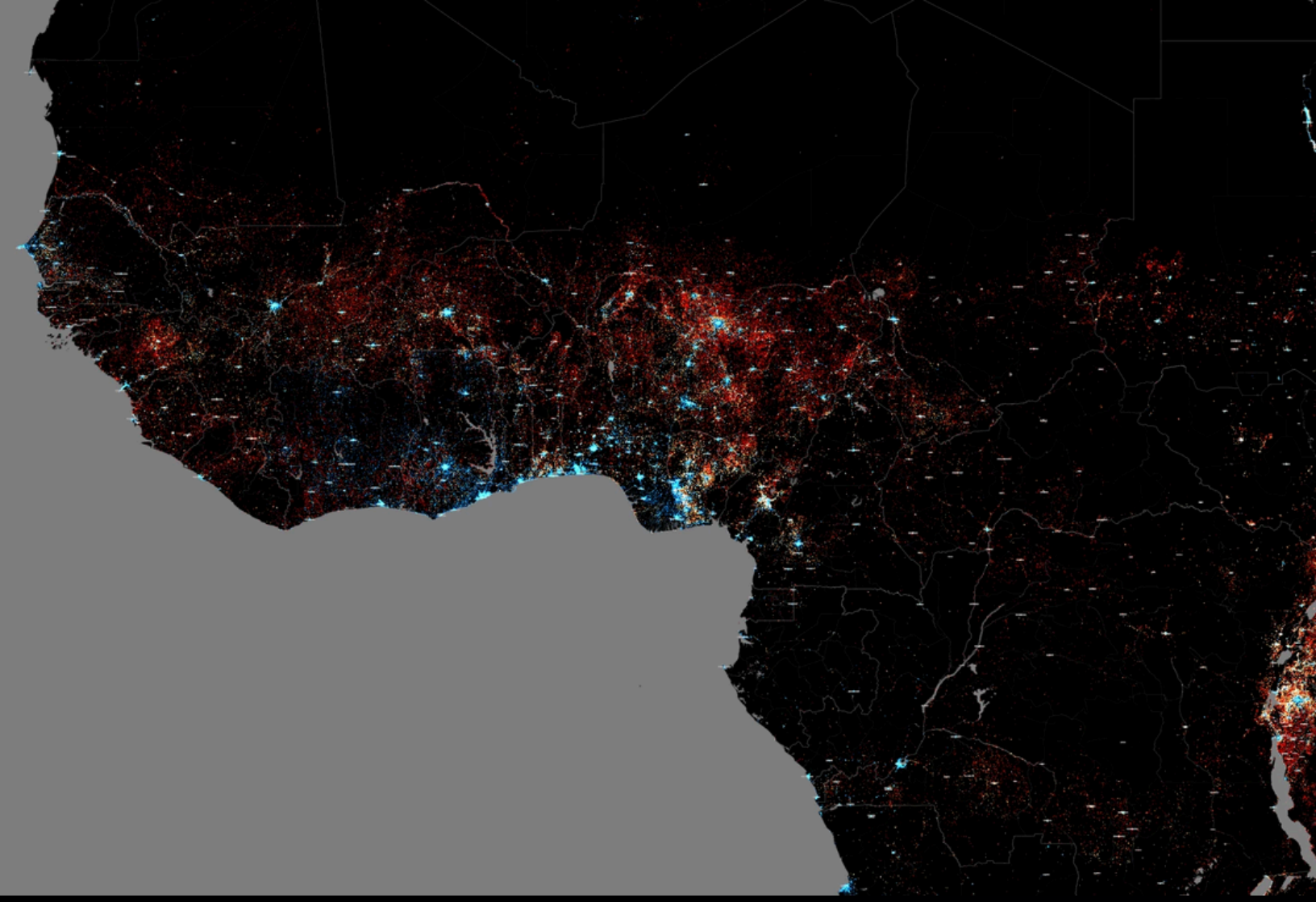
Health and medical care, food, and clothing are fundamental areas that must be prioritized before developing high-tech. The military and technological race toward space often causes countries to lose focus on prioritizing the basic needs of their citizens. Without stable agricultural and livestock production, as well as food distribution, a country's resilience system becomes weak and vulnerable.

Otherwise, what will emerge is an apocalyptic future, vulnerable to various disasters, the expansion of warfare, and a humanity that loses its focus on life, not on the development of prosperity and humanity, but on competition and a win-lose system.

Advanced societies are not those with the most sophisticated weapons stockpiles, nor are they those with the tallest towers in the world. But the most important thing is for the country to develop its human resources, by providing stable food security, and providing cheap, even almost free, education, information, arts and entertainment, to make its people grow up healthy, happy physically and mentally, and then lead to the development of high-tech infrastructure and building various sophisticated industries that will become a source of foreign exchange for sustainable development in each country.

Gina Al Ilmi

Editor-in-Chief

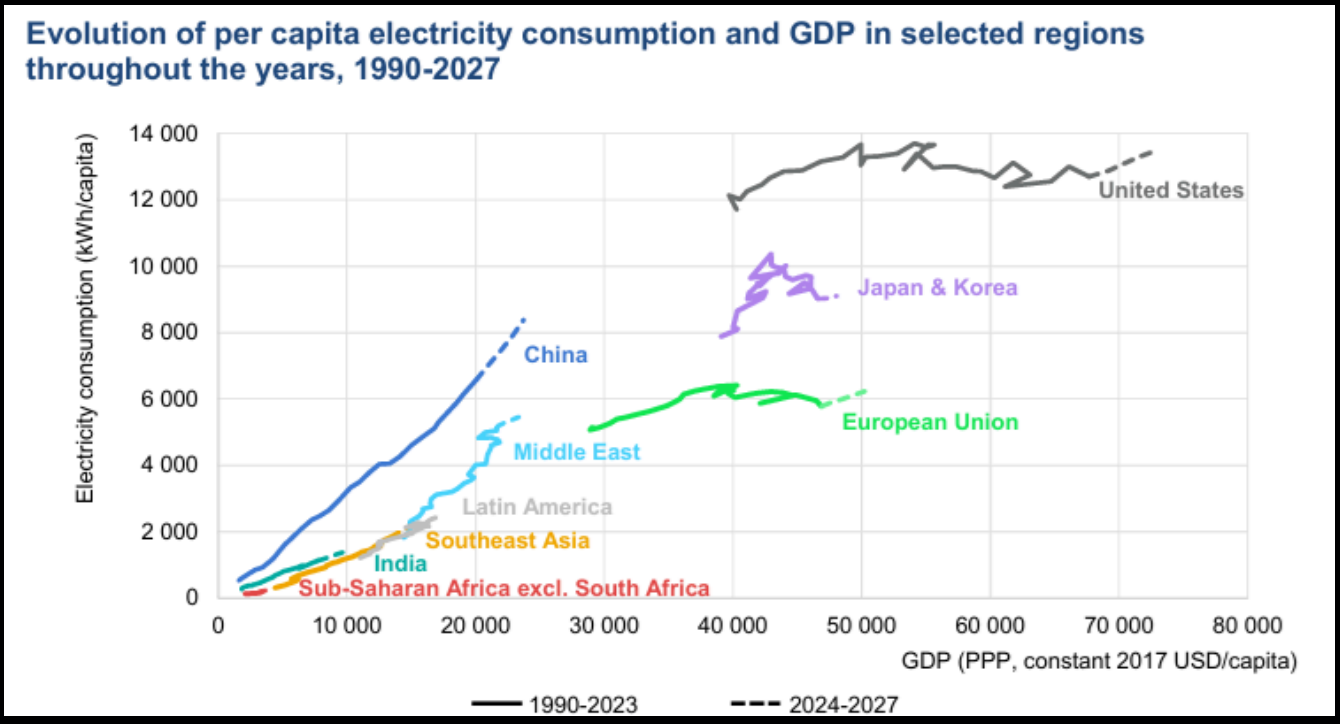


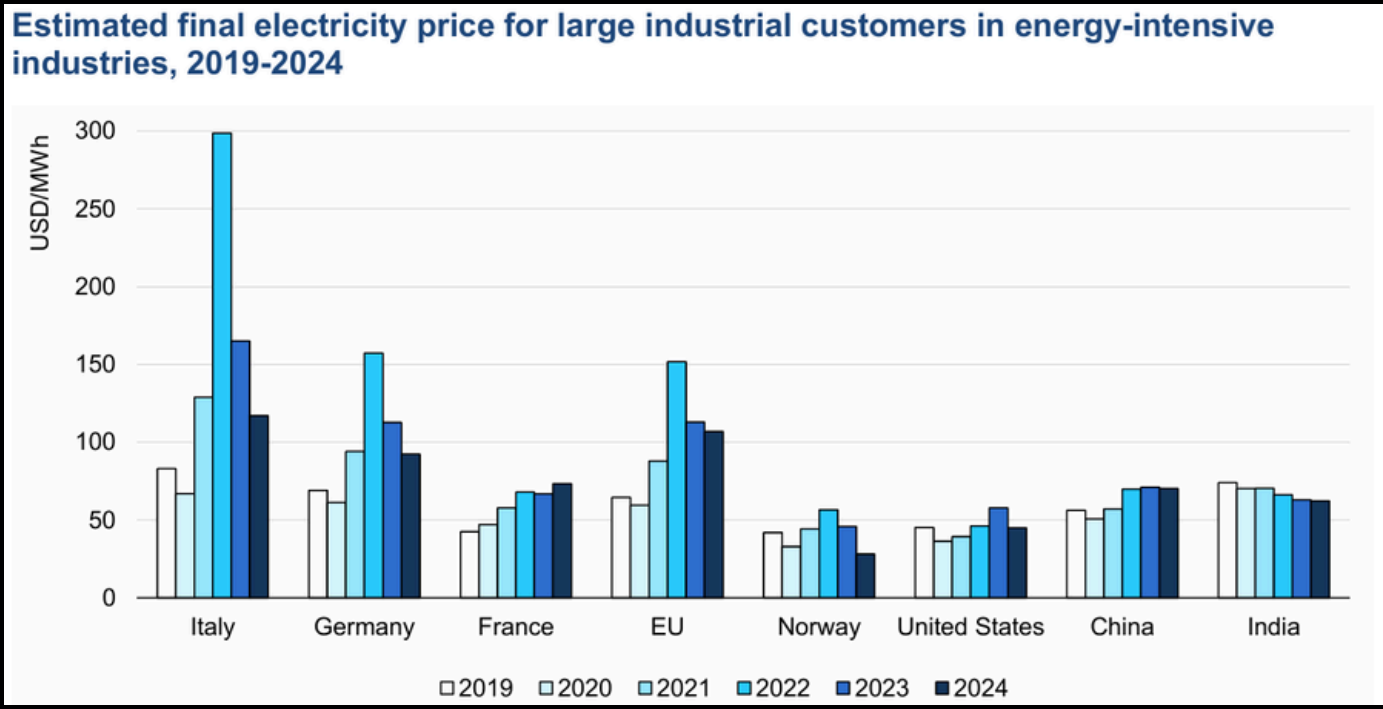
Global Electricity Source Scarcities

At least 1.18 billion people are energy poor and unable to access electricity, a figure 60% higher than the 733 million who had no electricity connection at all in 2020, according to official data. These 1.18 billion people live in areas so dark that no statistical evidence of electricity use is available from space. Most of them lack access to electricity.

However, World Bank research also reveals that 447 million people do not use electricity, despite having electricity according to official statistics. This could indicate data quality or coverage issues, but it also implies a lack of electricity service provision, whether due to frequent power outages, equipment failures, or gaps in the distribution network. Some connected consumers also choose not to use electricity, perhaps because they lack access to the services or equipment that make it useful, or because they cannot afford their electricity bills.

Barriers to productive electricity use remain high for many people across the developing world. Energy poverty is the lack of adequate, reliable, and affordable energy for lighting, cooking, heating, and other daily activities necessary for well-being and economic development. Without consistent access to reliable and affordable energy, even those in electrified areas miss out on many of the benefits of electricity. The consequences of energy poverty can be severe, including serious harm to physical health and mental well-being, social exclusion, stigmatization, and disruptions to social, political, and economic opportunities. (blog.worldbank.org)



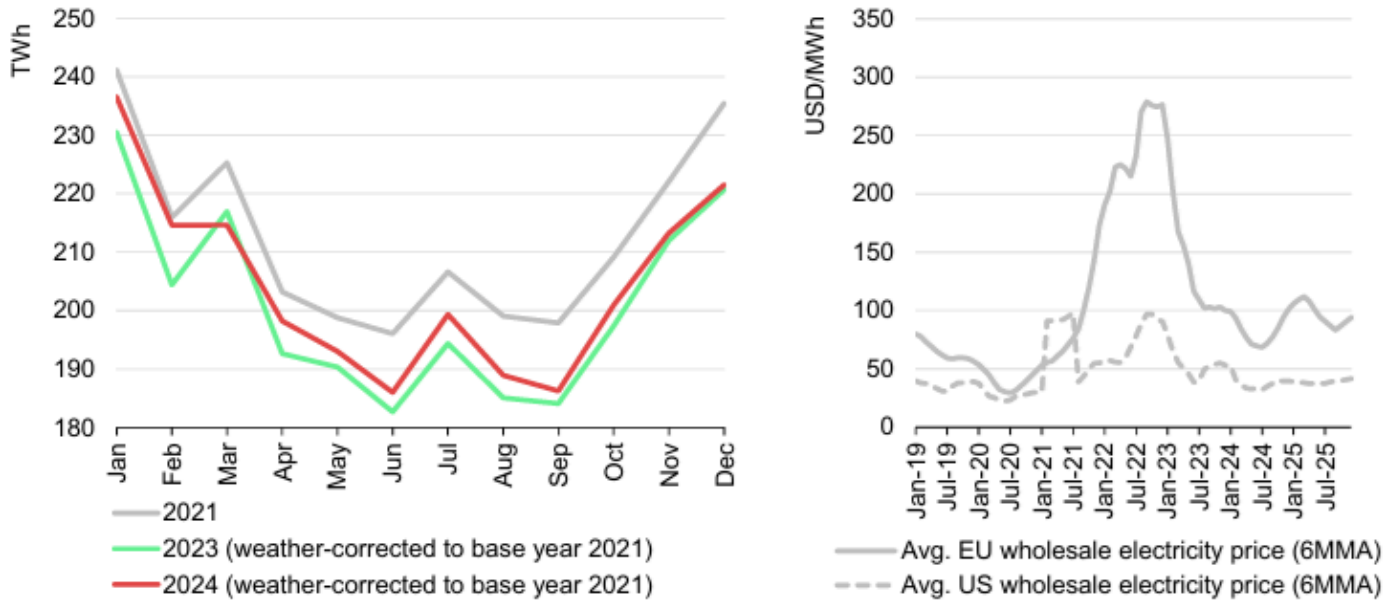


Growth Rates of Electricity Demand by Regions

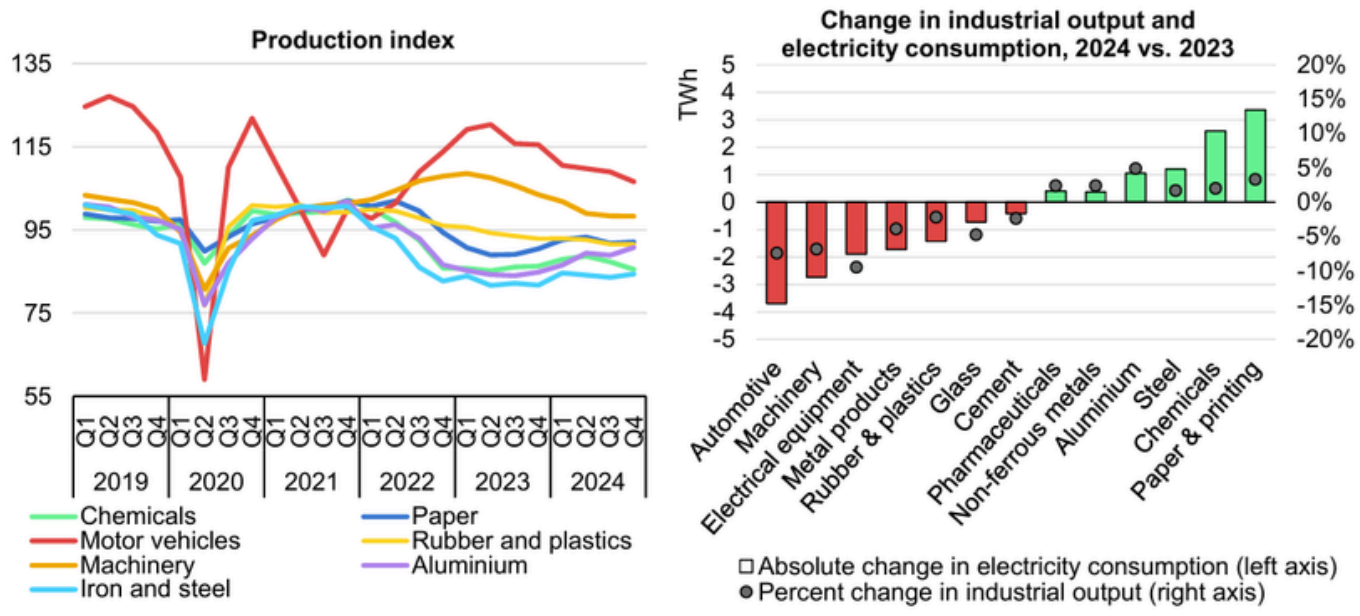
Historically, electricity consumption and GDP growth have generally gone hand in hand, as a stronger economic environment boosts activity in industry, manufacturing, and services, among other sectors, resulting in increased electricity demand. At the same time, access to affordable and reliable electricity drives growth in these sectors, which translates into economic development. This is especially true for emerging economies.

After a slowdown in 2023, preliminary data for 2024 show that average electricity prices for energy-intensive industries in the EU fell by only 5% compared to the previous year and were still 65% higher than in 2019. Although down from the record high in 2022 and slightly lower than in 2023, electricity prices for energy-intensive industries in the EU in 2024 were still, on average, double those in the United States and 50% higher than in China.

Monthly EU electricity demand, 2021-2024 (left), and average wholesale electricity prices in the European Union and the United States, 2019-2025 (right)



Production indices of selected industries in the European Union, 2019-2024, and electricity consumption trends 2024 vs. 2023



European Electricity Price Rising Due To High Demands

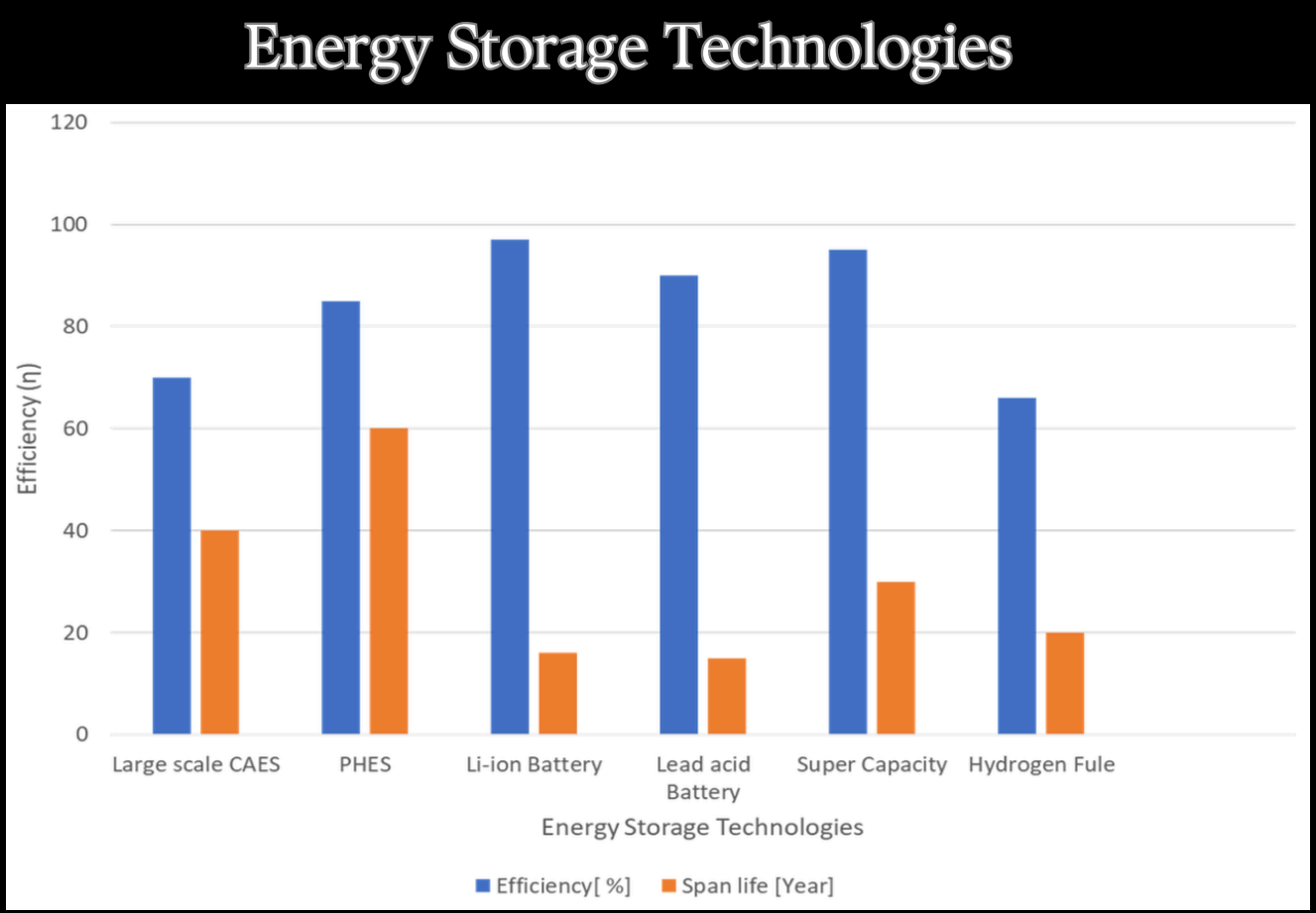
In most EU countries, businesses with low to medium electricity consumption enjoyed more stable tariffs between 2021 and 2024, resulting in reduced price volatility compared to larger consumers. On average, EU electricity prices for energy-intensive industries were 160% higher in 2022 compared to 2019, while medium-sized consumers saw an 80% increase and prices for low-consuming businesses rose by 60%.

In 2023, the situation changed, with low to medium-sized consumers continuing to face significant price increases, particularly in France, where businesses consuming between 2 and 20 GWh/year saw a 77% increase. The difference became less pronounced across consumption levels in 2024 in most EU countries, with retail prices for industry around 1.5 times higher than in 2019 on average across the EU.

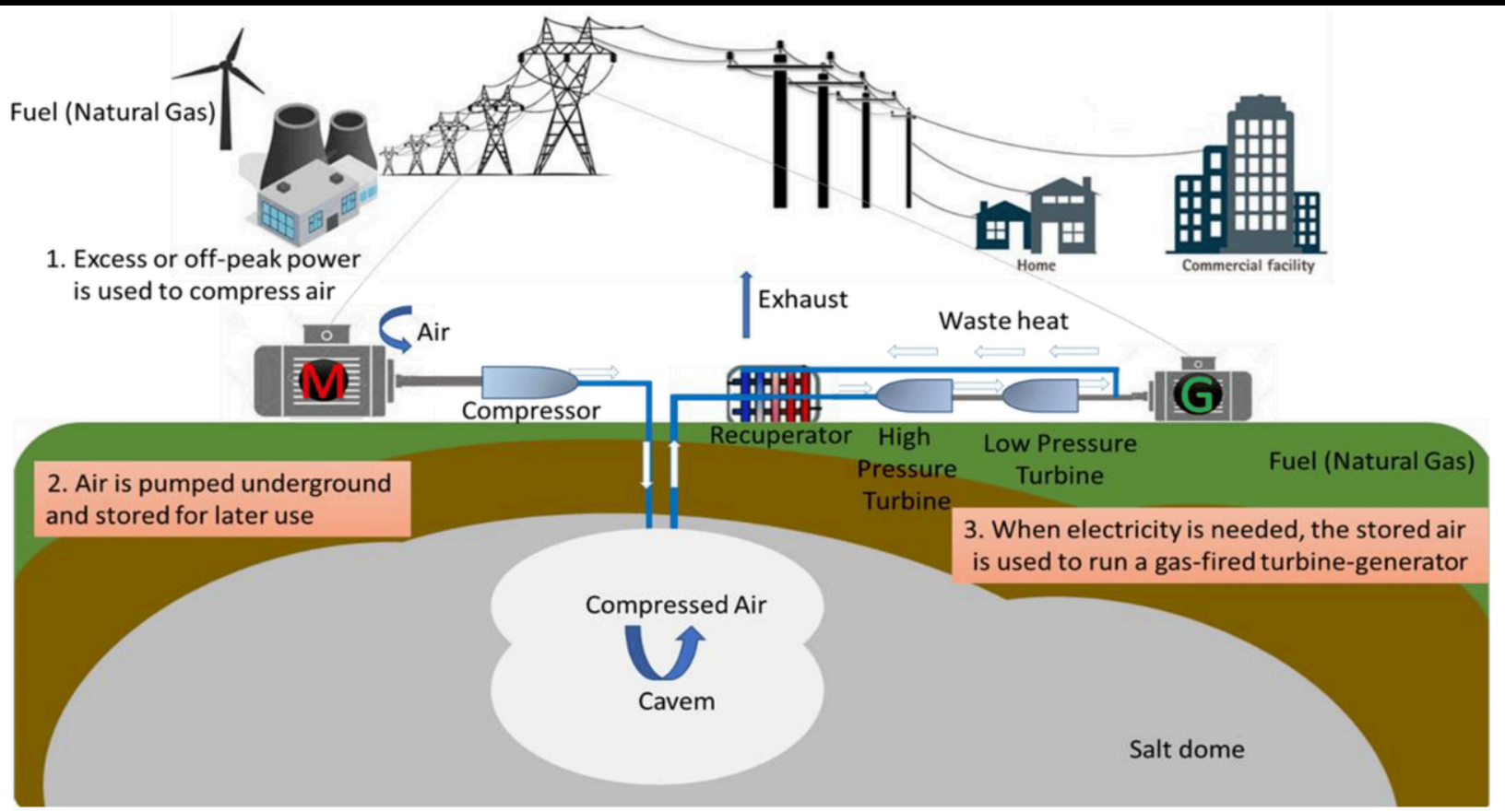
By 2030, renewable energy will contribute up to 36% of global energy. Energy storage systems provide an important performance option to improve energy efficiency and thus facilitate renewable energy integration by mitigating renewable energy fluctuations.

A variety of energy storage technologies are available, based on the type of energy stored. These include mechanical, electrochemical, electrical, chemical, and thermal energy storage. Because these technologies are so diverse and varied, they are further separated and subdivided.

There are several types of mechanical storage technologies available, including compressed air energy storage, flywheels, and pumped hydro; chemical storage includes conventional battery technologies (lead-acid, lithium-ion), flow cells, and fuel cells; electrical storage includes capacitors, supercapacitors, and magnetic storage; and thermal storage includes phase-change materials and cryogenic storage. Storage technologies from different categories can be combined under certain circumstances, such as the integration of thermal storage into CAES (Compressed Air Energy Storage) technology.



In contrast to other energy storage technologies listed in Figure 1, mechanical storage systems have significantly lower capital costs and relatively higher lifetimes and power/energy ratings. Therefore, these systems are suitable for load shearing, load leveling, time shifting, and seasonal energy storage. Large-scale commercial Compressed Air Energy Storage (CAES) plants are a common mechanical energy storage solution and are one of two large-scale commercial energy storage technologies capable of providing rated power capacities above 100 MW from a single unit, as has been repeatedly demonstrated in large-scale energy management. This paper provides a comprehensive study of CAES technology for large-scale energy storage and investigates CAES as an existing and emerging energy storage technology that can be integrated with renewable and alternative energy production systems and waste heat storage.



Compressed Air Energy Storage Electrical System

CAES uses energy supplied to the system (for example, by wind power) to run an air compressor, which pressurizes the air and forces it underground into natural storage areas such as underground salt caverns. Later, when electricity is needed, the compressed air is released back to the surface and heated. This air is then used to turn a turbine, which generates electricity.

CAES can be stored for long periods (several months) and is a technology that can be used for large-scale energy storage. CAES efficiency ranges from 60-80%. CAES systems store and deliver energy using technology and natural geological formations, using six main components:

1. A motor or generator with a coupling for alternate connection to the compressor/turbine train.
2. An air compressor with two or more stages, an intercooler, and an aftercooler, to achieve compression efficiency and reduce the moisture content of the compressed air.
3. A turbine train including a high-pressure and a low-pressure turbine.
4. Controls for the combustion turbine, compressor, and auxiliaries, as well as for regulating and controlling the transition from generation to storage mode.
5. Auxiliary equipment for facility operation, including fuel storage and handling, as well as mechanical and electrical systems for various heat exchangers.
6. Underground components consisting primarily of cavities for compressed air storage.

There are numerous advantages associated with large-scale CAES systems integrated with the grid, including peak trimming, load shedding, frequency management, and voltage management. Furthermore, CAES plants can be integrated with intermittent renewable energy sources, such as wind and solar, to smooth out power output. They have a lower environmental impact than natural gas-fired power plants. However, they do require geographical requirements such as caves and the combustion of fossil fuels.

Hubei Break World Record on CAES Energy Source

A 300-MW compressed air energy storage (CAES) power plant in central China's Hubei Province has successfully connected to the grid at full capacity, making it the world's largest operational project. The "Energy Storage No. 1" project utilizes a former salt mine cavern, reaching a depth of 600 meters, as its gas storage facility. This allows for a gas storage volume of nearly 700,000 cubic meters, resulting in a single-unit output of up to 300 MW and a storage capacity of 1,500 MWh. The system's conversion efficiency is approximately 70%. The system can store energy for eight hours and release energy for five hours each day, generating approximately 500 GWh per year.

According to the project operator, China Energy Engineering Corp (CEEC), Nengchu-1 has set three world records in terms of single-unit power, energy storage capacity, and conversion efficiency. Construction of the Yingcheng project began in July 2022 with technical support from the Institute of Rock and Soil Mechanics (IRSM) of the Chinese Academy of Sciences (CAS). Its operational life is estimated at 25 years.

Another site is the Jintan Salt Cavern CAES in Changzhou, Jiangsu Province. In late December, construction began on the second phase of the project, which includes two additional 350 MW non-fuel CAES units, with a total storage volume of 1.2 million cubic meters. This scale makes the Jintan project the world's leading CAES project in terms of single-unit power generation capacity, total storage capacity, and integrated efficiency of all CAES facilities worldwide. The plant's storage capacity will allow for up to 2.8 GWh of electricity per full charge, with an estimated 330 annual charge-discharge cycles. CAES is considered a mature technology for deep decarbonization and GW-scale deployment, with proven technological components used in industry for decades. Its operating principle is similar to that of a hydro pump. During periods of low electricity demand, electrical energy is used to compress air and store it in underground salt caverns.

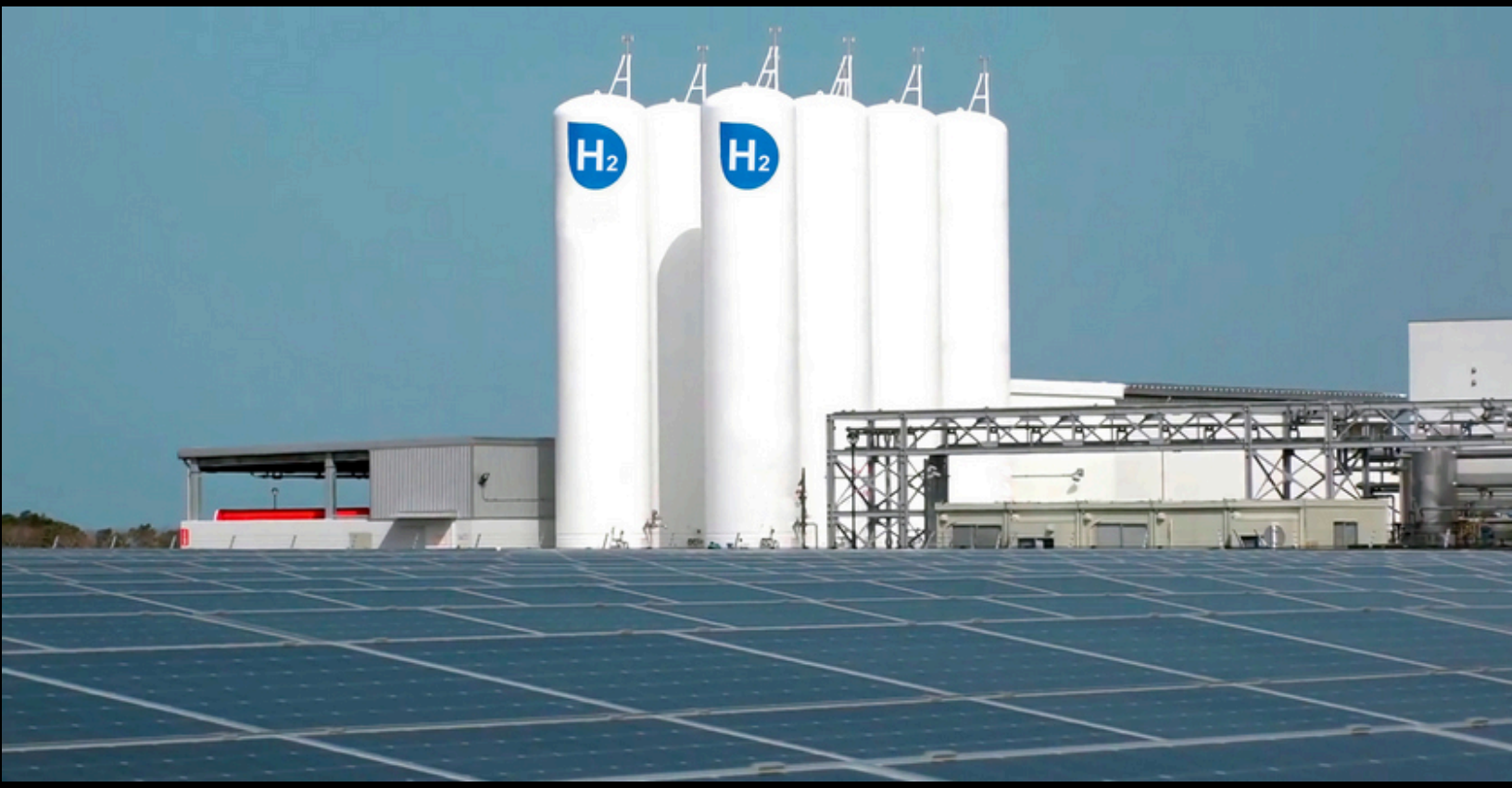
At Jintan, Food & Electricity Source Combined

This photo shows an aerial view of a 35 kV direct-installation medium-voltage energy storage power plant on March 24, 2022. The Jintan power plant combines several power generation methods, including CAES, hydropower, electrochemical energy from lithium-ion batteries, vanadium redox flow batteries, a hydrogen power source, and cold thermal energy storage. While preserving the natural environment, it also incorporates fish ponds in the area, which also serve as cooling for the various electrical power plants in the area.

The project uses electrical energy to compress air into underground salt caverns through a CAES electricity system during off-peak hours, and releases the compressed air to drive turbo-expanders to generate power when electricity demand increases.

The compressed air energy storage method mentioned above is one of the new energy storage methods. This refers to energy storage facilities, excluding pumped hydro energy storage, including energy storage systems using lithium-ion batteries, vanadium redox flow batteries, compressed air, hydrogen (ammonia), and thermal (cold) energy storage technologies.

Energy storage facilities can be thought of as giant "power banks" that are charged with electricity during optimal wind and solar conditions or low electricity demand and feed electricity into the grid during low wind turbine and solar panel output or high electricity demand.



Electricity & Green Hydrogen Production Combined

Sinopec (China Petroleum & Chemical Corporation) plans to produce 20,000 tons of green hydrogen per year upon completion of the facility, while the expected CO2 emission reduction is approximately 485,000 tons per year. The hydrogen production cost is only USD 2.67 per kilogram.

The plant, located in the northwestern region of Xinjiang, will cost approximately USD 470.8 million to build, with solar panels covering an area of over 630 hectares. The hydrogen production cost there is only USD 2.67 per kilogram, according to Chinese media reports.

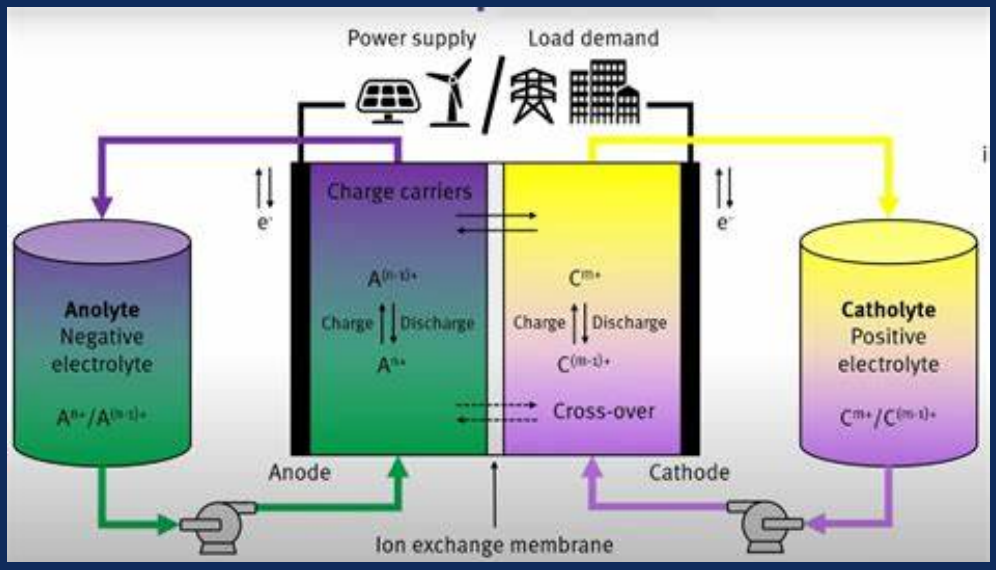
The state-owned energy giant previously announced that the project will cover the entire green hydrogen production and utilization process, from solar power generation, transformation, electrolyte production, storage, and transportation.

The facility will include a 300 MW solar power plant, a water electrolysis hydrogen production plant, hydrogen storage tanks, and a hydrogen pipeline network, according to previous reports.

Green hydrogen will replace the natural gas-based hydrogen used at Sinopec's Tahe oil refinery. The hydrogen produced at the future plant will be supplied to Sinopec's nearby Tahe oil refinery to replace natural gas-based hydrogen.

Sinopec estimates that in the future, the entire oil industry will create a market worth over USD 14.8 billion by replacing gray hydrogen, produced using electricity generated from fossil fuels, with green hydrogen.

Vanadium RedOx Battery; How it Works



A vanadium redox flow battery works as follows:

1. Electrolyte from the tank is pumped through the fuel cell stack. Ion exchange occurs across the membrane.
2. This exchange results in a reversible electrochemical reaction, allowing electrical energy to be stored and returned.
3. Most commercial flow batteries use vanadium salts as the electrolyte, with electrodes made of graphite bipolar plates.

China Electric Company, Sineng, has manufactured Vanadium RedOx Flow Batteries. The unit's four-hour operation will generate 75-300 MW of electricity per hour, ensuring continuous power availability.

The project utilizes VRFB technology, known for its scalability, durability, and safety. Given the unique demands of VRFB systems, Sineng Electric offers a customized energy storage solution featuring a 1375 kW central Power Conversion System (PCS).

This PCS is specifically engineered to operate over a wide DC voltage range of 700–1500 V at rated power, ensuring high efficiency, stability, and reliability even under challenging conditions such as high altitudes and extreme cold weather common in the region.

Designed for a four-hour duration, this energy storage plant has proven to be crucial for peak mitigation and frequency regulation, mitigating the impact of demand surges and ensuring a sustainable power supply. Furthermore, the project facilitates the integration of intermittent renewable energy sources, significantly contributing to the region's energy transition by providing stable and distributable power.

Wusu City is building a solar power plant with an estimated annual power production of 3 GW. A Super Computing Center and a Digital Economy Industrial Park are also being built concurrently with this project. This is expected to support the development of eight major industrial clusters around Wusu, Xinjiang.

The Baotang energy storage station, the largest facility of its kind in the Guangdong-Hong Kong-Macao Greater Bay Area, is poised to propel China's power storage industry forward with its continuous power supply and dominant use of lithium battery energy storage.

Covering an area of approximately 3.8 hectares, equivalent to the size of 5.5 football fields, the station has an installed capacity of 300 megawatts, accounting for one-fifth of the total new energy storage capacity in the Greater Bay Area. During off-peak hours, the station is recharged by renewable energy sources such as wind and solar power.

LEADING CAUSE OF DEATH

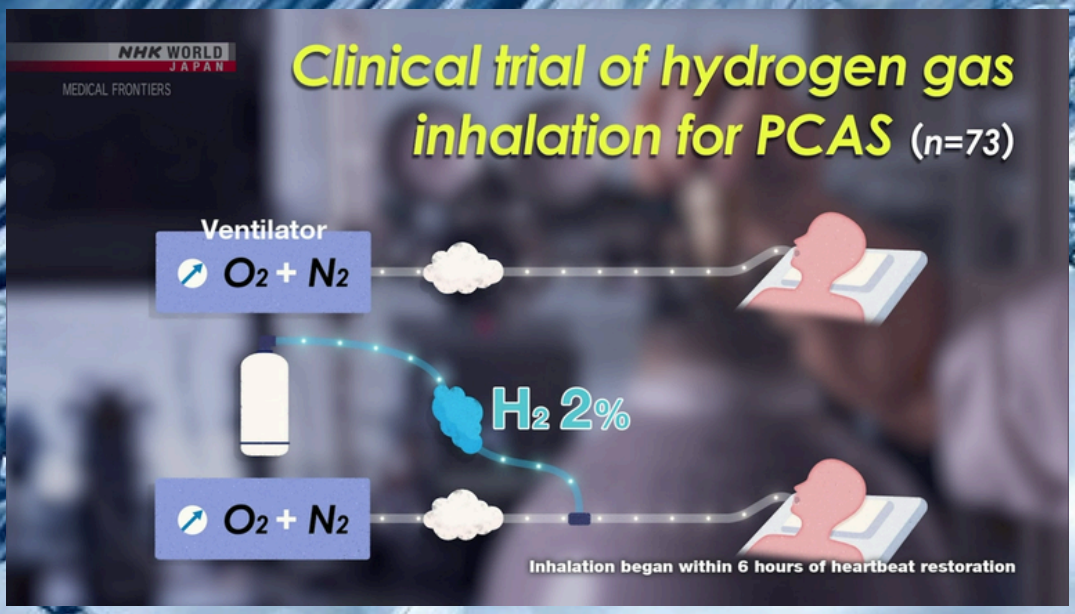
What Comes After Heart Attacks

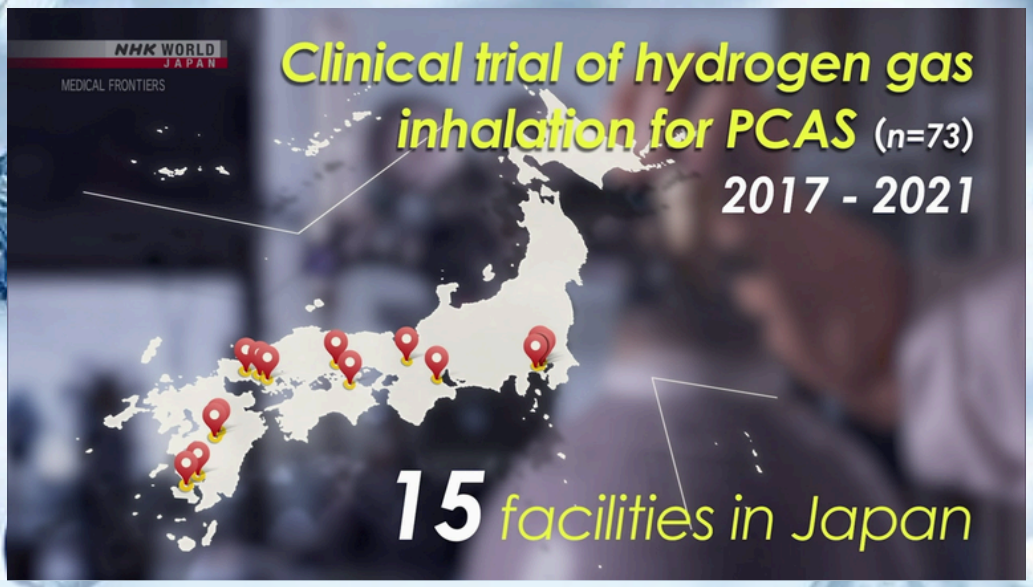
STROKES COMMONLY HAPPENED AFTER HEART ATTACKS. HEART ATTACKS ARE ALSO THE NO. 1 CAUSE OF DEATH.

Eva Susanti, Director of Prevention and Control of Non-Communicable Diseases at the Ministry of Health (Kemenkes), stated that cardiovascular disease, or heart disease, is the leading cause of death in Indonesia (dinkes.acehprov.go.id).
"The leading causes of death in Indonesia are stroke, at 19.42 percent, and ischemic heart disease (heart attack), at 14.38 percent," she said in a press conference commemorating World Heart Day 2023, which was attended online in Jakarta on Monday (September 25, 2023).

Eva noted that these two cardiovascular diseases are also a global concern, as ischemic heart disease causes 16.17 percent of deaths globally, while stroke causes 11.59 percent. Furthermore, several risk factors for cardiovascular disease, such as high blood pressure, high blood sugar, smoking, and obesity, are among the top five risk factors contributing to the disease burden in Indonesia. In 2022, she revealed, there will be an increase in funding for catastrophic diseases to IDR 24.06 trillion.
"These two types of cardiovascular diseases are the diseases with the largest financing costs for the National Health Insurance (JKN) at IDR 15.37 trillion," said Eva.

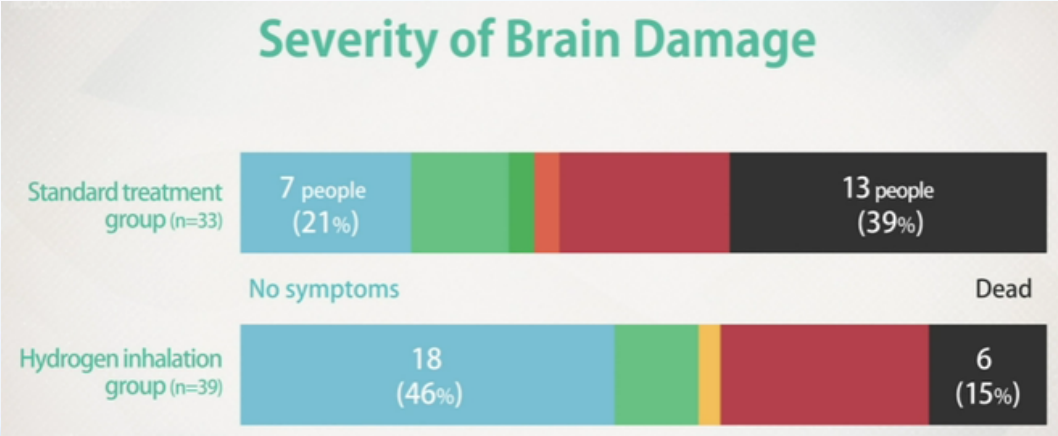
A STUDY CONDUCTED AT 15 HOSPITALS IN JAPAN
EXAMINED THE EFFECTIVENESS OF 2% HYDROGEN INHALATION
FOR 18 HOURS AFTER A HEART ATTACK
TO REDUCE THE RISK OF BRAIN INJURY

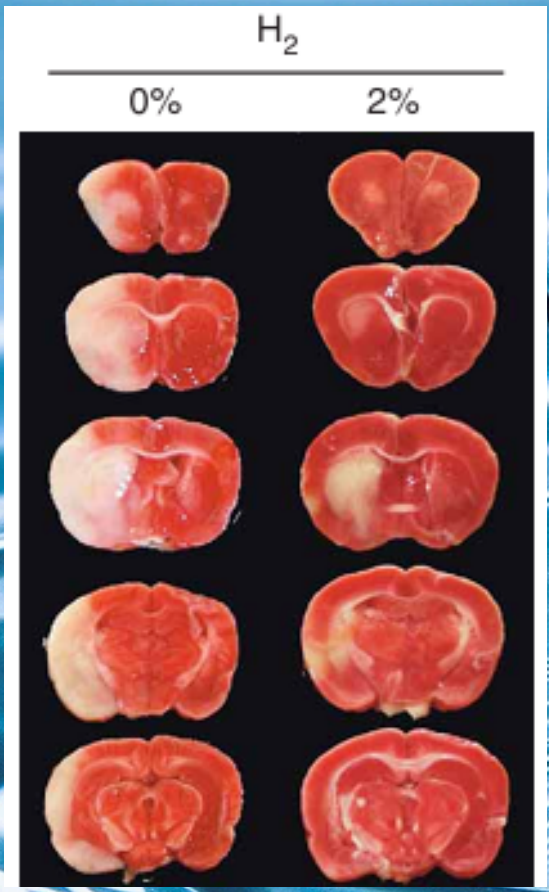




Keio University Japan conducted the HYBRID II study at 15 hospitals in Japan between February 1, 2017, and September 30, 2021. Patients aged 20–80 years who were in a coma after a heart attack were randomly assigned to receive supplemental oxygen with 2% H2 or oxygen (control) for 18 hours.

Brain injury remains the leading cause of short-term mortality in patients hospitalized after a heart attack. Molecular hydrogen (H2) has anti-oxidative, anti-inflammatory, and anti-apoptotic properties and reduces ischemia-reperfusion injury. Inhaled H2 is absorbed from the lungs and diffuses through the bloodstream to cellular organelles, including those in the brain. Therefore, H2 inhalation is a promising treatment, especially in emergency medicine and critical care.

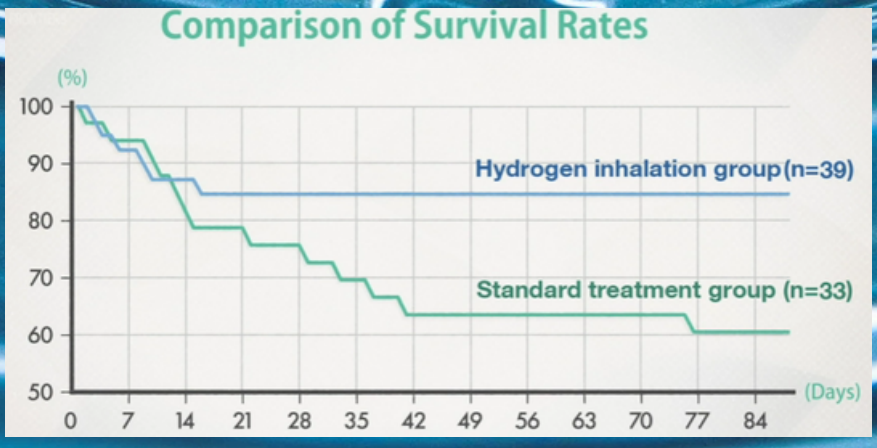




MRI Results of the Brain After Hydrogen Inhalation Therapy

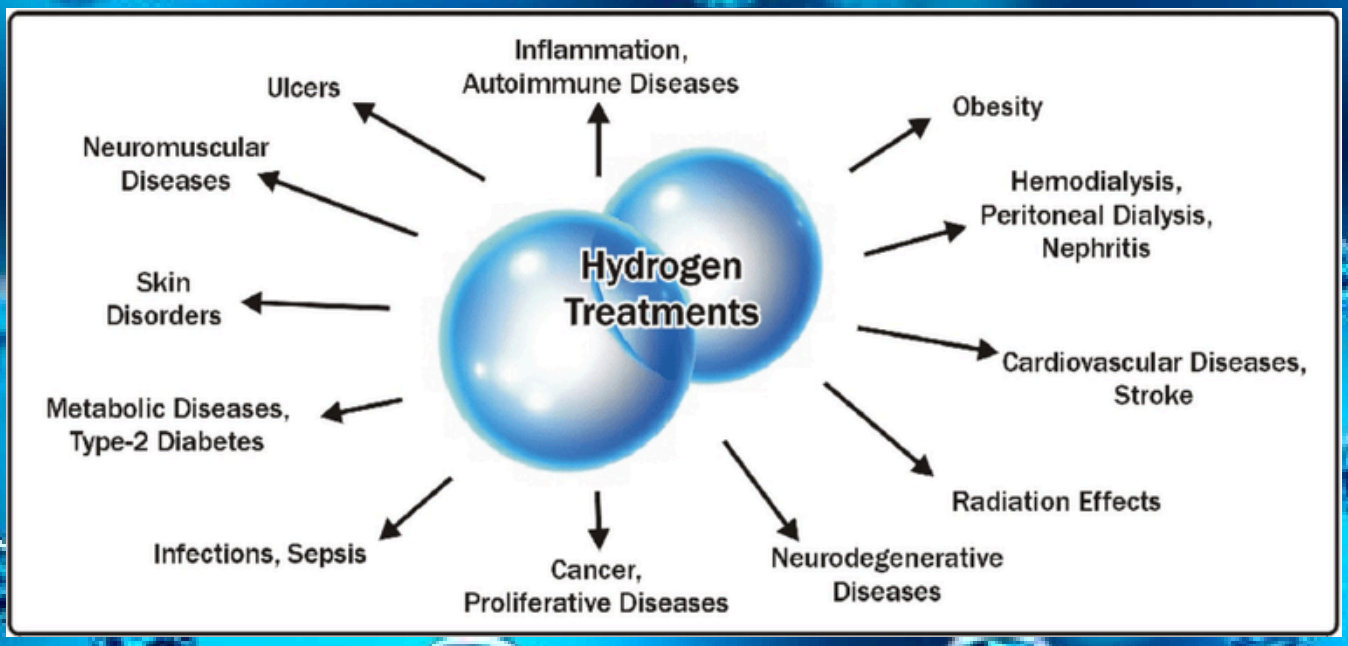
In the mouse brain image on the right, H2 inhalation improves survival and neurological function and attenuates histological neuronal damage regardless of the patient's body temperature after cardiac arrest.

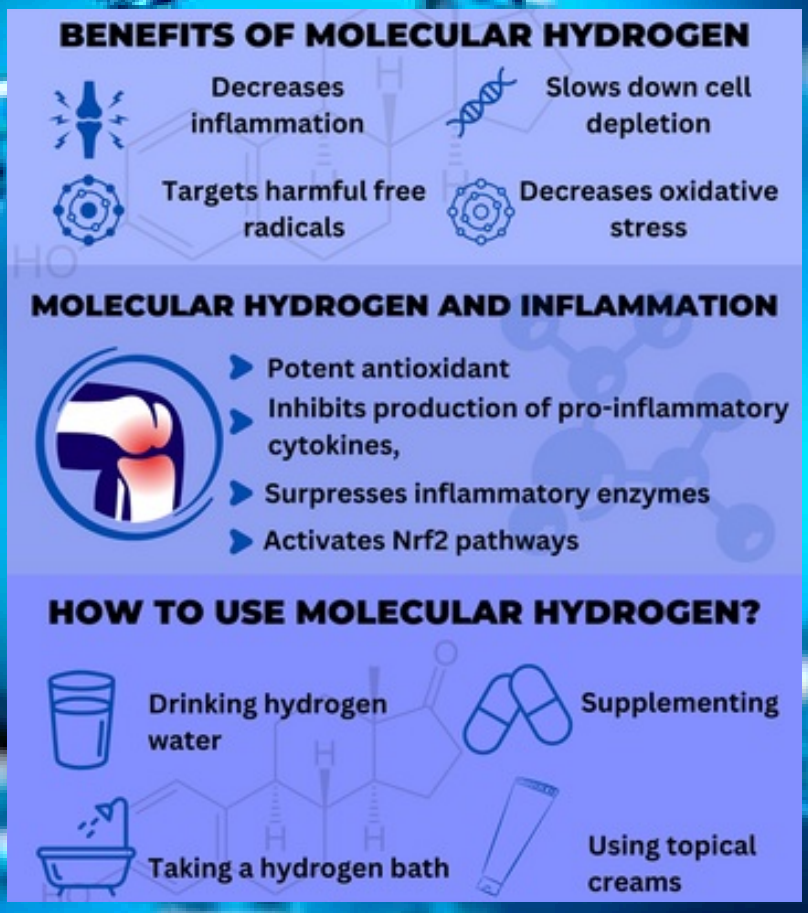
In this study, we developed an H2 inhalation system for patients that allows co-administration of 2% H2 and titrated oxygen (O2) via a ventilator; in a study of this system, Keio University Japan confirmed that H2 inhalation is safe and feasible for certain patients with coma after cardiac arrest.



Various Uses in Medicine

Hydrogen Treatments





Hydrogen therapy for patients who have recently experienced a heart attack offers numerous benefits. Among them, it can reduce the risk of stroke or other types of brain damage.

This is possible because hydrogen therapy reduces inflammation in various cells and tissues that are deprived of oxygen supply due to the heart attack.

This hydrogen therapy at the molecular level also reduces oxidative stress and slows the rate of cell damage caused by the stress of oxygen deprivation.

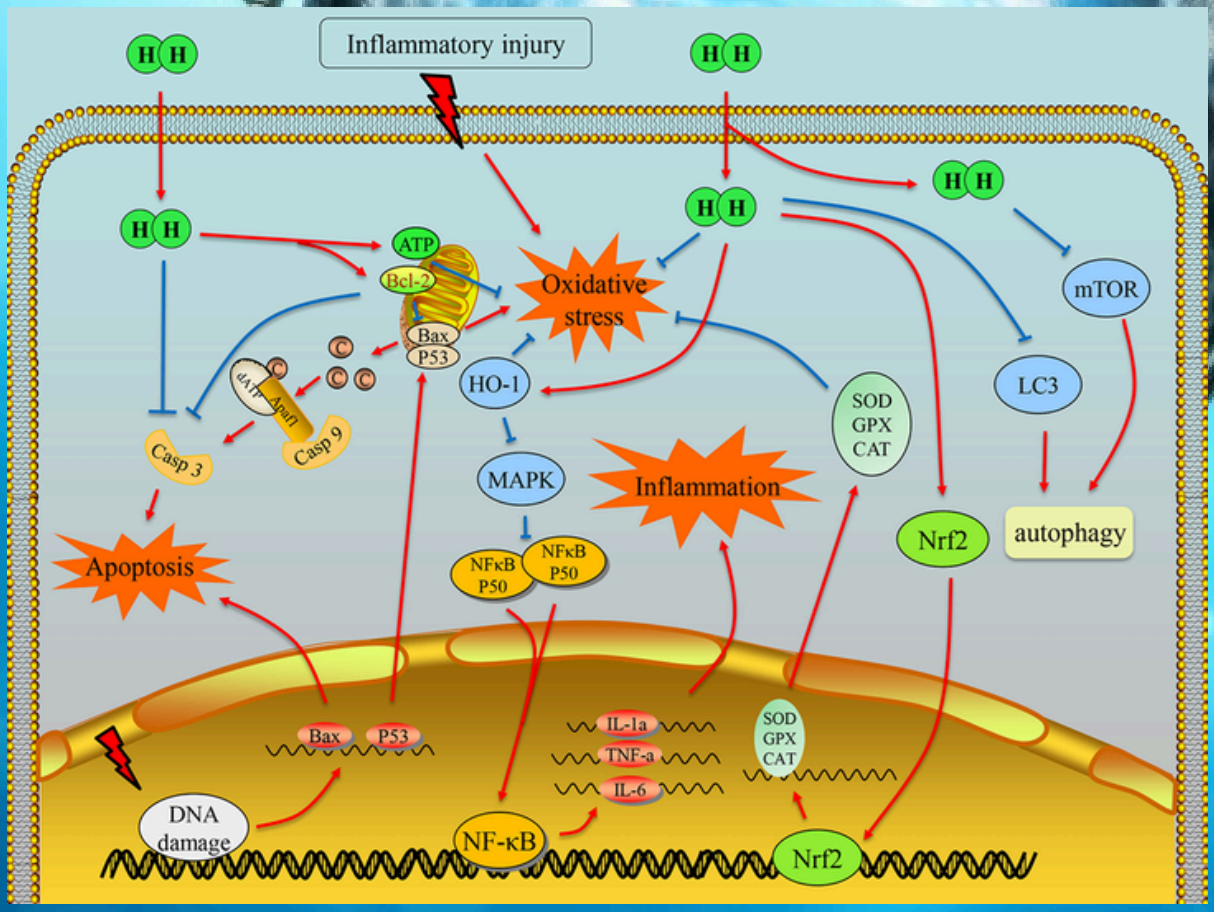
Hydrogen Therapy For Organ Inflammation

H2 has a relatively small molecular mass, which helps it diffuse rapidly and penetrate cell membranes to exert various biological effects. This is the primary mechanism of hydrogen therapy in inflammatory diseases.

Hydrogen therapy plays a role in the treatment and prevention of various acute and chronic inflammatory diseases, such as acute pancreatitis, sepsis, respiratory diseases, ischemia-reperfusion injury, and autoimmune diseases.

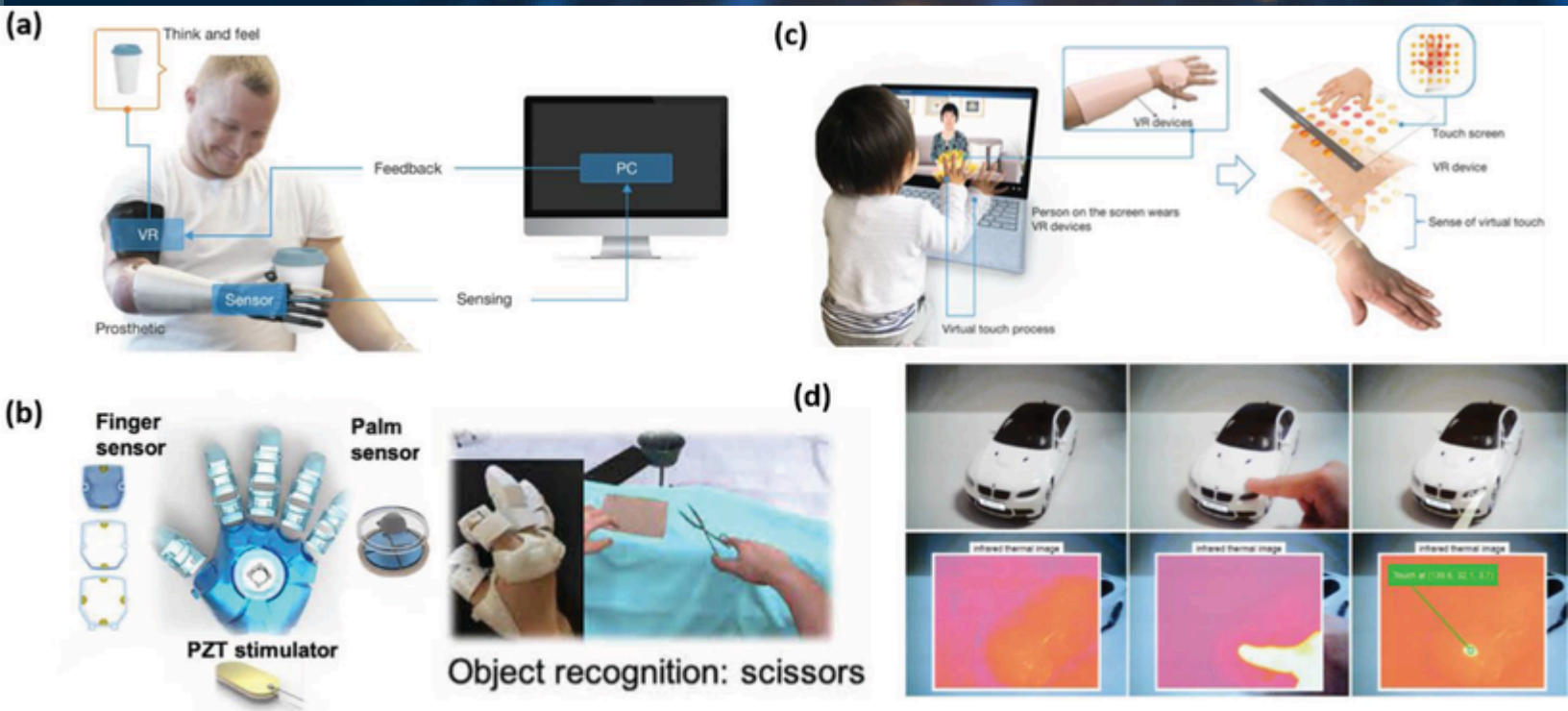
First, hydrogen can scavenge hydroxyl radicals due to its chemical properties. It can also exert antioxidant effects by regulating Nrf2 transcription and mitochondrial energy balance.

Furthermore, hydrogen can downregulate NF-κB transcription, thereby reducing inflammation. Through its effects on the antioxidant, anti-inflammatory, and anti-apoptotic factor Bcl-2 or its direct interaction with caspase-3, hydrogen can inhibit cell apoptosis.



HAPTIC TECHNOLOGY

From Resisitive Touchscreen to The Development of Devices to Help The Blind to Sees

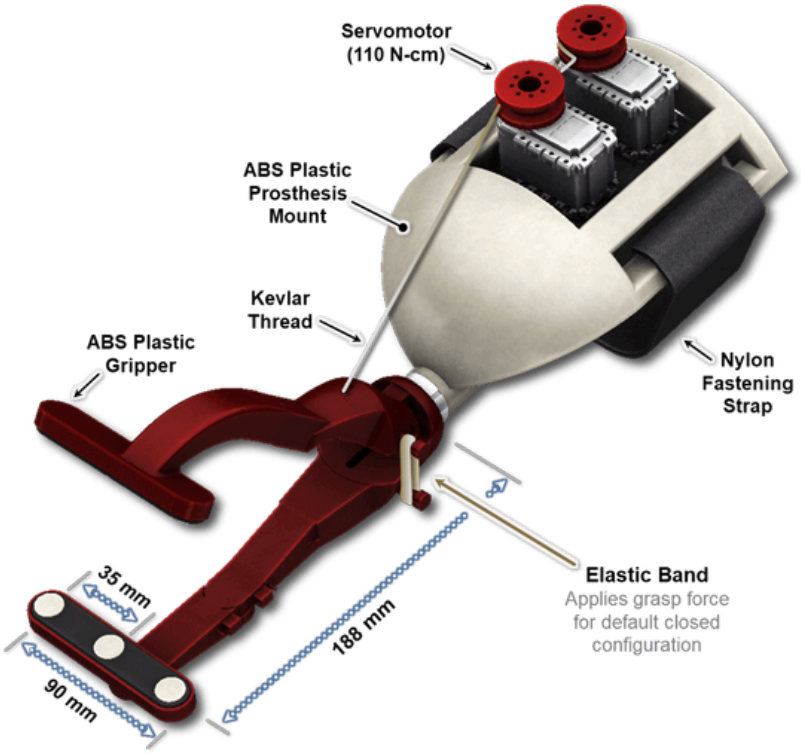


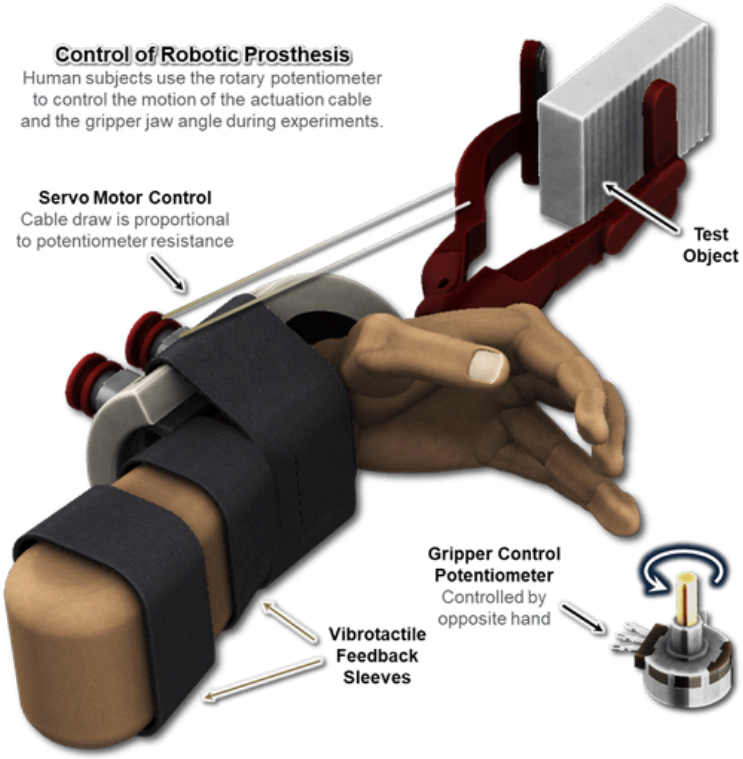
Low vision is estimated to affect 12 million adults over the age of 40 in the US, often due to conditions such as macular degeneration, glaucoma, retinitis pigmentosa, and diabetes-related eye disease.

Haptic technology originated with the development of touchscreens in electronic devices. This sensory response and reflection-based technology has since expanded to include a wider range of functions, enabling it to assist many people with physical disabilities.

Various forms of haptic technology utilize technologies such as ultrasound or virtual scans of the visible conditions in a person's environment, to provide auditory information about their surroundings. There are also haptic devices that can read aloud articles or novels for those who have lost the ability to read.

Haptic technology, such as devices shaped like canes for the blind, can also provide commands or suggestions to users about potential hazards, such as rocks, potholes, or when the cane user needs to turn left or right to reach a desired destination.





PROSTHETICS

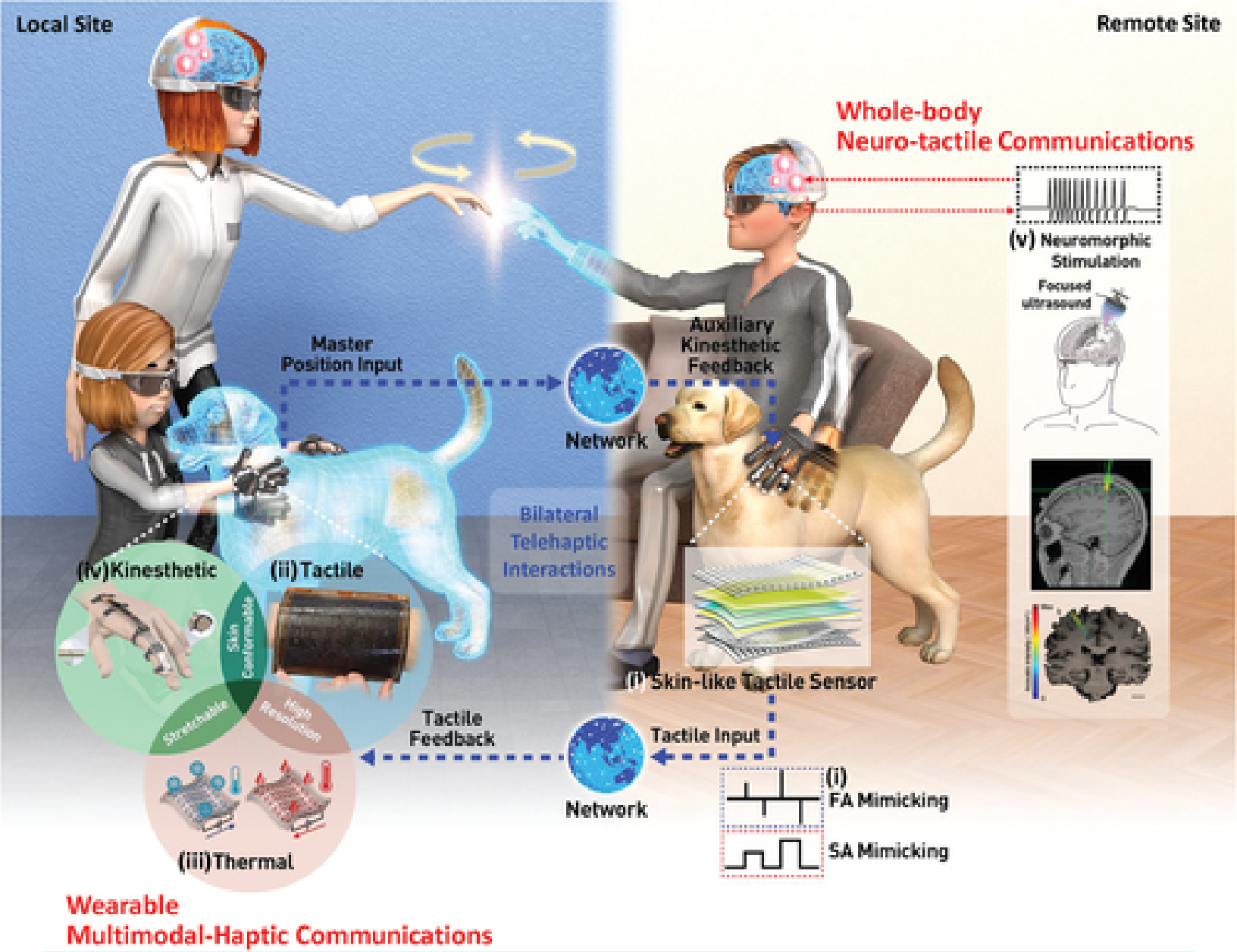
Vibro Tactile - Haptic Devices

Haptic technology is defined as technology that relies on computer-induced force, vibration, or movement to provide people with an artificial sense of touch. This technology, along with virtual reality, has become increasingly relevant in the medical field in the last decade.

Surgeons not only rely on virtual reality to perform surgery, but haptic technology can significantly improve the lives of amputees with robotic prosthetics.

In recent years, researchers have discovered that robotic prosthetics with the ability to provide patients with an artificial sense of touch significantly reduce the mental effort required to operate the prosthetic.

Artificial touch can also improve patients' overall ability to control their prosthetics. Rotary potentiometers control the movement of actuator cables, which can help determine grip strength (plastic gripper) in joint propriosections on the Vibro Tactile Haptic Device.

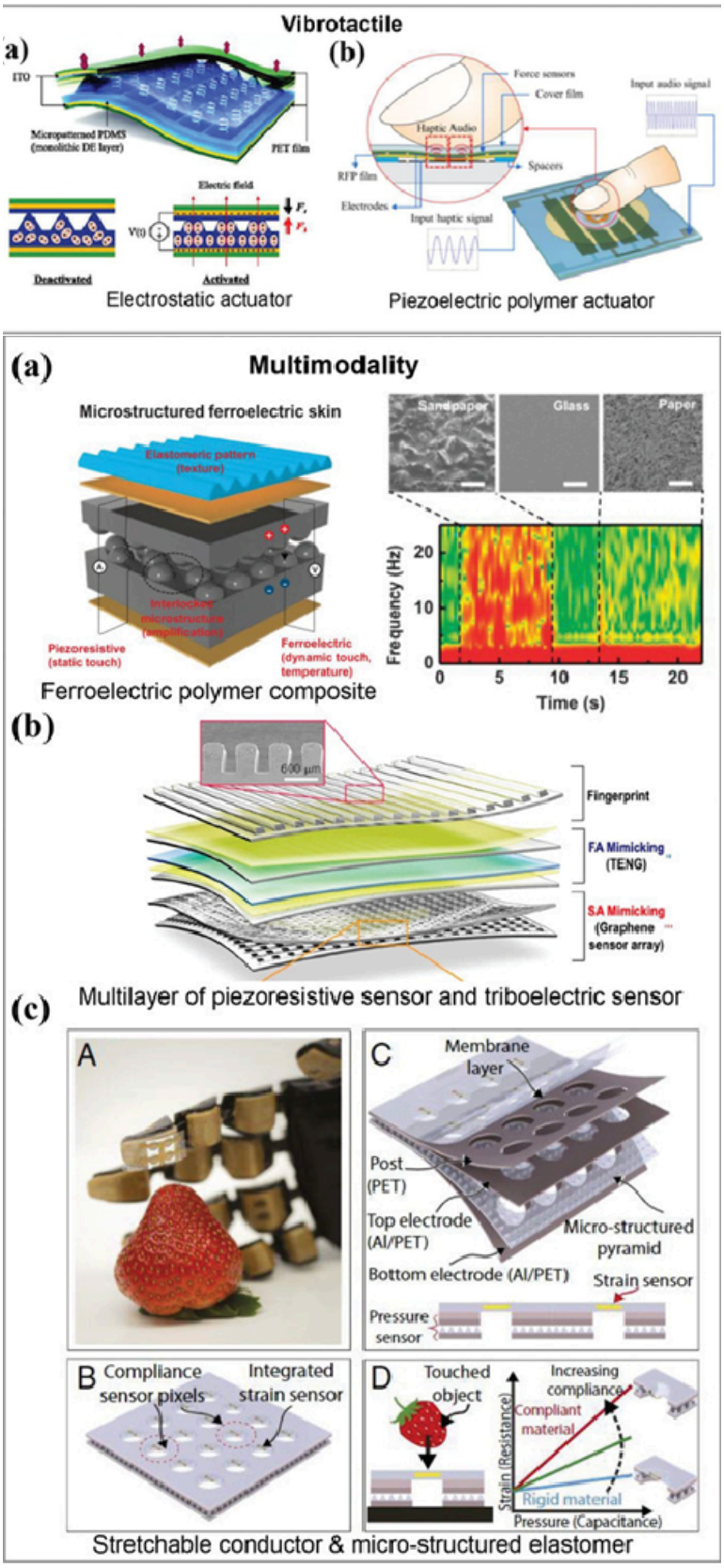


Wearable Multi-Modal Haptic Communications is a futuristic concept of bilateral and multimodal tele-haptic interaction that combines active material-based haptic technology and Virtual Reality/Augmented Reality interaction systems. A young woman and a man engage in haptic interaction while wearing flexible haptic gloves connected to Augmented Reality goggles.

These haptic gloves are equipped with skin-like tactile sensors (bottom, right) and a multimodal haptic feedback module (bottom, left), so that sensory information can be conveyed to the partner as haptic feedback. A woman and a man interact with a neuro-tactile modulation device connected to Augmented Reality goggles for full-body interaction (top, right) on their heads.

Various forms of haptic technology are shown in the image above, including Auxiliary Kinesthetic Feedback, which helps children with reduced sensitivity recognize what they touch. Bilateral Telehaptic Interactions facilitate interactive communication between two people using haptic devices. Whole-body neuro tactile communications combines neuromorphic stimulations or stimulation on devices with functions that resemble the actions and reactions of the human nervous system, with the help of Focus Ultra Sound.

How Vibro Tactile Actuator in Haptic Technology Work?



This haptic technology works by activating a Vibro-Tactile-based haptic actuator to detect the surface of a touched object and a piezo-resistance sensor system on the palm or fingertips of a glove.

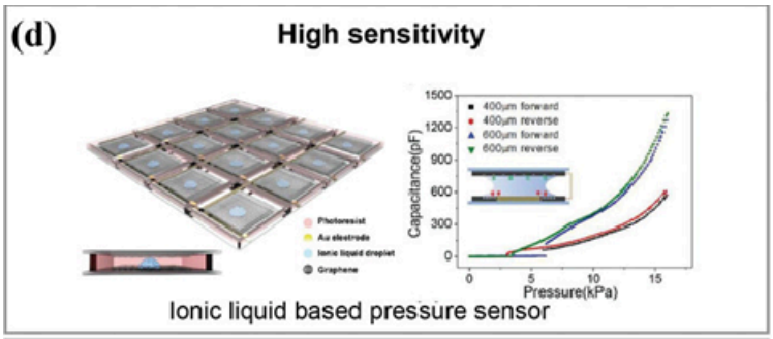
In this prosthetic hand-shaped haptic device, the haptic feedback mechanism is activated by an action and reaction mechanism that mimics the human nervous system.

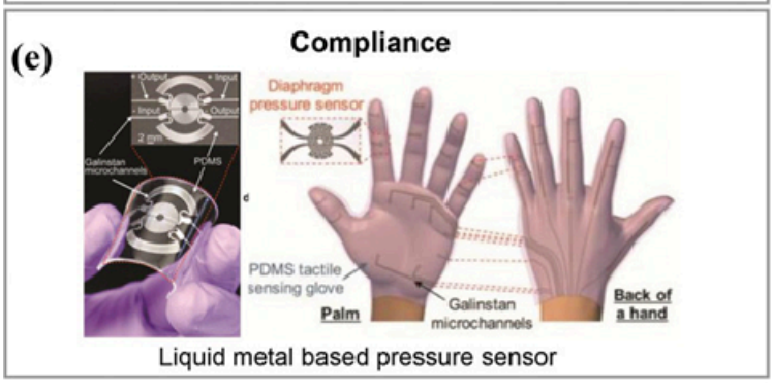
The neural response activation system mimicked in this haptic technology is a series of cables in a resistance potentiometer on the wrist that provides information to the prosthetic hand and fingers, enabling them to move according to the user's wishes.

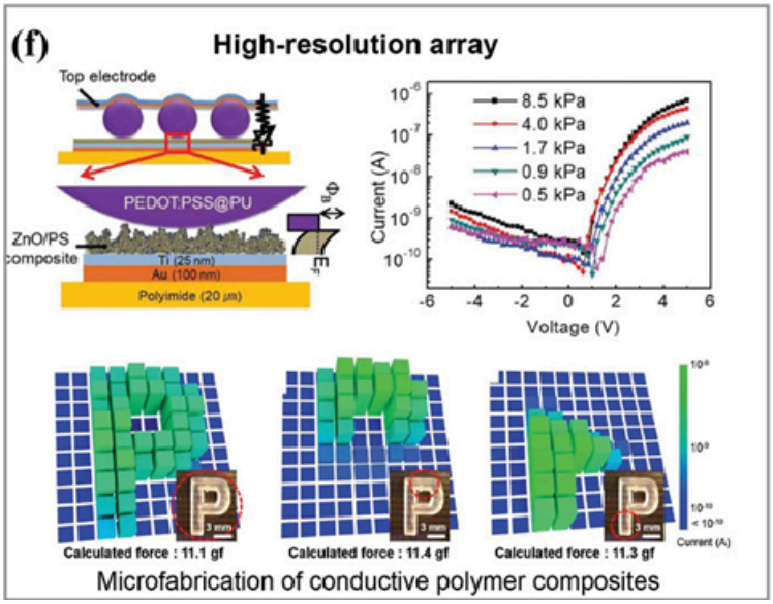
To perform the rotation function of the prosthetic hand equipped with this haptic technology, multisensory feedback is provided through an artificial sensor system (linear resonance actuator) that mimics the human ability to recognize the specific mass and shape of objects simultaneously (piezo ceramic actuator). This device can also determine the rotation or rotation of the prosthetic arm (eccentric rotating mass).

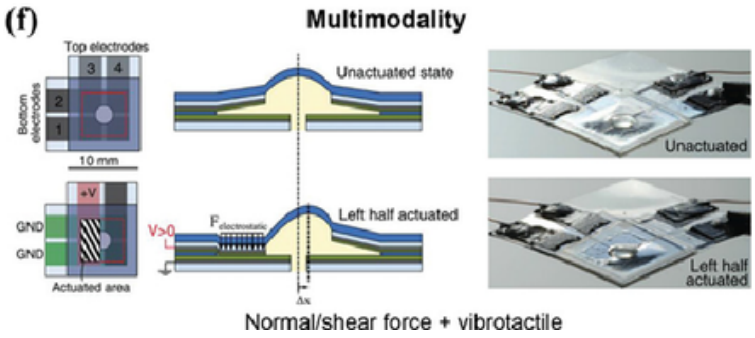
This action and reaction system that resembles the response of the human nervous system can work by activating a pneumatics-based haptic device using gas pressure to channel force and energy as a form of feedback reaction.

How Does the Shape Memory Alloys in Haptic Technology Work?









Another technology in this Haptic Device is Shape Memory Alloys, which create a specific layer that resembles a real object on a manufactured device. This device can change and adjust its shape thanks to electromechanical actuators that are sensitive to temperature and even light pressure.

Furthermore, it incorporates magnetic rheological fluids, which provide highly sensitive responses (large resistive forces) with instant reaction times, thus mimicking the nervous system in the human body, arm, and skin.

This high sensitivity is further enhanced by electro-active polymer (EAP) films that are sensitive to a variety of tactile stimuli, detected through flexible and expandable haptic actuators. This haptic device is skin-attachable, allowing the haptic feedback to be felt through the user's skin.

This is due to the soft and active materials used, consisting of sensitive nanocomposites, which possess biomimetic properties thanks to conducting polymers and a thin liquid layer, enabling it to function as a self-powered haptic actuator. The piezoelectric skin layer is also elastic, wireless, non-invasive, and comfortable to wear.

Some haptic wearables also feature machine learning and deep learning capabilities, allowing them to recognize complex movements previously recognized through virtual reality or augmented reality applications.

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