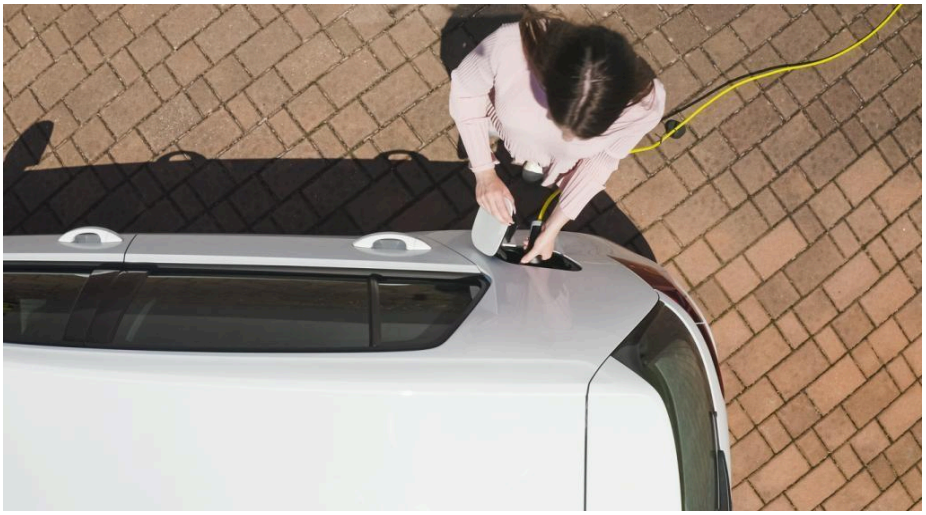
CURRENT AFFAIRS NOTES 09-02-2024

\SOLID STATE BATTERY



QuantumScape's solid-state battery technology represents a significant advancement in the field of electric vehicle (EV) batteries.

Details

High Capacity Retention: QuantumScape's prototype solid-state battery retained 95% of its capacity after completing 1000 charging cycles.

These batteries offer solutions to multiple challenges faced by EV batteries, including cost, safety, capacity, charging time, and durability.

Solid-State Electrolyte: This solid-state electrolyte offers improved safety, temperature tolerance, and non-flammability compared to liquid electrolytes.

Anode-Free Design: QuantumScape's solid-state lithium-metal cell features an anode-free design, which increases energy density. This design allows for the direct use of lithium metal from the cathode during the first charge, potentially leading to higher energy storage capabilities.

About Solid-state batteries

What are Solid-State Batteries?

Solid-state batteries are a type of battery technology that uses solid electrolytes instead of liquid or gel electrolytes found in traditional lithium-ion batteries.

These solid electrolytes can be made of various materials such as ceramics, polymers, or composites.

Components of Solid-State Batteries:

Anode: Typically made of lithium metal or other high-capacity materials such as silicon.

Cathode: Composed of materials like lithium iron phosphate, lithium cobalt oxide, or other lithium-containing compounds.

Solid Electrolyte: This is the key component that distinguishes solid-state batteries. It replaces the liquid electrolyte found in traditional batteries with a solid material, which can be a ceramic, polymer, or composite.

Separator: Separates the anode and cathode to prevent short circuits.

Advantages of Solid-State Batteries:

Safety: Solid electrolytes are non-flammable and less prone to leakage or thermal runaway, addressing safety concerns associated with traditional lithium-ion batteries.

Energy Density: Solid-state batteries have the potential to offer higher energy density, enabling longer driving ranges for electric vehicles and longer-lasting portable electronics.

Longevity: They have the potential for longer lifespan due to reduced degradation of electrodes and electrolytes over time.

Fast Charging: Solid-state batteries can potentially support faster charging rates compared to traditional lithium-ion batteries.

Temperature Stability: Solid-state batteries can operate over a wider temperature range compared to traditional batteries.

Challenges and Limitations:

Manufacturing Complexity: Solid-state batteries often require precise manufacturing techniques, which can increase production costs.

Interfacial Resistance: Interface issues between solid electrolytes and electrodes can lead to higher resistance, affecting battery performance.

Material Compatibility: Finding suitable solid electrolyte materials that are stable, conductive, and compatible with electrodes remains a challenge.

Scale-Up and Cost: Mass production of solid-state batteries at a competitive cost is a significant challenge.

Performance Optimization: While solid-state batteries offer potential advantages, achieving high energy density, power density, and cycle life simultaneously remains a goal for researchers.

Applications:

Electric Vehicles (EVs): Solid-state batteries could revolutionize the automotive industry by offering longer ranges, faster charging, and improved safety.

Consumer Electronics: Longer-lasting and safer batteries could enhance the performance and safety of smartphones, laptops, wearables, and other portable devices.

Grid Storage: Solid-state batteries could play a role in grid-scale energy storage, enabling more efficient and reliable renewable energy integration.

Build-operate-transfer (BOT) Model

The National Highways Authority of India (NHAI) has come up with a list of high-traffic density corridors for private developers to build and operate under the build-operate-transfer (BOT) model.

About build-operate-transfer (BOT) Model

It is a type of agreement often used in infrastructure projects, particularly in the construction and operation of public facilities or utilities.

It is a conventional public-private partnership (PPP) model in which a private entity (usually a company or consortium) is granted the rights and responsibilities to design, finance, construct, operate, and maintain a specific project or facility for a defined period of time.

The private entity, known as the "concessionaire" or "developer," bears the financial and operational risks associated with the project during the contract period.

The typical lifecycle of a BOT contract involves three phases:

Build: The concessionaire is responsible for financing, designing, and constructing the infrastructure project. This phase usually includes obtaining the necessary permits and approvals.

Operate: After the construction is completed, the concessionaire operates and maintains the facility for a specified duration. This can involve providing services, managing operations, and generating revenue from the facility (e.g., tolls, fees, or user charges).

Transfer: At the end of the contract period, the ownership and control of the facility are transferred back to the government or public authority, which may have been the original owner. The transfer is often accompanied by a predetermined valuation or compensation mechanism.

The private company gains revenue during the concession period, while the government benefits from infrastructure development without upfront investment.

However, the specifics of the financial arrangements and incentives vary depending on the individual BOT contract.

BOT is particularly well-suited for greenfield projects (new projects without prior work) and large-scale, capital-intensive projects.

Key Facts about National Highways Authority of India (NHAI)

NHAI is India's premier highway infrastructure creator, entrusted with developing, maintaining, and managing National Highways.

It is a statutory body under the administrative control of the Ministry of Road Transport and Highways.

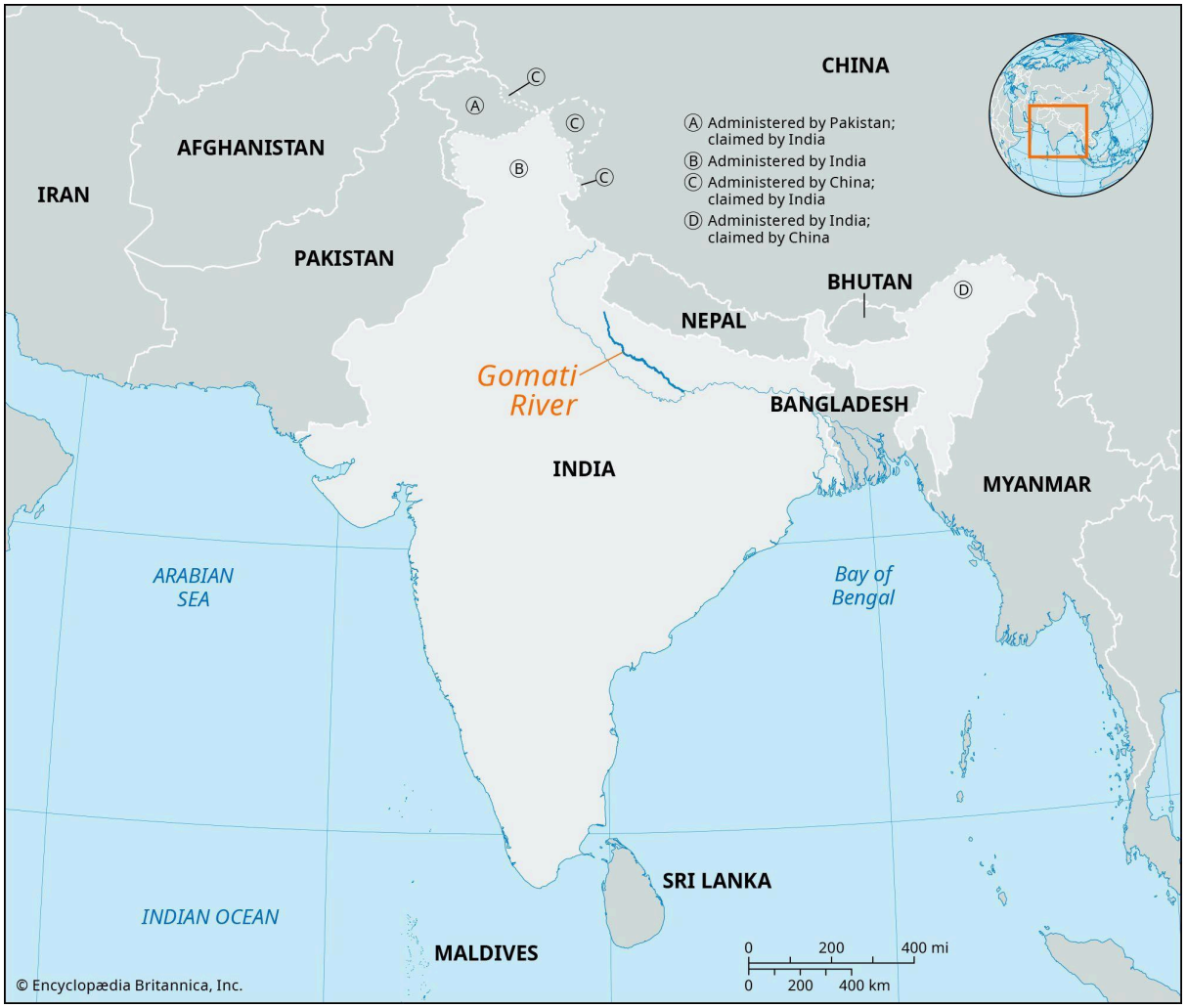
It was constituted under the National Highways Authority of India Act, 1998, and made operational in February 1995.

Composition: It consists of a full-time Chairman, and not more than five full time Members and four part-time members who are appointed by the Central Government.

NHAI has technical, Finance, Administrative and Vigilance Wings at its Headquarters.

Gomti River

Over 600 turtles seized from smugglers were released into the Gomti River recently.



About Gomti River

It is a tributary of the Ganges River.

Course:

Origin: It is an alluvial river that originates from the Gomat Taal, otherwise called Fulhaar Jheel, found near the Madho Tanda in Pilibhit district in Uttar Pradesh, India.

After flowing through an incised valley southwards through the districts of Sitapur, Lucknow, Barabanki, Sultanpur, and Jaunpur, it joins River Ganga near Varanasi.

The river extends to about 900 km.

The total drainage area of the river is 30,437 sq. km.

The characteristic of the river is perennial. The river is characterized by sluggish flow throughout the year, except during the monsoon season, when heavy rainfall causes a manifold increase in the runoff.

Major Cities: There are various cities that are situated on the banks of the River Gomti, such as Sultanpur, Lucknow, Jaunpur, and Lakhimpur Kheri.

Tributaries: Kathina, Bhainsi, Sarayan, Gon, Reth, Sai, Pili, and Kalyani.

The major tributaries of the Ganges River

Tributaries of Ganga include Ramganga, Gomti, Ghaghara, Gandak, Kosi and Mahananda from the left bank and Yamuna, Tamsa, Son and Punpun from the right bank.

Flue Gas Desulphurisation (FGD)

Overview:

The Union Minister for Power and New & Renewable Energy recently informed about the installation of Flue Gas De-sulphurisation (FGD) equipment in thermal power plants.

About Flue Gas De-sulphurisation (FGD)

It is a technology to eliminate sulfur dioxide (SO2) from exhaust emissions.

Where does Sulfur Dioxide come from?

Fossil fuels such as coal and oil often contain high amounts of sulfur, and when these fuels are burned, around 95% or more of the sulfur is converted to sulfur dioxide (SO2), which is emitted as flue gas.

Sulfur dioxide in itself is a major air pollutant which impacts all life. It is also a precursor of acid rain, which has significant adverse impacts on forests, freshwaters, and soils, in turn killing insect and aquatic life forms, causing paint to peel, corrosion of steel structures such as bridges, and weathering of stone buildings and statues.

The removal of sulfur dioxide is critical to establishing a safe and clean environment where toxic emissions are kept to a safe level.

FGD Process

FGD is done through the addition of absorbents, which can remove up to 95% of the sulphur dioxide from the flue gas.

Substances such as ammonia or sodium sulphite are used as absorbents; however, the use of lime or limestone slurry (wet limestone scrubbing) is also widespread.

The uncleaned flue gas is sprayed in a scrubber tower (absorber tower) with a mixture of water and limestone (scrubbing slurry), whereby most of the sulphur dioxide is bonded by chemical reaction.

limestone

Limestone is a sedimentary rock primarily composed of calcium carbonate ($CaCO_3$) in the form of mineral calcite or aragonite. It is one of the most common and widely distributed rocks on Earth, with a wide range of uses in various industries and natural settings.

Forever Chemicals

Researchers recently demonstrated a new lab-based method to detect traces of Forever Chemicals from food packaging material, water, and soil samples in just three minutes or less.

About Forever Chemicals

- PFAS (Per- and polyfluorinated alkyl substances), also known as the Forever Chemicals, are a large chemical family of over 4,700 highly persistent man-made chemicals.
- These were first developed in the 1940s and are now found in a variety of consumer products, including nonstick pans, water-resistant textiles, and fire suppression foams, due to their ability to repel both grease and water.
- PFAS are the most persistent synthetic chemicals to date. They hardly degrade in the natural environment and have been found in the blood of people and animals all over the world, and are present at low levels in a variety of food products.
- The secret to PFAS's indestructibility lies in its chemical bonds. PFAS contains many carbon-fluorine bonds, which are the strongest bonds in organic chemistry.
- These chemicals also cause pollution at every stage of production. At the PFAS chemical manufacturing facilities and garment factories, they often contaminate the air, water, and soil of the surrounding environment.

- Exposure to PFAS is linked to cancers, weakened immune systems among children, weight gain, and a wide range of other health problems.

SARTHI Portal

Recently, the union Minister of Agriculture and Farmers Welfare launched the Agri-Insurance Sandbox Framework Platform SARTHI and Learning Management System (LMS) Platform for the farming community under the Pradhan Mantri Fasal Bima Yojana (PMFBY) in Delhi.

About SARTHI Portal

Sandbox for Agricultural and Rural Security, Technology and Insurance (SARTHI) is the comprehensive digital insurance platform launched in collaboration with United Nations Development Programme (UNDP) India.

It extends coverage to health, life, home, shop, agriculture implements, motor, and parametric products.

It can be accessed via the AIDE app available on Android App Store.

This ambitious endeavour, aligned with the Sustainable Development Goals, not only aims to safeguard farmers' livelihoods but also to fortify the resilience of the agricultural sector as a whole.

Significance

It marks a significant advancement beyond traditional crop insurance, offering a diverse array of products tailored to farmers' needs.

By expanding insurance coverage to include vital assets like tractor machinery, SARTHI empowers farmers to comprehensively mitigate risks, securing their livelihoods and fostering long-term sustainability in agriculture.

Other initiatives

Learning Management System (LMS)

It is developed in collaboration with the National E-Governance Division (NeGD).

Its primary goal is to provide stakeholders, including farmers, insurance companies, Government officials, state Government representatives, and

participants in the Pradhan Mantri Fasal Bima Yojana (PMFBY), with the essential skills and knowledge needed for efficient crop insurance and agricultural credit.

The LMS will facilitate training and knowledge sharing through interactive modules, personalized training programs, and accessible resources. Stakeholders can deepen their understanding of agricultural practices, crop insurance protocols, and financial mechanisms.

NATURAL GAS FLARING

Natural Gas Flaring releases nitrogen oxides (NOx), which harm air quality and public health.

What is Natural Gas Flaring?

Natural gas flaring, also known as burning, is a common practice in the oil and gas industry where **excess natural gas, a byproduct of oil extraction, is burned off instead of being captured and utilized.**

This practice is often used when capturing or transporting the gas is deemed uneconomical or technically challenging.

While it reduces the climate impact and safety hazards of storing the gas on site, it releases nitrogen oxides (NOx) into the atmosphere, posing a significant air quality concern.

F3UEL Project and New Research

The **F3UEL project aims to improve US oil and gas emission estimates using data-driven approaches**. A recent study published in Environmental Science and Technology led by the University of Michigan directly measured NOx emissions from natural gas flares in three key regions, representing over 80% of US flared gas volumes.

Implications of the study

This research highlights the need for more accurate emission measurements to better understand the environmental impact of flaring.

It emphasizes the importance of targeting high-emission flares for mitigation strategies to reduce overall NOx emissions.

The findings suggest that reducing the volume of gas flared would have greater climate and air quality benefits than previously realized.

How much natural gas is flared?

According to the World Bank, **around 140 billion cubic meters of natural gas was flared globally in 2022**. This is equivalent to the annual gas consumption of Germany.

Where is natural gas flaring most common?

Natural gas flaring is most common in developing countries, where infrastructure is often lacking and regulations are weak. **The top five countries for gas flaring in 2022 were:**

Russia

Iraq

Iran

United States

Algeria

Environmental and Health impacts of flaring

Air pollution: Flaring produces various pollutants, including nitrogen oxides (NOx), which contribute to smog, ozone formation, and respiratory illnesses. This study highlights the concern that some flares emit NOx at much higher

rates than previously estimated, potentially impacting the health of workers and nearby communities.

Climate impact: While flaring reduces methane emissions compared to direct release, it still produces carbon dioxide, a greenhouse gas contributing to climate change.

Resource waste: Flaring represents a waste of valuable energy resources that could be captured and utilized for heating, electricity generation, or other purposes.

What is being done to reduce natural gas flaring?

Regulations: Some countries have implemented regulations that limit the amount of gas that can be flared. For example, the World Bank has a Zero Routine Flaring by 2030 initiative that aims to eliminate non-essential flaring.

Technology: New technologies are being developed to capture and use flared gas. For example, some companies are using gas flaring to generate electricity.

Market-based solutions: Some countries are using market-based mechanisms to encourage producers to capture and sell their gas. For example, some countries have implemented carbon taxes or emissions trading schemes.

Natural Gas Flaring

What is Natural Gas flaring?

- Natural gas flaring is the controlled burning of natural gas that is produced alongside oil during oil extraction. This gas, known as associated gas, is often burned off at oil wells because it is not economical or feasible to capture and transport it to market.
- Flaring is a common practice in the oil and gas industry, but it has significant environmental and economic consequences.

Why Natural Gas is flared?

- **Lack of infrastructure:** In some remote areas, there may not be pipelines or other infrastructure in place to capture and transport the gas. Building this infrastructure can be expensive, so producers may choose to flare the gas instead.
- **Low gas prices:** If the price of natural gas is low, it may not be economical to capture and sell the gas. In this case, producers may flare the gas to avoid paying taxes or royalties on it.
- **Safety concerns:** In some cases, flaring may be necessary for safety reasons. For example, if there is a leak or other problem at an oil well, flaring can help to prevent an explosion.

What are the impacts of Natural Gas flaring?

- **Climate change:** When natural gas is flared, it releases methane, a potent greenhouse gas, into the atmosphere. Methane is 80 times more effective at trapping heat than carbon dioxide, so flaring contributes to climate change.
- **Air pollution:** Flaring also releases other pollutants into the air, such as nitrogen oxides, sulfur oxides, and volatile organic compounds. These pollutants can cause respiratory problems, acid rain, and other health problems.
- **Waste of a valuable resource:** Natural gas is a valuable resource that could be used to generate electricity, heat homes, and power vehicles. Flaring this gas is a waste of energy and contributes to energy insecurity.
- **Public health:** People who live near flaring sites are more likely to experience respiratory problems, cancer, and other health problems.