

# Current Affairs 9<sup>th</sup> January 2024 by Saurabh Pandey

## Superconductivity & Meissner effect

### Superconductors: today and in the future

N. Nancheva  
University of Rousse  
Bulgaria

#### What is a Superconductor?

- A superconductor is a very pure metal, an alloy or a compound that allows electricity to be transmitted with minimal losses.
- A higher current flow may occur with lower energy losses than common conductors.
- Many elements can be coaxed into a superconductive state with the application of high pressure.

#### Type 1 Superconductors

- are very pure metals characterized as the "soft" superconductors
- were discovered first and require the coldest temperatures to become superconductive
- they exhibit a very sharp transition to a superconducting state and
- "perfect" **diamagnetism** - the ability to repel a magnetic field completely
- have too low critical magnetic field  $B_c$  and are not attractive to industry
- have different crystal lattices - FCC, BCC, HEX, TET, ORC, RHL
- BCS theory explains the behaviour of these superconductors by means of Cooper pairs

superconducting in different conditions metals, metallic compounds, ceramics, hydrides, etc.

- The Meissner effect is the expulsion of a magnetic field from a superconductor during its transition to the superconducting state when it is cooled below the critical temperature.
- This expulsion will repel a nearby magnet

- A group of scientists affiliated with research institutes in China and Japan have reported finding a sign of superconductivity in a material that was at the centre of a controversy last year over similar claims.

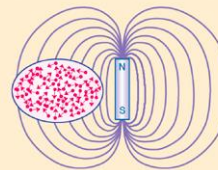
### What is the Meissner effect?

- The sign in question is called the Meissner effect.
- It is one of a few 'effects' certain materials exhibit when they're able to conduct electric currents without any resistance i.e. when they become superconductors.
- The researchers have reported in their paper that they observed the Meissner effect in a compound called copper substituted lead apatite.
- Scientists know many types of materials that become

## Meissner Effect

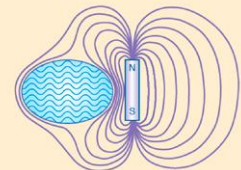
*An Example of Invincibility in the Quantum Physics of Superconductivity*

#### ORDINARY CONDUCTOR



In an ordinary electrical conductor, incoherent, disordered electrons allow penetration by an external magnetic field.

#### SUPERCONDUCTOR



In a superconductor, coherent collective functioning of the electrons spontaneously excludes an external magnetic field, and maintains its impenetrable status.

This example of invincibility is not unique in Nature: parallel phenomena of invincibility can be found in many aspects of the physical and biological sciences. In each case, it can be found that the ability of the system to resist disorder is always based on coherent collective functioning.

- They all have one thing in common: they become superconducting either when they're cooled to extremely low temperatures or when they're subjected to extremely high pressures.
- Many scientists are looking for a material that becomes superconducting at room temperature and pressure (RTP).

## Current Affairs 9<sup>th</sup> January 2024 by Saurabh Pandey

- Aside from scientific curiosity, such a material would have applications worth several billion dollars.
- It could be used to make wires that transport electricity with zero loss; such transmission losses are the largest source of electric energy loss in the world today.
- The material will also have uses in medical diagnostics, computing, power generation, advanced electronic circuits, and many other fields.
- For example, the water absorbing properties of modern diapers were first tested with particle accelerators, which use superconducting magnets to work.

The Hindu

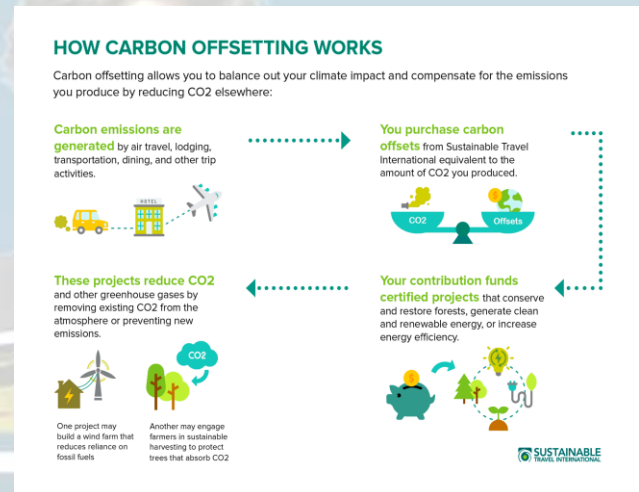
### South Korean researcher

- Another set focused on a material called LK99 that, a South Korean research group claimed, was an RTP superconductor.
- Independent studies soon found that when LK99 was prepared the way the South Korean group had indicated (albeit not clearly), it didn't become a superconductor.
- Instead, it acquired an impurity whose presence the group hadn't accounted for, and which distorted

measurements of the material's heat capacity and magnetism in a way an actual superconductor would have, misleading the scientists.

The Hindu

### Carbon offsetting



### Mulya Pravah

Mulya Pravah, which was notified in 2019. It seeks to inculcate human values and professional ethics in higher education institutions.

## Current Affairs 9<sup>th</sup> January 2024 by Saurabh Pandey

The stated intention is to build value-based institutions by orienting individuals and institutions towards developing a deep respect for fundamental duties and constitutional values and bonding with the country.

- The trigger is the findings of a survey of human resource managers which highlight unethical practices in various organizations.
- The most prominent of these are “favoritism in hiring, training, pay, and promotion; sexual harassment; gender discrimination in promotion; inconsistent view on discipline; lack of confidentiality; gender differentiation in compensation; nonperformance factors overlooked in appraisals; arrangements with vendors for personal gain; and gender discrimination during recruitment and hiring”

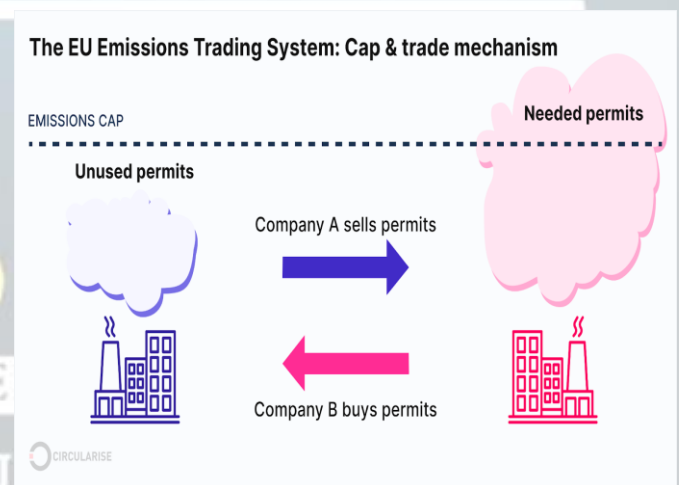
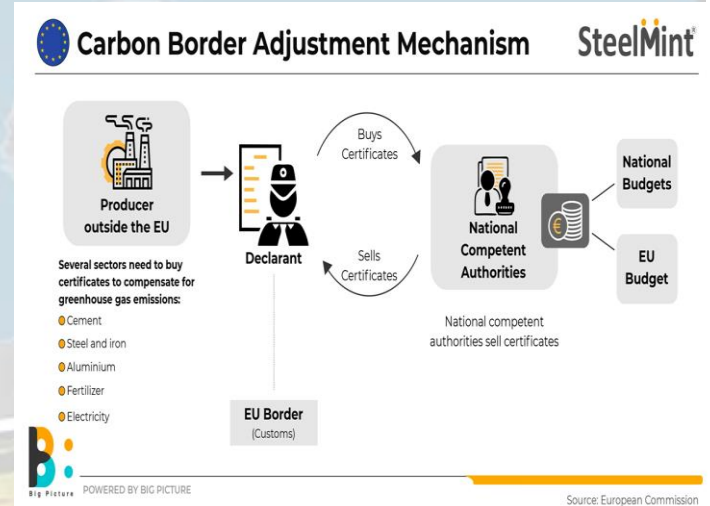
### Emphasis on transparency

- Mulya Pravah 2.0 underscores the need for utmost transparency in administration and highlights that decision-making in higher education institutions must be solely guided by institutional and public interest, and not be vitiated by biases.
- Higher education institutions must, in fact, be mandated to voluntarily

disclose all critical information and subject themselves to public scrutiny.

### • The Hindu

### • Carbon emission



### • European Union (EU)'s Carbon Border Adjustment Mechanism (CBAM).

- The policy, which intends to tax carbon intensive products coming into the EU from 2026, is divided into two phases, with the first phase



## Current Affairs 9<sup>th</sup> January 2024 by Saurabh Pandey

(transitional phase) kicking in from October 1, 2023.

- There has been constant exchange between the EU and India on the implications of the CBAM.

### What is CBAM?

The EU contended, while providing context for the CBAM, that it intends to achieve the target of a 55% reduction in greenhouse gas (GHG) emissions by 2030, compared to 1990 levels, under the European Green Deal.

- The CBAM is part of the package planned to achieve this.
- Second, there is a threat to EU products being replaced by carbon-intensive imports from other countries such as India or China.
- The EU argues that the higher standard of environmental compliance in its domestic industries will reduce their competitiveness.
- Thus, it intends to impose an import duty on carbon intensive industries from non EU countries to meet both these objectives.
- The CBAM is intended to work like the EU's Emission Trading System (ETS), which sets a cap on the amount of GHG emissions permitted.
- Under the EUETS, companies covered by the scheme have to 'buy'

allowances corresponding to their GHG emissions.

- Financial incentives are provided to them to cut emissions.
- But energy intensive industries receive free allowances to ensure their competitiveness.
- This is also a way of preventing carbon leakage, wherein carbon intensive production by EU based producers could move to non EU countries with lax environmental regulations.
- The CBAM has been pitched to replace this allocation of EUETS allowances.
- The CBAM's transitional phase will last until December 2025.
- In this stage, all EU manufacturers and importers of energy intensive industries will need to report the GHG emissions embedded in their imports without any financial obligations.
- From January 1, 2026, the CBAM will enter the definitive phase wherein, upon declaration of the emissions embedded in imports, the importers will be required to surrender annually the corresponding number of CBAM certificates

## Current Affairs 9<sup>th</sup> January 2024 by Saurabh Pandey

- India has just started working on its own carbon trading mechanism.
- In December 2022, it amended the Energy Conservation Act, 2001, to introduce the Carbon Credit Trading System (CCTS).
- This is proposed to combat climate change by incentivizing actions for emission reductions leading to increased investments in clean energy by the private sector.
- The Ministry of Power is still working on the specifics to operationalize the CCTS, including carbon valuation.
- It is principally designed to meet launch demands for the [U.S. government's National Security Space Launch](#) (NSSL) program for use by the [United States Space Force](#) and U.S. intelligence agencies for national security satellite launches.
- It will replace both of ULA's existing launchers ([Atlas V](#) and [Delta IV Heavy](#)) in this role, as these launchers are retiring. Vulcan Centaur will also be used for commercial launches, including an order for 38 launches from [Kuiper Systems](#).

### TERMS

The Hindu

### Lunar economy & ULA

- The first American spacecraft to attempt to land on the Moon in more than half a century is poised to blast off early Monday but this time, private industry is leading the charge.
- A brand new rocket, United Launch Alliance's Vulcan Centaur, lifted off from Cape Canaveral Space Force Station in Florida for its maiden voyage, carrying Astrobotic's Peregrine Lunar Lander
- Vulcan Centaur is a [two-stage-to-orbit, heavy-lift launch vehicle](#) developed by [United Launch Alliance \(ULA\)](#).
- A [two-stage-to-orbit \(TSTO\)](#) or two-stage rocket [launch vehicle](#) is a spacecraft in which two distinct [stages](#) provide propulsion consecutively in order to achieve orbital velocity.
- A [heavy-lift launch vehicle](#) is an orbital [launch vehicle](#) capable of generating a large amount of lift to reach its intended orbit. Heavy-lift launch vehicles generally are capable of lifting payloads between 20,000 to 50,000 kg (44,000 to 110,000 lb) (by [NASA](#) classification) or between 20,000 to 100,000 kilograms (44,000 to 220,000 lb) (by Russian classification) into [low Earth orbit \(LEO\)](#).

## Current Affairs 9<sup>th</sup> January 2024 by Saurabh Pandey

- As of 2023, operational heavy-lift launch vehicles include the [Long March 5](#), the [Proton-M](#), and the [Delta IV Heavy](#).
- United Launch Alliance, LLC, commonly referred to as ULA, is an American aerospace manufacturer, [defense contractor](#), and [launch service provider](#) that manufactures and operates [rocket](#) vehicles that launch spacecraft into orbits around [Earth](#) and other bodies in the [Solar System](#). ULA also designed and built the Interim Cryogenic Propulsion Stage for the [Space Launch System \(SLS\)](#).

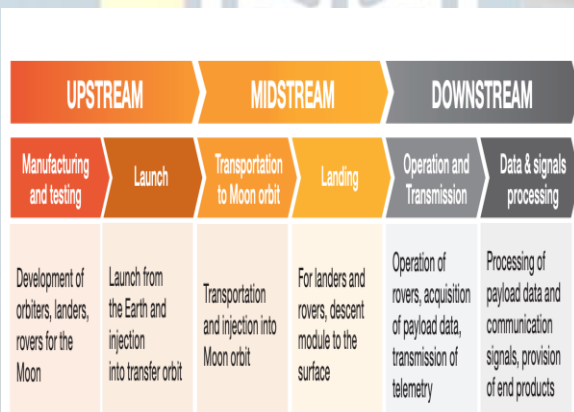


Figure 1 - Value chain for Lunar transportation market

- Significant steps were moved by the private sector into the wider space exploration domain (in lunar exploration, in Space Resources Utilization, or in the commercial exploitation of Low Earth Orbit)
- In 2015, NASA partnered with GM to develop a faster, more dexterous,

and more technologically advanced robot, Robonaut 2

- In 2016, PTS partnered with Audi to help build and launch a 3D printed rover.
- In 2019, JAXA and Toyota announced their collaboration on international space exploration.

### Mining Sector

- Remote-operating systems to minimize the danger in hazardous environments on Earth or in space.
- Mining technology and drills can be used to extract space resources.

- Technology transfer between the space sector and the O&G industry mainly for: robotics, advanced sensors, AI.

### Construction Sector

- The construction industry is expected to support the development of modern techniques that would enable building lunar habitats and structures in space while simultaneously facilitating the terrestrial industry in advancing 3D printing (additive manufacturing) capabilities

- Energy Sector**

## Current Affairs 9<sup>th</sup> January 2024 by Saurabh Pandey

- OxEon Energy worked with the Colorado School of Mines to integrate an electrolysis technology to process ice and separate the hydrogen and oxygen on the Moon.
- The molecules could then be cooled to produce fuel for cislunar transport.
- **Robotics Sector**

The energy industry and the robotics industry will also play vital roles in investing and developing lunar exploratory activities.

The Hindu

A man with glasses is reading a book. Above him is a yellow lightbulb icon. The book he is reading has 'INTERNAL SECURITY OF INDIA' visible on the cover.

---

# SAURABH PANDEY

# CSE

(CIVIL SERVICES EXAMINATION)

## FROM BASICS TO UPSC BRILLIANCE