Syllabus subtopic: Science and Technology - Developments and their Applications and Effects in Everyday Life.

Prelims and Mains focus: about the working of Li-ion battery: advantages and disadvantages; about India’s efforts to indigenously manufacture them

News: The Union Science Ministry responded to a query in Lok Sabha on India’s import of Li-ion batteries from 2016-18.

Background

- Indian manufacturers source Li-ion batteries from China, Japan and South Korea and the country is among the largest importers in the world.

- **China dominates the Li-ion battery market.** According to a report by BloombergNEF “. Around three-quarters of battery cell manufacturing capacity is in China, and Chinese companies have unparalleled control of required domestic and foreign battery raw materials and processing facilities.”

What figures did the ministry provide on battery imports?

- India has quadrupled its imports of lithium-ion (Li-ion) batteries and more than tripled its import bill on the product, vital for powering a range of devices from cellphones to electric vehicles, from 2016-2018.

- 175 million such batteries were imported in 2016, 313 million in 2017, 712 million in 2018 and 450 million from January 1, 2019, till November 30 of that year.

- The cost of these imports rose from $383 million (Rs.2,600 crore approx) in 2016 to $727.24 million (Rs.5,000 crore approx.) in 2017, $1254.94 million (Rs.8,700 crore) in 2018 and $929 million (Rs.6,500 crore) in 2019.
Indias efforts to manufacture Li-ion batteries

- To promote indigenous development of such batteries, the Union Cabinet in 2019 approved a programme, called a National Mission on Transformative Mobility and Battery Storage in the NITI Aayog to “drive clean, connected, shared, sustainable and holistic mobility initiatives.”

- Electric vehicles are expected to account for a significant share in the growth of the Li-ion battery demand in India though reports say this is unlikely at least until 2025, because electric cars are still significantly costlier than their combustion-engine counterparts. The government has announced investments worth $1.4 billion to make India one of the largest manufacturing hubs for electric vehicles by 2040.

- The Indian Space Research Organisation (ISRO) manufactures such batteries but volumes are limited and they are restricted for use in space applications.

- In June 2018, Central Electro Chemical Research Institute (CECRI) in Tamil Nadu’s Karaikudi, under the Council of Scientific & Industrial Research (CSIR) and RAASI Solar Power Pvt Ltd signed a Memorandum of Agreement for transfer of technology for India’s first lithium-ion (Li-ion) battery project.

About Li-ion battery

Li-ion battery (abbreviated as LIB) is a type of rechargeable battery. Lithium-ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications.

Components:

- Li-ion batteries use an intercalated lithium compound as one electrode material, compared to the metallic lithium used in a non-rechargeable lithium battery.

- The electrolyte, which allows for ionic movement, and the two electrodes are
the constituent components of a lithium-ion battery cell.

**Working:** In this, lithium ions move from the negative electrode to the positive electrode during discharge and back when charging.

**Advantages:**

- **High energy density:** With electronic equipment such as mobile phones needing to operate longer between charges while still consuming more power, there is always a need to batteries with a much higher energy density. In addition to this, there are many power applications from power tools to electric vehicles. The much higher power density offered by lithium ion batteries is a distinct advantage. Electric vehicles also need a battery technology that has a high energy density.

- **Self-discharge:** One issue with many rechargeable batteries is the self discharge rate. Lithium ion cells is that their rate of self-discharge is much lower than that of other rechargeable cells such as Ni-Cad and NiMH forms. It is typically around 5% in the first 4 hours after being charged but then falls to a figure of around 1 or 2% per month.

- **Low maintenance:** They do not require and maintenance to ensure their performance.

- **Cell voltage:** The voltage produced by each lithium ion cell is about 3.6 volts. This has many advantages. Being higher than that of the standard nickel cadmium, nickel metal hydride and even standard alkaline cells at around 1.5 volts and lead acid at around 2 volts per cell, the voltage of each lithium ion cell is higher, requiring less cells in many battery applications. For smartphones a single cell is all that is needed and this simplifies the power management.

- **Load characteristics:** The load characteristics of a lithium ion cell or battery are reasonably good. They provide a reasonably constant 3.6 volts per
cell before falling off as the last charge is used.

- **No requirement for priming:** Some rechargeable cells need to be primed when they receive their first charge. One advantage of lithium ion batteries is that there is no requirement for this they are supplied operational and ready to go.

- **Variety of types available:** There are several types of lithium ion cell available. This advantage of lithium ion batteries can mean that the right technology can be used for the particular application needed. Some forms of lithium ion battery provide a high current density and are ideal for consumer mobile electronic equipment. Others are able to provide much higher current levels and are ideal for power tools and electric vehicles.

**Disadvantages**

- **Protection required:** Lithium ion cells and batteries are not as robust as some other rechargeable technologies. They require protection from being over charged and discharged too far. In addition to this, they need to have the current maintained within safe limits. Accordingly one lithium ion battery disadvantage is that they require protection circuitry incorporated to ensure they are kept within their safe operating limits.

- **Ageing:** Lithium ion batteries suffer from ageing. Not only is this time or calendar dependent, but it is also dependent upon the number of charge discharge cycles that the battery has undergone. Often batteries will only be able to withstand 500 - 1000 charge discharge cycles before their capacity falls. With the development of li-ion technology, this figure is increasing, but after a while batteries may need replacing and this can be an issue if they are embedded in the equipment.

- **Transportation:** This li-ion battery disadvantage has come to the fore in recent years. Many airlines limit the number of lithium ion batteries they take, and this means their transportation is limited to ships.

- **Cost:** A major lithium ion battery disadvantage is their cost. Typically they are
around 40% more costly to manufacture than Nickel cadmium cells. This is a major factor when considering their use in mass produced consumer items where any additional costs are a major issue.

- **Developing technology:** Although lithium ion batteries have been available for many years, it can still be considered an immature technology by some as it is very much a developing area. This can be a disadvantage in terms of the fact that the technology does not remain constant. However as new lithium ion technologies are being developed all the time, it can also be an advantage as better solutions are coming available.