

## **GS Paper - 3**

### **Technology – Aug'18**

#### **RUCO Initiative**

*Syllabus: Science and Technology- developments and their applications and effects in everyday life*

#### **In News**

- The Food Safety and Standards Authority of India (FSSAI) has launched **RUCO (Repurpose Used Cooking Oil)**, an initiative that will enable **collection and conversion of used cooking oil to bio-diesel**.
- As of now, used cooking oil is either not discarded at all or is disposed in an environmentally hazardous manner & sometimes finds its way to smaller restaurants, dhaabas and street-vendors.
- FSSAI is also looking to introduce regulations to ensure that companies that use large quantities of cooking oil hand it over to registered collecting agencies to convert it into biofuel. E.g., McDonald's has already started converting used cooking oil to biodiesel from 100 outlets in Mumbai and Pune.
- The regulator believes India has the potential to recover 220 crore litres of used cooking oil for the production of biodiesel by 2022 through co-ordinated action.
- Further the regulations prescribe the **limit for Total Polar Compounds (TPC)** to be a **maximum 25%**, beyond which the cooking oil is unsafe for consumption.
- The ecosystem will serve as a word of caution to businesses and consumers to step back and stop usage of the cooking oil after repeated frying.
- FSSAI is also working in partnership with Biodiesel Association of India and food industry to ensure effective compliance of used cooking oil regulations. It will publish guidance documents, tips for consumers & posters in this regard & conduct awareness campaigns through its e-channels.
- FSSAI has additionally launched a **micro-site to monitor the progress** of the collection and conversion of used cooking oil into biodiesel.
- The regulator is implementing an **Education, Enforcement and Ecosystem (EEE) strategy** to divert UCO from the food value chain and curb current illegal practices. Thereby, ensuring good health and welfare of all its 130-crore citizens, aiding energy security, climate change mitigation, and leading to environmentally sustainable development.

#### **How Zika Virus Causes Microcephaly**

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### In News

- Scientists from National Brain Research Centre (NBRC) have successfully identified the molecular and cellular mechanisms by which Zika virus causes Microcephaly.
- The researchers found the envelop protein (E protein) of Zika virus, which is responsible for entry of virus into the brain stem cells and responsible for arresting proliferation of human foetal neural stem cells and also killing cells that were becoming neuron-like. The combined effect reduces the pool of foetal brain cells leading to smaller size of the brain.
- The study shows that neutralizing E protein of Zika virus can help prevent or reduce its harmful effects in developing foetus .The E protein can be seen as a likely therapeutic target.



### About Zika Virus

- Zika virus is a vector borne disease transmitted primarily by Aedes aegypti mosquitoes, which also transmits dengue. It can also spread through blood transfusion and sexual contact.
- It is capable of causing serious birth defects i.e. neurological disorders and foetal deformation known as Microcephaly in which infants are born with abnormally smaller heads.
- Besides, a possible link between the virus and Guillain-Barré syndrome (a condition in which the body's immune system attacks part of the nervous system) is also suspected.
- There is **no specific treatment or vaccine** currently available to treat Zika. The best form of prevention is protection against mosquito bites & clearing stagnant water where mosquitoes breed.

#### About National Brain Research Centre

- The National Brain Research Centre is a neuroscience research group, situated in Manesar in Gurgaon district.
- It is an Autonomous Government Institute accredited with the deemed university status and is a nodal center under Department of Biotechnology of the Ministry of Science and Technology.

### New Influenza Vaccine

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### In News

- India and European Union have collaborated on a research programme called the **Horizon 2020**.
- This programme will be used to develop the next generation of Influenza vaccine that will help in protecting people around the world. India's Department of Biotechnology (DBT) and EU have committed to 15 million Euros i.e. Rs. 240 crore for this research programme.

### What Is Horizon 2020 Research Project

- This project will focus on a cost-effective and affordable influenza vaccine that will be developed with the aims of advancing the efficacy, safety, duration of immunity, and reactivity against influenza strains.
- The vaccine will be developed by EU-India consortia. This effort will help at bringing together multi-disciplinary stakeholders who represent any part of the chain from lab to market and will comprise a minimum of three applicants from Europe or countries associated to EU programme Horizon 2020 and three applicants from India, where in other countries too are free to join these EU-India consortia.

### **What Will Be The Significance Of This Initiative**

This project will help in contributing to the achievement of a sustainable development goal 3 (SDG-3). It will ensure the health and well-being for all and also help the international community to prepare better in the event of an influenza pandemic.

### **Scientists Decode Complex Wheat Genome**

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#### **Background**

- Wheat is the most widely-cultivated crop on Earth. It provides more protein than meat in the human diet, and contributes about a fifth of calories consumed by humans. It also has a large and complex genome with 16 billion base pairs -- the building blocks of DNA -- which is more than five times larger than the human genome.
- But wheat is susceptible to drought and flood, and swathes of the crop are damaged each year by diseases such as wheat rust. The sequencing of its genome paves the way for much faster production of wheat varieties adapted to climate challenges, with higher yields, enhanced nutritional quality and improved sustainability.
- Sequencing the genome has long been a huge challenge. As well as its enormity, it has three sub-genomes and a large part of it is composed of repetitive elements. This means that vast parts of the genome are very similar, if not identical, to each other. This has made it difficult, until now, to distinguish each sub-genome and to put together the genome into its correct order
- Team of international researchers including 18 Indian scientists for first time has decoded wheat genome. In this research, DNA sequence of bread wheat was successfully ordered and it represents highest quality genome sequence generated to date for such wheat variety.

#### **Significance**

The research shows that bread wheat has complex hexaploid genome which is 40 times larger than that of rice genome and 5 times larger than human genome. Information generated by decoded wheat genome will help to identify genes controlling complex agronomic traits such as yield, grain quality, resistance to diseases and pests as well as tolerance to drought, heat, water logging and salinity. The availability of high quality reference genome will accelerate breeding of climate-resilient wheat varieties to feed ever-increasing world population and help address global food security in decades to come.

## **NASA's New Planet Hunting Probe - TESS**

*Syllabus: Awareness in the fields of IT, Space, Computers, robotics, nano-technology, bio-tech etc*

### **In News**

- NASA's latest planet hunting probe –**Transiting Exoplanet Survey Satellite (TESS)** – has started its search for new worlds around nearby stars.
- TESS is the next step in the search for planets outside of our solar system, including those that could support life. The mission will find Exoplanet that periodically block part of the light from their host stars, events called transits.
- TESS will survey 200,000 of the brightest stars near the sun to search for transiting Exoplanet. TESS launched on April 18, 2018, aboard a SpaceX Falcon 9 rocket.
- TESS scientists expect the mission will catalog thousands of planet candidates and vastly increase the current number of known Exoplanet. Of these, approximately 300 are expected to be Earth-sized and super-Earth-sized Exoplanet, which are worlds no larger than twice the size of Earth.

### **Mission Approach**

TESS will survey the entire sky over the course of two years by breaking it up into 26 different sectors. The powerful cameras on the spacecraft will stare at each sector for at least 27 days, looking at the brightest stars at a two-minute cadence. From Earth, the moon occupies half a degree, which is less than 1/9,000th the size of the TESS tiles.

### **The Transit Method**

The transit method of detecting Exoplanet looks for dips in the visible light of stars, and requires that planets cross in front of stars along our line of sight to them. Repetitive, periodic dips can reveal a planet or planets orbiting a star. Transit photometry, which looks at how much light an object puts out at any given time, can tell researchers a lot about a planet. Based on how much of a dip in light a planet causes in its star, we can determine that planet's size. Looking at how long it takes a planet to orbit its star, scientists are able to determine the shape of the planet's orbit and how long it takes the planet to circle its sun.

### **What Is an Exoplanet?**

All of the planets in our solar system orbit around the Sun. Planets that orbit around other stars are called Exoplanet. Exoplanet are very hard to see directly with telescopes. They are hidden by the bright glare of the stars they orbit.

## **ISRO Postpones Launch Of Chandrayaan-2 Mission**

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### **In News**

Indian Space Research Organisation (ISRO) has postponed Chandrayaan-2, India's second mission to moon to January 2019. This will be second time mission has been postponed.

### **Chandrayaan 2 Mission**

- Chandrayaan-2 is India's most challenging and India's second mission to Moon. It is advanced version of previous Chandrayaan-1 mission (launched in 2008) which only involved orbiting

around moon, Chandrayaan-2 is much complicated mission as it involves an orbiter, lander and rover.

- Chandrayaan 2 will be launched on board of Geosynchronous Satellite Launch Vehicle Mk III (GSLV-F10). It will be ISRO's first inter-planetary mission to land rover on any celestial body.
- The spacecraft (orbiter) weighs around 3,290 kg and it will orbit around moon and perform objectives of remote sensing moon.
- The six wheeled rover will move on unexplored lunar surface and collect soil or rock samples for on-site chemical analysis to gather scientific information on lunar topography, mineralogy, elemental abundance, lunar exosphere and signatures of hydroxyl and water-ice. The data will be relayed to Earth through orbiter. The rover will move around landing site in semi-autonomous mode as decided by the ground commands.
- The soft-landing on the lunar surface of the moon will be most complex part of Chandrayaan 2 mission. Only US, Russia and China have been able to soft land spacecraft on lunar surface.

### **Roadmap For Manned Flight To Space**

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#### **In News**

- Indian Space Research Organization (ISRO) unveiled details of its first indigenous human space mission dubbed as Gaganyaan to be launched in 2022. The mission was announced by Prime Minister during his 72nd Independence Day speech. Under it, three Indian astronauts (Gaganyatris) will be taken to space on board Gaganyaan spacecraft by 2022.
- This will be the first human space mission to be indigenously developed by ISRO. If successful, India will become fourth nation in the world to send astronaut into space after US, Russia and China. Former Indian Air Force (IAF) Rakesh Sharma was first Indian to travel to space. He was part of the Soviet Union's Soyuz T-11 expedition, launched on April 2, 1984, of the Intercosmos programme.

#### **Objectives of Gaganyaan Mission**

Enhancement of science and technology levels in the country, serve as national project involving several institutes, academia and industry, improve of industrial growth, inspire youth, develop technology for social benefits and improve international collaboration.

#### **Key Features of Mission**

**Launch Phase:** GSLV Mk-III launch vehicle will be used to launch Gaganyaan as it has necessary payload capability for this mission. It weighs approximately 7 tonnes and will be placed in low earth orbit (LEO) of 300-400 km.

**Orbital Phase:** The mission will send three-member crew to space for period of five to seven days. The launch vehicle will take off from spaceport of Sriharikota, Andhra Pradesh and it will reach desired orbit in 16 minutes. The crew will be selected by Indian Air Force (IAF) and ISRO jointly after which they will undergo training for two-three years. It will conduct microgravity experiment during the mission.

**Re-entry phase:** The velocity of whole module will be reduced and will be turned in opposite direction so that it can start to come down. When it will reach distance of 120 km from Earth's surface, service module will be removed and separated out. The module carrying crew alone will

come back to earth, this will take about 36 minutes to reach Earth. ISRO is planning to land crew module in Arabian Sea, closer to Gujarat coast or in Bay of Bengal or even on land from where the crew will be recovered.

### **World's First Wind-Sensing Satellite**

*Syllabus: Awareness in the fields of IT, Space, Computers, robotics, nano-technology, bio-tech etc*

#### **In News**

- European Space Agency (ESA) successfully launched wind-sensing satellite named 'Aeolus' into orbit on board of Vega rocket from French Guyana.
- It is world's first wind-sensing satellite dedicated to map Earth's wind on global scale in particular tropical winds which are very poorly mapped.
- The satellite is named after guardian of wind in Greek mythology. It will be placed at altitude of 320km above the Earth. It is part of the **Copernicus project**, a joint initiative of European Union (EU) and European Space Agency (ESA) to track environmental damage and aid disaster relief operations.

### **OSIRIS-REX SPACECRAFT**

*Syllabus: Awareness in the fields of IT, Space, Computers, robotics, nano-technology, bio-tech etc*

#### **In News**

- After an almost two-year journey through space, **NASA's Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer** (OSIRIS-REx) caught its first glimpse of Benu, a carbonaceous asteroid whose makeup may record the earliest history of our Solar System and began the final approach toward the asteroid.
- Using its multipurpose **PolyCam camera**, the spacecraft obtained the image of Benu from a distance of 1.4 million miles (2.2 million km), or almost six times the distance between the Earth and Moon.
- OSIRIS-REx, led by the University of Arizona's Lunar and Planetary Laboratory, is the first U.S mission to retrieve a sample from an asteroid and return it Earth for study. The material it returns will be the largest sample brought back from space since the Apollo era.
- The spacecraft is scheduled to reach small, roundish asteroid in 2018 and return to Earth after collecting some of its gravels by 2023. OSIRIS-Rex will capture 60 grams dirt and debris from surface of asteroid using its robotic arm without landing i.e. by hovering like hummingbird stirred up by nitrogen gas thrusters and then to Earth for detailed analysis of the collected samples.
- After arrival at Benu, OSIRIS-Rex spacecraft will spend first month performing flybys of asteroid's North Pole, equator and South Pole at distances ranging between 19 and 7 kilometers from it.
- These manoeuvres will allow for first direct measurement of Benu's mass as well as close-up observations of surface. These trajectories will also provide the mission's navigation team with experience navigating near the asteroid.

#### **Benu**



Bennu is near-Earth carbonaceous asteroid about the size of a small mountain in the Apollo group. It was discovered in September 1999 by the LINEAR Project. It is carbon-rich asteroid and believed to be the type of asteroids that may have chemical building blocks of life, along with lots of water. So, analysis of returned sample from it could help to reveal key insights about early solar system and the origin of life on Earth. It is potentially hazardous asteroid and there is very slight chance it could strike into Earth in the late 22nd century.

### **First Single-Chromosome Yeast**

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#### **In News**

Chinese scientists claimed to have created the first single-chromosome yeast while not affecting the majority of its functions.

#### **Key Highlights**

- Brewer's yeast, one-third of whose genome is said to share ancestry with humans, has 16 chromosomes. However, Chinese scientists have managed to fit nearly all its genetic material into just one chromosome while not affecting the majority of its functions.
- **The researchers used CRISPR-Cas9 genome-editing to create a single-chromosome yeast strain.** Using the CRISPR-Cas9, the research team removed the DNA at the telomeres, the ends of chromosomes that protect them from degrading.
- They also snipped out the centromeres, sequences in the middle that are important to DNA replication. First, they fused two chromosomes, then joined the product to another chromosome, and repeated the process in successive rounds until there was only one chromosome left.

#### **Significance**

- By simplifying a complex genome system, the research provides a new approach to studying the functions of telomeres. Earlier research found that the length of telomeres is related to early aging, the formation of tumours, and other diseases. Telomeres shorten as a cell splits, but if telomeres cannot shorten anymore, the cell dies. Hence, the breakthrough could help in furthering research related to aging and diseases in humans. It may also pave the way for new man-made species in the future.
- It showed that all the genetic information can be concentrated in just one chromosome.

#### **What is yeast**

- Yeast is a plant, according to the biologists, and is capable of reproducing itself. A piece of yeast consists of minute cells, with walls composed of cellulose, and an interior of living matter called protoplasm.
- One can feed it with a solution of sugar to make it grow, or it can be 'killed' by 'starvation' or heat, so Yeast are microscopic, single-celled organisms that are classified in the family Fungi.
- Individual yeast cells multiply rapidly by the process of budding, in which a new cell begins as a small bulge along the cell wall of a parent cell.
- In the presence of an abundant food source, huge populations of yeast cells gather. The cells often appear as long chains with newly formed cells still attached to their parent cells, due to the short budding time of two hours.

## **RISECREEK**

*Syllabus: Indigenization of technology and developing new technology.*

### **In News**

- Computer scientists from Indian Institute of Technology (IIT), Madras have **developed the first of family of six industry-standard microprocessors** under **Project Shakti**.
- Project Shakti was started in 2014 as IIT-M initiative and part of it is funded by Ministry of Electronics and Information Technology.

### **About RISECREEK Microprocessors**

- Their design is an open source and can be adapted by others.
- They optimize power use and compete with international units such as Cortex A5 from Advanced RISC Machines (ARM).
- They have better performance in terms of DMIPS [*Dhrystone MIPS (Million Instructions per Second), or DMIPS, is a measure of computer performance relative to the performance of the DEC VAX 11/780 minicomputer of the 1970s]* per megahertz.
- These viable industry-grade **microprocessors can operate at a frequency of 350 MHz**, thus meets demands of defence and strategic equipment of the country such as **NAVIC (Indian Regional Navigation Satellite) and Internet of Things (IoT) electronics**.
- These processors can also be tapped for future efforts in semiconductors.

## **Thermal Battery Plant Unveiled In Andhra**

*Syllabus: Indigenization of technology and developing new technology.*

### **In News**

- In a bid to go green, the world's first thermal battery plant will be unveiled in Andhra Pradesh.
- The battery plant will be operated by the Bharat Energy Storage Technologies Pvt Ltd (BEST) and is seen as a great alternative to the energy produced using fossil fuels.

### **Key Highlights**

- Hailed as the perfect alternative to non-renewable energy sources, thermal energy is considered to be even better than solar energy. Solar batteries cannot be charged or utilized to their optimum potential after sunset or even when the skies are densely clouded.
- Lithium batteries, which are widely used currently, have a heavy carbon footprint and can be expensive as they only last approximately 6-7 years. They will be priced at par with the Lithium batteries but will have a low carbon footprint and also last longer.
- BEST plans to make their plant in Andhra Pradesh a 100% eco-friendly one. For this purpose, they will use no hard metals in their plant and no inflammable substances. Instead, they are using equipment that comprises 95% re-usable materials.
- These thermal batteries will be produced to store energy to power telecommunications, commercial enterprises and charging systems. They will also charge electric buses that are expected to run as far as 800km on a single charge.



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*Syllabus: Awareness in the fields of IT, Space, Computers, robotics, nano-technology, bio-tech etc*

#### **In News**

- European Space Agency (ESA) successfully launched wind-sensing satellite named 'Aeolus' into orbit on board of Vega rocket from French Guyana.
- It is world's first wind-sensing satellite dedicated to map Earth's wind on global scale in particular tropical winds which are very poorly mapped.
- The satellite is named after guardian of wind in Greek mythology. It will be placed at altitude of 320km above the Earth. It is part of the **Copernicus project**, a joint initiative of European Union (EU) and European Space Agency (ESA) to track environmental damage and aid disaster relief operations.

### **OSIRIS-REX SPACECRAFT**

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#### **In News**

- After an almost two-year journey through space, **NASA's Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer** (OSIRIS-REx) caught its first glimpse of Benu, a carbonaceous asteroid whose makeup may record the earliest history of our Solar System and began the final approach toward the asteroid.
- Using its multipurpose **PolyCam camera**, the spacecraft obtained the image of Benu from a distance of 1.4 million miles (2.2 million km), or almost six times the distance between the Earth and Moon.
- OSIRIS-REx, led by the University of Arizona's Lunar and Planetary Laboratory, is the first U.S mission to retrieve a sample from an asteroid and return it Earth for study. The material it returns will be the largest sample brought back from space since the Apollo era.
- The spacecraft is scheduled to reach small, roundish asteroid in 2018 and return to Earth after collecting some of its gravels by 2023. OSIRIS-Rex will capture 60 grams dirt and debris from surface of asteroid using its robotic arm without landing i.e. by hovering like hummingbird stirred up by nitrogen gas thrusters and then to Earth for detailed analysis of the collected samples.
- After arrival at Benu, OSIRIS-Rex spacecraft will spend first month performing flybys of asteroid's North Pole, equator and South Pole at distances ranging between 19 and 7 kilometers from it.
- These manoeuvres will allow for first direct measurement of Benu's mass as well as close-up observations of surface. These trajectories will also provide the mission's navigation team with experience navigating near the asteroid.

#### **Benu**



Bennu is near-Earth carbonaceous asteroid about the size of a small mountain in the Apollo group. It was discovered in September 1999 by the LINEAR Project. It is carbon-rich asteroid and believed to be the type of asteroids that may have chemical building blocks of life, along with lots of water. So, analysis of returned sample from it could help to reveal key insights about early solar system and the origin of life on Earth. It is potentially hazardous asteroid and there is very slight chance it could strike into Earth in the late 22nd century.

### **First Single-Chromosome Yeast**

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#### **In News**

Chinese scientists claimed to have created the first single-chromosome yeast while not affecting the majority of its functions.

#### **Key Highlights**

- Brewer's yeast, one-third of whose genome is said to share ancestry with humans, has 16 chromosomes. However, Chinese scientists have managed to fit nearly all its genetic material into just one chromosome while not affecting the majority of its functions.
- **The researchers used CRISPR-Cas9 genome-editing to create a single-chromosome yeast strain.** Using the CRISPR-Cas9, the research team removed the DNA at the telomeres, the ends of chromosomes that protect them from degrading.
- They also snipped out the centromeres, sequences in the middle that are important to DNA replication. First, they fused two chromosomes, then joined the product to another chromosome, and repeated the process in successive rounds until there was only one chromosome left.

#### **Significance**

- By simplifying a complex genome system, the research provides a new approach to studying the functions of telomeres. Earlier research found that the length of telomeres is related to early aging, the formation of tumours, and other diseases. Telomeres shorten as a cell splits, but if telomeres cannot shorten anymore, the cell dies. Hence, the breakthrough could help in furthering research related to aging and diseases in humans. It may also pave the way for new man-made species in the future.
- It showed that all the genetic information can be concentrated in just one chromosome.

#### **What is yeast**

- Yeast is a plant, according to the biologists, and is capable of reproducing itself. A piece of yeast consists of minute cells, with walls composed of cellulose, and an interior of living matter called protoplasm.
- One can feed it with a solution of sugar to make it grow, or it can be 'killed' by 'starvation' or heat, so Yeast are microscopic, single-celled organisms that are classified in the family Fungi.
- Individual yeast cells multiply rapidly by the process of budding, in which a new cell begins as a small bulge along the cell wall of a parent cell.
- In the presence of an abundant food source, huge populations of yeast cells gather. The cells often appear as long chains with newly formed cells still attached to their parent cells, due to the short budding time of two hours.

## **RISECREEK**

*Syllabus: Indigenization of technology and developing new technology.*

### **In News**

- Computer scientists from Indian Institute of Technology (IIT), Madras have **developed the first of family of six industry-standard microprocessors** under **Project Shakti**.
- Project Shakti was started in 2014 as IIT-M initiative and part of it is funded by Ministry of Electronics and Information Technology.

### **About RISECREEK Microprocessors**

- Their design is an open source and can be adapted by others.
- They optimize power use and compete with international units such as Cortex A5 from Advanced RISC Machines (ARM).
- They have better performance in terms of DMIPS [*Dhrystone MIPS (Million Instructions per Second), or DMIPS, is a measure of computer performance relative to the performance of the DEC VAX 11/780 minicomputer of the 1970s]* per megahertz.
- These viable industry-grade **microprocessors can operate at a frequency of 350 MHz**, thus meets demands of defence and strategic equipment of the country such as **NAVIC (Indian Regional Navigation Satellite) and Internet of Things (IoT) electronics**.
- These processors can also be tapped for future efforts in semiconductors.

## **Thermal Battery Plant Unveiled In Andhra**

*Syllabus: Indigenization of technology and developing new technology.*

### **In News**

- In a bid to go green, the world's first thermal battery plant will be unveiled in Andhra Pradesh.
- The battery plant will be operated by the Bharat Energy Storage Technologies Pvt Ltd (BEST) and is seen as a great alternative to the energy produced using fossil fuels.

### **Key Highlights**

- Hailed as the perfect alternative to non-renewable energy sources, thermal energy is considered to be even better than solar energy. Solar batteries cannot be charged or utilized to their optimum potential after sunset or even when the skies are densely clouded.
- Lithium batteries, which are widely used currently, have a heavy carbon footprint and can be expensive as they only last approximately 6-7 years. They will be priced at par with the Lithium batteries but will have a low carbon footprint and also last longer.
- BEST plans to make their plant in Andhra Pradesh a 100% eco-friendly one. For this purpose, they will use no hard metals in their plant and no inflammable substances. Instead, they are using equipment that comprises 95% re-usable materials.
- These thermal batteries will be produced to store energy to power telecommunications, commercial enterprises and charging systems. They will also charge electric buses that are expected to run as far as 800km on a single charge.