

ENVIRONMENT❖ **What it will take to fulfill India's solar power dream**❖ **CONTEXT: Solar photovoltaics (PV) have driven India's push towards the adoption of cleaner energy generation technologies. From less than 10 MW in 2010, India has added significant PV capacity over the past decade, achieving over 50 GW by 2022.**

- By 2030, India is targeting about 500 GW of renewable energy deployment, out of which ~280 GW is expected from solar PV. This necessitates the deployment of nearly 30 GW of solar capacity every year until 2030.
- However, there are challenges that need to be overcome for the sustainability of the PV economy. Indian solar deployment or installation companies depend heavily on imports, as India currently does not have enough module and cell manufacturing capacity.

❖ **Key components**

- A typical solar PV value chain consists of first fabricating polysilicon ingots which need to be transformed into thin Si wafers that are needed to manufacture the PV mini-modules. The mini-modules are then assembled into market-ready and field-deployable modules.
- India's current solar module manufacturing capacity is limited to ~15 GW per year. The demand-supply gap widens as we move up the value chain — for example, India only produces ~3.5 GW of cells currently. India has no manufacturing capacity for solar wafers and polysilicon ingots, and currently imports 100% of silicon wafers and around 80% of cells even at the current deployment levels.
- Also, out of the 15 GW of module manufacturing capacity, only 3-4 GW of modules are technologically competitive and worthy of deployment in grid-based projects. India remains dependent on import of solar modules for field deployment.

❖ **Current govt policy**

- The government has identified this gap, and is rolling out various policy initiatives to push and motivate the industry to work towards self-reliance in solar manufacturing, both for cells and modules. Key initiatives include a 40% duty on the import of modules and 25% duty on the import of cells, and a PLI scheme to support manufacturing capex.
- Also, it is mandatory to procure modules only from an approved list of manufacturers (ALMM) for projects that are connected to state/ central government grids; so far, only India-based manufacturers have been approved. While this will certainly help to motivate industry, the major challenges are related to size and technology.

❖ **Size and technology**

- Most of the Indian industry is currently tuned to handling M2 wafer size, which is roughly 156 x 156 mm², while the global industry is already moving towards M10 and M12 sizes, which are 182 x 182 mm² and 210 x 210 mm² respectively. The bigger size has an advantage in terms of silicon cost per wafer, as this effectively means lower loss of silicon during ingot to wafer processing.
- In terms of cell technology, most of the manufacturing still uses Al-BSF technology, which can typically give efficiencies of ~18-19% at the cell level and ~16-17% at the module level. By contrast, cell manufacturing worldwide has moved to PERC (22-23%), HJT(~24%), TOPCON (23-24%) and other newer technologies, yielding module efficiency of >21%.
- Producing more solar power for the same module size means more solar power from the same land area. Land, the most expensive part of solar projects, is scarce in India — and Indian industry has no choice but to move towards newer and superior technologies as part of expansion plans.

❖ **Raw materials supply**

- There is a huge gap on the raw material supply chain side as well. Silicon wafer, the most expensive raw material, is not manufactured in India. India will have to work on technology tie-ups to make the right grade of silicon for solar cell manufacturing — and since >90% of the world's solar wafer manufacturing currently happens in China, it is not clear how and where India will get the technology.
- Other key raw materials such as metallic pastes of silver and aluminium to form the electrical contacts too, are almost 100% imported. India is more of an assembly hub than a manufacturing one, and in the long term, it would be beneficial to move up the value chain by making components that could drive the price and quality of both cells and modules.

❖ **Academics plus industry**

- Establishing state-of-the-art manufacturing facilities for cells, modules, and raw material needs access to technology. It is unlikely that companies that have spent millions of dollars on in-house and external R&D would make it easy for India to access the latest technologies easily or at a lower cost.
- India has hardly invested in creating high-quality high-TRL technology centres such as IMEC Belgium or the Holst Centre in the Netherlands, which can help the industry to try and test the technologies in a cost-effective manner.
- India needs to create such industry-like centres to work on specific technology domains with clear roadmaps and deliverables for the short and long term, monitored by a right mix of specialists from industry and academia.

❖ **Conclusion**

- Although India is making great progress in the deployment of solar PV modules for power generation, its path to become a manufacturing hub for the same requires more than just putting some tax barriers and commercial incentives in the form of PLI schemes, etc. It will warrant strong industry-academia collaboration in an innovative manner to start developing home-grown technologies which could, in the short-term, work with the industry to provide them with trained human resource, process learnings, root-cause analysis through right testing and, in the long term, develop India's own technologies. High-end technology development requires substantial investment in several clusters which operate in industry-like working and management conditions, appropriate emoluments, and clear deliverables

PRELIMS

1. Recalling 'Quit India', when ordinary Indians took to the streets with a vow to 'Do or Die'

❖ **CONTEXT: 80 years ago — on August 9, 1942 — the people of India launched the decisive final phase of the struggle for independence. It was a mass upsurge against colonial rule on a scale not seen earlier, and it sent out the unmistakable message that the sun was about to set on the British Empire in India.**

- Mahatma Gandhi, who had told the Raj to "Quit India" on the previous day (August 8) was already in jail along with the entire Congress leadership, so when August 9 dawned, the people were on their own — out on the street, driven by the Mahatma's call of "Do or Die".
- This truly people-led movement was eventually crushed violently by the British, but by then it was clear that nothing short of their final departure was acceptable to India's masses.

❖ **Build-up to August 1942**

- While factors leading to such a movement had been building up, matters came to a head with the failure of the Cripps Mission.
- With World War II raging, the beleaguered British government needed the cooperation of its colonial subjects. With this in mind, in March 1942, a mission led by Sir Stafford Cripps arrived in India to meet leaders of the Congress and the Muslim League. The idea was to secure India's whole-hearted support in the war, and the return offer to Indians was the promise of self-governance.
- But things did not go that way. Despite the promise of "the earliest possible realisation of self-government in India", Cripps only offered dominion status, not freedom. Also, there was a provision for the partition of India, which was not acceptable to the Congress.
- The failure of the Cripps Mission made Gandhi realise that freedom would come only if Indians fought tooth and nail for it. The Congress was initially reluctant to launch a movement that could hamper Britain's efforts to defeat the fascist forces. But it eventually decided on mass civil disobedience. At the Working Committee meeting in Wardha in July 1942, it was decided the time had come for the movement to move into an active phase.

❖ **Gandhi's address: Do or Die**

- On August 8, 1942, Gandhi addressed the people in the Gowalia Tank maidan in Bombay (Mumbai) and call for
- 'Do or Die'. Aruna Asaf Ali hoisted the Tricolour on the ground. The Quit India movement had been officially announced.
- The government cracked down immediately, and by August 9, Gandhi and all other senior Congress leaders had been jailed. Gandhi was taken to the Aga Khan Palace in Poona (Pune), and later to Yerwada jail. It was during this time that Kasturba Gandhi died at the Aga Khan Palace.

❖ **The people vs. the Raj**

- The arrest of their leaders failed to deter the masses. With no one to give directions, people took the movement into their own hands.

- In Bombay, Poona, and Ahmedabad, hundreds of thousands of ordinary Indians clashed with the police. The following day (August 10), protests erupted in Delhi, UP, and Bihar. There were strikes, demonstrations and people's marches in defiance of prohibitory orders in Kanpur, Patna, Varanasi, and Allahabad.
- The protests spread rapidly into smaller towns and villages. Till mid-September, police stations, courts, post offices, and other symbols of government authority came under repeated attack. Railway tracks were blocked, students went on strike in schools and colleges across India, and distributed illegal nationalist literature. Mill and factory workers in Bombay, Ahmedabad, Poona, Ahmednagar, and Jamshedpur stayed away for weeks.
- In some places, the protests were violent. Bridges were blown up, telegraph wires were cut, and railway lines were taken apart.

❖ **The slogan 'Quit India'**

- While Gandhi gave the clarion call of Quit India, the slogan was coined by Yusuf Meherally, a socialist and trade unionist who also served as Mayor of Bombay. A few years ago, in 1928, it was Meherally who had coined the slogan "Simon Go Back".

❖ **Brutal suppression of protests**

- The Quit India movement was violently suppressed by the British — people were shot and lathi charged, villages were burnt, and backbreaking fines were imposed. In the five months up to December 1942, an estimated 60,000 people had been thrown into jail.
- However, though the movement was quelled, it changed the character of the Indian freedom struggle, with the masses rising up to demand with a passion and intensity like never before: that the British masters would have to Quit India.

2. Indian Virtual Herbarium

❖ **CONTEXT: Recently, the Union Environment Minister inaugurated India's largest online herbarium database, the 'Indian Virtual Herbarium' web portal.**

- Indian Virtual Herbarium is the biggest virtual database of flora in the country, as it contains details of about one lakh plant specimens. It was developed by the scientists of the Botanical Survey of India (BSI).
- Each record in the digital herbarium includes an image of the preserved plant specimen, scientific name, collection locality and date, collector name, and barcode number.
- The digital herbarium also includes features to extract the data State-wise and users can search plants of their own States which will help them to identify regional plants and in building regional checklists.
- The digital herbarium has some of the oldest botanical specimens dating as early as 1696.
- The herbarium provides information on plants in different categories such as Cryptogams (spore bearing plants). Phanerogams (seed bearing plants). Both the groups are again divided into two categories which includes general specimen and type specimens.

❖ **Herbarium**

- The Herbarium is a collection of dried plant specimens that are stored, catalogued, and arranged by family, genus and species for study. Herbaria are the "dictionaries" of the plant kingdom and provide comparative material that is indispensable for studies in plant taxonomy and systematics. Herbarium collections are often housed in botanical gardens, arboretums, natural history museums, and universities.
- The Botanical Survey of India, by 2024, plans to provide a platform to all the herbaria in the country, so that they can display their herbarium collection on the platform.

3. PESA Act

❖ **CONTEXT: Aam Aadmi Party (AAP) leader Arvind Kejriwal declared a six-point "guarantee" for tribals in Gujarat's Chhota Udepur district, including the "strict implementation" of The Panchayats (Extension to the Scheduled Areas) Act (PESA Act).**

- The PESA Act was enacted in 1996 "to provide for the extension of the provisions of Part IX of the Constitution relating to the Panchayats to the Scheduled Areas". (Other than Panchayats, Part IX, comprising Articles 243-243ZT of the Constitution, contains provisions relating to Municipalities and Cooperative Societies.)
- Under the PESA Act, Scheduled Areas are those referred to in Article 244(1), which says that the provisions of the Fifth Schedule shall apply to the Scheduled Areas and Scheduled Tribes in states other than Assam, Meghalaya, Tripura, and Mizoram. The Fifth Schedule provides for a range of special provisions for these areas.

❖ **How is the PESA Act, 1996 supposed to work?**

- The PESA Act was enacted to ensure self-governance through Gram Sabhas (village assemblies) for people living in the Scheduled Areas. It recognises the right of tribal communities, who are residents of the Scheduled Areas, to govern themselves through their own systems of self-government, and also acknowledges their traditional rights over natural resources.
- In pursuance of this objective, the Act empowers Gram Sabhas to play a key role in approving development plans and controlling all social sectors. This includes the processes and personnel who implement policies, exercising control over minor (non-timber) forest resources, minor water bodies and minor minerals, managing local markets, preventing land alienation and regulating intoxicants among other things.
- State governments are expected to amend their respective Panchayati Raj Acts without making any law that would be inconsistent with the mandate of PESA.
- Ten states — Andhra Pradesh, Chhattisgarh, Gujarat, Himachal Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, and Telangana — have notified Fifth Schedule areas that cover (partially or fully) several districts in each of these states.
- After the PESA Act was enacted, the central Ministry of Panchayati Raj circulated model PESA Rules. So far, six states have notified these Rules, including Gujarat.

❖ **Provisions**

- Based on Dilip Singh Bhuria committee report, it was enacted on 24 December 1996 to extend the provisions of Part IX of the Constitution to Scheduled Areas, with certain exceptions and modifications.
- Scheduled Areas means the Scheduled Areas as referred to in Clause (1) of Article 244[4] of the Constitution.
- These are areas identified by the Fifth Schedule of the Constitution of India.
- These areas are found in ten states of India which have a predominant population of tribal communities. They are Andhra Pradesh (including Telangana), Chhattisgarh, Gujarat, Himachal Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha and Rajasthan. These are not covered by the Panchayati Raj Act.
- The PESA Act conferred the absolute powers to Gram Sabha, whereas state legislature has given an advisory role to ensure the proper functioning of Panchayats and Gram Sabhas.
- The power delegated to Gram Sabha cannot be curtailed by a higher level, and there shall be independence throughout.
- PESA provides the right to Gram Sabhas to be consulted before land acquisition.
- The consent of the Panchayats or the Autonomous Districts Councils shall be obtained in cases where the Gram Sabha does not exist or has not been constituted.

4. AzaadiSAT

- AzaadiSAT is an 11-kilogram satellite built by 750 girl students from 75 schools across India.
- The satellite, which will be launched into orbit as a co-passenger satellite on SSLV, has long range communication transponders, and selfie cameras that will click pictures of its own solar panels.
- AzaadiSAT has a mission life of six months.
- The project is expected to encourage girl students to take up STEM (Science, Technology, Engineering, and Mathematics) subjects.
- The satellite has been developed by Space Kidz India, an aerospace organisation creating young scientists for the country.
- The AzaadiSAT project is a first-of-its-kind space mission with an 'all women concept' to promote 'Women in STEM', a statement released by Space Kidz India said.

5. Combined Maritime Forces (CMF)

❖ **CONTEXT: Recently, India began cooperation with Bahrain-based Combined Maritime Forces (CMF) .**

- It is a multinational maritime partnership, which exists to uphold the Rules-Based International Order (RBO) by countering illicit non-state actors on the high seas and promoting security, stability, and prosperity across approximately 3.2 million square miles of international waters, which encompass some of the world's most important shipping lanes.
- **Focus:** Counter-narcotics, counter-smuggling, suppressing piracy, encouraging regional cooperation, and engaging with regional and other partners to strengthen relevant capabilities in order to improve

overall security and stability, and promoting a safe maritime environment free from illicit non-state actors. When requested, CMF assets at sea will also respond to environmental and humanitarian incidents.

6. **New Start Treaty**

❖ **CONTEXT: Russia told USA that it would not allow its weapons to be inspected under the START nuclear arms control treaty for the time being because of travel restrictions imposed by USA and its allies.**

- New START (Strategic Arms Reduction Treaty) is a nuclear arms reduction treaty between the United States and the Russian Federation with the formal name of Measures for the Further Reduction and Limitation of Strategic Offensive Arms. It was signed on 8 April 2010 in Prague and, after ratification entered into force on 5 February 2011. It is expected to last at least until 2021.
- New START replaced the Strategic Offensive Reductions Treaty (SORT), which was due to expire in December 2012. Its name is a follow-up to the START I treaty, which expired in December 2009, the proposed START II treaty, which never entered into force, and the START III treaty, for which negotiations were never concluded.

❖ **Provisions**

- Deployed intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and heavy bombers assigned to nuclear missions are limited to 700.
- It does not limit the number of non-deployed ICBMs and SLBMs, but it does monitor them and provides continuous information on their locations and on-site inspections to confirm that they are not added to the deployed force.
- It limits each country to no more than 1,550 deployed nuclear warheads and 700 deployed missiles and bombers.
- It envisages sweeping on-site inspections to verify compliance. Limits each country to no more than 1,550 deployed nuclear warheads
- Each deployed ICBM, SLBM, and nuclear-capable bomber is counted as one delivery vehicle against the 700 limits. Each deployed and non-deployed missile launcher or bomber is counted as one launcher against the 800 limits. Non-deployed missiles are monitored but not limited in number.

ANSWER WRITING

Q. What is microbial fuel cell and discuss its applications?

Introduction

A microbial fuel cell (MFC) is a device that converts chemical energy to electrical energy by the action of microorganisms. It is a bio-electrochemical system that uses bacteria as the catalyst to oxidize organic and inorganic matter, and consequently, generate electric current out of it. It has applications in various fields such as power generation systems, bio-recovery, waste-water treatment, etc.

Application

- MFCs are attractive for power generation applications that require only low power, where replacing batteries may be impractical such as wireless sensor networks. Wireless sensors, powered by microbial fuel cells can then, for example, be used for remote monitoring.
- It is the only technology that can generate energy out of waste, without the input of external/additional energy, and this renders MFCs suitable for remote area access via the robotics route or remote power generation.
- MFC can be used as a convenient biosensor for wastewater streams. Wastewater is evaluated based on the amount of dissolved oxygen required by aerobic bacteria to break down the organic contaminants present in a body of water. The richer the wastewater stream is, the greater the current an MFC can provide.
- The use of MFC is not only enclosed to electricity production and wastewater treatment it has also been expanded to produce clean energy fuel like hydrogen and desalination process.
- Moreover, this emerging technology is significantly devoted to alleviating the environmental stress associated with the emission of greenhouse gases into the environment. It can act as an alternative to reduce the burden of an increased energy crisis and meet societal needs.

Conclusion

MFCs is still a nascent technology but through continuous research and development in such technologies, we may find solutions to our global environmental problems. Hence, MFCs can play a role in the future for the next generations

MCQs

1. With reference to solar power production in India, consider the following statements:
 1. India is the third largest in the world in the manufacture of silicon wafers used in photovoltaic units.
 2. The solar power tariffs are determined by the Solar Energy Corporation of India.
 Which of the statements given above is/are not correct?
 - a) 1 only
 - b) 2 only
 - c) **Both 1 and 2**
 - d) Neither 1 nor 2
2. AI-BSF technology is sometimes mentioned in news, is associated with which of the following?
 - a) **Solar cell**
 - b) Lithium-ion battery
 - c) Turbine rotation
 - d) Wind energy
3. In the recent report, what is the rank of India in renewable energy installations?
 - a) 1st
 - b) 2nd
 - c) **3rd**
 - d) 4th
4. In a Solar cell, which of the following effects is responsible for converting light energy into electrical energy?
 - a) Physical effect
 - b) Atmospheric effect
 - c) Magnetic effect
 - d) **Photovoltaic effect**
5. New START (Strategic Arms Reduction Treaty) is between which two nations?
 - a) India- USA
 - b) **USA – Russia**
 - c) Ukraine – Russia
 - d) EU - Russia
6. Consider the following statements with regards to AzaadiSAT recently seen in news
 1. It is an earth observation satellite has a mission life of six months developed by ISRO
 2. It carried 75 different payloads which build by Girl students from rural regions across the country.
 Choose the correct statement using the codes given below
 - a) 1 only
 - b) **2 only**
 - c) Both 1 and 2
 - d) Neither 1 nor 2
7. Which organisation/ministry conducts Industrial Outlook Survey (IOS)?
 - a) **RBI**
 - b) Ministry of Commerce
 - c) Ministry of statistics and programme implementation
 - d) MSME
8. The Government enacted the Panchayat Extension to Scheduled Areas (PESA) Act in 1996. Which one of the following is not identified as its objective?
 - a) To provide self governance
 - b) To recognise traditional rights
 - c) **To create autonomous regions in tribal areas**
 - d) To free tribal people from exploitation
9. Dilip Singh Bhuria committee recently seen in news is related to which of the following?
 - a) **PESA Act**
 - b) NCPCR
 - c) POCSO Act
 - d) NHRC
10. Which of the following is not a member nation of Combined Maritime Forces (CMF)?
 - a) UK
 - b) USA
 - c) Australia
 - d) **India**