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Table of Contents

Page 06 **Syllabus : GS 2 : Governance & Social Justice**	**Prisons plagued by lack of medical, mental health professionals: report**
Page 07 **Syllabus : GS 2 : Social Justice**	**Making primary health care visible, accessible and affordable**
Page 10 **Syllabus : GS 3 : Environment**	**Is the once-extinct dire wolf back?**
Page 10 **Syllabus : GS 3 : Science and Technology**	**How can V2G technology help India's power sector?**
In News	**Flue Gas Desulphurisation (FGD)**
Page 08 : Editorial Analysis: **Syllabus : GS 2 : International Relations**	**Trumponomics deserves to be taken seriously**

The India Justice Report (IJR), supported by Tata Trusts, periodically evaluates the justice delivery system in India. Its 2025 edition throws light on alarming conditions in Indian prisons—especially concerning the lack of healthcare and mental health facilities amidst severe overcrowding.

Prisons plagued by lack of medical, mental health professionals: report

Bindu Shajan Perappadan
NEW DELHI

With a national average occupancy rate of more than 131%, Indian jails face extreme overcrowding and are battling multiple health challenges, according to the recently released India Justice Report 2025.

The report highlights the fact that India's prison inmate population is projected to reach 6.8 lakh by 2030, even though prison capacity is only likely to grow to 5.15 lakh.

The capacity shortage is not restricted to space alone, but extends to health staff.

There are only 25 psychologists for the entire nation's prisoners, at a time when the recorded number of prisoners with mental illnesses has jumped from 4,470 in 2012 to 9,084 in 2022. Yet, the response remains largely absent, the report says.

Upward trend: The prison inmate population of India is projected to reach 6.8 lakh by 2030. AP

43% vacancy

Prisons also record a 43% vacancy among medical officers. The report, titled "The State of Public Health in India's Prisons: India Justice Report 2025 – Findings on Gaps in Staffing & Medical Care", explains that the model prison manual (2016) benchmarks the prisoner-doctor ratio at 300 prisoners to one doctor. "India's national average far exceeds that, standing at 775 prisoners per doctor," says the report.

It also highlights the non-availability of health data on prisoners entering jail with a disability, and those who acquire a disability within the prison.

Overcrowding could also be a root cause of the spread of several communicable diseases, the report says. In the decade between 2012 and 2022, there have been worrisome upward shifts in prison populations in several areas.

As of 2022, no State or Union Territory met the benchmark of one psychologist or psychiatrist per 500 inmates. At that time, there were only 69 sanctioned posts for psychologists and psychiatrists across India's 1,330 prisons and 5.7 lakh inmates, but not even half of these positions were filled.

"The data record the presence of only 25 or one for every 22,929 prisoners. Twenty-five States/Union Territories make no provision for a psychologist or psychiatrist within their cohort of correctional staff," said Valay Singh, the lead author of the India Justice Report.

Major Findings of the Report

- India's prisons are operating at a 131% occupancy rate, far beyond their intended capacity. While the prison population is projected to reach 6.8 lakh by 2030, the infrastructure is expected to support only 5.15 lakh inmates, indicating a serious mismatch.
- A critical health concern arises from a severe shortage of medical and mental health professionals. There are only 25 psychologists serving the entire inmate population across over 1,300 jails, despite the number of prisoners with mental illness doubling in the last decade—from 4,470 in 2012 to 9,084 in 2022.
- Additionally, 43% of medical officer posts remain vacant, and the current prisoner-to-doctor ratio is 775:1, which is well above the Model Prison Manual (2016) recommendation of 300:1. This makes healthcare delivery inadequate and unreliable for inmates.
- The report also criticizes the lack of data transparency, particularly the absence of records on prisoners entering jail with disabilities or acquiring disabilities during imprisonment. This gap makes it difficult to assess the needs and human rights conditions of such inmates.
- Furthermore, overcrowded conditions contribute significantly to the spread of communicable diseases, and the current healthcare staffing is grossly insufficient to handle potential outbreaks.

Legal & Constitutional Context

- Article 21 of the Indian Constitution guarantees the Right to Life and Personal Liberty, which includes access to basic healthcare and human dignity—even for prisoners. The Supreme Court, in landmark cases such as Sunil Batra v. Delhi Administration, upheld the rights of prisoners and emphasized humane treatment.
- Despite these protections, most states are yet to comply with the Model Prison Manual 2016, which recommends adequate staffing and infrastructure, especially in mental healthcare services.

Key Issues Identified

- Overcrowding leads to poor living conditions, violence, and inadequate access to medical care.
- Vacancies in health staff show administrative apathy and neglect.
- Mental health services are virtually non-existent in many states.
- Lack of health data hampers targeted reforms.
- Policy non-compliance with national standards persists across most states and UTs.

Suggested Reforms

- There is a need for immediate recruitment drives to fill medical and psychological vacancies. Digitizing prison health records would help track inmate health histories and streamline interventions. Mental health units should be made compulsory in central jails, and regular health audits must be conducted by independent bodies like NALSA or NHRC.
- To tackle overcrowding, prison decongestion strategies such as faster trials, plea bargaining, parole, and bail reforms should be strengthened. States must be compelled to adopt and implement the Model Prison Manual in letter and spirit.

UPSC Mains Practice Question

Ques : Despite constitutional safeguards, Indian prisons suffer from overcrowding and healthcare neglect. Critically examine the findings of the India Justice Report 2025 in this context. **(250 Words)**

India's healthcare challenges are evolving, with **non-communicable diseases (NCDs)**, **mental health issues**, and **antimicrobial resistance** now at the forefront. The **Ayushman Bharat** programme was introduced in 2018 to shift the paradigm toward **comprehensive and accessible public healthcare**, especially at the **primary level**. However, recent health accounts show only **marginal increases in government health spending** and underline the need to make public health care **more visible, affordable, and trusted**.

Making primary health care visible, accessible and affordable

Modern public health challenges such as antimicrobial resistance, chronic diseases, and mental health issues highlight the urgent need for a public health system that sees health as more than the absence of disease, factoring in interactions between the environment, socio-economic factors and health-seeking behaviour

Irfan Shakeer
Janane S.

Change is inevitable and is health any exception to that? The nature of public health has changed globally in conjunction with the ever-expanding economy and modern lifestyles. A few modern public health challenges include antimicrobial resistance, chronic non-communicable diseases (NCDs), zoonotic diseases, and mental health illnesses. NCDs continue to account for more than 60% of global deaths and are estimated to increase by 17% in the next decade. These challenges are complex, multifaceted and require a new public health system that comprehensively understands health, one that extends beyond the absence of diseases. This new system needs to see public health as a product of ongoing interactions between the environment, socio-economic determinants, and people's health-seeking behaviour.

The Government of India introduced the 'Ayushman Bharat' scheme in its 2018 Budget as an ambitious project to transform and strengthen India's public health system, including through public funding for the healthcare of disadvantaged groups. This nationally-funded scheme incorporates three major components: Pradhan Mantri - Jan Arogya Yojana (PM-JAY), Ayushman Arogya Mandir (AAM) and Pradhan Mantri Ayushman Bharat Health Infrastructure Mission (PM-ABHIM).

PM-JAY, being the largest publicly funded health insurance, provides financial coverage of ₹5 lakh to BPL cardholders and senior citizens. On the other hand, AAM aims to transform and strengthen primary health care through its Health and Wellness Centres (HWCs) holistically. The delivery of public health services through these centers is anchored around the concept of continuous comprehensive (preventive, promotive, curative, rehabilitative and palliative) care. This brings services related to non-communicable diseases (hypertension, diabetes and high priority cancers), ENT, mental health, oral health, geriatric and palliative care, health promotion and wellness activities closer to the general community. The PM-ABHIM component was launched in 2021 to equip India's comprehensive care system with required health infrastructure to deliver and maintain high quality services within the country.

Public-funded programmes like these are designed to improve survival and well-being, while safeguarding the community from catastrophic healthcare expenditure (CHO). The World Health Organization defines CHO as 'out-of-pocket payments greater than 40% of the capacity to pay for health care.'

As per the latest report from the Union Ministry of Health and Family Welfare, as of November 2024, a total of 1,75,338 AAMs have been established and operationalised with a footfall of 350 crore consultations. If we closely examine the National Health Accounts report 2021-2022, we can see how the Health Ministry has marginally increased healthcare expenditure in recent years. The report also shows a decreasing trend of per capita out-of-pocket health expenditure (OOPHE) in the country. Along with dedicated budgets from respective States, the Central government additionally complements a State's public health infrastructure through schemes like the National Health Mission and Ayushman Bharat.

For a better tomorrow: A closer look at the National Health Accounts 2021–2022 reveals that the Health Ministry has only marginally increased healthcare spending in recent years. FILE PHOTO

Visibility of public health system

In India, however, there exist a few blind spots in the public health system such as user experience, and people's trust and confidence in the system. People's 'trust' in public health or healthcare has always been ambiguous; however, this has been linked with many health outcomes such as health-seeking behaviour, healthcare utilisation and continuity of care and self-satisfaction.

"Trust in healthcare' is defined as 'an optimistic acceptance of a helpless situation where the trustee (patients) believes that the trustor (doctors) will care for their concern or interest' . Many lower- and middle-income nations, including India, still struggle to foster people's trust in their public health systems.

Every country's public health system plays a crucial role in health service delivery and trust brings people closer to the publicly-funded system and safeguards the community against catastrophic health expenditure from the private sector. The private healthcare sector in India still holds a lion's share of health spending.

People often turn to the private sector for consistent care, timely access, and clean infrastructure. India has a respectable public health system that has gradually improved over time, especially at the primary level. Publicly funded sub-centers, primary health centers, and community health centers have been established at the primary level to address the public health needs of the populace, both in urban and rural areas. Each of these institutions provides healthcare services in accordance with their designated catchment areas.

While Ayushman Bharat and the National Health Mission (Urban and Rural) aim to strengthen public health accessibility and infrastructure, the Indian government also introduced the National Quality Assurance Standards (NQAS) to raise public health facilities to global standards. These standards are based on The International Society for Quality in Healthcare (ISQua), and have been developed to improve quality in eight areas of concern: service, patient rights, inputs, support services, clinical care, infection control, quality management and outcomes.

India's SDG (sustainable development goals) 2030 commitments call for a high-quality public health system.

Way forward

According to The Lancet Global Health Commission on High Quality Health Systems, a high performing health system is not always indicated by the mere existence of basic infrastructure (such as human resources, medications, running water, power, etc.). The commission further defines a high-quality health system as "one that optimises health care in a given context by consistently delivering care that improves or maintains health outcomes, by being valued and trusted by all people, and by responding to changing population needs."

The Indian Public Health Standards were released in 2007, prescribing only the most basic standards for our publicly-funded healthcare facilities, but it's time to assign top priority to NQAS, which guarantees healthcare that meets international standards. Even though the system produces measurable data about service management and utilisation, it misses a few parameters that people care about. By capturing user experience and making the findings publicly available, we can potentially increase people's trust and confidence in our public health system.

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THE GIST

- The Government of India introduced the 'Ayushman Bharat' scheme in its 2018 Budget as an ambitious project to transform and strengthen India's public health system, including through public funding for healthcare of disadvantaged groups
- Publicly-funded programmes like these are designed to improve survival and well-being, while safeguarding the community from catastrophic healthcare expenditure
- In India, however, there exist a few blind spots in the public health system, such as user experience, and people's trust and confidence in the system

Key Public Health Challenges in India Today

- **Chronic NCDs** (e.g., hypertension, diabetes): Account for **over 60% of global deaths**.
- **Mental Health**: Rising prevalence but lack of community-based treatment infrastructure.
- **Zoonotic & AMR threats**: Worsened by environmental degradation and overuse of antibiotics.

- **Trust Deficit**: Many still prefer **private sector** due to perceptions of quality and reliability.

Government Interventions: Ayushman Bharat & Related Schemes

1. **Pradhan Mantri Jan Arogya Yojana (PM-JAY)**
    - **₹5 lakh** insurance cover per family/year for BPL households.
    - Largest publicly funded health insurance programme in the world.
2. **Ayushman Arogya Mandir (AAM)**
    - Establishing **Health & Wellness Centres (HWCs)** to deliver **comprehensive primary care**, including for NCDs, mental health, palliative and geriatric care.
    - As of Nov 2024: **1,75,338 centres operational**, **350 crore consultations delivered**.
3. **PM Ayushman Bharat Health Infrastructure Mission (PM-ABHIM)**
    - Launched in 2021 to build critical **public health infrastructure** and strengthen emergency preparedness.
4. **National Health Mission (NHM)**
    - Ongoing support to both urban and rural health missions with focus on **maternal and child health**, **communicable disease control**, and **public health workforce**.

National Health Accounts & Public Spending Trends

- **Public health spending** has increased marginally in recent years.
- **Per capita Out-of-Pocket Health Expenditure (OOPHE)** is **declining**, indicating increased **financial protection** for the poor.
- Despite progress, the **private sector still dominates** health spending and service delivery in India.

Challenges in the Public Health System

- **Lack of Trust & Perception Issues**:Many people continue to choose private care due to better **infrastructure, consistent service**, and **cleanliness**.
- **Basic Standards vs. Quality Assurance**:
    - **Indian Public Health Standards (2007)** offer only minimum infrastructure benchmarks.
    - **National Quality Assurance Standards (NQAS)** align with **global ISQua benchmarks**, but implementation is limited.
- **Poor User Experience Data**:User satisfaction, care continuity, and dignity are often not **captured or shared publicly**.

Way Forward

1. **Strengthen Primary Health Care**

- Fully operationalise **Health & Wellness Centres (HWCs)** with **trained personnel, telemedicine**, and medicine availability.

2. **Scale up NQAS**
   - Make **international-standard quality assurance** a **norm**, not an exception.
3. **Build Public Trust**
   - Capture and publicize **user experiences**.
   - Improve **patient rights**, accountability, and transparency.
4. **Improve State-Centre Coordination**
   - Align Central schemes like Ayushman Bharat with State-specific priorities through **co-funding and flexibility**.
5. **Address Social Determinants of Health**
   - Integrate **nutrition, sanitation, education, gender equity**, and **mental health** into health system planning.

UPSC Mains Practice Question

Ques : Discuss the significance of Ayushman Bharat in transforming primary health care in India. What are the key challenges in ensuring equitable and high-quality healthcare for all?**(250 words)**

On April 7, 2025, Colossal Biosciences, a U.S.-based biotechnology company, claimed to have brought back the dire wolf — a species extinct for over 12,000 years. The company released videos of pups it called "genetically resurrected dire wolves," which quickly gained public attention.

Is the once-extinct dire wolf back?

How did Colossal Biosciences use the genome of gray wolves to 'de-extinct' dire wolves? Why is the practice of de-extinction considered controversial and impractical? How will it affect environmental landscapes? Can ancient species thrive in today's world?

EXPLAINER

Arun Panchapakesan

The story so far:

On April 7, a biotechnology company in Texas, U.S., named Colossal Biosciences announced that it had "resurrected" a dire wolf, a large predator that went extinct more than 12,000 years ago. The company's claim that it had facilitated the birth of three dire wolf pups was met with a mix of wonder and delight. Videos of the baby wolves howling went viral, with the company calling their howls the first to be heard on earth in 10 millennia.

Have dire wolves been de-extincted?

The total DNA content of an organism, called its genome, is important to understand its identity. The genome of a gray wolf consists of 2.447 billion base pairs. This means there are 2.447 billion positions in the DNA filled by one of the four nucleotides: adenine, thymine, cytosine, and guanine. The order in which these four nucleotides appear determines the genetic identity of an organism. In a preprint paper uploaded on April 11, Colossal Biosciences claimed that the genomes of the gray wolf (*Canis lupus*) and the dire wolf (*Aenocyon dirus*) are 99.94% identical, meaning 2.445 billion of the 2.447 billion base pairs were in the same places in the two genomes.

This small difference is enormous in genetic terms. Humans and chimpanzees share about 98.77% of their DNA, yet no one would mistake one for the other. In the case of wolves, the 0.06% difference still corresponded to 1.47 million base pairs differing between the two species.

These differences are what make the two animals distinct. To create these 'dire wolf' pups, Colossal scientists edited the genome of a gray wolf and implanted embryos with the modified genome into surrogate dog mothers. While Colossal hasn't revealed the exact nature of the changes its scientists made, it says on its website that it made "precise genetic edits at 20 loci across 14 genes" on the genome of a gray wolf to "recreate" the dire wolf. In other words, even if there were a few hundred individual edits across those 20 loci (or positions on the genome), the new animals probably contain 0.02% of the changes that would make them a true dire wolf. And this is an optimistic estimate. Put another way, the new wolf pups are far from being dire wolves.

From the past: Colossal's 'dire wolf' pups Romulus and Remus at 15 days old. AFP

What changes did scientists make?

The 20 locations where Colossal scientists edited the gray wolf genome all appear to be places that would result in cosmetic changes. For example, one of these regions is on a gene called LCORL, which is responsible for the dire wolves' larger size. Other edits include genes involved in fur colour and density. Thus, Colossal Biosciences can be said to have made gray wolves that look like dire wolves.

While the nature and magnitude of the genetic differences already undermine Colossal's claims, a 2021 study published in *Nature* raised a more fundamental issue. The study suggested that despite genetic similarities, dire wolves may not be true wolves at all, but rather a distinct canid lineage that diverged long before modern wolves evolved. This study prompted scientists to reclassify dire wolves, and their species name changed from *Canis dirus* to *Aenocyon dirus*. This means dire wolves' behaviour, social structure, and ecological roles are likely different from that of modern wolves.

Why is de-extinction controversial?

Colossal has said on its website that its mission is to "secure the health and biodiversity of our planet's future." To achieve this, the company aims to revive several extinct species – including the woolly mammoth, the thylacine, and the dodo – and reintroduce them in the wild. Bringing back animals that lived thousands of years ago, like the dire wolf or woolly mammoth, carries significant ecological risks. The environmental conditions, plant communities, prey species, and climate that once supported these animals no longer exist. Modern landscapes are fragmented, and heavily altered by human influence.

Reintroducing extinct species to such drastically changed habitats could do more harm than good, potentially disrupting current ecosystems rather than restoring ancient ones.

How is conservation changing?

Misguided claims like these can often have a detrimental effect on lawmakers' priorities. For instance, *The Washington Post* reported Colossal's dire wolf announcement buttressed the Trump administration's plan to weaken federal protections for endangered species.

It quoted Interior Secretary Doug Burgum as saying innovation rather than government regulations will protect species.

Scientists have estimated that 99.9% of all species that ever lived on the earth are now extinct. Dire wolves themselves most likely died out at the end of the last ice age when the numbers of large herbivores, their main prey, started dwindling. The idea of reviving extinct animals is certainly captivating but it seems more prudent to apply this technology to protect and strengthen existing ecosystems rather than reviving extinct ones.

The birth of the genetically modified gray wolf pups may mark the beginning of a new era in conservation, but doubt lingers on what kind of an era it will be.

Arun Panchapakesan is an assistant professor at the Y.R. Gaitonde Centre for AIDS Research and Education, Chennai.

THE GIST

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- Colossal has said on its website that its mission is to "secure the health and biodiversity of our planet's future."
- Bringing back animals that lived thousands of years ago, like the dire wolf or woolly mammoth, carries significant ecological risks.

What is De-Extinction?

De-extinction refers to using biotechnological tools like genome editing to bring back extinct species or create genetically similar organisms. Colossal used CRISPR gene editing to modify the genome of gray wolves to resemble that of dire wolves.

However, even though gray wolves and dire wolves share 99.94% of their DNA, the small difference of 0.06% translates to 1.47 million base pairs — a huge difference in genetic terms. Therefore, even with edits at 20 locations across 14 genes, the resulting animals only look like dire wolves but are not functionally or genetically true Aenocyon dirus.

Why Is This Claim Disputed?

Although the animals may visually resemble dire wolves, scientific studies suggest dire wolves belonged to a completely separate lineage. A 2021 Nature study reclassified them as Aenocyon dirus instead of Canis dirus, placing them outside the evolutionary path of modern wolves. This means their behavior, physiology, and ecological role were likely different, making current claims misleading.

Why Is De-Extinction Controversial?

De-extinction raises several practical and ethical concerns:

- **Scientific Limitations:** Modifying visible traits doesn't recreate the full complexity of an extinct species. Their instincts, behaviors, and social structures cannot be recreated through a few genetic edits.
- **Ecological Risk:** Modern ecosystems have changed drastically. Climate, flora, fauna, and prey species that once supported extinct animals are no longer the same. Introducing recreated species could disrupt current biodiversity and lead to unforeseen ecological consequences.
- **Ethical and Legal Issues:** Creating genetically altered organisms raises questions about animal welfare, genetic manipulation, and potential misuse of such technologies.
- **Conservation Funding Diversion:** Investing heavily in resurrecting extinct species may shift resources away from conserving currently endangered animals and habitats, which need urgent attention.

Impact on Policy and Public Perception

Announcements like Colossal's may influence public discourse and policymaking. For instance, the Trump administration cited such technological breakthroughs to argue for reducing government regulations for species protection. This undermines science-based, habitat-centric conservation efforts and may lead to misguided priorities.

Conservation Outlook

The extinction of dire wolves was likely due to changes at the end of the last Ice Age, including loss of prey. Bringing them back, even partially, does not address the root causes of extinction. Instead, modern

conservation should focus on protecting current species, restoring habitats, and using genetic tools to boost resilience (e.g., disease resistance), not for spectacle or nostalgia.

Conclusion

While the idea of bringing back extinct species is fascinating, it remains largely symbolic and potentially harmful if misapplied. Science should aim at preserving what is, rather than reviving what was, especially in an age of rapid environmental degradation.

UPSC MainsPractice Question

Ques :*Discuss the scientific, ecological, and ethical challenges involved in the de-extinction of species. Can de-extinction be a viable conservation strategy in the 21st century? (250 words)*

Kerala State Electricity Board (KSEB), in collaboration with IIT Bombay, has launched a **pilot project** to explore **Vehicle-to-Grid (V2G)** technology. The project aims to assess the feasibility of using **Electric Vehicles (EVs) as distributed energy storage** to support grid stability, especially during **peak demand hours**.

How can V2G technology help India's power sector?

What are Vehicle-to-Grid technologies? What is the status of this technology in India?

Chandana Sasidharan
Deepak Sriram Krishnan

The story so far:

The Kerala State Electricity Board (KSEB) and the Indian Institute of Technology Bombay (IIT Bombay) have initiated a pilot project to explore the implementation of Vehicle-to-Grid (V2G) technology across the State. This collaboration aims to assess the feasibility of integrating Electric Vehicles (EVs) into the State's power grid.

What is V2G?

V2G refers to technologies that enable EV batteries to send power back to the grid. When an EV is not in use, it can act as a decentralised battery energy storage device. An idle EV, when connected to a bi-directional charger, can provide support to the distribution grid. By incorporating V2G technologies, EVs offer an opportunity to facilitate the integration of Renewable Energy (RE) and support a demand response market. Technologies for integrating an EV to the grid will need to consider both the charging and discharging of EV batteries. In the first case, there is a transfer of power from the grid to the vehicle (G2V) to charge the vehicle. And in the second case, an EV functions as a distributed energy source where it can provide power based on the requirement of the grid. Overall, the ability of EV batteries to transfer power encompasses many possibilities such as V2G, Vehicle to Home (V2H), Vehicle to Vehicle (V2V) etc. Among these, V2G is the most popular use case.

Is V2G being applied globally?

V2G technologies have gained significant traction in mature EV markets such as Europe and the U.S. EVs have emerged as a cost-effective form of distributed energy storage, with owners incentivised to supply power back to the grid. In the U.K. and The Netherlands, EV owners are compensated for supplying excess energy back to the grid during peak hours. In places like California, EV users are actively encouraged to participate in the ancillary services segment of the electricity market, helping improve grid stability and reliability. Under this market mechanism, the compensation is high enough to encourage EV users to offer services during periods of variation in RE generation. EVs are also an important decentralised storage resource, serving as an emergency power resource. With increasing climate-linked disasters, V2G must be encouraged.

What's the situation in India?

In India, V2G integration is currently in a nascent stage. The response to growing EV sales largely focuses on planning of the distribution grid with integration of EV charging infrastructure. A few DISCOMs have planned pilot projects for smart charging and V2G integration. The Central Electricity Authority (CEA) has set up a committee to frame guidelines for reverse charging, that is, from batteries to the grid. This committee highlighted smart charging as a key enabler to ensure EV growth with minimal impact on the grid. However, the electricity market structure in India is not the same as in the U.S. or Europe, and the current structure is not suited for decentralised solutions like EVs to send power back to grid. This is due to challenges that arise from the variable nature of RE and mismatches between electricity supply and demand. To mainstream V2G, supportive regulatory changes are needed.

What is KSEB-IIT Bombay project?

Kerala is currently experiencing a rapid adoption of EVs, and KSEB has taken several steps to support EV charging. The increased electricity demand for charging has resulted in concerns about evening peak demand. There has also been an exponential growth in rooftop solar adoption. The project plans to assess an EV's ability to support the grid during peak demand when solar energy is not available.

Chandana Sasidharan is a Program Research Fellow and Deepak Sriram Krishnan is the Deputy Director for WRI India's Energy Program. Views expressed are personal.

THE GIST

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- In India, V2G integration is currently in a nascent stage. The response to growing EV sales largely focuses on planning of the distribution grid with integration of EV charging infrastructure.
- Kerala is currently experiencing a rapid adoption of EVs, and KSEB has taken several steps to support EV charging.

What is V2G Technology?

Vehicle-to-Grid (V2G) refers to a system where **electric vehicles (EVs)** not only **draw electricity from the grid** to charge (Grid-to-Vehicle or G2V) but can also **supply electricity back** to the grid when needed.

- EVs act as **decentralized energy storage units**.
- When plugged into a **bi-directional charger**, idle EVs can discharge power to support the grid.
- V2G is part of a broader set of energy exchange models:
  - **G2V** – Grid to Vehicle
  - **V2G** – Vehicle to Grid
  - **V2H** – Vehicle to Home
  - **V2V** – Vehicle to Vehicle

How Can V2G Help India's Power Sector?

1. **Grid Balancing:**Helps balance supply and demand, especially during **peak hours** or **renewable intermittency** (e.g., after sunset when solar drops).
2. **Renewable Energy Integration:**Acts as **buffer storage** for solar and wind power — critical for India's **energy transition goals**.
3. **Reduction in Storage Costs:**Reduces the need for large-scale, expensive **battery storage systems** — EV batteries become **dual-use assets**.
4. **Emergency Backup:**EVs can serve as power sources during **natural disasters or outages**.
5. **Demand Response Mechanism:**EV owners can be **incentivized** to supply power to grid during high-demand periods.

Global V2G Applications

- **Europe & U.S.:**EV owners are **paid** for supplying excess energy during **peak demand**.
    - **U.K., Netherlands:** Active programs with time-of-use pricing and grid feedback.
    - **California:** EV users contribute to **ancillary grid services** and grid stability.
- Seen as a way to **decentralize** power supply, increase **resilience**, and support **carbon neutrality goals**.

Status in India

- **Nascent Stage**:Focus still on **EV charging infrastructure**, not yet on two-way energy flow.
- **Pilot Projects**:DISCOMs in a few states, like Kerala, are exploring **smart charging** and **reverse flow** technologies.
- **Regulatory Framework**:Central Electricity Authority (CEA) has formed a **committee** to frame guidelines for **reverse charging**.
- **Challenges in India**:
    - Lack of **real-time pricing** and **decentralized electricity markets**.
    - Grid not yet equipped for **two-way power flow** from millions of small units.
    - RE supply variability and weak demand forecasting.

About the Kerala Project (KSEB–IIT Bombay)

- **Objective**: Evaluate how EVs can support the **grid during evening peak** (when solar dips).
- **Context**:
    - **High EV adoption** in Kerala.
    - **Rooftop solar** growth adds surplus day-time power.
    - But evening demand is rising — V2G could help balance this mismatch.

Conclusion

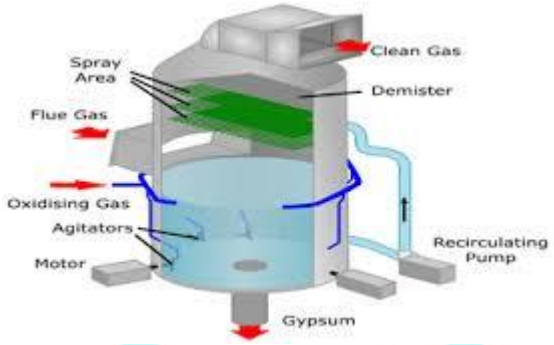
Vehicle-to-Grid (V2G) technology offers India an opportunity to transform EVs from passive energy consumers into **active participants** in the electricity ecosystem. However, to unlock this potential, **policy reforms**, **market restructuring**, and **technological readiness** are essential. Pilot projects like KSEB's in Kerala can serve as **models** to scale V2G nationwide.

UPSC Mains Practice Question

Ques : *What is Vehicle-to-Grid (V2G) technology? Discuss its potential in strengthening India's energy infrastructure and promoting renewable energy integration. (250 words)*

In News : Flue Gas Desulphurisation (FGD)

A recent study commissioned by the Principal Scientific Adviser said that the Union Environment Ministry should roll back its 2015 policy mandating all of India's 537 coal-fired plants to install a class of equipment called Flue Gas Desulphurisation (FGD).



About Flue Gas Desulphurisation

- In an FGD system, sulphur compounds, particularly sulfur dioxide (SO2), are removed from the exhaust emissions of fossil-fuelled power stations.
- This is done by means of an industrial process through the addition of absorbents. This can remove up to 95 % of the sulphur dioxide from the flue gas (exhaust gas).
- The wet process has become the main method of FGD in large, fossil-fuelled power plants.
- In this method, the flue gases are steam-saturated with the absorbent in aqueous solution.
- 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.

Why Do We Need Flue Gas Desulphurisation (FGD)?

- Most fossil fuels (coal, oils, etc.) contain some sulphur.
- When a fossil fuel is burnt, the sulphur it contains is released to the atmosphere via the process of combustion.
- Some coals may contain up to 4% sulphur, which is a significant amount considering that a coal power station may burn in excess of 5,000 tonnes of coal per day.
- 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.

UPSC PrelimsPractice Question

Ques :With reference to Flue Gas Desulphurisation (FGD) technology, consider the following statements:

1. FGD systems are used to remove nitrogen oxides (NOx) from the exhaust gases of coal-based power plants.

2. The wet limestone scrubbing method is a commonly used technique in FGD systems.

3. Flue Gas Desulphurisation helps in reducing sulfur dioxide (SO_2) emissions, which are a major cause of acid rain.

Which of the statements given above is/are correct?

(A) 1 and 2 only

(B) 2 and 3 only

(C) 1 and 3 only

(D) 1, 2 and 3

Ans : b)

Page : 08 Editorial Analysis

Trumponomics deserves to be taken seriously

"To me," United States President Donald Trump has famously said, "tariff is the most beautiful word in the dictionary". Mr Trump has shown that he means it. By imposing tariffs of varying degrees on a wide range of countries, he has initiated a trade war, the likes of which the world has not seen since the Second World War.

Following turbulence in the American bond market, Mr. Trump has announced a 90-day pause on tariffs on all countries except China. Hardly anybody thinks that Mr Trump will back off from tariffs for fear of visiting serious dislocation on the U.S. economy and the world at large. Trumponomics is a mission to fundamentally remake the American economy. It deserves to be taken seriously if only because the world will need to adjust to it.

T.T. Ram Mohan

is a former Professor at IIM Ahmedabad

While Donald Trump's detractors believe that he has embarked on the impossible, the fact is that this is a mission that the world will need to adjust to

First, the propositions

Trumponomics rests on a few key propositions. The first is that America needs to bring back manufacturing, lost to China and other economies over the past several decades. It needs to do so for several reasons.

Globalisation and the offshoring of manufacturing in the U.S. have meant the loss of millions of jobs. Estimates of jobs losses in manufacturing vary. Stephen Miran, Chair, Council of Economic Advisers, The White House, cites a study that estimates jobs lost in manufacturing between 2000 and 2011 at two million (Stephen Miran, *A User's Guide to Restructuring the Global Trading System*). Robert E. Lighthizer, who was the U.S. Trade Representative in Mr. Trump's first term, says five million manufacturing jobs were lost in the period 2000-09.

Job losses have been concentrated in particular areas. Thriving industrial centres have been reduced to ghost towns and whole communities hollowed out. There are other social costs: homelessness, rising crime, drug abuse, and broken families. America's services sector has absorbed a portion of those who lost jobs in manufacturing. But these are low-wage jobs. For the vast majority of American adults, manufacturing remains the sole route to a high-wage job.

Trumponomics argues that America also needs manufacturing for the purpose of national security. It cannot afford to have its defence sector rely heavily on imports of steel, aluminium, and semi-conductors. In a crisis, American military capabilities could be seriously compromised. As Mr. Trump puts it, "If you don't have steel, you don't have a country".

A second key proposition of Trumponomics is that free trade is not necessarily fair trade. Imports from China are cheaper because China provides subsidies to its firms in various forms, uses slave labour to drive down costs, invests funds in state-owned technology companies, and indulges in industrial espionage and theft of intellectual property. It makes no sense to have American companies wiped out by competitors that do not adhere to the rules of a free market economy.

The third proposition is that America's chronic trade deficits are unaffordable as the flip side is foreigners using their trade surpluses to acquire more and more American assets. In recent years, trade deficits have been of the order of $500 billion to $1 trillion a year.

Trade deficits are said to be self-correcting. When a country runs a trade deficit, the exchange rate of its currency is expected to depreciate. Exports will then rise and imports will fall, leading to a reduction in the trade deficit. Mr. Miran argues that the principle does not apply to the U.S. economy because the dollar happens to be the world's reserve currency. Nations park much of their foreign exchange reserves in U.S. government securities. This results in an overvalued dollar.

An overvalued dollar means more imports, less exports and hence a persistent trade deficit. As Mr. Miran puts it, America runs a trade deficit not because it imports more; it imports more because it is the provider of reserve currency to the world.

Impetus for domestic manufacturing

How to restore manufacturing to the U.S. and reduce America's trade deficit when faced with "unfair" trade and an overvalued dollar? Enter tariffs on imports. Tariffs will raise the cost of imports and cause imports to fall, thereby reducing the trade deficit. They will spur domestic manufacturing by protecting American manufacturers from import competition.

Economists fret that tariffs run counter to the principle of economic efficiency. Tariffs, they say, will spell higher costs for American consumers, an increase in the inflation rate and an inefficient manufacturing sector. Trumponomics says these concerns are based on first-round effects. Look farther and the outcomes change.

By raising the cost of imports, tariffs will result in fewer imports. A fall in imports will result in an appreciation of the dollar. If the "currency offset" to tariffs is perfect – say, a 10% tariff is offset by a 10% appreciation in the dollar – the dollar price of imports after tariffs will remain unchanged. The American consumer does not pay anything extra. Since the exporting country's currency has weakened, it earns fewer dollars than it did earlier.

Mr. Trump has been ridiculed widely for saying that the exporting nation, and not the American consumer, will pay for U.S. tariffs. Once you take into account the currency offset to tariffs, Mr. Trump's statement makes more sense. To be sure, if the currency offset is not perfect, there will be costs to the American consumer and an increase in the inflation rate. Mr. Miran estimates a one-time impact on the inflation rate of about 0.3-0.6 percentage points, an impact that is eminently bearable. This assumes there are no retaliatory tariffs.

Tariffs can lead on to other favourable second-round effects. As input costs rise, American manufacturers will look for ways to enhance efficiency and lower costs. Tariffs will compel American and foreign companies to move operations to the U.S. and this will enhance efficiency and output in the U.S. economy. There are signs that major U.S. companies are already making such a move.

The other 'Trump cards'

More importantly, tariffs are but one of four elements in Trumponomics. There are three other elements: tax cuts, deregulation and more drilling of oil. Tax cuts, made possible by tariff revenues, will compensate companies for the higher costs of imports. Deregulation will drastically reduce compliance and operational costs. More drilling of oil will help lower oil prices and counter the inflationary effects of tariffs. Taken together, the four elements constitute a plausible alternative to the current economic model.

Trumponomics is driven by the principle that efficiency cannot be the sole or even overriding consideration in economic policy-making, a principle that India's policymakers had wisely embraced decades ago. Mr. Trump's detractors believe that he has embarked on Mission Impossible. Well, Mr. Trump does not think so. He is determined to pursue his vision of MAGA (Make America Great Again) regardless of the short-term cost to the U.S.. As for the rest of the world, Mr. Trump does not particularly care.

Paper 02:International Relations

UPSC Mains Practice Question:Trumponomics challenges the primacy of economic efficiency in favor of strategic and social imperatives. Critically examine this approach in light of global trade trends. (250 words)

Context :

Former U.S. President **Donald Trump's economic philosophy** — commonly dubbed **"Trumponomics"** — reemerged in policy discussions as he continues to influence American political and economic discourse. Characterized by **protectionism, deregulation, tax cuts**, and **energy independence**, Trumponomics seeks to **rebuild American manufacturing**, reduce trade deficits, and reassert U.S. economic sovereignty.

Core Pillars of Trumponomics

1. **Tariffs on Imports:**
    - Imposed to reduce dependency on Chinese goods and revive U.S. manufacturing.
    - Aims to correct "unfair" trade practices by China (e.g., subsidies, IP theft, slave labor).
    - Tariffs are also viewed as a tool for **national security** (e.g., ensuring steel and semiconductor production domestically).
2. **Tax Cuts:**
    - Reduce corporate tax burden to encourage domestic investment.
    - Funded partially by revenue from tariffs.
3. **Deregulation:**
    - Cuts down on compliance and operational costs to enhance business competitiveness.
    - Focused on environmental and labor laws.
4. **Energy Independence:**
    - Promotes domestic oil drilling to lower fuel prices and reduce inflationary pressures.

Theoretical Justification:

- **Manufacturing Revival:** Offshoring of industries has led to mass job losses in the U.S., with social consequences — drug abuse, unemployment, crime.

- **Trade Deficit Problem:** Persistent U.S. trade deficit is attributed to the dollar's status as the **global reserve currency**, preventing automatic correction through currency depreciation.
- **Currency Offset Argument:** Trump argues that **tariffs will not burden American consumers** if the dollar appreciates proportionally (offsetting higher import prices).
- **Efficiency Critique:** Trumponomics challenges the traditional view that **economic efficiency** (via free trade) must override all other objectives, such as **national security and equity**.

Critical Evaluation of Trumponomics

Merits:

- **Industrial Revival:**May lead to onshoring of critical sectors like semiconductors, pharmaceuticals, and defense equipment.
- **Job Creation in Rust Belt:**Politically appealing as it targets economically distressed regions.
- **Strategic Autonomy:**Reduces dependence on China amid rising geopolitical tensions.
- **Currency Insight:**Raises valid concerns about structural issues in global financial architecture due to the **dollar's overvaluation**.

Concerns and Limitations:

- **Global Retaliation Risk:**Tariffs may spark trade wars, reducing global trade volumes and disrupting supply chains.
- **Consumer Burden & Inflation:**If the "currency offset" is incomplete, tariffs increase **import costs**, impacting inflation and purchasing power.
- **Inefficiency Risk:**Protectionism could shelter inefficient domestic firms, lowering competitiveness in the long run.
- **Environmental Costs:**Increased oil drilling and deregulation pose **ecological threats** and compromise **climate commitments**.
- **Erosion of Multilateralism:**Undermines WTO norms, affecting **global trade governance**.

Implications for India & the World

- **India–U.S. Trade Relations:**Trumponomics complicates India's export strategy. Indian goods may face **higher tariffs** in the U.S.
- **Opportunity for India:**Rising U.S.-China trade tensions offer India a **chance to attract diverted investments** in sectors like electronics and chemicals.
- **Global Trade Landscape Shift:**Trumponomics, if mainstreamed, may lead to a **multipolar trade order**, with **regional blocks** gaining salience over global free trade.

- **India's Parallel Thinking:**Like Trumponomics, India also adopts **strategic protectionism** through PLI schemes, "Aatmanirbhar Bharat," and tariff interventions in critical sectors.

Conclusion

Trumponomics represents a bold attempt to redefine economic policy — emphasizing **sovereignty, security, and social restoration** over orthodox notions of **efficiency and openness**. While controversial, it has forced the global economic order to rethink assumptions about trade, labor, and growth. For India, it offers both **challenges and opportunities** as it balances **global integration** with **strategic autonomy**.