



**Sanskriti IAS**

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**IMPORTANT**

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## GS 2: INTERNATIONAL RELATIONS

### THE HINDU PAGE : 1

# Indian refiners are procuring Iranian crude, says Centre

**The Hindu Bureau**  
NEW DELHI

The Ministry of Petroleum and Natural Gas on Saturday dismissed reports that an Iranian crude oil tanker heading to India was diverted to China over payment issues, stating that Indian refiners are, in fact, securing Iranian crude oil.

"Amid Middle-East supply disruptions, Indian refiners have secured their crude oil requirements, including from Iran; and there is no payment hurdle for Iranian crude imports, contrary to rumours being circulated," the Ministry said in a social media post.

Although the quantum of purchase has not been disclosed, the move marks a reversal from 2019, when India stepped away from purchasing Iranian crude following U.S. sanctions.

While refuting reports attributing vessel diversion to payment issues, the Ministry underlined that companies have "full flexibility to source oil from different sources and geographies based on commercial considerations". It clarified that changes in vessel destinations during transit are common in global oil trade, as bills of lading often indicate tentative discharge ports and cargoes may be rerouted for operational and commercial reasons.

Indian refiners are looking to purchase a few cargoes of Iranian oil on water following the recent sanctions waiver by Washington.

## Crude tracks



The move marks a reversal from 2019, when India stepped away from purchasing Iranian crude following U.S. sanctions

- Indian companies have 'full flexibility' to source oil from different sources, says Centre

- India currently imports crude oil from over 40 countries

- No payment hurdle for Iranian crude imports, says Centre

"It is reiterated that India's crude oil requirements remain fully secured for the coming months," the Ministry said.

An Iranian crude oil carrier, *Ping Shun*, that had crossed the Strait of Hormuz and was signalling that it was heading to Vadinar, India, for the past three days, is now signalling it is headed for China, as per marine logistics and commodity markets analytics firm Kpler.

Meanwhile, motor tanker *Aurora* (new name *Sea Bird*) has been discharging 43,910 metric tonnes of Liquefied Petroleum Gas (LPG) at New Mangalore Port (NMP) since April 2.

Another LPG tanker, *MT Al Ain*, sailing from Saudi Arabia's Yanbu Port, too, berthed at NMP on Saturday and began discharging 23,000 metric tonnes of LPG for three public sector oil marketing companies (OMCs).

(With contribution from Anil Kumar Sastry)

## GS 3: ENERGY SECURITY

### INDIAN EXPRESS PAGE : 11

#### 'HOTTER-THAN-NORMAL' SUMMER & GAS SHORTAGE

# Why greater reliance on coal may spur record solar power curtailments

Pratyush Deep  
New Delhi, April 4

AS INDIA heads into a "hotter-than-normal" summer, with forecasts pointing to an above-average number of heatwave days, the government plans to rely more on coal-based power to meet peak summer demand.

The central government, on March 30, informed the Parliament that the country's power system remains "adequately positioned" to meet peak summer demand, despite gas supply constraints triggered by the ongoing conflict in West Asia.

While gas-based power accounts for a relatively small share of the energy mix, it plays a crucial role during non-solar hours, with nearly 10 gigawatts (GW) of capacity typically relied upon during high demand summer months.

The government said it plans to use "alternative sources" like coal-based generation, renewables energy and energy storage systems compensating for reduced gas-based generation.

However, this shift may come with trade-offs that extend beyond immediate supply concerns, experts said.

A greater reliance on coal could lead to curtailment of renewable energy, particularly solar, due to the operational inflexibility of coal plants.

Gas-based power plants, meanwhile, are more flexible and can ramp generation up or down to accommodate renewable power while keeping the grid stable during evening peak hours when solar generation is unavailable.

#### Greater coal reliance

Coal-based power plants already dominate India's electricity generation mix, contributing over 70%. Gas contributes around 1-2% in the country's overall power generation.

Power generated from gas-based units is typically more expensive than coal and renewable energy.

However, due to their flexibility, they are generally used during high-demand periods, such as peak summer months when cooling demand surges, to meet evening peak demand.

In the past, the government has invoked emergency measures to ensure utilities operate both gas and coal plants at full capacity when soaring temperatures push electricity consumption to record levels.

However, disruption of gas supply due to the conflict in West Asia has cast a shadow over availability of gas for the country's gas-based power plants as the government decided to prioritise certain sectors during the shortage.

To meet this gap and summer demand, the government told the Parliament that a series of measures are being rolled out to ensure adequate power supply.

A few days ago, the government directed Tata Power to operate its 4 GW imported coal-based plant in Gujarat at full capacity, after it had remained idle for six months.

The plant is set to resume operations from April 1.

The government also said it is closely monitoring the progress of thermal and hydro pro-

jects slated for commissioning by June 2026. Meanwhile, thermal power plants have been asked to defer their planned maintenance to make available adequate generation capacity.

"From this, about 10,000 MW will be made available during April to June, 2026," the government told the Parliament. Further, all the power generating companies, including imported coal-based power plants and Central generating stations, have been advised to generate and maintain full availability on a daily basis excluding the period of planned maintenance or forced outage, the government said.

On clean power sources, the government maintained hydro-based generation is being scheduled in a manner so as to conserve water for meeting demand during peak periods. "Accelerated clearances are being provided for commissioning of renewable energy plants, particularly wind power plants and Battery Energy Storage Systems (BESS)," it added.

#### RE curtailment

A greater reliance on its coal-based power plants could potentially lead to curtailment of renewable energy, particularly solar, due to the operational inflexibility of coal plants, experts maintained.

Duttatreya Das, an analyst with global energy think tank Ember, told The Indian Express that India could see record levels of solar power curtailment this summer as coal-based plants are prioritised to ensure grid stability.

Between May and November last year, India's grid operator curtailed as much as 23 GW of renewable energy to maintain grid safety and stability. The curtailment was largely necessitated because a significant portion of India's coal-based thermal fleet failed to operate below 55% Minimum Technical Load (MTL), according to a report by a committee of the Central Electricity Authority (CEA).

MTL is the lowest stable generation level at which a thermal unit can safely operate without shutting down. With renewable energy generation surging during daytime hours, a lower MTL is increasingly seen as essential to allow coal plants to back down further and accommodate green power. "Earlier, solar met daytime demand while expensive coal plants remained largely idle during summer, with gas stepping in to meet the evening peak. Now, with greater reliance on coal, these costly plants will remain operational even during the day, forcing cheaper renewable energy to be curtailed," Das added.

Sharath Rao, Visiting Fellow at the Centre for Social and Economic Progress (CSEP), said renewable energy curtailment in India is driven largely by grid-security considerations — especially periods of high frequency, state underdrawal, and transmission congestion.

"This has been observed particularly in high-renewable states such as Rajasthan and Gujarat, and at times in other states as well," Rao said.

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## GS 3: SPACE

## THE HINDU PAGE : 4

# ISRO to test astronaut capability in a high altitude environment

**Press Trust of India**

NEW DELHI

The Indian Space Research Organisation (ISRO) has announced the launch of a mission in Ladakh to examine the physiological, psychological and operational dynamics of astronauts and ground teams functioning in a high-altitude environment.

Known as Mission MITRA (Mapping of Interoperable Traits and Response Assessment), the study will be conducted until April 9 at an altitude of approximately 3,500 metres in Leh, simulating the environmental conditions of hypoxia, low temperature and isolation as a natural analog for spaceflight operations.

“This study is targeted to generate vital understanding on the team inter-



Astronauts will be kept in challenging conditions. PTI

operability between crew and ground control teams and effectiveness of decision making under environmental and operational stress,” the ISRO said in a statement on April 3. “Analog missions conducted under controlled yet realistic conditions are utilised to understand how crew performs under challenging conditions.”

# GS 2: POLITY

## THE HINDU PAGE : 8

### What are the concerns over the FCRA Bill?

How does the Home Ministry regulate foreign donations to NGOs in India? What are the key changes proposed to the Foreign Contribution (Regulation) Amendment Bill, 2026? Why has the Opposition objected to the Bill and why was the Bill deferred? What is its current status?

**Vijaita Singh**

**The story so far:**

The Central government proposed to introduce the Foreign Contribution (Regulation) Amendment Bill, 2026 during the Budget Session of Parliament, which concluded on April 2. The Bill seeks to amend the Foreign Contribution (Regulation) Act, 2010, under which registration is mandatory for non-governmental organisations (NGOs) and associations to receive foreign funds or donations. It was introduced in the Lok Sabha on March 25; however, following an uproar by Opposition parties, its discussion and passage were deferred.

According to the statement of objects and reasons, around 16,000 associations are registered under the FCRA and receive approximately ₹22,000 crore annually. The Act regulates the acceptance and utilisation of

The Catholic Bishops' Conference of India said the Bill amounts to executive overreach and that it could unduly interfere with minority institutions and civil society

foreign contributions to ensure that such inflows do not adversely affect national interest, public order, or national security.

**What are the key changes proposed?**

One of the key changes proposed in the Bill is the appointment of a 'designated authority' to take over, manage, or dispose of assets created from foreign funds when an NGO's FCRA registration is suspended, cancelled, or not renewed. This authority will have the powers of a civil court and can order the transfer or sale of assets owned by NGOs to either the government or any other body. The 2010 Act provided for regulation of foreign fund flows, but lacked a statutory framework for managing assets created from such funds. The government said that Section 15 of the Act provides for vesting of assets, but the absence of a comprehensive framework for the supervision, management, and disposal of such assets has led to administrative uncertainty and scope for misuse.

Another proposed amendment broadens the definition of an NGO's 'key functionary' beyond office bearers and directors to include trustees, partners, the Karta of a Hindu undivided family, governing body members, or anyone controlling or managing the organisation, and makes them liable for FCRA offences unless they can prove lack of knowledge or due diligence.

**What are the other changes proposed?**

The Bill seeks to amend Section 43 of the parent Act to require any law enforcement agency or State government to obtain prior approval from the Central government before initiating investigations into FCRA-related complaints.

It also proposes timelines for the receipt and utilisation of foreign contributions under the 'prior permission' category (one-time receipt of funds), and provides for automatic cessation of certificates upon expiry or non-renewal.

The Bill proposes to reduce the maximum imprisonment for FCRA offences from five years to one year. It also proposes fixed timelines for the utilisation of foreign funds received under the 'prior permission' category unlike the open-ended provision under the 2010 Act.

**How does the Ministry of Home Affairs (MHA) regulate foreign donations in India?**

The MHA regulates foreign donations in the country through the FCRA to ensure that such funds do not adversely affect the country's internal security. The legislation was first enacted in 1976. In 2010, it was repealed and replaced with a new legislation. The 2010 Act came into force on May 1, 2011 and has been amended in 2016, 2018, and 2020.

The FCRA registration is valid for five years, after which the NGO has to apply for a renewal. Since 2015, the FCRA registrations of more than 18,000 NGOs have been cancelled. As on April 3, there are 14,965 FCRA-registered NGOs active in the country. NGOs can receive foreign contributions for social, educational, religious, economic, and cultural programmes.

**Why is the Bill being opposed?**

The Catholic Bishops' Conference of India said the Bill amounts to "executive overreach" and raises concerns about "undue interference" in the functioning of minority institutions and civil society groups. The body objected to "clauses that grant sweeping powers to the Central government, allowing it to deny renewal or cancel licenses of organisations" and the powers "to assume control over institutions, including their funds, properties, and other assets." The Chief Ministers of poll-bound Tamil Nadu and Kerala have opposed the Bill as well.

**What is the status of the Bill?**

The Bill was deferred following an uproar by the Opposition. In Kerala and Tamil Nadu, there were fears it could be misused to seize assets of minority institutions, such as churches. Meanwhile, the Bharatiya Janata Party has been reaching out to the Christian community in Kerala to build a support base. The legislation remains active.



Opposition MPs demanding the withdrawal of the Foreign Contribution (Regulation) Amendment Bill, 2026, during the Budget Session of Parliament, in New Delhi. ANI

## GS 3: SCIENCE AND TECHNOLOGY

### THE HINDU PAGE : 10

#### Nuclear fusion cost models too optimistic to be viable: experts

**Vasudevan Mukunth**

Researchers and investors worldwide are currently pouring billions of dollars into nuclear fusion in the hopes that it will prove to be a reliable source of green power. These investments often bank on economic models that assume the cost of the underlying technologies will drop rapidly as the industry expands. However, researchers have published an analysis in *Nature Energy*

concluding that these projections are based on arbitrary numbers rather than hard evidence.

The authors, from ETH Zürich in Switzerland, have added that if investors continue to use over-optimistic forecasts, they risk misallocating vital funds that can be routed to other, more fruitful climate mitigation plans.

The team's analysis focuses on the percentage by which a technology's cost drops every time its global

capacity doubles – a factor called the experience rate. Solar panels and batteries have high experience rates, so their prices have plummeted in the last decade. Current nuclear fusion models often assume experience rates between 8% and 20%. After interviewing 28 experts in magnetic fusion and laser-based inertial fusion technologies, the researchers found that these figures are likely too high.

**Fusion plants are bound**

to be large, with experts estimating even the smallest viable facilities having to produce hundreds of megawatts to overcome the energy requirements of their own cooling and heating systems.

Nuclear fusion is also extraordinarily complex, with experts rating design complexity as being equal to or even exceeding nuclear fission. One expert described a traditional fission reactor as “trivial” compared to a fusion reac-

tor. Magnetic fusion devices also use an onion-like structure where changing even one component requires redesigning the whole system, making it difficult to streamline manufacturing. Fusion plants also have to be tailored to the local seismic risk, access to cooling water, and the regulatory regime, preventing mass production.

Taken together, the researchers estimated that fusion power's experience rate is closer to fission pow-

er's historical rate, around 2%. Because the technology's capital costs are also high, a low experience rate foretells a significant challenge to becoming price-competitive with solar or even advanced fission.

The researchers instead urge the research community to consider alternative designs, such as those using different fuels or smaller reactor configurations, which could offer the potential for better cost reductions.

## GS 3: SCIENCE AND TECHNOLOGY

### THE HINDU PAGE : 10

# ‘Cloning’ hurdle skirted to perfectly copy quantum state

The no-cloning theorem is a quantum physics rule that prohibits a user from perfectly duplicating unknown quantum states; researchers have reported a way around it that could pave the way for technologies like quantum cloud storage

S. Srinivasan  
Vasudevan Mukunth

Quantum physics has a rule called the no-cloning theorem that prevents you from making a perfect copy of an unknown quantum state. It has shaped everything from quantum cryptography to quantum computing, and researchers have largely accepted it as an inalienable constraint.

Copying data in classical computing is trivial. We routinely copy files to the cloud for backup and make copies of code to share it. Quantum computers, however, cannot do any of this in the obvious way because of the no-cloning theorem, which is thus a serious obstacle to building robust quantum infrastructure.

But recently, a team of physicists from Japan, Canada, Germany, and IBM Quantum experimentally demonstrated a loophole in the theorem, showing that quantum information can indeed be duplicated provided the clones remain encrypted.

#### A key for noise

Previous researchers had developed approximate methods that produced imperfect copies with about 83% fidelity, the proven maximum for these approaches. But these copies were noisy and impractical.

In 2023, Koji Yamaguchi and Achim Kempf – two of the new paper’s authors – reported the loophole (published in *Physical Review*

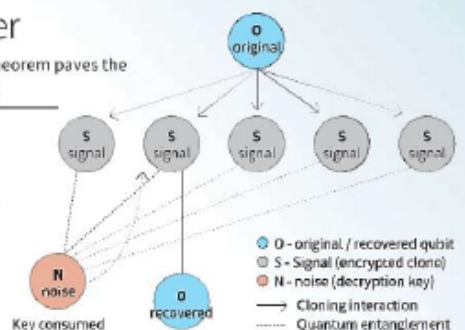
### A quantum copier

A way to sidestep the no-cloning theorem paves the way for quantum cloud computing

■ Researchers have shown a loophole in the no-cloning theorem by creating perfect copies using ideas from information theory

■ The no-cloning theorem is a quantum physics rule that prohibits a user from perfectly duplicating unknown quantum states

■ The clones appear as useless random noise until a specific decryption key is applied to restore them



A schematic diagram showing how the new protocol works. IMAGE CREATED WITH SONNET 4.6

■ Decrypting a single clone consumes the key, which prevents users from accessing multiple perfect copies simultaneously

■ Experiments on IBM superconducting processors successfully produced hundreds of encrypted clones while maintaining high reliability

■ The finding allows scientists to develop quantum cloud storage where data can be recovered even if servers fail

*Letters* on January 6 this year). Rather than accepting degraded copies, they proved (on paper) that it is possible to create perfect ones as long as each copy is scrambled by quantum noise so that it is individually useless.

This noise is not random. It is recorded in a set of ‘noise qubits’ that serves as the decryption key. To create clones, the original qubit is allowed to interact with a series of signal qubits, called the quantum register, in a way that spreads the information across signal qubits. At this stage, each new qubit is a clone but also a maximally mixed state, meaning it looks like random noise to an observer.

When you want to recover the original state, you apply the decryption operation to any one of the encrypted clones using the full set of noise qubits. This

restores the original perfectly. But the decryption process consumes the key. So after you decrypt one clone, the key is gone and every remaining clone becomes permanently scrambled. Which means you only get one perfect recovery. (The no-cloning theorem says you cannot freely access multiple identical copies.)

#### Four tests

To test this idea, the team ran experiments directly on the IBM Heron R2 superconducting processors, which feature 156 physical qubits, using up to 154 qubits across four experiments.

The first experiment measured how fidelity – how close the recovered state is to the original state – decayed as the number of encrypted clones grew from 2 to 15. The team found that making more

copies did not make each copy harder to recover. The second test confirmed that the clones were quantum rather than classical.

The third was the most ambitious. Instead of creating all clones in a single step, the team cloned one qubit, then cloned those clones, and so on.

Using all 154 available qubits, the researchers found that with more qubits with equal levels of noise, up to 729 clones could be produced while keeping the signal detectable.

Finally, the team applied the protocol in parallel across multiple qubits simultaneously entangled in a GHZ state – a complex form of entanglement involving many qubits. And they confirmed that they could use encrypted cloning to back up entire quantum registers rather than just single isolated qubits.

According to the authors of the study, their experiments require scientists to refine the understanding of the no-cloning theorem. They argued that the real constraint is not that quantum information cannot be copied and spread widely – it can – but that the access to that information is restricted and that each setup allows only one shot at retrieving it.

#### Rare instance

“For example, encrypted cloning enables... redundant quantum cloud storage: a quantum cloud storage provider hosts encrypted clones of a client’s quantum data on separate servers,” the authors wrote. “As long as at least one of the servers survives, the client can recover all of their data perfectly by decrypting the surviving clones. Quantum cloud storage could serve as a platform also for quantum cloud computing.”

This is a rare instance in which a new, profound idea has been tested almost immediately, and the initial results prove that the protocol performs as expected.

A key advantage of this protocol over many earlier proposals is that the recovered qubit is identical to the original state rather than an approximate copy. The work is sure to stimulate further research on building reliable quantum memories, which are essential for many quantum information processing protocols.

(S. Srinivasan is a professor of physics at Krea University)