Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?



MAINS MASTERY 2026 · GS PAPER III · QUESTION 11 · STUDENT EDITION

India's Energy Security: Growth and Sustainability

THE QUESTION, AS SET IN UPSC CSE MAINS 2026

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

Directive: Explain and suggest | 15 marks | 250 words

Energy security: growth and sustainability

1 **PYQ Deep Decode**
Demand, hidden demand and structure

2 **PYQ Intelligence**
Energy PYQs and the 2026 shift

3 **Additional information**
Risks, reforms and policy debates

4 **Pitfalls and variations**
Six pitfalls and answer variants

5 **The model answer**
Three-part 252-word answer

6 **Other ways to write it**
Four viable alternative outlines

7 **Quick recall**
Sixteen facts and distinctions

8 **Write it yourself**
Seven checks and source trail

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Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

1 PYQ Deep Decode

Read the question through its two explicit demands and its hidden policy dilemma: the challenges to secure energy supply, the measures that answer them, and the test of whether those measures also support economic growth and sustainability.

1.1 The demand

The question asks **two things, in order**: explain the key challenges to India's energy security, then suggest measures that ensure energy security **along with economic growth and sustainability**. **"Explain"** requires showing why each challenge threatens reliable, affordable supply, rather than merely naming problems. **"What measures do you suggest"** requires actionable interventions, not a catalogue of existing schemes. The two conditions, **economic growth and sustainability**, apply to the proposed measures themselves: each should be tested for its contribution to industrial competitiveness, affordability, employment, environmental protection or emissions reduction. The answer must cover **energy as a whole**, not electricity alone.

Words in the question	What they ask you to do	What goes wrong if you miss them
Explain	Identify the main challenges and trace how each undermines energy availability, reliability, accessibility or affordability.	Listing import dependence, coal and renewables without explaining their consequences.
key challenges	Prioritise structural vulnerabilities, not every problem in the energy sector. Cover imported fuels, rising demand, infrastructure, financial weaknesses and transition risks.	Spending the answer on minor technical issues while overlooking external dependence and system reliability.
India's energy security	Consider petroleum, natural gas, coal, electricity, clean energy, supply chains and affordable access across households, agriculture and industry.	Confusing energy security with uninterrupted electricity supply or merely with domestic fuel production.
What measures do you suggest	Propose feasible, linked actions showing how each tackles an identified vulnerability.	Writing only existing government initiatives, without specifying what should improve.
along with economic growth	Assess whether interventions provide competitively priced, dependable energy for industry, transport, services, jobs and rising living standards.	Recommending expensive or abrupt changes that threaten employment, investment or affordability.
and sustainability	Test measures against emissions, pollution, resource use, ecological costs and long-term resilience.	Treating greater fossil-fuel production or renewable capacity as sufficient without considering environmental impacts.

THE DEMAND IN ONE LINE

Explain why India's energy remains vulnerable to disruptions and high costs, then propose a diversified, reliable and affordable energy strategy that supports economic growth while reducing environmental damage.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

1.2 The hidden demand

Security, growth and sustainability pull against each other. Coal supplies dependable domestic electricity and supports industrial employment, but creates emissions and pollution. Renewable energy reduces fuel-import exposure and operating emissions, but requires storage, flexible generation, transmission and manufacturing supply chains. Natural gas can provide operational flexibility, yet imported LNG creates price and geopolitical exposure. Energy subsidies protect consumers but can strain public finances and weaken efficiency incentives.

The hidden demand is therefore **not to choose one goal**. It is to show how the energy system can advance all three, while recognising that some interventions involve real costs and transitional trade-offs. The key distinction is between **installed capacity and actual electricity generation**: in 2025 India crossed 50% non-fossil installed capacity, yet non-fossil sources supplied only 29.2% of electricity generated in FY2025-26, according to the Ministry of New and Renewable Energy's April 2026 figures. More capacity is necessary, but reliable clean supply also requires system integration.

The same measure may help one objective while complicating another. A strong answer identifies the condition under which it advances all three.

Policy choice	The immediate gain	The condition that makes it sustainable
Maintain sufficient coal-based generation during transition	Firm supply for industry and peak demand.	Improve efficiency and pollution control, avoid unnecessary carbon lock-in, and plan a managed transition for coal-dependent workers.
Accelerate solar and wind deployment	Domestic generation, investment, jobs and lower fuel exposure.	Add storage, transmission, demand flexibility and secure equipment supply chains.
Expand strategic fuel buffers and diversify suppliers	Protection against supply interruptions and price shocks.	Use reserves for resilience, while reducing long-term oil demand through efficiency and cleaner mobility.

WEAK

India imports oil and depends on coal. It should increase renewable energy, adopt electric vehicles and achieve sustainable development.

STRONG

With crude-oil import dependence near 88%, diversified sourcing and petroleum reserves provide short-term security; electrified public transport reduces long-term oil demand. Renewable expansion must be matched by storage and grid flexibility, so cleaner supply remains reliable for households and industry.

1.3 The structure

The question contains **two explicit tasks**: explain the challenges, then suggest measures meeting the growth and sustainability conditions. The approved hidden demand becomes a **short third part** that tests how security, growth and sustainability can be reconciled. The shares below refer to the body between the introduction and conclusion; they are teaching guidance, not a UPSC rule.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

Introduction	1. Key challenges about two-fifths	2. Measures about two-fifths	3. Balancing the three goals about one-fifth	Conclusion

Part 1 **Key challenges to India's energy security** about two-fifths

External dependence	Crude imports near 88%; exposure to supplier concentration, chokepoints and global prices.
Growing demand	Industrialisation, urbanisation, cooling and transport raise energy and peak-power requirements.
Structural weaknesses	Coal dependence, transmission bottlenecks, distribution losses and electricity-sector finances.
Transition vulnerabilities	Variable renewable output, storage needs and critical-mineral and equipment dependence.

Part 2 **Measures for energy security with growth and sustainability** about two-fifths

Secure supply	Diversified imports, strategic reserves and responsibly managed domestic resources.
Diversify generation	Renewables, nuclear and appropriate firm low-carbon options; green hydrogen for hard-to-abate uses.
Strengthen systems	Storage, transmission, distribution reforms, demand response and energy efficiency.
Build resilience	Domestic manufacturing, mineral recycling, cleaner mobility and affordable energy access.

Part 3 **Balancing security, growth and sustainability** about one-fifth

Security	Firm capacity, diversified supply, reserves and contingency planning.
Growth	Affordable industrial power, investment, reliable supply and employment protection.
Sustainability	Efficiency, cleaner energy, environmental safeguards and a just transition.
Policy judgment	Sequence the transition by reliability and cost, not by capacity announcements alone.

1.4 How to present it

The strongest format is **headed points organised into three parts**. Under challenges, each heading should combine **vulnerability and consequence**. Under measures, each should specify the intervention and show why it supports secure supply, growth or sustainability. A compact **security, growth, sustainability test** makes the hidden demand visible without displacing the main answer.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

Form	Fit here	Reason
Three parts with headed points and a short balancing judgment	**Best**	Follows both demands in order; explains threats and matches them with actionable solutions.
Challenge-to-measure table	Good	Shows causal matching clearly, but needs a final judgment on the three competing goals.
Supply-chain flowchart	Good	Useful for illustrating diversification, generation, grid delivery and demand reduction.
A catalogue of energy schemes	Weak	Describes government action without explaining the original challenges or policy trade-offs.

1.5 The introduction and the conclusion

The introduction serves the whole question. It establishes that expanding India's access to reliable, affordable energy is essential for growth, but imported fuels, structural weaknesses and environmental constraints make supply insecure. Do not spend it defining every dimension of energy security.

The conclusion settles the demand. It argues for a phased, diversified transition: secure the present energy system, reduce vulnerability through efficiency and domestic low-carbon supply, and protect affordability, employment and ecological resilience throughout.

2 PYQ Intelligence 2013 to 2026

Why energy security was salient before the 2026 examination, how UPSC's earlier questions developed the theme, and what this progression requires an aspirant to prepare.

2.1 Why the subject was topical in 2026

Energy security had become a question about **the entire energy system**. India's heavy reliance on imported hydrocarbons coexisted with rapid additions to clean electricity capacity, new industrial and mineral supply-chain policies, growing storage requirements and a major nuclear milestone. International disruptions exposed the risks of imported fuels, while India's clean-energy expansion raised questions of reliability, cost and industrial competitiveness. The Council on Energy, Environment and Water (CEEW) brought these vulnerabilities together in its **17 June 2026 energy-security report**. These developments provide context for the 2026 question, **not evidence of why UPSC set it**. The events below predate the August 2026 Mains papers.

When	What happened	Why it matters for this question
4 January 2023	The Union Cabinet approves the **National Green Hydrogen Mission** with ₹19,744 crore in initial outlay, targeting at least **5 million metric tonnes annually by 2030**.	Reducing fossil-fuel import exposure in refining, fertilisers and other hard-to-abate sectors while creating new industry.
13 and 29 February 2024	**PM Surya Ghar: Muft Bijli Yojana** is launched on 13 February; the Cabinet approves it on 29 February with ₹75,021 crore for rooftop solar in one crore households.	Domestic clean supply, consumer affordability and distributed generation can advance together.

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When	What happened	Why it matters for this question
29 January 2025	The Cabinet approves the **National Critical Mineral Mission**, involving ₹16,300 crore in government expenditure and ₹18,000 crore in expected investment by public-sector undertakings and others over seven years.	Moving from imported fossil fuels to clean technologies creates new vulnerabilities in minerals and processing.
1 February 2025	The Union Budget announces a **₹20,000 crore Nuclear Energy Mission for research and development of small modular reactors**, targeting at least five indigenous SMRs operational by 2033; it sets out an ambition of at least 100 GW nuclear capacity by 2047.	Firm low-carbon power is an important complement to variable renewables, but requires finance and safety safeguards.
20 March 2025	The Ministry of Petroleum and Natural Gas reports **5.33 million metric tonnes** of established strategic crude-oil storage capacity at Visakhapatnam, Mangaluru and Padur; an additional 6.5 MMT had received approval in July 2021.	Strategic reserves reduce exposure to short-term interruptions; proposed capacity must not be counted as operational.
June 2025	India crosses **50% non-fossil installed electricity capacity**, achieving the capacity-share target in its NDC ahead of 2030. The Ministry of Power later confirms **242.78 GW out of 484.82 GW** as on 30 June.	Capacity achievement is substantial, but it must not be confused with generation or total energy consumption.
June 2025	The Ministry of Power approves another **battery energy storage system viability-gap funding scheme**, supporting 30 GWh with ₹5,400 crore from the Power System Development Fund.	Renewable expansion requires dispatchable electricity and grid flexibility, not capacity installation alone.
5 February 2026	The Ministry of Power reports that national **aggregate technical and commercial losses** in distribution utilities fell from 21.91% in FY2020-21 to **15.04% in FY2024-25**.	Distribution reform improves the financial ability to procure and supply reliable, affordable electricity.
March to April 2026	Government data for **31 March 2026** put non-fossil installed power capacity at **283.46 GW**. During FY2025-26, non-fossil sources supplied **29.2% of electricity generated**, according to an April 2026 ministry release.	The capacity-generation gap exposes the need for storage, dispatchable supply and stronger networks.
6 April 2026	India's indigenously developed **500 MWe Prototype Fast Breeder Reactor** at Kalpakkam attains first criticality, confirmed by the Department of Atomic Energy on 7 April.	A long-term indigenous nuclear capability advances, but first criticality is not equivalent to commercial electricity generation.
17 June 2026	**CEEW** publishes *How Secure Is India's Energy Future?*, assessing accessibility, reliability and affordability. It estimates import dependence of approximately **88% for crude oil, 48% for natural gas and 26% for coal**, and examines concentrated suppliers, shipping routes and strategic stocks.	The security problem extends beyond supply volumes to the ability to obtain the right fuel, at the right time and an affordable price.

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2.2 The skill UPSC keeps testing

From 2013 onwards, UPSC repeatedly examined **how energy choices create benefits and costs**. Coal extraction raised questions of environmental limits; cheaper solar power challenged conventional generation; renewable energy, nuclear power and energy efficiency raised questions of scale and reliability; and SDG-linked access brought affordability and sustainability together. The 2026 question integrates these strands into **a national energy-security strategy**. The questions reproduced below are verbatim from the specified question-paper record; their original punctuation and spacing are retained.

Year	The question as UPSC set it	What it asked of you	What changed in 2026
2013 GS III, Q19	What are the consequences of Illegal mining ? Discuss the Ministry of Environment and Forests' concept of GO AND NO GO zones for coal mining sector.	Resource extraction and ecological safeguards.	Domestic fuel security must be tested against environmental and social costs.
2015 GS III, Q9	To what factors can the recent dramatic fall in equipment costs and tariff of solar energy be attributed ? What implications does the trend have for the thermal power producers and the related industry ?	Solar economics and effects on conventional generation.	Cost is now tested alongside system reliability and industrial competitiveness.
2016 GS III, Q11	Give an account of the current status and the targets to be achieved pertaining to renewable energy sources in the country. Discuss in brief the importance of National Programme on Light Emitting Diodes (LEDs).	Renewable deployment and demand-side efficiency.	Energy saved becomes part of energy secured.
2018 GS III, Q1	"Access to affordable, reliable, sustainable and modern energy is the sine qua non to achieve Sustainable Development Goals (SDGs)." Comment on the progress made in India in this regard.	Energy access and the four linked attributes of SDG 7.	From evaluating progress to prescribing an integrated security strategy.
2018 GS III, Q16	With growing energy needs should India keep on expanding its nuclear energy programme? Discuss the facts and fears associated with nuclear energy.	Nuclear power's security benefits and risks.	Firm low-carbon supply becomes one element of the broader energy mix.
2020 GS III, Q16	Describe the benefits of deriving electric energy from sunlight in contrast to the conventional energy generation. What are the initiatives offered by our Government for this purpose?	Solar power's advantages and policy support.	Renewable capacity must now be accompanied by storage and grid reform.
2022 GS III, Q12	Do you think India will meet 50 percent of its energy needs from renewable energy by 2030 ? Justify your answer. How will the shift of subsidies from fossil fuels to renewables help achieve the above objective ? Explain.	Renewable-energy ambition, subsidy choices and fiscal trade-offs.	The distinction between energy demand, electricity generation and installed capacity becomes essential.
2026 GS III, Q6	Distinguish between a Fast Breeder Reactor (FBR) and a thermal nuclear reactor. In the context of first indigenously developed prototype FBR at Kalpakkam, explain the term 'criticality'. What are its implications for clean energy future of our country ?	Advanced nuclear technology and its implications for clean energy.	The same paper also asks for an economy-wide security strategy covering multiple energy sources.

Also related, verbatim: 2014 GS III, Q15: Environmental Impact Assessment studies are increasingly undertaken before a project is cleared by the Government. Discuss the environmental impacts of coal-fired thermal plants located at coal pitheads. 2023 GS III, Q15: The adoption of electric vehicles is rapidly growing worldwide. How do electric vehicles contribute to reducing carbon emissions and what are the key benefits they offer compared to traditional combustion engine vehicles?

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CARRY THIS METHOD TO ANY ENERGY-SECURITY QUESTION

1. **Identify** which part of security is threatened: availability, reliability, accessibility or affordability.
2. **Explain** the mechanism: import exposure, price transmission, infrastructure weakness or inadequate flexibility.
3. **Match** each major vulnerability to a feasible policy instrument.
4. **Test** the instrument for growth, affordability and environmental sustainability.
5. **Distinguish** present capacity and announced targets from delivered energy and measurable outcomes.
6. **Conclude** with a sequenced, diversified strategy rather than an absolute preference for one fuel.

2.3 What to prepare next

POLICIES, INSTITUTIONS AND COMMITMENTS

SDG 7	Affordable, reliable, sustainable and modern energy for all; linked to industrialisation, poverty and health.
India's updated NDC (2022)	About 50% cumulative installed electric-power capacity from non-fossil sources by 2030, and a 45% reduction in emissions intensity of GDP from 2005 levels. Neither is a target for 50% of total energy consumption.
500 GW non-fossil ambition	Installed electric-power capacity by 2030, not annual generation.
ISPRL and PPAC	Strategic petroleum-storage facilities and official petroleum-sector data.
CEA, MNRE, BEE	Electricity planning, renewable energy policy and demand-side energy efficiency.
RDSS and Electricity Act, 2003	Distribution reform, metering, utility viability and the power-sector regulatory framework.

CONCEPTS AND ANALYTICAL DISTINCTIONS

Primary energy versus electricity	Oil and gas used in transport or industry cannot be represented by power-capacity figures alone.
Installed capacity versus generation	GW indicates rated capacity; GWh or billion units measure electricity produced or consumed over time.
Energy security dimensions	Accessibility, reliability and affordability, with environmental sustainability as a necessary long-term condition.
Firmness and flexibility	A secure grid needs supply when demanded, using storage, flexible plants, transmission and demand response.
Strategic versus operational stocks	Emergency petroleum reserves are distinct from normal commercial fuel inventories.
Just transition	Worker protection, reskilling, regional diversification and affordable energy while decarbonising.

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3 Additional information

Everything needed for a high-quality answer. Tier 1 connects India's specific energy-security vulnerabilities to practical interventions. Tier 2 examines the wider technology, economics and justice questions that explain why the energy transition cannot be reduced to a single target.

TIER 1 · ESSENTIAL: CHALLENGES, MEASURES AND THE THREE-GOAL TEST

What exactly makes India's energy supply insecure?

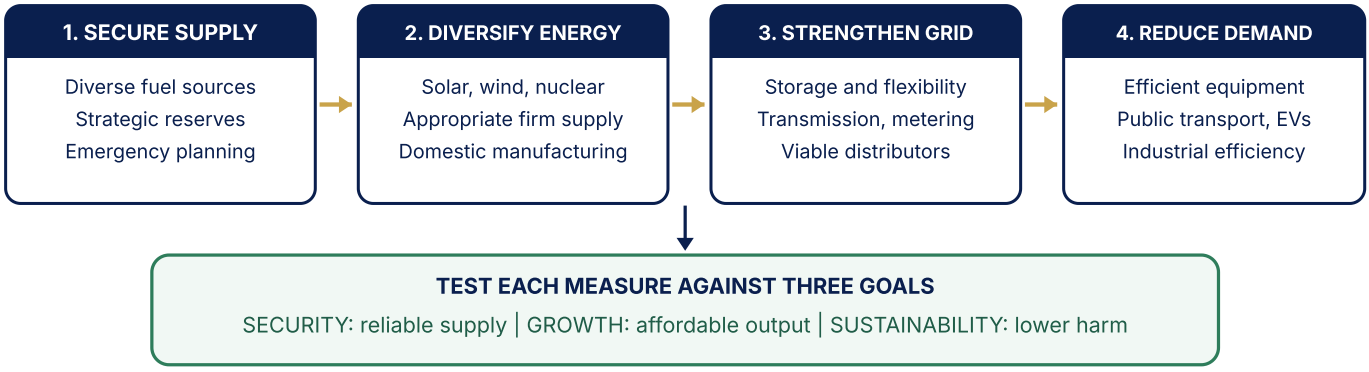
Challenge	Verified Indian evidence or mechanism	Why it threatens energy security
1. Fossil-fuel import dependence	CEEW's June 2026 assessment reports approximately **88% crude-oil, 48% natural-gas and 26% coal import dependence**. Domestic crude production is insufficient relative to demand.	International disruptions can affect fuel availability, freight and insurance costs, inflation and the external account.
2. Concentrated external supply	CEEW reports that over **85% of crude imports** in FY2024-25 came from six suppliers. West Asian shipping routes remain strategically important; refinery configurations constrain rapid switching between crude grades.	Supplier diversification on paper may not translate into immediate physical substitution during a crisis.
3. Demand growth and peak stress	India met an all-time peak electricity demand of approximately **250 GW in FY2024-25**, according to the Ministry of Power. Cooling, industrialisation and electrification alter the timing and scale of demand.	Generation adequacy can coexist with local outages, congestion and high peak-period supply costs.
4. Coal dependence and climate costs	Coal still contributes over **70% of electricity generation**, as reported by the Ministry of Coal in August 2026. Coal-based production also involves particulate pollution, emissions, land and water use.	Coal supplies firm power but creates long-term health, ecological, climate and investment-transition risks.
5. Variable renewable generation	Non-fossil sources represented over half of installed power capacity, but produced **29.2% of electricity in FY2025-26**. Solar output varies with daylight; wind and hydropower vary with weather and season.	Variable generation without storage or flexible balancing can increase grid-management difficulty and dependence on fossil backup.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

Challenge	Verified Indian evidence or mechanism	Why it threatens energy security
6. Distribution and financial weaknesses	National **AT&C losses were 15.04% in FY2024-25** despite improvements; power-delivery constraints and payment weaknesses remain uneven across utilities.	Losses, delayed investment and weak revenue collection restrict reliable service and new capacity procurement.
7. Clean-technology supply chains	Batteries, solar equipment, motors and grids need lithium, graphite, rare earths and processing capabilities; the **National Critical Mineral Mission** responds to this vulnerability.	Import dependence may shift from fossil fuels to minerals, manufacturing components and intellectual property.
8. Unequal access and climate exposure	Low-income households and smaller firms are sensitive to tariffs and fuel-price shocks. Heatwaves intensify cooling demand; extreme weather can interrupt fuel logistics and damage electricity infrastructure.	Nominal supply may exist without affordable or reliable access, while climate hazards can simultaneously increase demand and disrupt delivery.

How to design a secure, growth-supporting and sustainable response

The sequence below is a **teaching decision flow**, not an officially prescribed government procedure. It shows how to move from short-term resilience to long-term structural security.



Simple examination flow: secure, diversify, strengthen, economise, then test the trade-offs.

Measures: what they do, and the conditions for success

Measure and evidence	Security and growth benefit	Sustainability test or limitation
Diversify fuels and build buffers ISPRL: 5.33 MMT established crude-storage capacity in March 2025. Further approved capacity: 6.5 MMT.	Widen sourcing geography, grades and contractual options; strengthen emergency cover to prevent disruptions to transport and production.	Strategic stocks provide insurance, not permanent independence. Reduce long-term petroleum demand through efficiency and cleaner transport.
Expand distributed renewables PM Surya Ghar: ₹75,021 crore; one-crore-household objective. PM-KUSUM supports solar applications in agriculture.	Reduces exposure to imported fuel, creates installation and maintenance jobs and can ease household electricity expenditure.	Integrate feeders and distribution networks; handle end-of-life panels responsibly; protect distribution utility finances.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

Measure and evidence	Security and growth benefit	Sustainability test or limitation
Make clean electricity dependable June 2025 VGF scheme: 30 GWh of proposed BESS with ₹5,400 crore support.	Storage, pumped hydro, flexible generation and demand response move energy to periods when industry and households need it.	Compare full system costs, including storage, grid upgrades and minerals, rather than generation tariffs alone.
Strengthen low-carbon firm options Nuclear Energy Mission: ₹20,000 crore SMR R&D allocation. PFBR attained first criticality on 6 April 2026.	Reliable low-carbon output can complement solar and wind and support industrial loads; indigenous reactor research builds capability.	Require rigorous nuclear safety, transparent regulation, waste management, realistic project costs and schedules.
Decarbonise difficult industrial uses National Green Hydrogen Mission: ₹19,744 crore; 5 MMT annual production target by 2030.	Offers a route to substitute imported fossil-based hydrogen and build electrolysers, skills and industrial value chains.	Green hydrogen remains energy-intensive; target steel, fertilisers and refining where direct electrification is difficult.
Secure critical-mineral chains NCMM approved 29 January 2025; ₹16,300 crore public expenditure plus expected investment.	Domestic exploration, refining, recycling and overseas sourcing reduce bottlenecks for batteries, renewable equipment and manufacturing.	Maintain environmental safeguards in mining and processing; favour material efficiency, recycling and supplier diversity.
Repair delivery-sector economics RDSS smart metering, loss reduction and utility reforms; AT&C losses 15.04% in FY2024-25.	Improves revenue collection, lowers technical and commercial losses, supports reliable procurement and attracts investment.	Ensure fair tariffs, targeted consumer protection, accurate billing and safeguards against exclusion.
Reduce energy intensity BEE programmes, efficient appliances, industrial process improvements and cleaner public transport.	Lower demand for each unit of economic output reduces import bills, industrial costs and peak stress.	Prioritise verified savings; efficiency must expand affordable services rather than restrict access.

Figures identify approved schemes, reported achievements and targets separately. A target does not establish actual delivery, and a research milestone does not constitute commercial generation.

Why diversified supply matters even during a clean transition. Oil continues to power much of transport and petrochemical production. Abruptly withdrawing available supply would threaten livelihoods and inflation. Strategic stocks, alternative suppliers and demand reduction must therefore proceed together.

Why clean capacity alone does not guarantee security. A solar plant may deliver inexpensive electricity at midday but not during an evening peak. Storage, dispatchable low-carbon sources, transmission and flexible demand determine whether clean energy can substitute for fossil-based generation without compromising reliability.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

TIER 2 · EXTENDED UNDERSTANDING: THE WHOLE TOPIC AROUND IT

Five distinctions that improve analysis

1. **Energy versus electricity:** primary energy includes oil, coal, gas and other sources used directly or converted into electricity. A power target does not cover the whole economy.
2. **Energy independence versus security:** a country may import fuel securely through diversified, affordable arrangements; domestic production can still be insecure if costly, unreliable or environmentally damaging.
3. **Capacity versus output:** a GW of installed solar capacity and a GW of coal capacity do not necessarily produce the same annual electricity or meet demand at the same time.
4. **Import substitution versus import relocation:** domestic renewable power lowers exposure to fuel imports, but imported modules, batteries and minerals can introduce different dependencies.
5. **Clean generation versus sustainable systems:** lifecycle mining, water requirements, land use, waste, affordability and employment matter beyond operational carbon emissions.

What determines implementation success

1. **Resource adequacy:** match demand projections with firm and flexible capacity, not nameplate capacity alone.
2. **Price-risk management:** combine longer-term supply agreements, flexible procurement, emergency reserves and prudent fiscal policies.
3. **Grid investment:** strengthen inter-State and intra-State transmission, forecasting, flexible dispatch and storage procurement.
4. **Distribution viability:** reliable metering, payment discipline, appropriate cost recovery and transparent subsidies.
5. **Industrial capability:** build manufacturing, mineral processing, recycling, skilled employment and research ecosystems.
6. **Social safeguards:** protect vulnerable consumers and workers in fossil-dependent regions during structural change.

Five policy connections worth knowing

Connection	How it enriches this answer
Energy security and macroeconomics	Oil-price shocks can raise the import bill, inflation, production costs and current-account pressures. Efficiency and domestic renewable generation provide long-term protection against repeated external shocks.
Energy security and federalism	The Centre influences national fuel strategy, generation policy and major transmission programmes; State electricity regulators, distribution utilities and governments shape tariffs, procurement, subsidies and service quality.
Energy security and industrial policy	Solar manufacturing, battery cells, critical minerals, green hydrogen and advanced nuclear technology connect strategic autonomy with jobs and export competitiveness. Import substitution still needs cost discipline.
Energy security and climate justice	Reducing emissions is important, but low-income households must retain affordable energy access. Coal-region transition plans should include worker reskilling and economic diversification.
Energy security and resilience	Extreme heat raises demand while floods, cyclones and droughts can disrupt generation and networks. Distributed supply, hardened grids, contingency stocks and rapid restoration capabilities reduce cascading failures.

Growth, security and sustainability: the policy balance

India requires a **managed transition rather than a single-fuel prescription**. In the immediate term, adequate firm generation, fuel logistics, operational reserves and reliable distribution protect the productive economy. Over the medium term, storage, efficient electricity use, renewables, public transport and competitive domestic manufacturing reduce both import exposure and production costs. Over the longer term, low-carbon firm power, green hydrogen where economically justified, circular mineral supply chains and modernised networks help decarbonise hard-to-abate activities. The difficult task is **sequencing**: safeguard present services while ensuring that investment today does not create avoidable technological, fiscal or carbon lock-in tomorrow.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

Two debates worth knowing

Should India accelerate coal retirement?

One position: coal dependence worsens pollution, climate risk and potential stranded assets; accelerated clean-energy investment can reduce these burdens. **The other:** existing coal plants provide dependable output while storage, grid flexibility and transmission remain insufficient in parts of the system. **The balanced reading:** replace coal generation progressively as reliable alternatives become available, avoid unnecessary new lock-in, improve existing-plant efficiency and prepare coal-dependent regions for employment transition.

Is complete energy self-reliance the best security strategy?

One position: domestic renewables, nuclear technology, fossil-resource exploration and critical-mineral processing reduce external dependence. **The other:** autarky may increase consumer costs, restrict access to efficient technologies and divert investment from more productive uses. **The balanced reading:** pursue strategic autonomy through diversified trade, domestic capabilities in vulnerable segments, emergency buffers and lower energy intensity, rather than treating all imports as inherently insecure.

4 Pitfalls and variations

Six recurrent errors, the claims that should never appear in an answer, and how the structure changes when the examiner alters the scope or directive.

4.1 Six pitfalls, each with its correction

Challenges without causal explanation

~~India faces import dependence, coal pollution, rising demand and transmission losses.~~

Show the consequences: import dependence transmits global price shocks; weak networks interrupt supply despite available generation; inadequate flexibility restricts reliable renewable substitution.

Confusing electricity with total energy

~~India has crossed 50% clean energy, so its energy-import problem is almost solved.~~

The achieved milestone concerns non-fossil installed **electricity capacity**. Transport, industrial fuels and actual generation remain distinct.

Listing schemes instead of suggesting measures

~~PM Surya Ghar, PM-KUSUM, Green Hydrogen Mission, RDSS, NCMM and Nuclear Energy Mission.~~

Connect each scheme to a threat and specify the needed improvement: storage, reliable distribution, cost-effective substitution, recycling or supply diversification.

Ignoring affordability and industrial competitiveness

~~Switch the energy system immediately to low-carbon sources, whatever the cost.~~

Assess firm supply, integration costs, tariff effects, investment requirements and the need to protect productive activity and vulnerable consumers.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

Treating renewables as automatically dependable

~~More solar capacity always means less need for other generation.~~

Explain the different timing of renewable output and electricity demand; add storage, dispatchable supply, forecasting, transmission and demand response.

No judgment on the three competing goals

~~Thus India should balance growth, energy security and environment.~~

Advocate a phased strategy: secure current supply, expand reliable low-carbon alternatives, improve efficiency and maintain affordability through a just transition.

4.2 Never write these

- "India generates over 50% of its electricity from non-fossil fuels."
  India achieved more than 50% non-fossil installed capacity in 2025; the non-fossil generation share was 29.2% in FY2025-26.
- "India will meet half of its total energy needs from renewables by 2030 under its NDC."
  The NDC's 50% target concerns cumulative installed electric-power capacity from non-fossil sources, which includes nuclear power.
- "India is entirely dependent on imported coal."
  India produces substantial quantities of coal domestically; coal-quality requirements and particular sectors still create import exposure.
- "The approved 6.5 MMT additional petroleum reserves are already operational."
  The March 2025 ministry statement distinguishes 5.33 MMT of established facilities from the separately approved additional capacity.
- "Kalpakkam's Prototype Fast Breeder Reactor started commercial electricity supply on 6 April 2026."
  That date marks first criticality, the beginning of a controlled chain reaction, not commercial grid operation.
- "The Nuclear Energy Mission has already established 100 GW of nuclear capacity."
  100 GW by 2047 is an ambition; the March 2026 installed nuclear capacity was 8.78 GW.
- "Green hydrogen is the most efficient substitute for every fossil-fuel use."
  Conversion losses and costs make direct electrification preferable in many applications; hydrogen is particularly relevant for difficult-to-abate uses.
- "Energy security means eliminating all imported fuels."
  Reliability, diversification, accessibility and affordable supply matter alongside domestic production. Absolute self-sufficiency is not required for security.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

4.3 If the question changes

If it asks	The structure becomes	What must change
Critically examine India's dependence on imported crude oil	Import profile; geopolitical and price risks; domestic production limits; reserves, diversification and demand reduction; assessment.	Petroleum becomes the centre; electricity-sector policies are supporting material only.
Can India achieve **500 GW non-fossil capacity by 2030**?	Target and present capacity; deployment obstacles; land, finance, manufacturing, transmission and storage; feasibility judgment.	Distinguish capacity targets from actual energy output; assess achievement, not the whole energy-security system.
Role of **nuclear energy** in India's security	Firm low-carbon output; indigenous PHWRs and FBRs; uranium and thorium strategy; safety, cost and waste; future role.	Evaluate nuclear technology in depth rather than giving a broad fuel comparison.
Green hydrogen and energy independence	Mission objectives; difficult-to-abate sectors; import substitution; cost, water, renewable electricity and infrastructure constraints.	Analyse where hydrogen is justified, not merely its production target.
Just transition away from coal	Coal's present economic role; climate and pollution costs; regional employment; retraining, investment and social protection.	Put distributive justice and regional economic adjustment at the centre.
Discuss energy security and climate action together	Common objectives; genuine trade-offs; renewable integration, efficiency, storage and resilient systems; conditional judgment.	Give greater weight to synergies and conflicts between energy and climate policy.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

5

The model answer

One model answer, written to the UPSC Gurus house range of 250 to 253 words (**252 words**, counting every whitespace-separated token, including section numerals, headings and point labels; UPSC's printed limit is 250 words). The form follows the question: explained challenges, matched measures supporting growth and sustainability, and a short final judgment on the competing goals. The introduction covers the whole question; the conclusion resolves its demand.

Model answer ### Challenges, matched measures and a balancing judgment **252 words**

India needs affordable, dependable energy for industrialisation and inclusive growth, but imported fuels, fragile delivery systems and environmental pressures threaten long-term security.

1. Key challenges

- **Import exposure:** About 88% crude-oil dependence transmits geopolitical shocks into inflation, freight costs and industrial competitiveness (CEEW, 2026).
- **Demand pressure:** Expanding manufacturing, transport and cooling increase fuel requirements and peak electricity loads.
- **Coal dependence:** Firm domestic electricity comes with air pollution, emissions, water stress and transition risks.
- **Distribution weaknesses:** AT&C losses of 15.04% (FY2024-25) constrain utility finances, investment and reliable access.
- **Transition bottlenecks:** Variable solar and wind need storage and transmission; imported critical minerals create fresh dependencies.

2. Measures supporting growth and sustainability

- **Supply resilience:** Diversify import sources, maintain strategic petroleum reserves and strengthen domestic exploration subject to safeguards.
- **Clean diversification:** Scale solar, wind and nuclear alongside appropriate firm capacity, supporting jobs and lower fuel imports.
- **Grid reliability:** Invest in batteries, pumped storage, transmission and demand response; strengthen DISCOM metering and cost recovery.
- **Efficient demand:** Expand efficient appliances, industrial energy audits, electric public transport and building retrofits to lower bills.
- **Secure new chains:** Implement critical-mineral recycling and responsible processing; deploy green hydrogen selectively in hard-to-abate industries.

3. Balancing competing goals

Sequence fossil-fuel displacement as reliable alternatives expand. Annual generation, rather than installed capacity alone, must inform investment choices and effective transition sequencing. Protect vulnerable consumers and coal-region workers through targeted support, reskilling and transparent environmental safeguards.

Thus, diversified supply, efficient consumption and dependable clean electricity can reinforce energy security, economic competitiveness and a socially just, sustainable transition.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

DEMAND
Explain the key challenges to India's energy security, then suggest measures that secure supply while supporting economic growth and sustainability

HIDDEN DEMAND
Security, growth and sustainability pull against each other

STRUCTURE
About two-fifths on challenges, two-fifths on measures meeting both conditions, and one-fifth on balancing the three goals

BALANCE
Introduction 22 words, conclusion 21 words; 252 words in all

Why it works: The introduction places energy security within India's growth and environmental challenge. Part 1 explains five vulnerabilities, with two verified quantitative anchors: crude-oil dependence and distribution losses. Part 2 matches them with concrete measures across fuel security, clean generation, grid flexibility, demand management and critical-mineral supply chains. Part 3 answers the hidden demand by distinguishing installed capacity from delivered energy and protecting affordability and workers during transition. The conclusion gives a clear policy judgment: security, competitiveness and sustainability must reinforce one another.

6 Other ways to write it

The model answer above remains the recommended answer. These alternative outlines show how the same demands can be met through different presentations, without sacrificing explanation, policy feasibility or the final judgment.

Approach	How it is built	When it works
Challenge-to-remedy matrix	Two columns linking each vulnerability to its remedy: imports to diversification and reserves; renewable variability to storage; DISCOM losses to distribution reform; minerals to recycling and supply-chain development. Close with the three-goal test.	When causal matching and compact presentation are priorities.
Supply, system and demand	Group problems and remedies under fuel supply, electricity generation and delivery, and energy consumption. Include a final paragraph on affordability, emissions and employment.	When you want to demonstrate the entire energy value chain rather than focus only on generation.
Security, growth, sustainability matrix	Explain the vulnerabilities first; then evaluate each major policy against reliable supply, industrial affordability and environmental performance, identifying the conditions for success.	When the three competing goals are the central analytical focus.
Immediate, medium and long term	Begin with risks; propose immediate supply diversification and buffers, medium-term grid and efficiency reforms, and longer-term low-carbon industry, critical-mineral resilience and worker transition.	When the question emphasises a strategic roadmap or policy sequencing.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

7 Quick recall and Prelims crossover

Sixteen high-value facts covering India's energy imports, petroleum buffers, non-fossil capacity, electricity generation, distribution reforms and major clean-energy initiatives. Distinguish a policy target from an achieved outcome.

1. **Crude oil:** approximately **88%** import dependence in 2024 (CEEW, June 2026).
2. **Natural gas:** nearly **48%** import dependence in 2024 (CEEW).
3. **Coal:** approximately **26%** import dependence in 2024, as assessed by CEEW; India remains a major domestic producer.
4. **Crude suppliers:** around **85%** of India's crude imports came from just six countries, according to CEEW's 17 June 2026 release.
5. **Strategic petroleum reserves: 5.33 MMT** established at Visakhapatnam, Mangaluru and Padur (MoPNG, 20 March 2025).
6. **Additional SPR: 6.5 MMT** approved in July 2021 for Chandikhol and Padur; separate from established capacity.
7. **Non-fossil generation: 29.2%** of India's electricity generated in FY2025-26 (MNRE, April 2026).
8. **Non-fossil capacity: 300.50 GW** on **31 July 2026**, announced by MNRE on 9 August; more than 54% of installed electricity capacity.
9. **AT&C losses: 15.04%** in FY2024-25, down from 21.91% in FY2020-21 (Ministry of Power).
10. **Updated NDC:** about **50%** cumulative installed electric-power capacity from non-fossil sources by 2030; approved **3 August 2022**.
11. **2030 ambition: 500 GW** non-fossil installed electric-power capacity, distinct from annual generation or total energy demand.
12. **BESS:** additional **30 GWh** viability-gap funding scheme approved in June 2025, with **₹5,400 crore** financial support.
13. **PM Surya Ghar:** approved **29 February 2024**; **₹75,021 crore** outlay; one crore households targeted.
14. **Green Hydrogen Mission:** approved **4 January 2023**; **₹19,744 crore**; at least **5 MMT/year** production-capacity target by 2030.
15. **National Critical Mineral Mission:** approved **29 January 2025**; ₹16,300 crore government expenditure plus ₹18,000 crore expected investment.
16. **Kalpakkam PFBR: 500 MWe** reactor attained first criticality on **6 April 2026**; this was not commercial electricity generation.

THE ONE SENTENCE TO CARRY OUT OF THIS DOCUMENT

India's energy security will be strengthened not by choosing between growth and sustainability, but by securing reliable supply today while reducing the cost, imports and environmental damage associated with each unit of future growth.

Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

8 Write it yourself

Write a fresh answer in 250 words without looking back, then examine its explanation, structure, evidence and judgment against these seven checks.

	Check	Yes / No
1	Does the introduction connect **energy security, economic growth and sustainability**, instead of discussing only rising electricity demand?	
2	Does Part 1 **explain why** each major vulnerability threatens reliable or affordable energy, rather than merely list challenges?	
3	Have I covered **import dependence, rising demand, coal-related risks, system weaknesses and transition bottlenecks**?	
4	Does Part 2 propose **specific, feasible measures**, matched to the challenges, with clear growth and sustainability benefits?	
5	Have I distinguished **electricity capacity from generation**, and considered storage, affordability, critical minerals and reliable supply?	
6	Does the small final part resolve the **security-growth-sustainability trade-off** through sequencing, safeguards and a just transition?	
7	Is the answer **250 words or a little over**, counting headings and labels, with a conclusion of roughly the introduction's length and no inaccurate claim from section 4.2?	

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Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

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Explain the key challenges for India's energy security. What measures do you suggest for ensuring energy security along with economic growth and sustainability ?

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