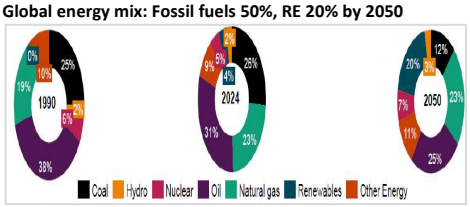
ENERGY TRANSITION

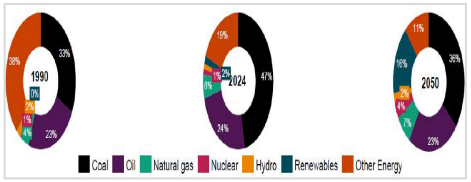
SECTOR UPDATE

nuvama institutional equities

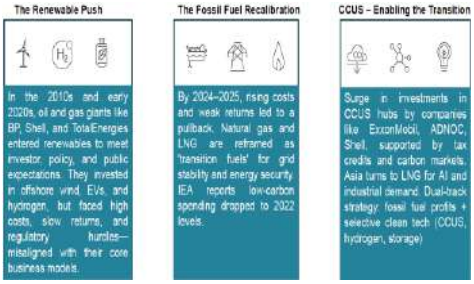
Global energy mix: Fossil fuels 50%, RE 20% by 2050



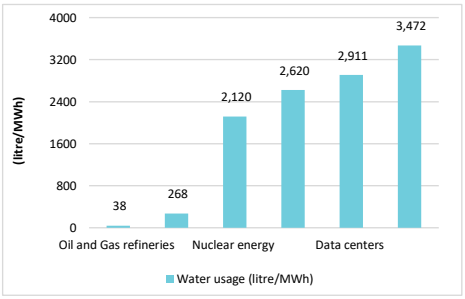
India's energy mix: Fossil fuels 66%, RE 16% by 2050



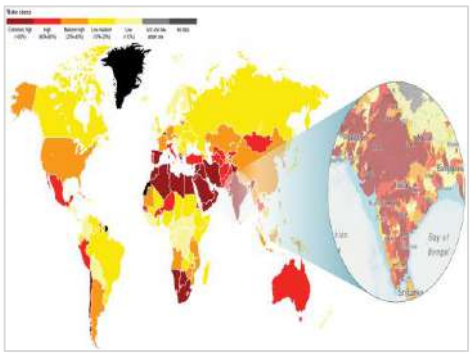
Rebalancing: Purely Renewables to Fossil Fuels with CCUS



New energy technologies shall drive fresh water demand



India ranks 13th among 17 most water-stressed countries



Expert: Paradoxes of energy transition

We hosted Ms Gauri Jauhar, ED – Energy Transitions & Clean Tech Consulting, S&P Global to understand paradoxes of energy transition.

Highlights: i) Fossil fuels (77%) dominate India's energy mix; RE share to be 16% by 2050 (2024: 2%). ii) Gas was a key transitional fuel in other countries (19% in 1990 to 23% 2024); India has room to grow gas use for transition. iii) Coal-to-gas transition vital; scalability, commerciality limit direct coal-to-RE transition. iv) Emission fall below target, even in ambitious pledge. v) Focus shifts to CCUS/GH2 to meet net-zero target. vi) Rising power demand to lift water use; ESG spotlights sustainability risks. vii) Investor confidence in green firms intact despite low profitability during ramp-up. Gainers: RIL, Waaree, SWSOLAR.

Energy transition versus security; India: gas key for energy transition

India's energy mix in 2024 was dominated by fossil fuels (77%) with renewables at just 2%; by 2050 though, fossil fuels are projected to drop to 66% and renewables to rise to 16%. Investments in renewables by giants such as BP, Shell and Total Energies did not deliver comparable returns, which drew focus back on fossil fuels; energy security became key owing to geopolitical concerns. Government schemes like PAHAL and DBT reduced biomass use from 38% in the 1990s to 19% in 2024, curbing indoor air pollution. That said, while the US, Europe and other Southeast Asian countries have seen a favourable transition from coal-to-gas, India has trailed in leveraging gas as a transition fuel, particularly in the power sector. By 2050, gas shall be the only fossil fuel with a potential increase in the energy mix for US, China and India. Scalability and commerciality limit direct coal-to-renewable transition.

Emission reduction likely below targets; focus shifts to CCUS and GH2

S&P Global Commodity Insights' review identified a 43% gap between the emission reduction targets by 2030 relative to 2019 levels, under the current nationally determined contributions (NDC) target. However, even in the most ambitious reduction pledges, it estimates emissions shall likely decline by only 5% by 2030E. Capital allocation will need to shift towards material net-zero technologies such as carbon capture utilisation and storage (CCUS) and green hydrogen (GH2), which shall become an integral part in achieving global and India's net-zero target by 2070.

Energy-water nexus; ESG concerns highlight sustainability risks

Many energy technologies and rising AI-driven data demand are highly water-intensive, straining resources in water-stressed countries like India. Technologies like CCUS can lift water usage by 25–40%. By 2030, India's freshwater demand may rise to 52tn litres; energy sector shall account for 12tn litres. ESG concerns, especially the breached planetary boundaries, highlight urgent sustainability risks. Strong investor confidence in green energy firms despite lower RoCE shows investor optimism. **Key beneficiaries:** We argue energy transition will benefit companies building New Energy factories across the value chain—*RIL, Waaree Energies, etc*—and BESS/EPC companies—*Sterling & Wilson Renewables*—on large order inflows.

Jal Irani
Jal.Irani@nuvama.com

Akshay Mane
akshay.mane@nuvama.com

Tanay Kotecha
tanay.kotecha@nuvama.com

Energy transition: RE rising, but gas rules

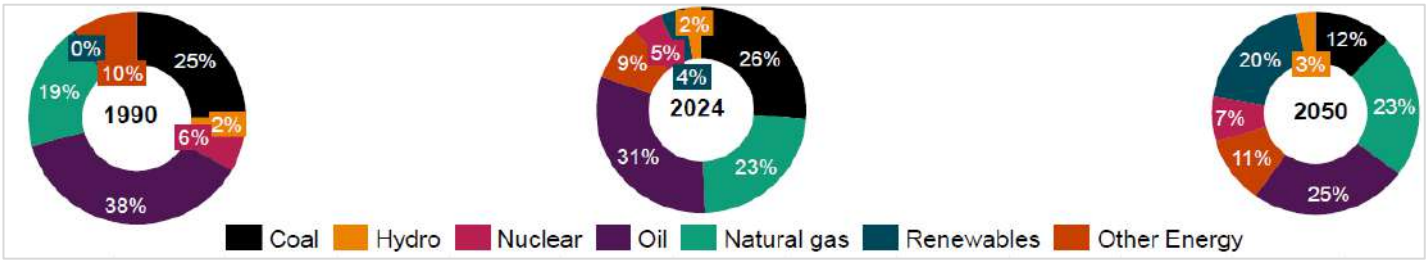
Despite the *energy transition* narrative, coal, oil and natural gas remain dominant fuels. Renewables are expected to rise from roughly 4% now to about 20% by 2050 in the global primary-energy mix; yet fossil fuels would account for more than 50% in 2050.

Oil and natural gas are expected to remain the dominant fuel in the US energy mix. In the US, renewables would reach about 17% by 2050 aided by the coal-to-gas substitution that took off in 2017 when gas first overtook coal in the US power mix, which had a direct impact on USA's emission profiles.

Renewable energy (RE) adoption in China is expected to outpace other nations by 2050. China will be outpacing other nations in RE adoption by 2050 with an aggressive renewables build-up as it dominates most of the renewable and rare-earth supply chains.

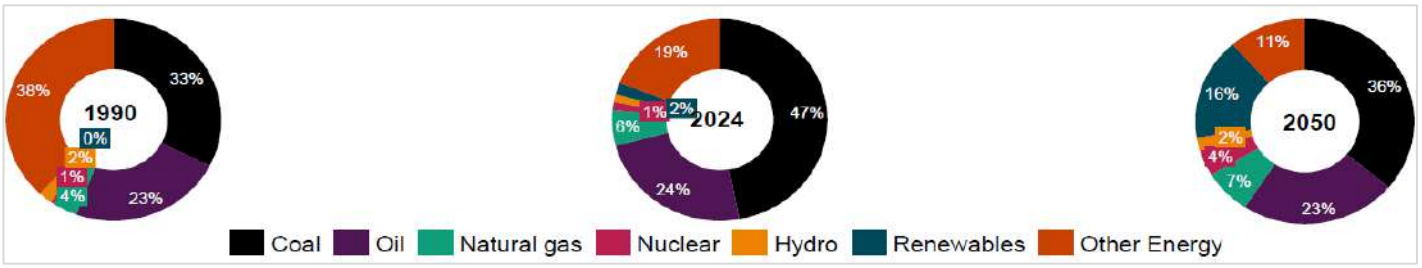
India's energy mix in 2024 is dominated by fossil fuels (77%) with renewables at just 2%; by 2050 though, fossil fuels are projected to drop to 66% and renewables to rise to 16%. It is noted that even by the time India gets to 500GW, the system would still be about 76% thermal from legacy sources, underscoring the balancing challenge.

Exhibit 1: Global primary energy mix inflections – Base case (1990–2050)



Source: S&P Commodity Insights, Nuvama Research

Exhibit 2: India primary energy mix inflections – Base case (1990–2050)



Source: S&P Commodity Insights, Nuvama Research

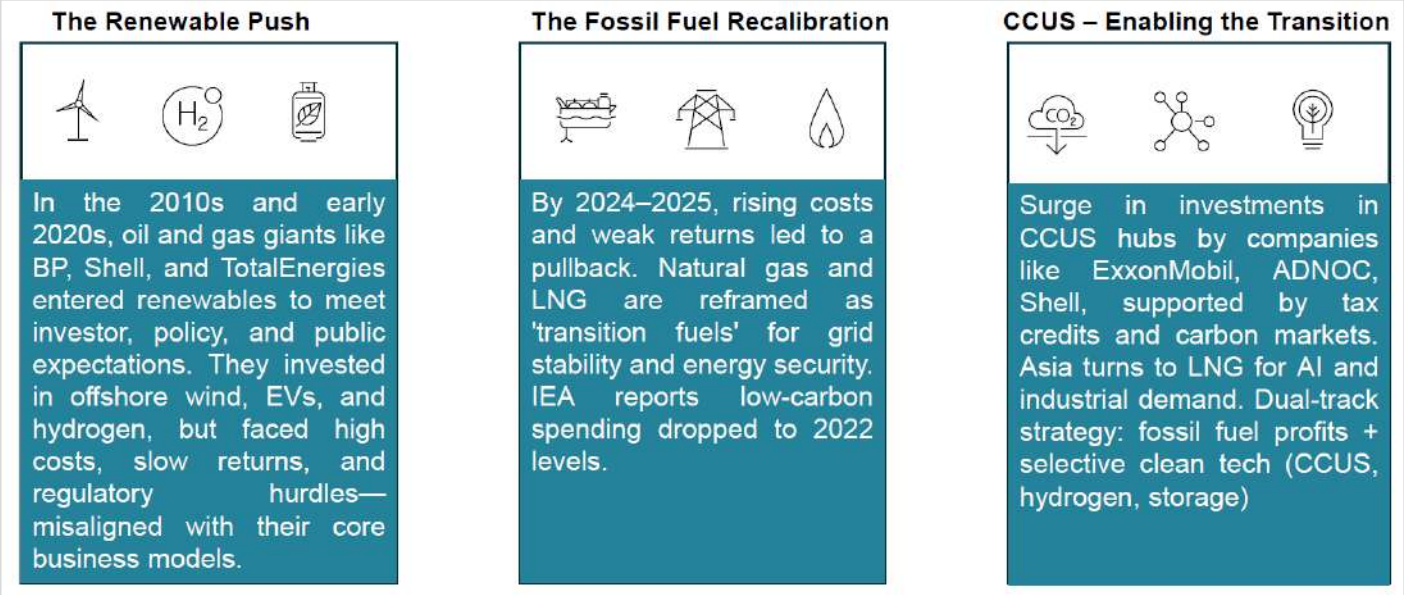
Paradox: Energy transition or security!

Climate ambition stalls as NDC submissions continue to lag

Commodity Insights' review identified a gap of 19–23 gigatons of CO2 equivalent (GtCO2e) between the stated goal of a 43% emissions reduction by 2030 (relative to 2019 levels) and projected emissions under the current 2030 NDC targets.

Even if the most ambitious reduction pledges—many of which rely on international support—were fully implemented, global GHG emissions would decrease by only 5% by 2030 (relative to 2019). A similar pattern emerges for 2035, with emissions projected to fall by 15%. However, this analysis remains speculative as most parties are yet to outline their 2035 climate strategies and emission reduction targets under the next round of NDC.

Exhibit 3: Strategic rebalancing: From Renewables to Fossil Fuels with Carbon Capture

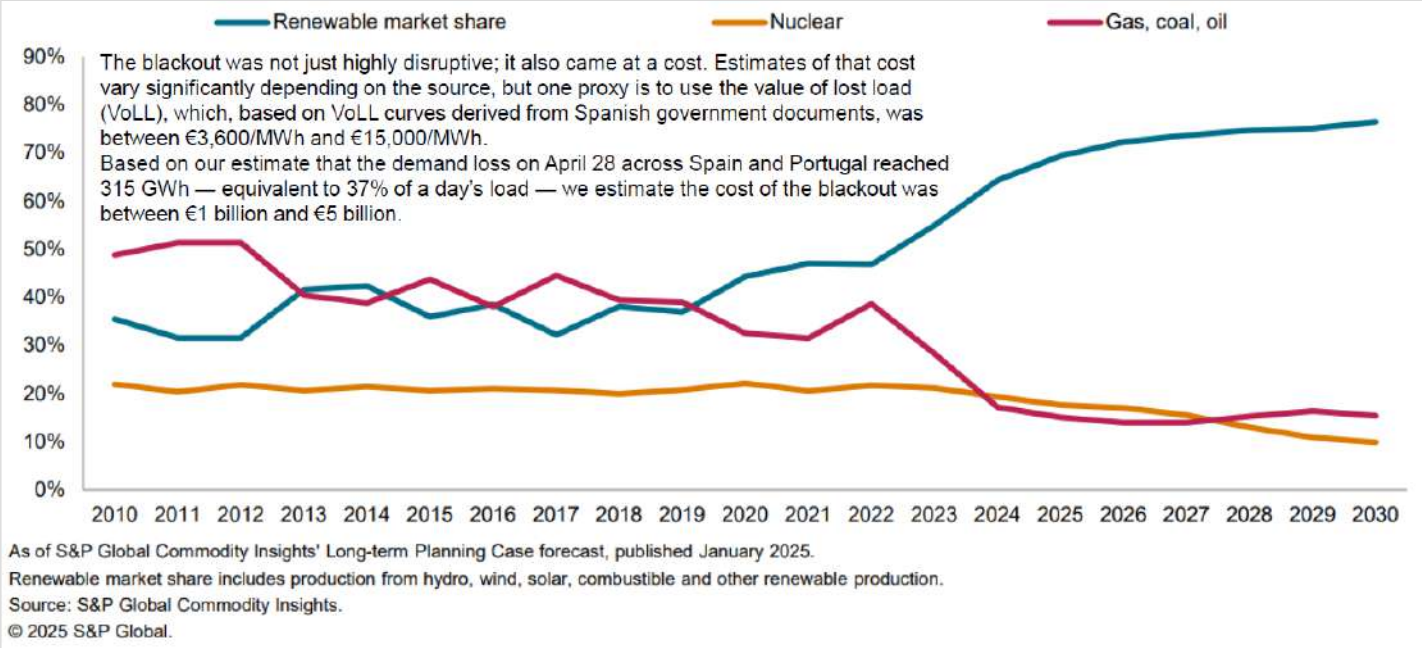


Source: S&P Commodity Insights, Nuvama Research

Spain — A case study

Need for grid stability and flexibility with rising renewables

Exhibit 4: Historical and forecast generation market share in Spain (generation as % of net demand)



Source: S&P Commodity Insights, Nuvama Research

Paradox of energy-water nexus

Most energy technologies are water-intensive

Thermoelectric power generation (coal, nuclear, oil and gas) is a major driver of freshwater withdrawals worldwide, particularly in countries with large fossil fuel fleets such as the US, China and India. In the US, thermoelectric plants account for ~40% of total freshwater withdrawals, consistent with global trends in industrialised nations.

Water-intensive technologies

Nuclear energy: A single reactor uses between 1,514 and 2,725 litres of water per MWh.

Coal power plants: Consume about 2,620 litres of water per MWh of electricity generated.

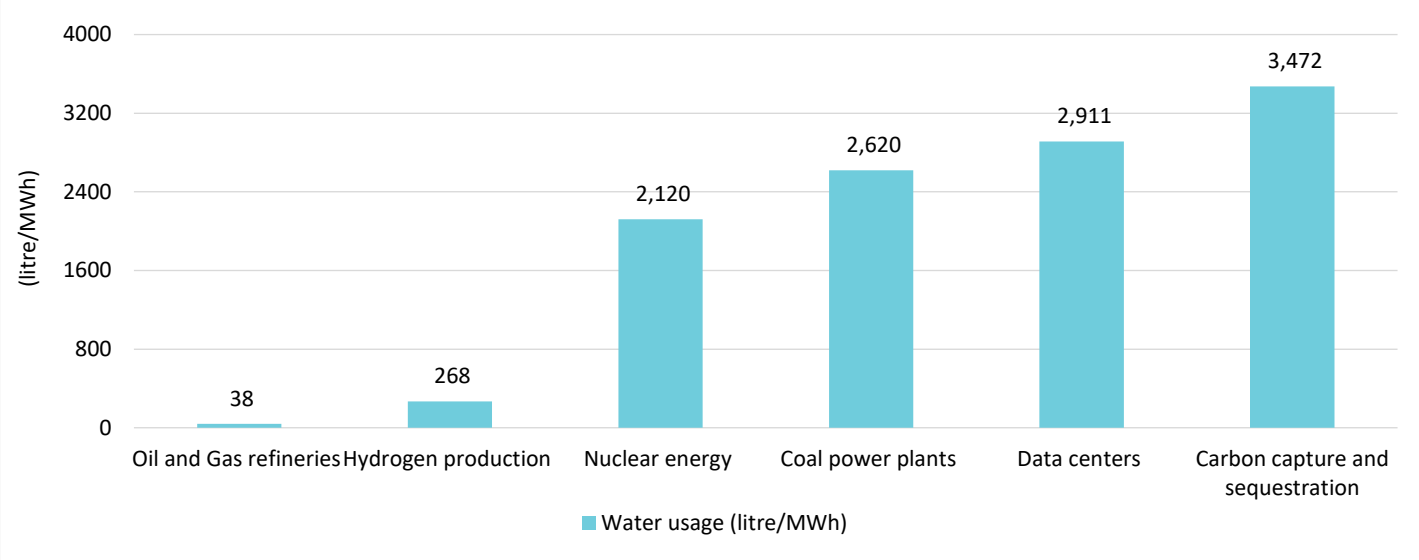
Hydrogen production: Consumes about 268 litres of water per MWh of energy it provides.

Data centres: A data centre consumes 2,911 litres of water per MWh just for cooling.

Oil and gas refineries: Consume 32–44 litres of water per MWh of energy derived from crude oil.

Carbon capture and sequestration: Raises water use by 25–40% depending on specific technology; for a coal power plant with CCS, water consumption ranges from 3,275–3,668L/MWh.

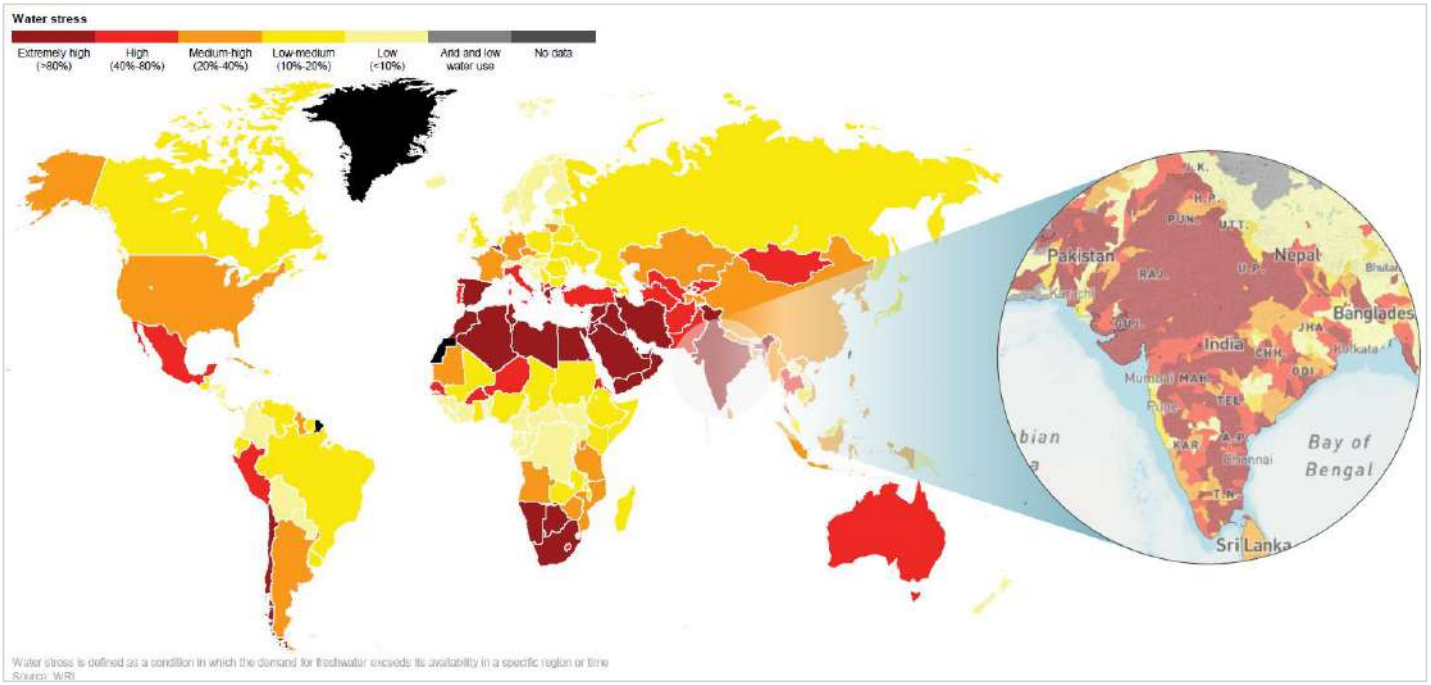
Exhibit 5: New energy technologies shall drive demand for fresh water



Source: S&P Commodity Insights, Nuvama Research

By 2030, India's freshwater demand will hit 52.36 trillion litres—tripling today's residential usage. The energy sector alone will account for 11.69 trillion litres, fuelled by coal, nuclear, hydrogen and digital infrastructure.

Exhibit 6: By 2050, >1bn people could face extreme water stress; India ranks 13th among 17 most water-stressed countries

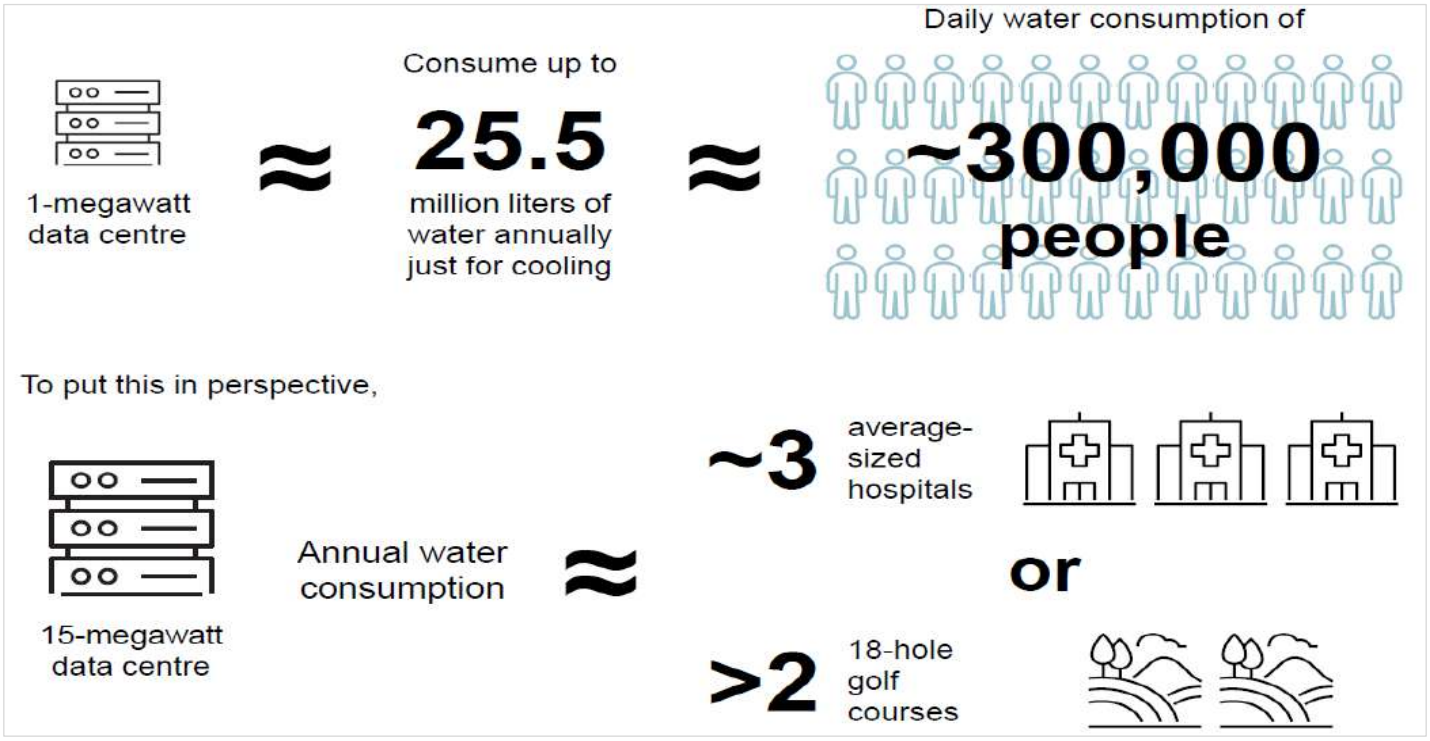


Source: S&P Commodity Insights, Nuvama Research

Data centres driving massive power and water demand

- According to the International Energy Agency, data centres currently consume over 560 billion litres of water annually, which could possibly rise to 1.2 trillion litres a year by 2030.
- Global data centre power demand could grow 10–15% annually, reaching up to 2,050TWh by 2030, equal to Japan's current electricity use. AI-driven growth presents major opportunities in data centre and energy infrastructure.
- Hyperscale facilities operated by companies such as Google demonstrate the true scale of the challenge. Each of Google's facilities use ~200 million gallons of water annually while Microsoft's global operations consumed 1.69 billion gallons last year, implying a 34% increase.
- Hyperscale data centres like those run by Google, Meta, Microsoft and Amazon could account for ~30% of projected power demand. Generative AI is a major driver, using 10–30× more energy than traditional AI tasks.

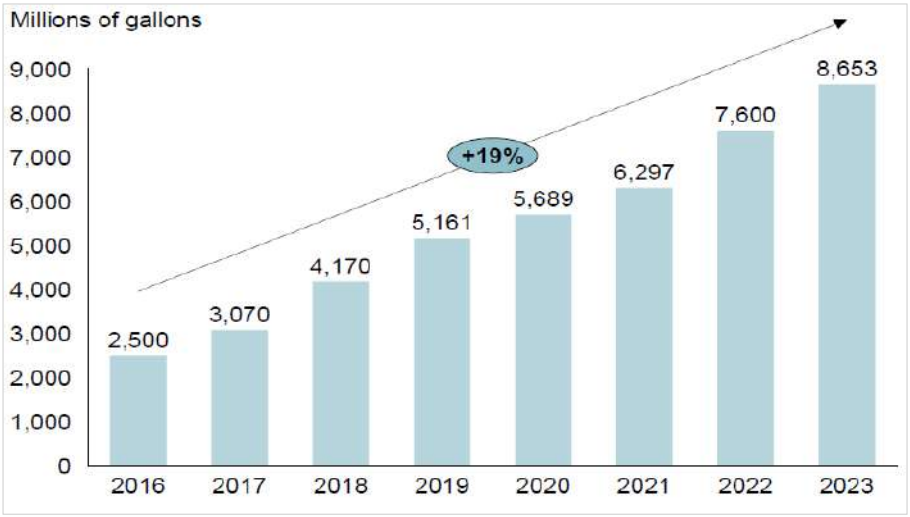
Exhibit 7: Key data on water consumption by data centres



Source: S&P Commodity Insights, Nuvama Research

Google is at the forefront of 'fuelling' water use in data centres owing to its expanding infrastructure and AI workloads. Google's water consumption has more than tripled since 2016. In 2022 and 2023, 87–89% of water withdrawals were for data centres.

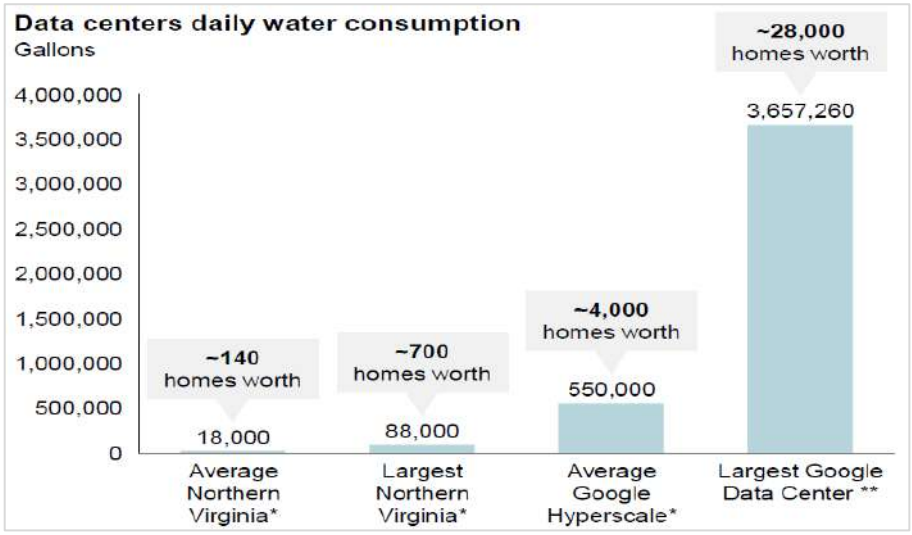
Exhibit 8: Google: Total water withdrawals by year



Source: S&P Commodity Insights, Nuvama Research

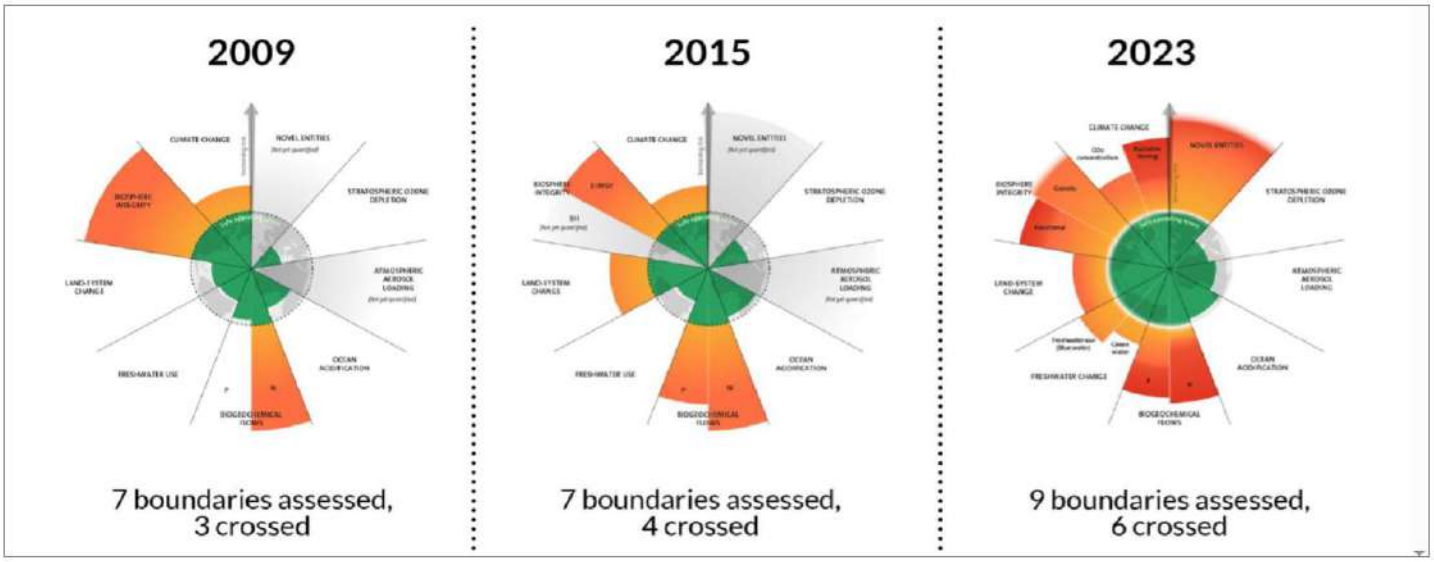
In 2024, Google's Council Bluffs, Iowa data centre consumed 1.3bn gallons of potable water (~3.7 million gallons per day (similar to the amount used by a large university).

Exhibit 9: Data centres' daily water consumption



Source: S&P Commodity Insights, Nuvama Research

Exhibit 10: Nine interdependent planetary boundaries



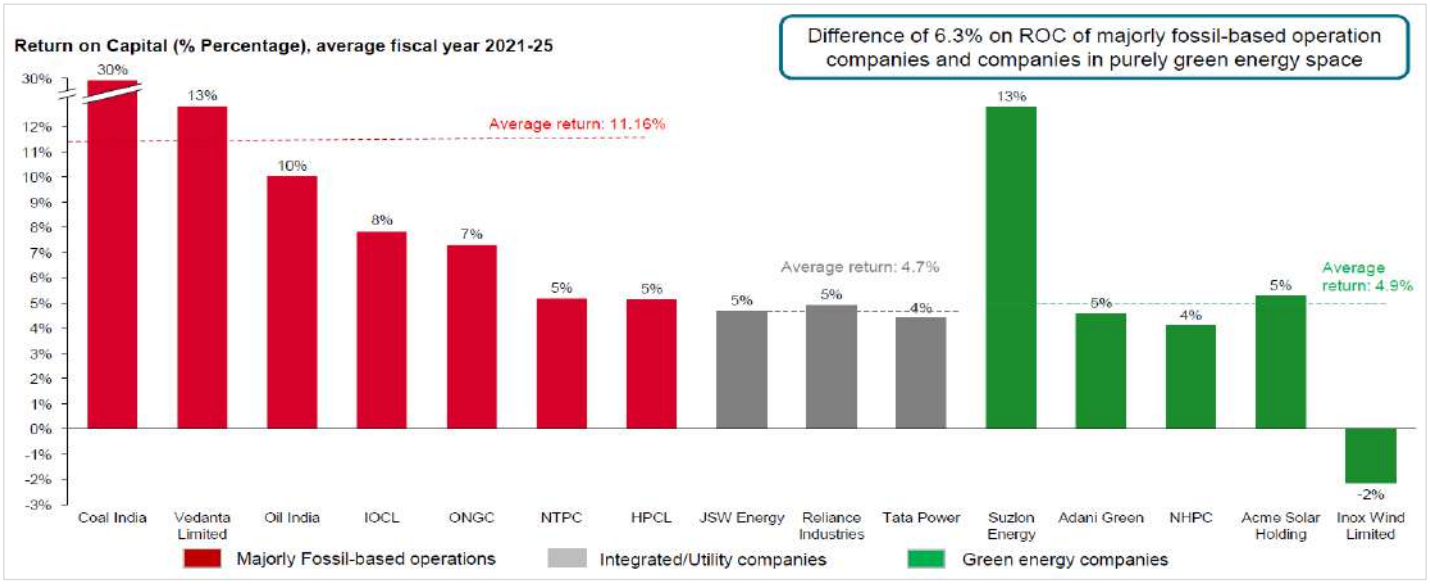
Source: S&P Commodity Insights, Nuvama Research

Paradox of money

Return gaps and investor choices

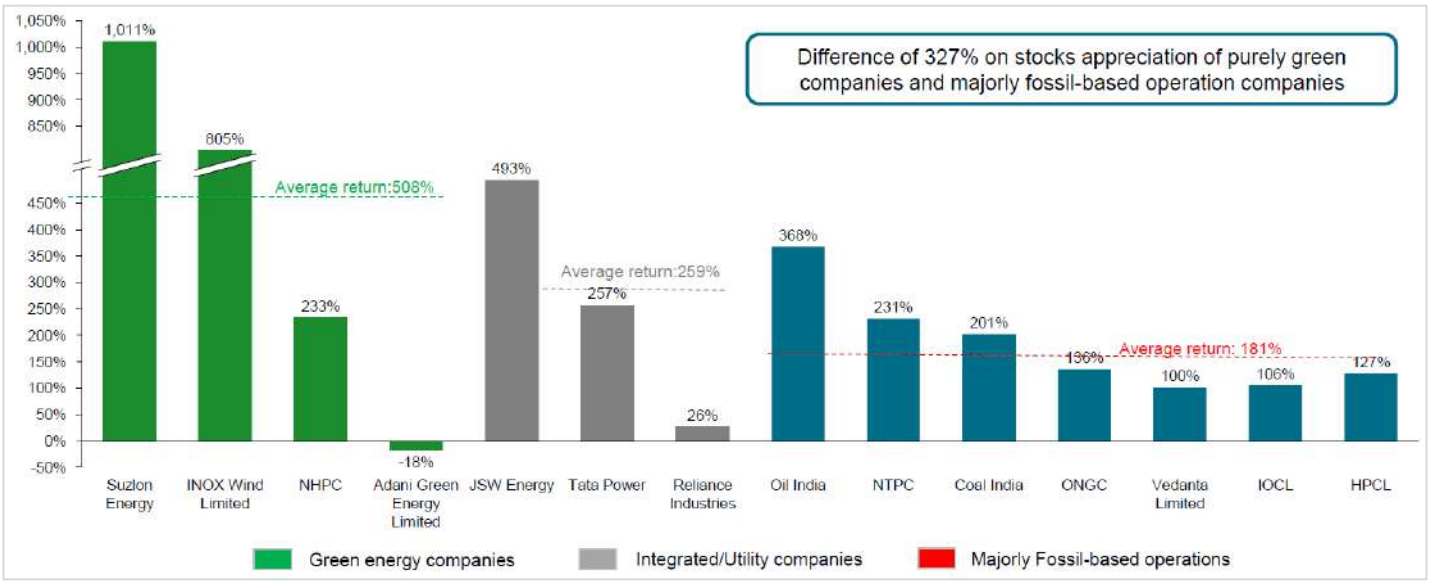
- India's green firms lag in returns but lead in stock performance, reflecting investor optimism.
- Higher stock market returns than actual return on capital employed.

Exhibit 11: Return on capital (average FY21–25)



Source: S&P Commodity Insights, Nuvama Research

Exhibit 12: Percentage change in stock price (average FY20–24)



Source: S&P Commodity Insights, Nuvama Research

Key takeaways

Global renewable energy mix to rise from 4% to 20% by 2050

- Renewables are expected to rise from roughly 4% now to about 20% by 2050 in the global primary energy mix; fossil fuels would still account for more than 50% in 2050.
- In the United States, renewables would reach about 17% by 2050 aided by the coal-to-gas substitution that took off in 2017 when gas first overtook coal in the US power mix, which had a direct impact on USA's emission profiles.
- Even by the time India gets to 500GW, the system would still be about 76% thermal (from legacy sources), underscoring the balancing challenge.
- China is likely to outpace other nations in RE adoption by 2050 with an aggressive renewables' build-up as it dominates most of renewables and rare-earth supply chains.
- In all cases, coal usage is going to decrease. At the global level, it expected to decrease by 14% between now and 2050. In the US, it would be about 8%. In China coal would decline by 34%. In India, coal is expected to decrease by about 12% while gas will be the only fossil fuel to increase everywhere (Global 0.29%, US 3%, China 2% and India 1%).

India's transition: Pushed by government policies

- India is targeting 500GW of non-fossil capacity by 2030, and policy levers—including recent GST rate cuts—are intended to support the pace.
- The category of 'other energy sources', essentially traditional biomass (cooking), is declining sharply—being replaced by LPG. Government schemes such as 'PAHAL' and targeted LPG subsidies have driven this shift leading to a reduction from 38% to 19% with expected further decline.

Pledges versus Reality

- Energy transition is uniquely linked to climate ambition that started with the Kyoto Protocol and crystallised at the Paris Agreement in 2015.
- There is an almost a 43% shortfall to emission-reduction targets by 2030 relative to 2019, even if the most ambitious pledges are fully implemented under current NDCs.
- Under current NDC pledges, global emissions could still increase by roughly 5% by 2030 versus 2019.

Energy security and *energy transition* must advance together

- Energy transition and energy security need to go hand-in-hand. Gas can be used as an effective transition fuel as gas's viable role is flexibility, not baseload. Gas as the cleanest fossil can be best used for balancing/peaking to integrate renewables—its long-run share rises by only ~1% point in India by 2050.
- Policy could still play a niche role in helping India achieve the target of 15% share for gas. Bringing gas under GST and adding carbon-market incentives could meaningfully lower delivered prices (by about 40%), improving utilisation of the existing infrastructure.

- On comparing regional technology preferences, North Asia and Europe lean toward hydrogen, whereas the US favours a mix of electrification and CCUS (Carbon Capture Utilisation & Storage) with CCUS attracting investments by large companies and strong US incentives.

The Energy–Water Nexus tightening

- Water is likely to emerge as a binding constraint on India's energy pathway as more than 1bn people could face water stress by 2050. India already ranks 13th among 17 most water-stressed countries.
- Thermal plants account for ~40% of total freshwater withdrawals. On demand, by 2030 India could represent ~22% of the referenced water need.
- While coal and nuclear are broadly comparable in water intensity, CCUS, nuclear, coal, hydrogen and data centres are also water-intensive choices; for context, a 15MW data centre uses roughly as much water annually as three hospitals. Energy security must be planned with water security.

Digital/AI demand versus sustainability

- AI workloads consume 10–30× more energy than traditional tasks.
- India's data centre power demand could grow 10–15% per year with ~65% of data centre OPEX being energy.

Sustainability versus Markets

- Over the period cited by the speaker, cumulative stock market performance was: renewables ~500% plus, utilities ~260% and fossil-fuel companies ~180%; this implies a spread of about 327 percentage points.
- Capital markets have rewarded transition narratives far more than legacy fossil players even as fossil fuels are still projected to be ~66% of the 2050 primary-energy mix. However, optimism and capital flows do not always line up with near-term RoCE and debt realities.

Q&A session

Is India's momentum mainly regulatory, or does it also have structural advantages and competitive strengths?

India is signalling multi-front ambition such as a newly announced deep-water mission in oil and gas, the prior Hydrogen Mission, and nuclear support in this year's budget, which, combined with scale targets such as 500GW by 2030, underpin India's capability; however, execution pace and system flexibility remain the two key watch-outs.

Why is India's gas share stuck at lower level, and what will it take to move from ~6% to 15%?

Gas is the cleanest fossil fuel, but remains costlier than coal and current renewables, and uptake improves most when gas is used for balancing and peaking. India already has about 20GW of gas power that is under-utilised or non-performing, which is a lost asset for system flexibility. Taxes' build-up materially lift end-customer prices, with the path from landed LNG/well-head price to delivered price adding 40–50% to the final customer price. Bringing gas under GST and adding carbon-market-linked incentives could narrow this gap, but without such a change, a 15% share is hard to reach in the near term.

On CGD, India's gas demand is led by city-gas (CNG/PNG) and gas used mainly for balancing/peaking rather than baseload—is this model common in developed markets (e.g. the US)? Is India's gas-for-balancing approach common elsewhere?

It's not common in developed markets for gas demand to be led by CGD (CNG/PNG) while using gas mainly for balancing/peaking rather than baseload. Pushing India's gas share from ~6% toward 15% will be difficult without pricing/tax reforms: the path from landed LNG to delivered price adds 40–50% to the final consumer price. Bringing gas under GST and adding carbon-market incentives could meaningfully lower delivered prices (though not by the full 40–50%) and help utilise the ~20GW under-used gas-based fleet for flexibility. It is notable that gas now competes with hybrids/EVs in transport and with renewables-plus-storage in power. So, the policy clarity and relative economics will determine how far CGD can pull demand.

As renewables scale quickly, could India face Spain/Iberia-style grid stress and curtailments? What safeguards—like RTC tenders, hybrids and storage—are being put in place to avoid that? With corporate build-outs of 40GW (and potential for 100GW), are we taking sufficient pre-emptive safeguards?

India is designing RTC (round-the-clock) tenders and hybrid configurations to smooth variability, but the decisive factors will be the scale and duration of storage. The open question is whether deployments will move beyond 4-hour batteries to 8-hour and longer durations because much of today's activity is still at pilot scale. Even by the time we get to 500GW, the system would still be about 76% from legacy thermal sources (as noted in the talk), so grid balance will remain central.

If gas comes under GST, could end-customer prices fall by the full 40–50% uplift we see from landed to delivered?

They would not fall by the full amount because not all of the 40–50% adders are taxes and state-level taxes vary; nonetheless, GST plus potential carbon-credit support should deliver meaningful reductions, but not a one-for-one 40–50% drop.

Speaker's background

Ms Gauri Jauhar, Executive Director at S&P Global

Ms Jauhar's primary focus is conceptualising and leading the delivery of consulting projects in Indian energy—energy policy development, energy market opening and utilising global energy best practices to create a competitive energy sector.

She has 28 years of experience in the energy, applied economics and finance fields with focus on ESG in the Energy Transitions and the integration of clean fuels in the energy spectrum and multi-sector mitigation strategies.

Her areas of specialisation are integration of new energy sources to the energy spectrum for companies and countries, financial and operational competitor benchmarking, energy pricing, market entry strategies and energy policy development.

She is the co-head of S&P's India Research Chapter.

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Abneesh Roy
Head of Research Committee
Abneesh.Roy@nuvama.com

ABNEESH KUMAR ROY

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