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THE MARKETS ON MONDAY		
Sensex	27,687.30 ▲	363.30
Nifty	8,373.65 ▲	111.30
Nifty Futures*	8,372.80 ▼	0.85
Dollar	₹63.72	₹63.52**
Euro	₹72.64	₹72.15**
Brent crude($/bbl)	66.24 *	65.79**
Gold (10 g)##	₹27,710.00 ▲	₹110.00

*(May) Premium on Nifty Spot; **Previous day's close; # At 6 pm IST
Market rate, including VAT and premium

SOUTH KOREA TO GIVE INDIA $10 BN FOR INFRA PROJECTS

'PLANNING ₹3 LAKH CRORE OF ROAD PROJECTS IN 6 MONTHS'

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Shifts and risks in energy

INFLEXION POINTS

ARUNABHA GHOSH

In 2014, 49 per cent of US crude oil production (4.2 million barrels a day) came from tight oil resources — that is, oil embedded in shale, sandstone and carbonate rock formations. This revolution in US energy has been a function, of course, of technological breakthroughs in horizontal drilling and hydraulic fracturing, but also of an ecosystem that supports financial risk-takers, gives clear property rights to landowners, encourages thousands of entrepreneurs and has a deep infrastructure to deliver energy resources. The United States has, consequently, become the world's leading producer of oil and natural gas combined. Yet, thanks to the fall in oil prices, more than half of the rigs have been laid down. Some investors are questioning their long-term viability. But such price and production volatility aside, there is now growing focus on assessing broader risks to this evolving energy system.

Last month, the United States published its first Quadrennial Energy Review (QER). Twenty-two federal agencies coordinated to report on the energy system's economic, environmental and security priorities, the adequacy of energy policy and priorities for research and development (R&D).

But the real thrust of the first QER was to analyse challenges facing energy transport, storage and distribution infrastructure. The United States has 2.6 million miles of pipelines, 640,000 miles of high-voltage transmission lines, 414 natural gas storage facilities, 330 ports handling crude oil and petroleum products, and 140,000 miles of railways to transport oil, gas and coal. It needs $2.6-3.5 billion of annual investment in pipelines alone for the next 15 years.

The risks come not only from an ageing infrastructure but also from climate change, storm surges and coastal flooding, which make existing assets more vulnerable and test the resilience and reliability of planned investments. The number of extreme weather events, which have caused damages of more than $1 billion, has increased steadily: five in 2005, when Hurricane Katrina hit, to 16 in 2011 and 11 in 2012. Extreme weather impacts all sorts of energy infrastructure, from electrical power to refineries and liquefied natural gas (LNG) terminals. During 2003-13, power outages caused by severe weather cost the US economy $18 billion to $33 billion each year.

Another set of risks emerges from adapting to a new energy paradigm and the need to modernise the electric grid. Technology has changed expectations of consumers and companies who increasingly want to control the production and delivery of electricity. The grid has to be flexible and nimble enough to manage the injection of renewable energy. Investment in electricity transmission infrastructure by investor-owned utilities reached $14 billion in 2012. But the transmission and distribution (T&D) infrastructure will need $900 billion of investment by 2030. Alternatively, end-use efficiency, demand management, electricity storage and distributed generation could reduce the needed investments in transmission.

Since 1975, the United States has maintained a strategic petroleum reserve (SPR), comprising 62 salt caverns and four sites in Louisiana and Texas, with a current inventory of 691 million barrels. In case of a supply disruption, the facility can inject 4.4 million barrels a day into distribution networks. The role of the SPR is no longer merely to ensure that oil reaches refineries. Instead, since the United States has become a "swing producer" in global oil markets, the SPR has to ensure that oil reaches refineries *before* a global oil price shock damages the United States *and* the global economy by freeing up more oil for global markets.

But ironically, the boom in US domestic oil and gas production has also exposed new vulnerabilities of the SPR system. Historically, oil flowed south to north to inland refineries. Now, with shale exploration and production in North Dakota and Montana, oil is flowing north to south and to east- and west-coast refineries. Similarly, shale oil from Texas is also flowing to Gulf Coast refineries. This new "geography of oil" is putting pressure on refinery capacity and increasing congestion at commercial facilities, which limits the SPR's ability to quickly load oil on to barges and tankers. New infrastructure is now needed to increase distribution capacity, from coastal docking facilities to transporting them to new refineries and additional caverns.

What lessons can India learn from the QER? First, as the National Institution for Transforming India (NITI) Aayog prepares a new energy policy, an emphasis on risk assessments and timely response must be an integral part of any new strategy. Risks are no longer limited to physical attacks and security concerns. Natural disasters, in part exacerbated by climate change, will threaten coastal and inland infrastructure in India. The costs of replacing infrastructure versus building in resilience in advance would have to be carefully calculated. An Indian QER is needed.

Secondly, investments in power transmission and the grid must recognise that renewable energy will be a growing share of India's electricity mix. The grid must respond to new energy sources, not the other way round. This would imply commensurate investment in R&D for grid-scale energy storage as well as managing the integration of decentralised energy sources (40 gigawatts are intended from rooftop solar projects) into the grid.

Thirdly, India is building its own SPR of five million tonnes, with facilities in Visakhapatnam, Mangaluru and Padur. But the management of the SPR must be in line with India's integration into global energy markets. The effectiveness of the domestic infrastructure will be tested not solely by its storage capacity, but also by its ability to handle reserves from points of import to points of final use.

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