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India's Century: Sustainable and Inclusive Growth in the Energy Sector (Power, RE and Hydrogen)

A FICCI-McKinsey multi-year forum

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India's energy sector has multiple tailwinds and endowments...

- Well developed power and RE industry with **mature players**
- **Urbanization, demographics and digitalization** drivers for growth in electricity demand
- **Attractive market for investors** (consistently in top 10 in BNEFs Climatescope for 107 emerging markets, #1 in 2021) with reputed global debt / equity investors
- Geographic advantage making India amongst the **lowest cost RE countries** globally for solar, onshore wind, hybrids, and potentially, green hydrogen
- Favorable **economics** as baseload **RE (Hybrids) already cheaper than thermal power on full-cost**, expected to be cheaper than operating cost in 5-7 years
- **Ambitious climate targets** (INDCs) with **strong policy support** for RE industry & Green H₂ (e.g., ISTS waiver, national missions, PLI scheme)
- Increasing trend towards "Net Zero" commitments by leading corporates driving demand for **adoption of RE power by C&I customers**
- Rapid growth in **sustainable investments** globally and in India

... which can enable India to define an ambitious century vision for the Energy Sector

Support India's energy transition and economic growth by becoming one of the world's most competitive green energy producers



Enable clean energy access and a just energy transition through reliable electrification and decarbonization



Achieve global leadership through green energy / technology exports enabled by widespread green manufacturing and export opportunities for Indian industry



Bolster energy security through domestic manufacturing, grid modernization and technology innovation

Targets

Net Zero emissions by 2070

Generation Capacity by 2030

Non-fossil fuel and Renewable: **From 155 GW To 500 GW**

Fossil fuel and Non-Renewable: **From 250 GW to 300 GW**

Manufacturing Capacity by 2030

RE Equipment: (Solar Cell, Modules, Wind) **From ~25 GW To 50 GW**

Green Hydrogen: **Currently: NIL 5 MTPA**

Electrolyser: **Currently: NIL 10 GW**

However, India will need to address certain challenges

Challenges	Details
Accelerating RE capacity addition (to improve power availability and decarbonization)	<ul style="list-style-type: none">• Power demand to grow by 5-6% annually driven by increasing per capita consumption and electrification• Need to add 20-30 GW annually in next decade compared to 10-12 GW currently• Issues pertaining to land availability, supply chain constraints, grid capacity, counterparty risks (delay in PPA adoption, renegotiation risks and payment delays), demand forecasting, etc.
Reliably integrating large-scale RE	<ul style="list-style-type: none">• Limited flexible generation capacity leading to challenges (e.g., curtailment, non-adoption of PPAs)• Power market structures lacking depth - the wholesale market share is only around ten percent; there is no ancillary services market, incentives for peak-load plants are inadequate, and time-of-day tariffs lack granularity
Improving financial viability, attracting capital while ensuring affordability	<ul style="list-style-type: none">• Most public DISCOMs are loss making, and under heavy financial stress (\$100 Bn of debt / payables) which is spilling over to entire sector• Estimated transition finance of \$200-300 bn by 2030 and \$2-3 tn by 2050• Undergoing the transition while improving affordability of power, and delivering on <i>Just Transition</i> (i.e., securing rights and livelihoods of workers from low-income areas, especially in the coal mining sector)
Ensuring energy security	<ul style="list-style-type: none">• India imports 80-90% of its solar modules, import bill could be \$300-400 bn in 2050 at same import levels• Ongoing race to control raw materials for solar PV / storage (rare earth metals, etc.)• Very limited R&D and innovation on alternative material science applications for solar PV, battery, etc
Streamlining governance, policy making and planning	<ul style="list-style-type: none">• Limited convergence between multiple ministries needed to enable transition (e.g., Power, RE, road transport, heavy industries, commerce, external affairs)• Lack of coordination and policy cohesion between Federal and State Governments

Key Unlocks that could help achieve India's century vision – 1 of 3

UNLOCKS

■ Company Level

■ Industry Level

■ Policy-maker Level

Now – fix the basics

Next - explore adjacencies

New – explore frontiers

Reducing land and grid bottlenecks for RE projects

1

- **Central RE infrastructure planning and project monitoring agency**¹ to resolve supply-side issues for RE to:
 - Identify attractive **land pockets** (esp. wasteland), and coordinate with Transcos for **building injection points**
 - Create **data-bank** with details on solar & wind potential (could lower interest rates, and promote insurance products)
 - Collaborate with state governments to facilitate land acquisition (via **solar park model or by aggregating government and private land and examining leasing options**)
 - Provide **project level debottlenecking** through monthly discussions chaired by Hon'ble Power Minister

Accelerating DISCOM Reforms

2

- Ensure strict monitoring and adherence to the recent reforms (RDSS), reforms for bankability of PPAs, contract protection and making lending to DISCOMs (including from private banks) more stringent² and conditional to performance and reforms
- Plan road map for business transformation – improving **last mile delivery (quality/ reliability), customer service and competition**
- Strengthen the capacity and **performance of regulators** (for example, by ensuring timely and adequate tariffs)

Creating new financing mechanisms and de-risking projects

3

- Standardize disclosure guidelines (sustainability/ carbon) for companies to build transparency
- Enable access to **global low-cost finance** (e.g., easing foreign listing / IPOs, liberalization of ECBs, partnerships with global sustainability themed funds, multilateral agencies)
- Increase **availability of low-cost domestic capital** via setting up of Clean Energy Fund, tax-saving RE bonds, increased priority sector lending limit for RE, leveraging blended finance and low-cost RE finance by govt owned financial institutions
- Maturity driven incentives for energy technologies – a) Maturing tech (solar, wind) – funding support (Priority sector lending); b) Emerging tech (energy storage) – demand side levers for scaling (PLI scheme, committed offtake); c) New tech (electrolysers, CCUS etc.) both demand and supply side levers to attract greenfield investments
- Adopt new financing mechanisms such as InvITs, Green Bonds, pooling etc., and expand collaboration between insurance, banking and RE players for creation of **insurance and guarantee products**
- Build **green transition bank** for financing towards 'hard to abate' use cases and build **'green venturing'** community

1. Possibly by increasing scope of IREDA

2. Case in Point: Prudential lending norms released by Ministry of Power for lending to DISCOMs

Key Unlocks that could help achieve India's century vision – 2 of 3

UNLOCKS

■ Company Level

■ Industry Level

■ Policy-maker Level

Now – fix the basics

Next - explore adjacencies

New – explore frontiers

Accelerate power market redesign for adoption of low-cost green energy

4

- Eliminate barriers and **encourage consumers to procure RE power** - easier open access approvals, facilitating inter-state open access with lower charges, launching green tariffs via DISCOMs, end use green power / hydrogen mandate for industry, VPPAs / CfD
- Deepen power markets – launch derivatives / futures, launch ancillary services and capacity markets (with SEBI / CERC support)
- Leverage **demand-side flexibility** (consumer ToD tariffs, demand response aggregators, EV charging) and **supply-side flexibility** (blended thermal / hydro-RE, compensation to coal/ hydro plants for flexibility services); \$150-200 bn of battery capex savings

Promote local manufacturing and setup green innovation hub

5

- Setup **end-to-end manufacturing** giga-factories for PV modules, storage, electrolysers through policy / economic support; incentivize upstream integration and setup collaboration for **developing/ acquiring upstream** assets (e.g., O&G/ mining players)
- Create **green innovation clusters** comprising of RE companies, public agencies (IREDA / SECI / AREAS etc.), academia, start-ups to lead R&D, prototyping and scale-up of future energy technologies¹ (e.g., off-river pumped storage, fuel cells, novel chemistries for storage, perkovsites, thorium based nuclear, electrolysers) enabled by higher R&D spend, PE/VC funds and govt. incentives
- Leverage data stack, democratize data access and incentivize startups/ tech players to **build AI/ ML solutions** across value chain (e.g., weather and generation forecasting, integrated resource planning and prescriptive models, predictive maintenance)
- **Global Recycling Hub: Enable Recycling and second life usage** of batteries, PV modules for sustainability, **reducing precious metals imports** by implementing Extended Producer Responsibility, creating standardization around second life usage (incl. testing and refurbishment standards), incorporating material recycling as part of ESG goals, setting up recycler plants
- Create **demand side assurance for new technologies** by providing better visibility of upcoming project pipeline, mandating uptake (via SECI / IREDA – similar to dedicated solar / wind missions), committing incentives (tariff, production / performance linked)

Improving viability of Indian green energy exports

6

- Build **inter-country transmission projects** to connect grids in the Middle East, South Asia and South-East Asia
- Set up dedicated export zones with incentives for **export promotion** of RE equipment (PV modules, storage, electrolysers etc.); leverage global alliance like ISA to facilitate
- Explore bilateral tie-ups with countries with active green hydrogen import program¹ via **export agreements / H2 consortiums**;

1. Focus Technologies – Non-Li/Co/Mn chemistries, novel LDES and next gen solar (e.g., perovskite / Monocrystalline IBC / Monolithic Cells HJT1), new RE (geothermal, tidal), H2 DRI, FCEV, H2 ICE, clean ammonia (for shipping), LH2, synfuels, Pumped Hydrogen Storage

Key Unlocks that could help achieve India's century vision – 3 of 3

UNLOCKS

■ Company Level

■ Industry Level

■ Policy-maker Level

Now – fix the basics

Next - explore adjacencies

New – explore frontiers

Enabling convergence and integrated planning to ensure 'Just Transition' and 'Energy Security'

7

- Create a government-industry **task-force to develop comprehensive roadmap** for 'Just Transition' including roadmap for thermal plants/ coal mines (retrofits for high ramping and compensation, gradual ramp-down, decommissioning, re-purposing), and re-balancing of central and state governments revenues
- Collaboration of industry with **Council for Green Jobs** to reskill thermal/ coal mining workforce for RE/ rare earth metals mining
- Create a Net Zero or Energy Transition committee comprising of all stakeholders across center (MoP, MNRE, MoF, MoEFCC, MoRTH, etc), states and industry. This could also have multi-level forums **for addressing challenges**, developing a **comprehensive framework, integrated planning** and debottlenecking the **implementation** of energy transition (e.g., import/ supply of modules till domestic capacity is established, electrification, RE capacity trajectory by states, land, grid reliability, convergence of transport & power)
- Launch **Carbon Market** with consensus-based, stringent carbon accounting standards and granular foot-printing methodologies; and setup a network of carbon validation and verification agencies
- **Diversify Energy Mix:** Mandate on building **nuclear power**¹ and incentivize the first 5-10 GW of **offshore wind** (via \$20-30 bn support). This could reduce solar requirement by 20-30% (~60-100 GW in 2030 and 400-500 GW by 2050)

Creating Global Hub for Green Hydrogen

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- Earmarking specific corridors/ districts/ regions for creation of Green Energy Hubs (**including RE and Hydrogen Clusters**) aggregating large-scale consumers situated at Ports / Industrial Centers capturing industrial and export (via Hydrogen SEZs) hydrogen demand. The clusters would include players along the entire hydrogen value chain (production, storage, pipeline distribution, refueling) to optimize costs and kick-start large scale adoption.
- **Mandating hydrogen usage by setting up targets for partial / full adoption** and providing VGF funding in some identified sectors. For e.g. industrial applications (green fertilizer, refining, green steel), Hydrogen mixing in CCGT, mixing in City gas distribution, launch of hydrogen based Heavy Duty Vehicles, use of H-CNG etc.
- **Set up standards** for hydrogen electrolysers, fuel cells, embedded products (green steel, fertilizers) along with tracking-based labelling
- Set-up **PLI / capital subsidy scheme** for electrolysers, green ammonia and OEM manufacturers for potential H2 use-cases

1. Possibly focused on India's abundant thorium reserves; Leverage emerging technologies such as Modular Nuclear Power