STRATEGIC ROADMAP | INDIA 2026–2047

Powering Viksit Bharat @2047

Mitigating India's Energy Transition Challenges with multi-pronged Growth Strategy and Skill Development



ENERGY • ENGINEERING • EMPLOYMENT

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Strategic presentation for government, industry, utilities and academia

The central proposition

India’s energy transition is both a climate imperative and a capability-building opportunity.

Reliable, affordable power

Modernize the electricity value chain and strengthen consumer outcomes.

Clean, flexible energy

Integrate renewables with networks, storage, flexible demand and markets.

Atmanirbhar technology

Build Indian design, manufacturing, software, testing and IP.

Youth-led growth

Turn technical talent into research, enterprises, exports and skilled jobs.

Success = measurable system performance + domestic value creation + quality employment + verified climate outcomes

A connected agenda: from reform to national capability

01

National goals & transition context

Climate commitments, energy security and Viksit Bharat

02

Power-sector challenges

Regulatory, technical, financial and environmental

03

Priority technology domains

Grids, renewables, energy storage, hydrogen, energy digitalization

04

Youth skills & research

Specialisations, labs, industry immersion and innovation

05

Jobs, enterprise & Atmanirbharta

Value chains, start-ups, manufacturing and exports

06

Mission design & execution

Governance, funding, milestones and outcome dashboard

India’s climate and development milestones

2030

45%

Emissions-intensity reduction

Updated 2022 NDC: relative to 2005

2030

~50%

Non-fossil installed power capacity

Cumulative installed electric-power capacity

2070

NET ZERO

Long-term ambition

India’s announced net-zero emissions goal

2047

VIKSIT

Developed India vision

Prosperity, resilience and technological self-reliance

The NDC sets direction; engineering, institutions, finance and talent convert commitments into outcomes.

Sources: India’s updated NDC (2022); LT-LEDS (2022); Government of India climate updates (2026).

Four interdependent challenge areas

REGULATORY

Tariff adequacy • contract enforcement • open access • predictable rules

TECHNICAL

Grid flexibility • ageing assets • losses • integration • cyber resilience

SYSTEM

FINANCIAL

DISCOM cash flows • payment discipline • cost recovery • investment

ENVIRONMENTAL

Emissions • water stress • climate risks • circularity • compliance

The reform flywheel: connect policy to outcomes

1

Clear rules

Tariffs, contracts, market access

2

Viable utilities

Revenue, procurement, financial discipline

3

Modern networks

Automation, storage, flexible operations

4

Clean integration

Forecasting, balancing, market flexibility

5

Better outcomes

Reliability, affordability, lower emissions

Youth contribution: design tools, operating decisions, build products and verify impact at every step.

Indian case studies: lessons for scalable reform

Delhi distribution reforms

Private distribution management, metering, energy accounting, operational focus on service and commercial performance. Transfer lessons, not assumptions: local conditions matter.

Odisha distribution restructuring

Distribution reform and private participation on governance, investment, accountability and service delivery. Outcomes depend on regulatory control and execution.

RDSS & smart metering

National program links distribution infrastructure, loss reduction and metering. Success is counted through billing, collection and reliability outcomes.

Renewable integration

India's large renewable build-out increases the value of transmission, forecasting, storage, flexible generation and improved scheduling.

Green Hydrogen Mission

Domestic electrolyzer manufacturing, R&D, pilot projects and skills create new industrial value chains—subject to cost, demand and infrastructure readiness.

Rooftop solar & local jobs

Distributed deployment creates geographically dispersed design, installation, maintenance and sustained job opportunities.

Sources: Ministry of Power; PFC DISCOM ratings; MNRE; National Green Hydrogen Mission; CEEW–NRDC (2026).

Twelve priority domains for youth-led energy transition

1. Smart grids & power systems
2. Renewables & hybrid plants
3. Batteries & long-duration storage
4. Power electronics & HVDC
5. Green hydrogen & electrolysers
6. AI, digital twins & analytics
7. Industrial decarbonisation
8. EVs & charging systems
9. Nuclear, hydro & firm low-carbon power
10. Carbon management & CCTS
11. Energy markets & regulation
12. Efficiency & circularity

Smart grids: where engineering talent meets system reliability

FIELD ASSETS	Transformers • breakers • meters • DER • storage
CONNECTIVITY & CONTROL	Sensors • communications • IEC 61850 • SCADA/RTU • edge devices
APPLICATIONS	ADMS • DERMS • EMS • OMS • forecasting • protection analytics
DECISION & MARKETS	Planning • dispatch • flexibility • outage response • settlement

Research agenda: hosting capacity • grid-forming controls • FLISR • digital twins • cyber-OT • data interoperability

Renewables need flexibility—not capacity additions alone

Solar + wind variability → **Forecasting + scheduling** → **Flexible supply + demand** → **Reliable system**

Storage

Batteries • pumped hydro • thermal storage

Flexible generation

Hydro • thermal flexibility • fast response

Flexible demand

Demand response • EV charging • smart loads

Markets

Ancillary services • dispatch • price signals

Youth roles: storage modelling, inverter controls, battery safety, forecasting, dispatch optimisation and market design.

Atmanirbhar Bharat: move up the energy technology value chain

1 **Materials**

Cells, catalysts, semiconductors

2 **Components**

Inverters, BMS, sensors, stacks

3 **Systems**

Grid controls, storage, plants

4 **Software**

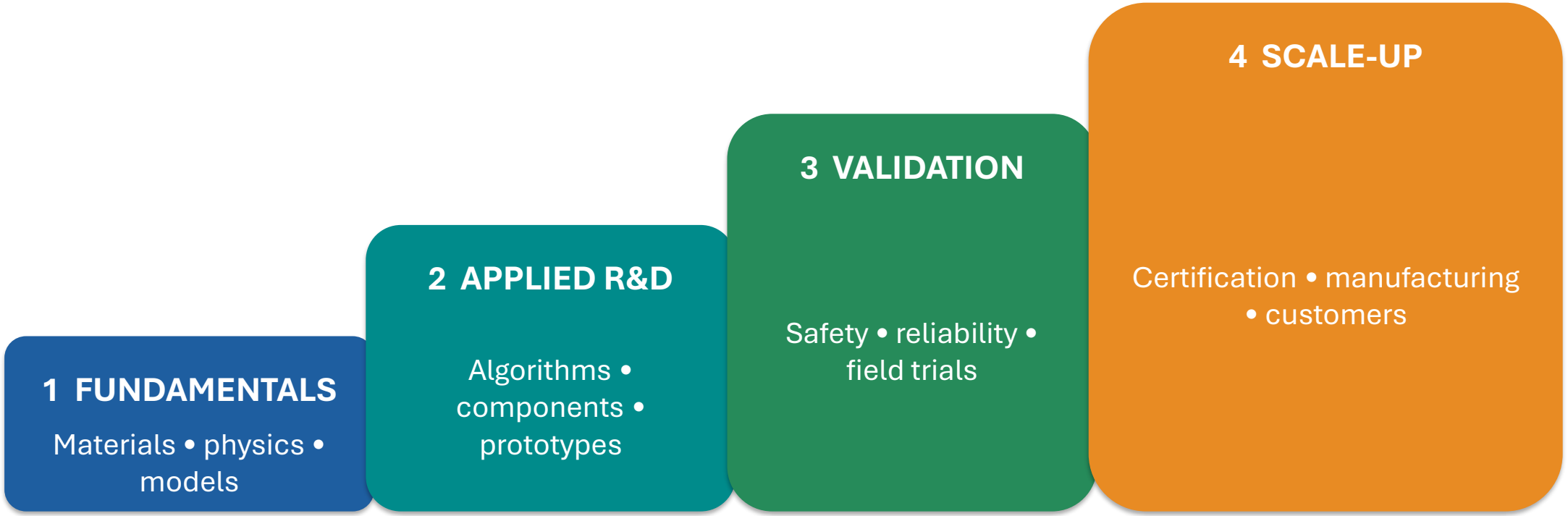
Forecasting, optimization, cyber

5 **Lifecycle**

Testing, repair, recycling, exports

Build domestic design, IP, testing, reliability and manufacturing—not assembly capacity alone.

Close the gap from laboratory research to market adoption



Funding principle: stage-gate investment; release the next tranche when technical, safety and market milestones are demonstrated.

A competency model for energy-transition professionals

CORE ENGINEERING	Power systems • electronics • thermodynamics • materials • controls • safety
SPECIALISATION	Grid automation • batteries • hydrogen • industrial decarbonisation • energy AI
DIGITAL + COMMERCIAL	Programming • data quality • cybersecurity • lifecycle cost • project economics
PROFESSIONAL PRACTICE	Applied research • technical writing • teamwork • standards • entrepreneurship

Research questions that can produce Indian products and jobs

Grid stability

Indigenous grid-forming inverter controls; fault response; hosting capacity

Storage

Safety, degradation, second-life diagnostics and recycling

Hydrogen

Stack durability, catalyst dependence, variable-load operation

Industrial efficiency

Waste-heat recovery, electrification, process optimisation

Digital energy

Forecasting, predictive maintenance, secure utility AI

Climate resilience

Heat/flood risk, resilient assets, restoration planning

Every research call should name the problem owner, performance metric, test protocol and route to adoption.

Green jobs span the full energy asset lifecycle

1

R&D

Research scientists
Design engineers

2

MAKE

Manufacturing
Quality & testing

3

BUILD

Project engineering
Commissioning

4

OPERATE

O&M • analytics
Asset management

5

TRADE

Markets • finance
Regulation • carbon

6

CREATE

Start-ups • IP
Exports • services

Policy goal: create durable technical careers and Indian enterprises—not just short-term project employment.

What the employment evidence says—and does not say

657,845

Estimated additional workers across renewable-energy sectors studied between FY2023 and FY2026.

4.4 million FTE

Modelled full-time-equivalent jobs associated with study assumptions for non-fossil capacity and green hydrogen.

11%

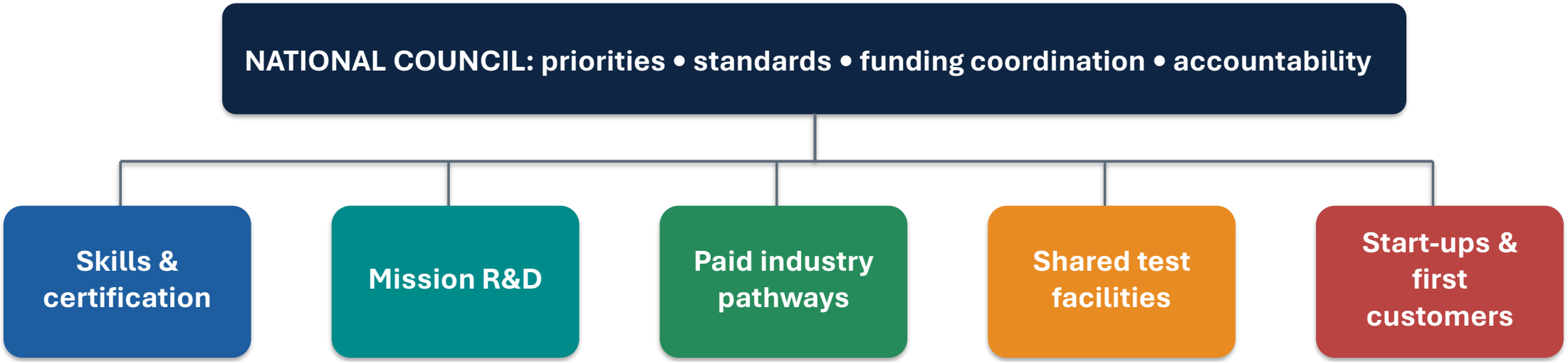
Reported women's representation in solar and wind deployment and manufacturing workforce in the study.

Interpretation matters

- FTE estimates are not counts of vacancies or guaranteed permanent jobs.
- Separate direct/indirect jobs, job-years, temporary construction work and sustained employment.
- Measure retention, wages, technical role quality, regional distribution and gender participation.

Source: CEEW–NRDC, Driving Energy Transition: Workforce, Skills, and Gender in India's Renewable Energy Sector (2026).

Proposed National Young Energy Professionals Mission



Outcome measures: jobs • prototypes adopted • domestic value added • exports • energy saved • emissions avoided

Regional innovation hubs: build on local industry strengths

NORTH	WEST	SOUTH	EAST	HIMALAYAN / HYDRO
Grid modernisation Digital Energy Market analytics	Clean Energy Batteries Hydrogen Industrial electrification	Wind EVs Embedded systems Power electronics	Steel & Industrial Decarbonisation Circular materials	Hydro flexibility Pumped storage Climate resilience

Each hub should connect universities, polytechnics, utilities, manufacturers, start-ups and regional employers through shared facilities and industry projects.

Regional models should follow skills mapping, demand, existing infrastructure and equitable access.

Roadmap to 2047: establish, scale, lead

PHASE I | 2026–2030

ESTABLISH

Skills map • competency standards
Paid placements • shared labs
Challenge-led research
Employment dashboard

PHASE II | 2030–2035

SCALE

Domestic components & products
Industry demonstrators
First-customer procurement
Research-to-market pathways

PHASE III | 2035–2047

LEAD

Indian IP and global products
Advanced manufacturing
Exports and engineering services
Lifelong reskilling ecosystem

Targets should be set after baseline assessment and milestone setting.

Accountability: measure outcomes, not activity

EMPLOYMENT	TECHNOLOGY	CLIMATE
Relevant placements • 12/24-month retention • wages • career progression	Prototypes validated • products adopted • IP licensed • domestic value added	Verified energy savings • emissions avoided • renewable integration performance

INDUSTRY	INCLUSION	PROGRAMME QUALITY
Downtime reduced • efficiency improved • local supply chains • export contracts	Women in technical roles • regional participation • accessible training	Employer satisfaction • lab utilisation • cost per sustained placement

Publish definitions and methods; independently verify reported employment, technology and emissions outcomes.

Ten actions to launch the energy transition talent mission

1. Coordinate existing energy, skills, research and industrial programmes.
2. Prioritise six critical technology clusters and map occupational shortages.
3. Make paid, supervised industry experience part of specialist training.
4. Fund research around measurable engineering challenges and real users.
5. Create shared labs for grid systems, power electronics, batteries and hydrogen.
6. Support Indian design, intellectual property, testing and manufacturing.
7. Open transparent pilot and first-customer pathways for qualified start-ups.
8. Track vacancies, placements, retention and skills shortages nationally.
9. Expand women's participation and regional access to technical careers.
10. Report jobs, domestic value added, reliability gains and verified climate impact.

From demographic dividend to energy-technology leadership

ENGINEER
Solve India's energy challenges

INNOVATE
Build Indian products and IP

EMPLOY
Create skilled jobs and enterprises

The goal is not only to participate in the energy transition—but to design its technologies, build its industries and shape its future markets.

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Discussion: three questions for leadership

1. **Which five engineering capabilities are most critical for your organisation over the next five years?**

2. **What real operational or manufacturing problem could be offered as a paid student/research project?**

3. **What would it take to move one promising Indian prototype from laboratory to field deployment?**

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Thank you!



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