Sattva Knowledge Institute SKI primer | FIDE Foundation for Interoperability in Digital Economy

ENABLING ENERGY TRANSITION THROUGH OPEN NETWORKS

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Acknowledgements

Contributors

Sohini Dutta, Naaz Narang, Samriddhi Diwan and **Abhishek Modi.**

Reviewers

Rathish Balakrishnan and Anantha Narayan

Partners

Sujith Nair, CEO and Co-Founder, FIDE and **Anirban Sinha,** Senior Associate-Open Market Innovations, FIDE

Disclaimer

About Sattva Knowledge Institute

Sattva Knowledge Institute (SKI), established in 2022, is our official knowledge platform at Sattva. The SKI platform aims to guide investment decisions for impact, shedding light on urgent problems and high potential solutions, so that stakeholders can build greater awareness and a bias towards concerted action. Our focus is on offering solutions over symptoms, carefully curating strong evidence-based research, and engaging decision-makers actively with our insights. Overall, SKI aims to shift intent and action toward greater impact by influencing leaders with knowledge. All of our content proactively leverages the capabilities, experience and proprietary data from across Sattva.

Editing: **Anagha Wankhede** **Design:** **Usha Sondhi Kundu**; cognitive.designs@gmail.com

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EXECUTIVE SUMMARY

India stands third in terms of annual CO2 emissions; decarbonising India's energy sector is a key solution.

Greenhouse gas emissions, carbon dioxide in particular, are the top contributors to temperature rise. **India is the third largest carbon emitter, driven by its power sector that remains dependent on fossil fuels.** While renewable energy capacity is being developed at a rapid pace, the associated intermittency and variability challenges limit its actual generation potential; the centralised grid is unable to integrate renewable energy sources at the needed pace. There is a **disconnect between renewable energy producers, potential consumers, and services** like storage, microgrid, battery banks, demand aggregation, which can help alleviate the challenge posed by intermittency.

While policy action can help reduce emissions, a decentralised energy sector is the way to go.

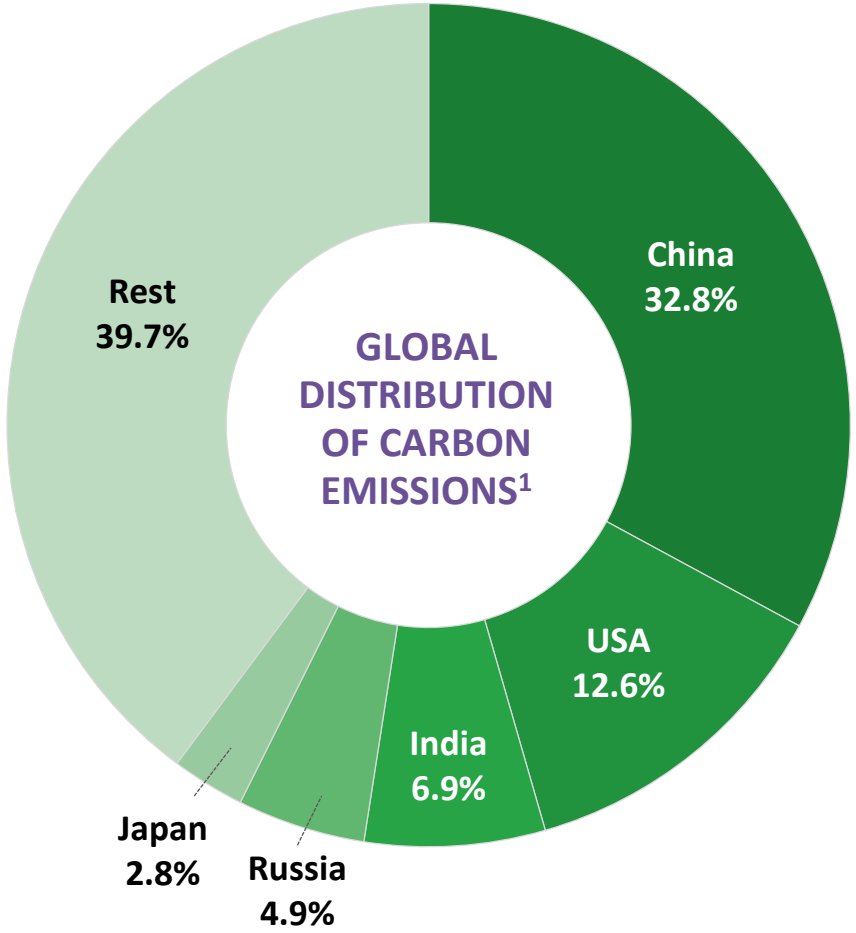
India has committed to the goal of net zero emissions by 2070. The policy action aimed at achieving that goal, through short and medium-term commitments designed over the last decade, highlight India's intent to achieve its goal. However, India's NDCs offer only a 7% emission reduction by 2050. **A bottom-up approach mobilising stakeholders across the value chain,** ensuring transparency, visibility, trust, and direct participation can help alleviate disaggregation. **Fostering decentralised transactions** between players of all scale–renewable energy providers, DISCOMs, local prosumers, storage solutions providers, EV service providers, industrial consumers, household users, and so on—is imperative.

Open Networks have the potential to unlock several use cases for a decentralised green energy space.

Open networks have emerged as tangible solutions to address social issues. Drawing upon three key characteristics–**interoperable systems, standardised vocabulary, and unbundling of roles**–they can facilitate decentralised exchanges for actors across the value chain. Thus, unlocking a dynamic green energy marketplace, open networks can support India meet its renewable energy targets and race towards its carbon neutrality goal.

POWER GENERATION: KEY DRIVER OF INDIA'S CARBON EMISSIONS

India is the third largest carbon emitter in the world.



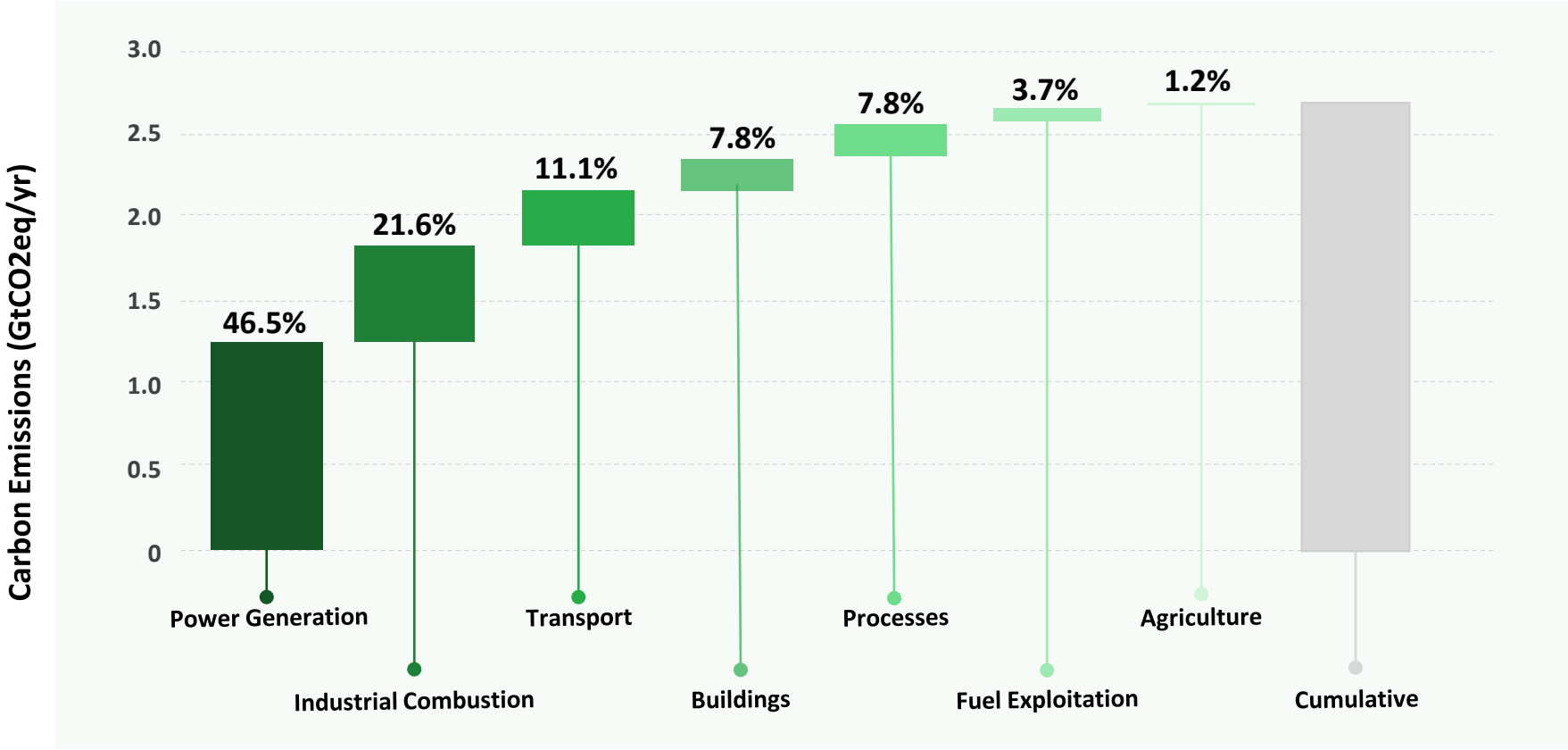
2.6 Giga tonnes (GtCO2eq/yr) **of carbon dioxide were emitted** by India in 2022.[2]

47% **Increase in India's per capita emissions** since 2010 levels.[3]

68% Relative **increase in India's cumulative carbon emissions** since 2010.[4]

80% Of India's CO2 emissions stem from three sectors: **Power generation, industrial combustion,** and **transport**.[5]

Power generation is the highest sectoral contributor.



India Carbon Emissions 2022 by Sector (GtCO2 eq/yr)[6]

1.2 Gt

carbon emissions were attributed to India's **power sector** in 2022.[7]

60%

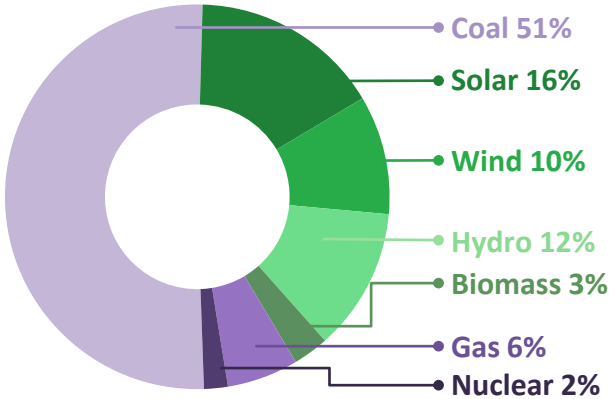
increase in India's **power sector emissions** in the last decade.[8]

Source: EDGAR report (The European Commission, The Emissions Database for Global Atmospheric Research (EDGAR) Report 2022.)

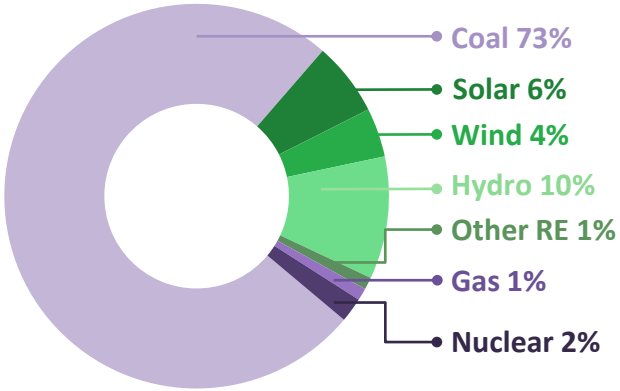
This can be attributed to the dominance of carbon-intensive fossil fuels in India's energy mix.

Renewable energy generation lags behind installed capacity...

INSTALLED GENERATION CAPACITY by Source (2023)[9]



TENTATIVE GROSS GENERATION by Source (2023)[10]



Source: Central Electricity Authority (2023) Report on Optimal Generation Capacity Mix For 2029-30

...due to challenges associated with integration into existing grid infrastructure.

INTERMITTENCY

Inconsistent renewable energy supply (for example, low wind speed means less power generation) make it unreliable, continuing reliance on fossil fuels to plug demand-supply gap.

DISTRIBUTED SOURCES

Low energy density of renewables necessitates deploying them over wider areas to generate significant energy, raising infrastructure and transmission costs.

STORAGE CONSTRAINTS

Lack of affordable storage solutions and inability to capture excess renewable energy, leads to underutilisation and continued reliance on traditional systems.

INDIA'S RENEWABLE ENERGY POLICY OVERVIEW

India is committed to achieving Net Zero Emission targets by 2070.

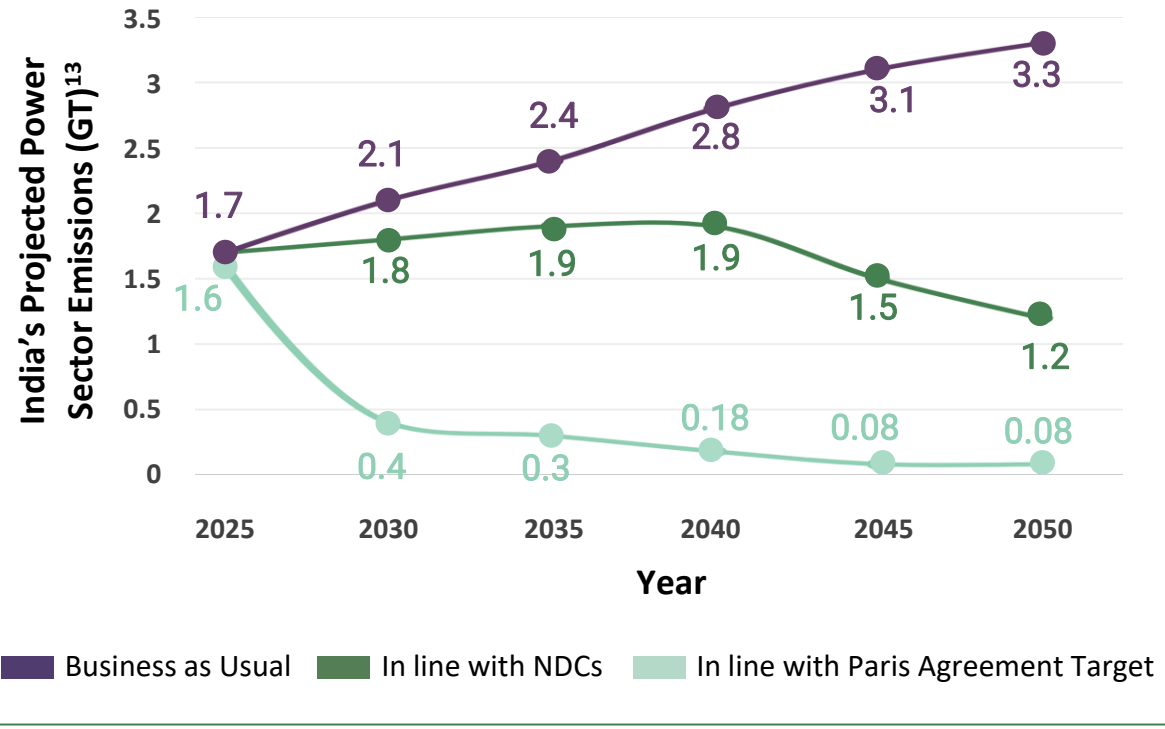
India's Nationally Determined Contributions (NDCs)...

50%
of India's energy needs met by RE

2.3 to 3 billion ton
of additional carbon sink

45%
Less carbon intensive GDP

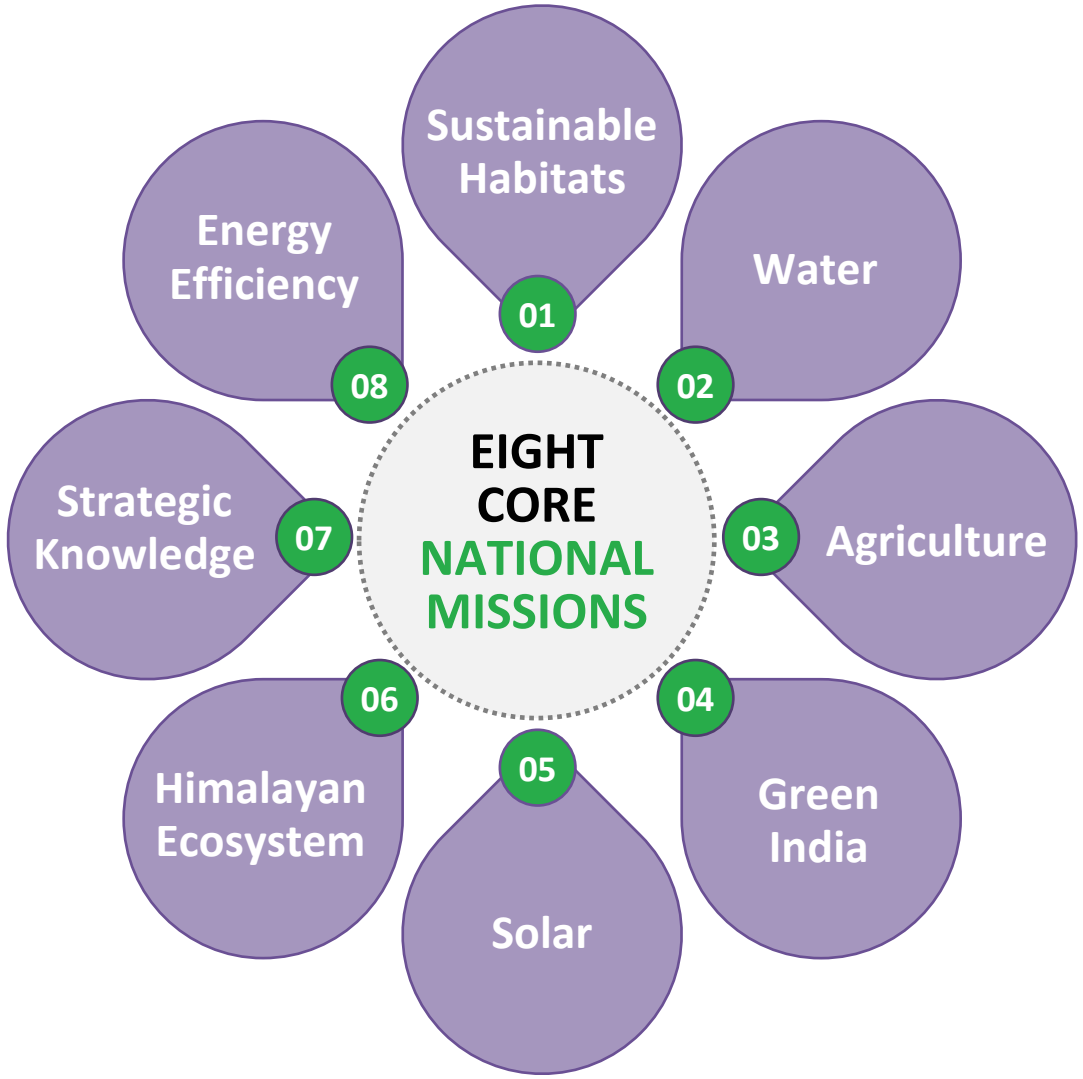
...offer a path to reducing emissions and reach 2070 targets.



Source: World Emissions Clock, World Data Lab

- Business-as-usual projections paint a dangerous picture: total emissions increase by **72%**, power sector increase by 94% by 2050.
- India's NDCs offer a path to modest emissions reduction (**7%** total decrease, **-25%** in the power sector) by 2050
- However, achieving Paris Agreement targets requires more dramatic reductions **(-76%** total, **-95%** power).

The National Action Plan on Climate Change will be instrumental in achieving the net-zero goals by 2070.



The NAPCC is focussed on enhancing energy efficiency, clean energy adoption, and fostering a collaborative research community to maintain India's momentum for climate change mitigation

ENERGY EFFICIENCY

Promote energy efficiency via industry efficiency mandates, affordable technology, demand-side financing, & fiscal Incentives.

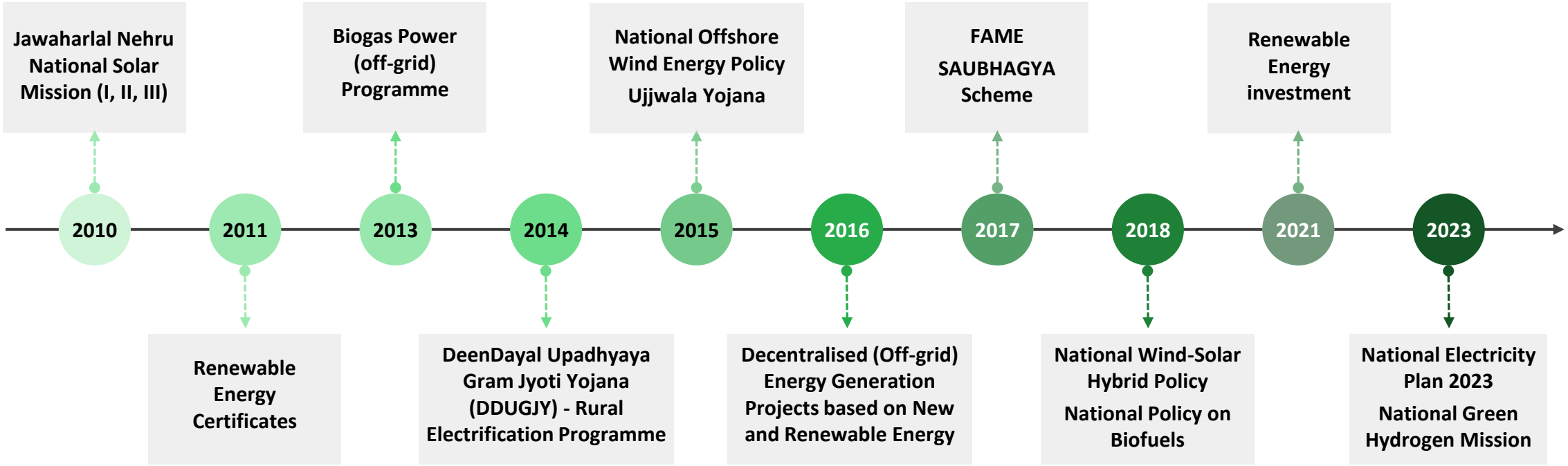
SOLAR ENERGY

Enhance India's solar energy capacity to 280 GW by 2030 and achieve grid parity.

STRATEGIC KNOWLEDGE

Drive global collaboration, domestic research and innovative climate solutions.

Additionally, there is a strong tailwind through a series of policies and initiatives around green energy transition.



KEY CHALLENGES AMONG STAKEHOLDERS

Achieving energy transition needs collaboration between key stakeholders across government, community, and market.

Government

- Policymakers
- Centre/State Energy Departments
- Public Energy Utilities
- Central Electricity Authority
- Municipal Corporations

Market

- Renewable Energy Solutions Providers
- Public and Private Utilities
- Energy Storage Solutions (ESS) providers
- Financial Institutions
- Conventional Energy Companies

Community

- Industrial Consumers
- Small and Medium Enterprises
- Household Consumers
- Renewable Energy Prosumers
- Marginalised Communities

In a collaborative energy ecosystem, all stakeholders have crucial roles to play.

	 Government	 Market	 Community
Generation	• Form policies, incentives, and targets. • Promote development via approvals, clearances, research	• Invest in RE Project Development. • Manufacture equipment for RE projects	• Install rooftop solar panels • Participate in local energy ecosystems (microgrid-use)
Transmission	• Undertake grid development, maintenance, and upgradation • Ensure grid access and regulation of tariffs	• Build and develop grid infrastructure • Develop grid management solutions	• Aid decentralised transmission via community microgrid and RE projects
Storage	• Fund storage projects and ease regulatory hurdles • Promote grid integration of distributed storage projects	• Finance and develop Battery Energy Storage Solutions (BESS) and Pumped Hydro Storage Projects	• Create energy back-ups using BESS • Engage in energy arbitrage using BESS
Consumption	• Develop efficiency mandates • Implement demand-side management measures, subsidies and incentives	• Develop energy-efficient technologies • Develop energy trading platforms	• Adopt energy-efficiency measures • Choose clean energy sources

Disaggregation and disconnect between these stakeholders creates various impediments at each stage.

Generation

- Variability and intermittency of renewable energy source sustains dominance of fossil fuels.
- Energy producers are unable to map demand. Consequently, they suffer energy waste and curtailment losses due to production surplus.
- Disconnect between small-scale energy producers/ prosumers and potential consumers.

Transmission

- Unidirectional grid infrastructure design cannot support bidirectional models like peer-to-peer trading and vehicle-to-grid.
- High transmission and distribution losses leads to economic costs and energy wastage.
- Limited integration of distributed small-scale clean energy providers, traders, and storage solutions.

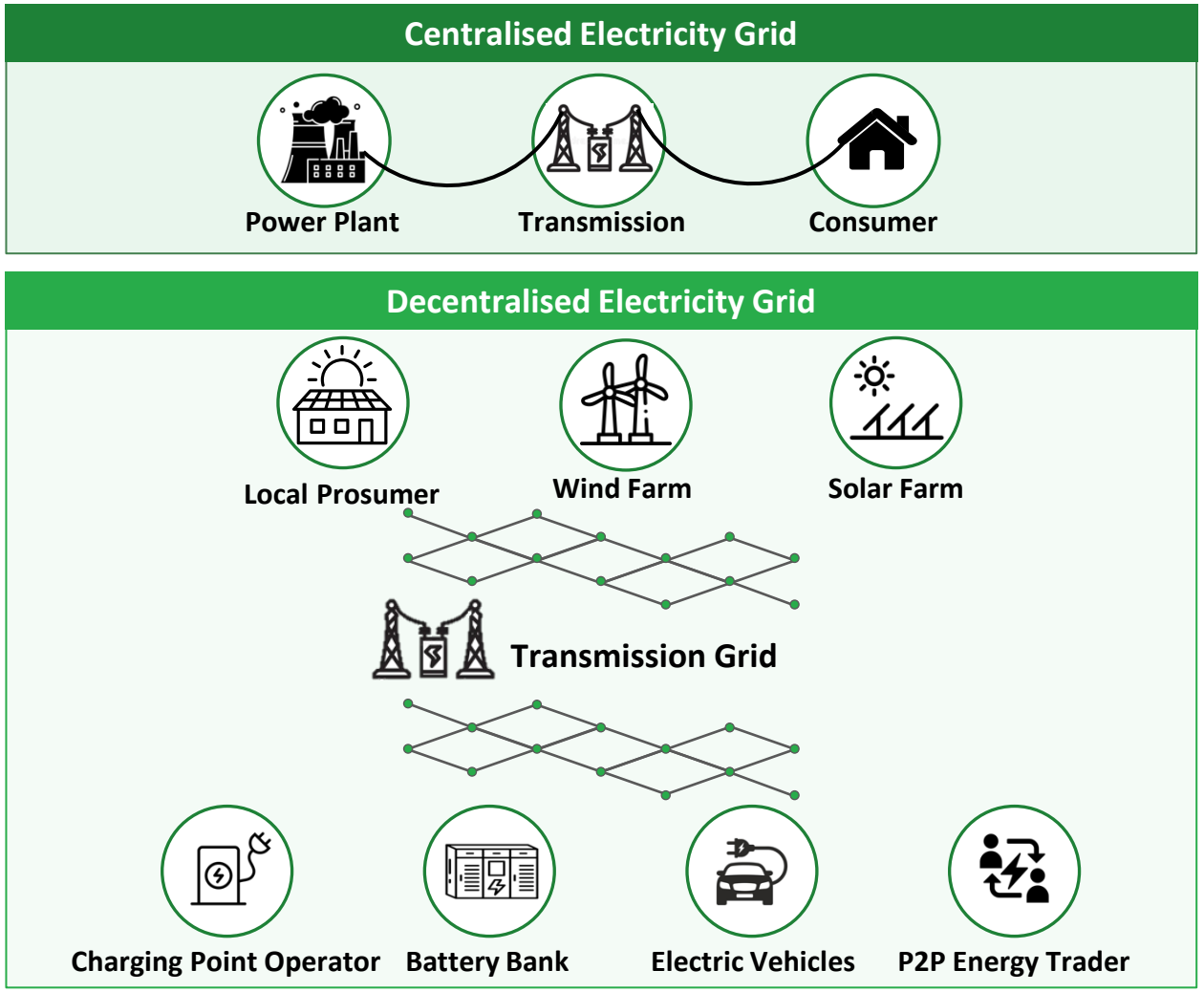
Storage

- High costs due to scarcity of rare-earth metals in India that are crucial for Battery Energy Storage Solution (BESS) projects.
- Lag in domestic manufacturing of lithium-ion.
- Lack of uniform technological specification across diverse storage solutions may hinder interoperability.

Consumption

- Lack of data transparency regarding source of electricity generation.
- Limited scope for direct participation of consumers in energy arbitrage.

Decentralised transactions and demand aggregation can play a catalytic role in the green energy transitions.



DECENTRALISED ENERGY MARKETS

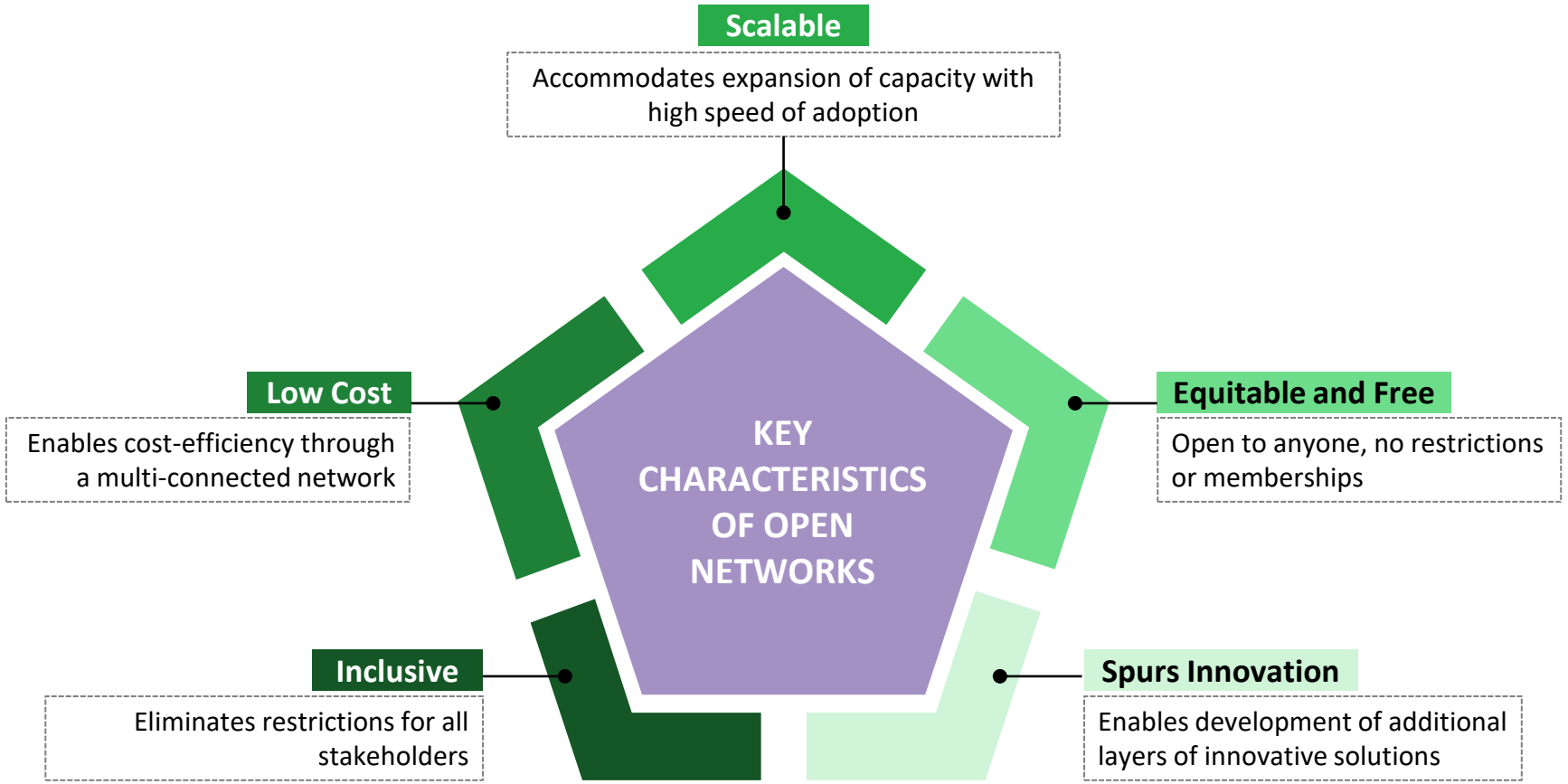
- Integrates distributed renewable sources of varying scales, facilitating many-to-many transactions for a green energy transition.
- Enables two-way energy transactions, boosting renewable energy adoption and empowering consumers with more choices.
- Empowers DISCOMs with wider options and cheaper renewable sources, lower transmission losses, and alternative financial avenues like P2P revenue.

DEMAND AGGREGATION

- Encourages project development near high demand centres, fostering consumers' bargaining power, aiding accessibility and affordability.
- Creates self-sufficient energy ecosystems by developing community microgrids and local renewable energy resources.
- Enhances DISCOMs' financial health through revenue from installation facilitation, system design, operation and maintenance, billing and collection, etc.

ACCELERATING DECARBONISATION WITH OPEN NETWORKS

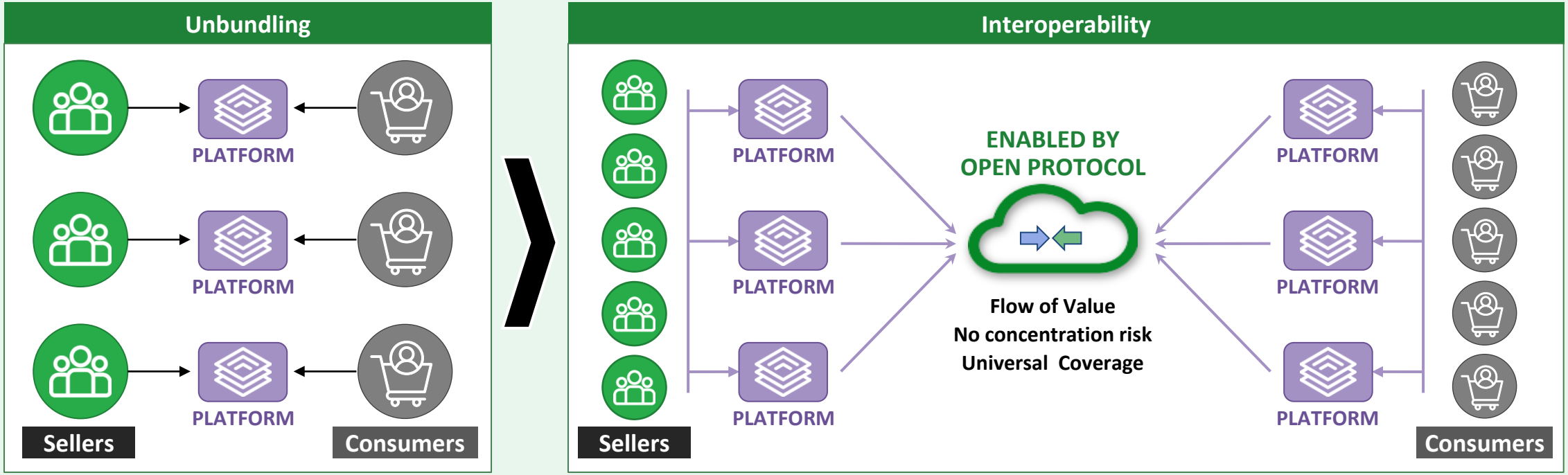
Open Networks enable sharing and collaboration for everyone, fostering synergy in the ecosystem.



- Open networks are digital spaces where resources, information, and connections are **freely accessible** to anyone, fostering collaboration and innovation.
- The basic idea is to welcome everyone **without any restricted entry barriers.**
- They **drive faster innovation** which can benefit a large group of people.

Source: FIDE; Sattva Consulting (2023) [23]

By unbundling roles of actors and enabling interoperability between platforms, open networks allow bidirectional flow of value between sellers and consumers.[24]



ILLUSTRATIONS

Websites talk the same language:

Open protocols like HTTP (Hypertext Transfer Protocol) ensure open communication between web browsers and servers for free and open access of internet.

Emails reach anyone:

Open protocols like SMTP (Simple Mail Transfer Protocol) ensure different emails providers to connect.

Beckn protocol enables open networks, creating decentralised digital ecosystems for multi-sector transactions.

- Beckn is an economic resource discovery and transaction protocol that enables **location aware economic transactions across sectors.**[26]
- As a transaction protocol, it allows **discovery, ordering, fulfillment and post-fulfillment** between consumers and providers.[27]

Enables decentralised **peer-to-peer digital transactions** across various sectors.

Decentralises **intelligence, influence** and **control** to create an open network economy.

Enables open, interoperable interactions in an industry through **specific technical standards.**

Enables seamless information transactions across platforms using a **universal machine readable language.**

SECTOR-WISE ADOPTION [25]

Mobility	namma yatri; Open Kochi
Health & Wellness	Unified Health Interface (**UHI**)
Skill & Education	Open Network for Education and Skilling Transactions **(ONEST)**; BELÉM ABERTA
Grocery and Food	ONDC Open Network for Digital Commerce
Logistics	ONDC Open Network for Digital Commerce
Hyperlocal Commerce	AMSTERDAM
Hospitality & Mobility	OGa Open Gambia Network

USE CASES FOR ENERGY TRANSITION

Open Networks can drive several use cases addressing challenges in green energy transition.*

Green Energy Marketplace

Enables discovery of energy resources and direct transactions between network participants.

Green Buildings

Connects buildings with renewable energy sources for them to optimise their energy use, and help grid stability.

Carbon Markets

Enables small-scale clean energy projects to enter carbon markets via streamlined verification process and interoperable carbon markets.

Circular Economy

Connects end-of-life EV batteries with processing units and potential buyers for recycling and reuse through a marketplace.

Green EV Charging Infrastructure

Facilitates discoverability of credible green energy charging solutions through data-driven user matching and battery integrations.

Energy Storage

Enables discovery of all storage solutions by processing anonymised consumption data, battery health, and so on.

Skill Development for Green Jobs

Open access skilling modules to prepare individuals employed in conventional energy sectors to transition green jobs.

Democratising Green Finance

Aids small RE projects to build creditworthiness through consent-based sharing of transaction patterns.

**Indicative list*

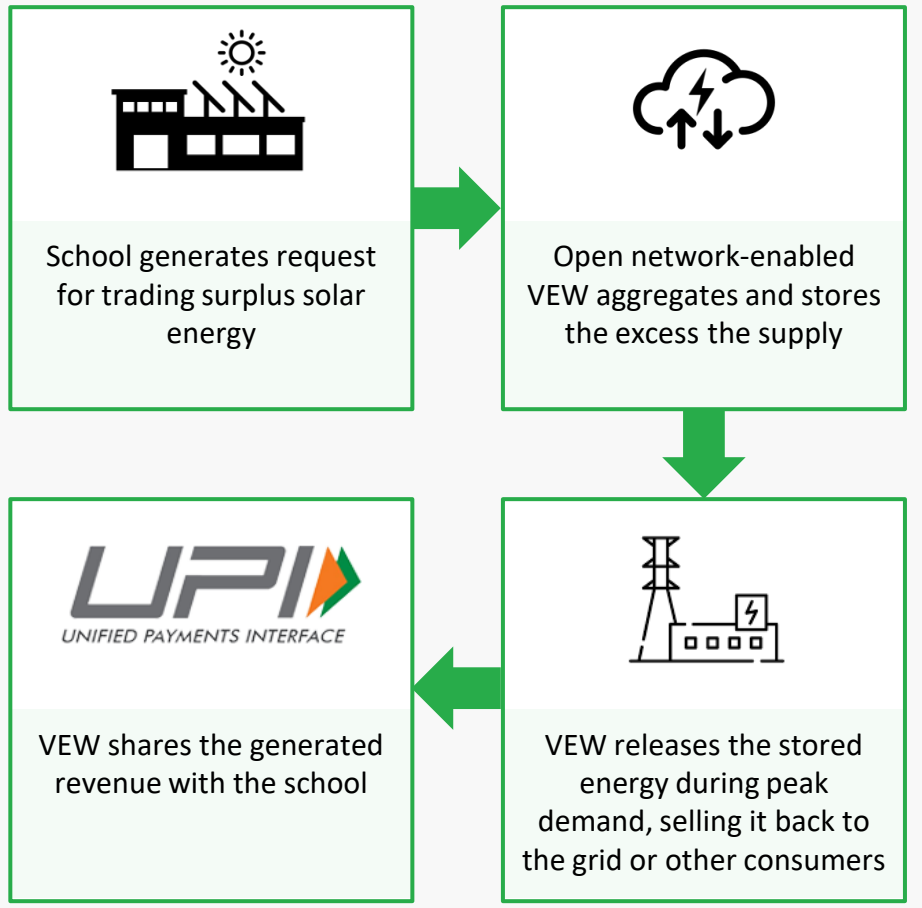
Open Networks can facilitate peer-to-peer transaction for prosumers with surplus green energy.

Profile	**School with rooftop solar panels generating excess energy during summer vacations**
Location	Rural Rajasthan
Problem Statement	Inability to sell excess green energy to the grid leads to energy wastage and missed economic opportunities
Actors	Prosumer (School), Virtual Energy Warehouse (VEW), Grid Operator, Consumers (households, small businesses), DISCOMs

Open Network Solution

Discoverability	VEW can provide prosumers with the option of transacting with multiple consumers in the network.
Higher Profitability	Prosumers can access real-time demand and price data to sell at lucrative prices.
Greater Market Opportunities	VEW pools excess energy from prosumers, beyond individual net metering limits, facilitating large scale energy exchange.
Optimised Grid Integration	VEW uses real-time data to manage stored energy, releasing during peak demand for grid stability.

Open Network-enabled User Flow



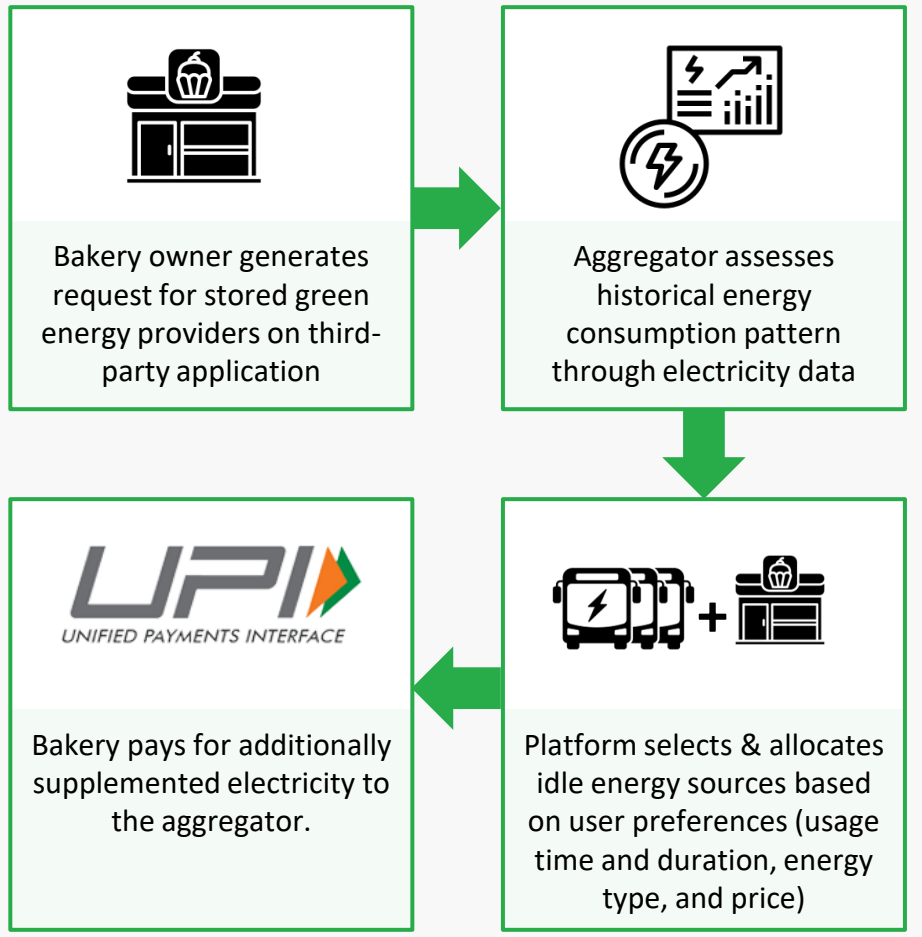
Open Networks can balance demand between idle battery in storage and consumer.

Profile	**Small-scale bakery shop owner aiming to reduce electricity bills by supplementing energy needs with renewable energy (RE)**
Location	Mumbai, Maharashtra
Problem Statement	Lack of visibility into the available options for stored green energy solutions.
Actors	Consumer (Bakery owner), Third-party application, RE provider (EV owners, EV fleet operators, battery owners)

Open Network Solution

Ease of Discoverability	Interoperability between existing application allows users visibility of all available storage solutions.
Enhanced user experience	Consumer's historical energy consumption pattern helps map user to compatible options matching specific needs.
Convenience-based listings	Consent-based location data used to match users with geographically convenient options, minimising transportation needs to complete the exchange.
Informed decision-making	Integrated user reviews on battery providers to help consumers make informed decisions.

Open Network-enabled User Flow



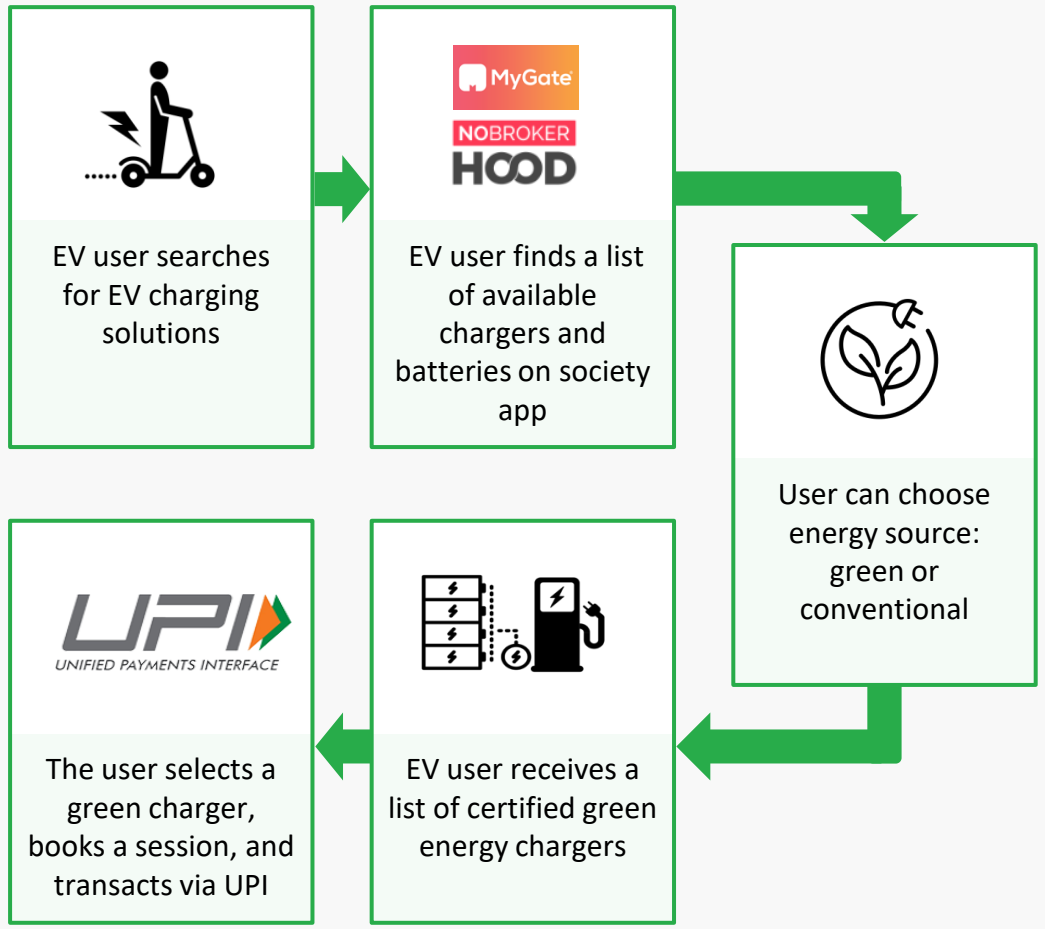
Open Networks can enable discovery and green energy selection capability during EV charging.

Buyer Profile	**Two-wheeler EV owner residing in a gated society**
Location	New Delhi
Problem Statement	Lack of visibility of green energy powered EV charging solutions
Actors	Consumer (EV Owner), Provider (Charging Point Operators), Third Party-App, Green Rating Projects, DISCOMs

Open Network Solution

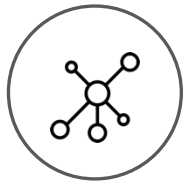
Easy Discoverability	Interoperability between CPO networks, allows visibility of convenient and cost-effective options on one application.
Improved Efficiency	Consent-based location detection matches the user to compatible charging options.
Green Choices	Visibility of verified green options helps shape consumer choice. Visibility of certifications enables trust.
Secure Transactions	Eliminates the need for multiple app wallets and minimum balances by integrating UPI for secure transactions.

Open Network-enabled User Flow



WAY FORWARD FOR SCALING OPEN NETWORKS

Unlocking use cases and scaling open networks in this domain requires stakeholders to pursue critical actions.

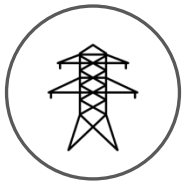


Building Tech Infrastructure

Policy makers should develop frameworks and guidelines for encouraging standardisation and data sharing.

Private entities, philanthropies, and government fund the development of secure platforms and data banks for efficient market functioning.

Tech companies develop secure open network platforms and open-source data repositories.



Enhancing Grid Integration

Government bodies establish favourable policies and financial instruments to help DISCOMs procure more green energy.

Utilities deploy smart meters and microgrids to incorporate Distributed Energy Resources (DERs) and create a decentralised grid.

Utilities, community microgrid projects, storage providers integrate decentralised storage to support grid stability with increased use of DER.

Engaging Stakeholders

Regulatory bodies, energy companies, open-network startups develop market participation tools to incentivise stakeholder participation.

NGOs create capacity building modules, training small-scale RE providers to use open network energy market for greater profits.

Aggregating agencies group consumer demand, enhancing consumers' bargaining power and driving locally situated RE projects.

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