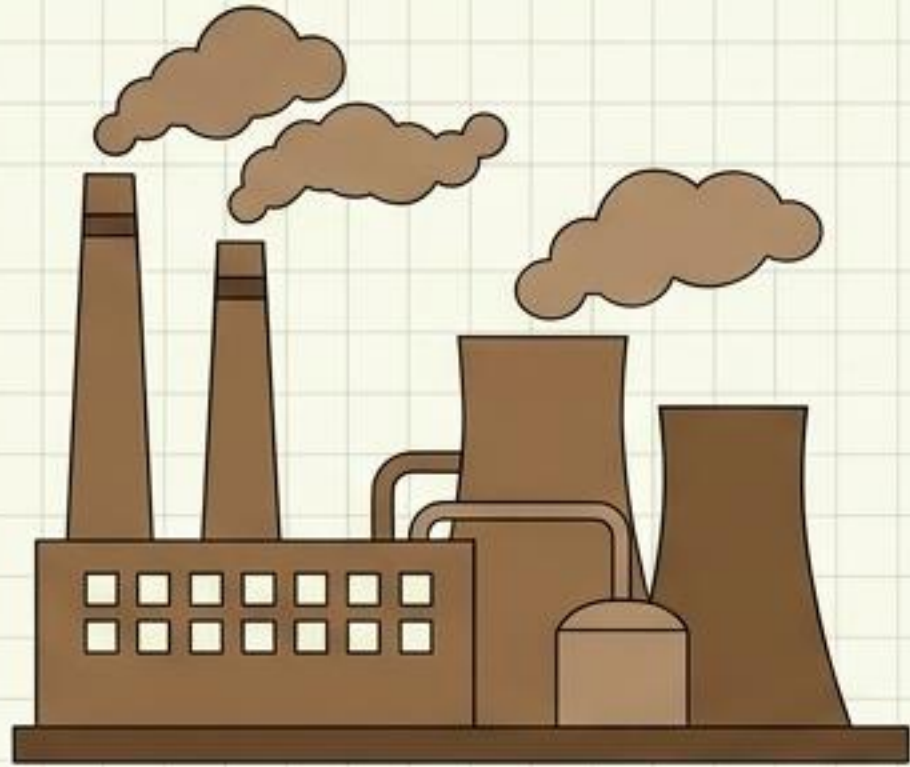


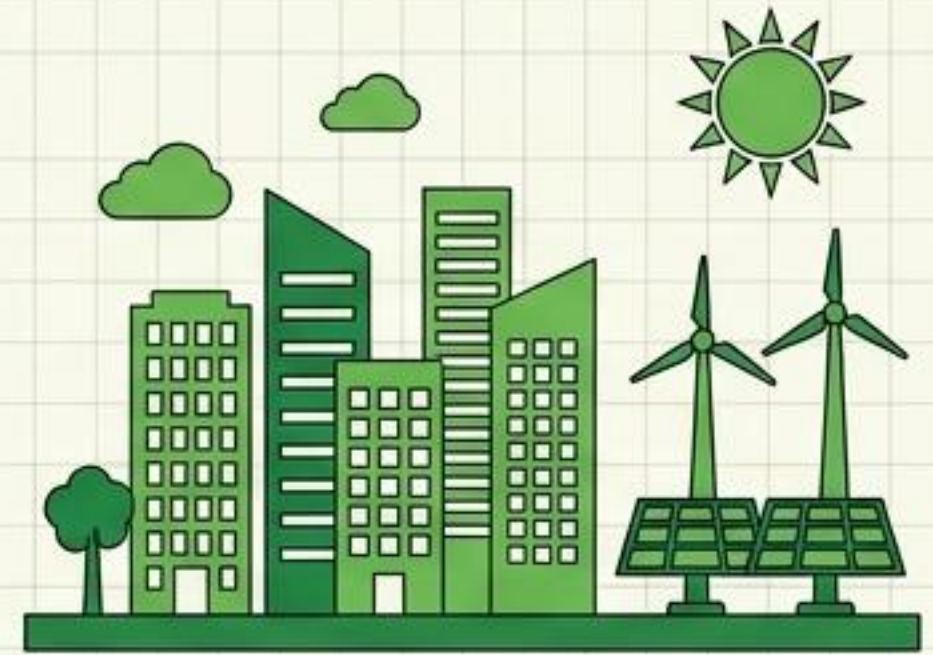


TRADITIONAL
CENTRALIZED
POWER GENERATION
(FOSSIL FUELS)

Energy Scenario and Energy Conservation

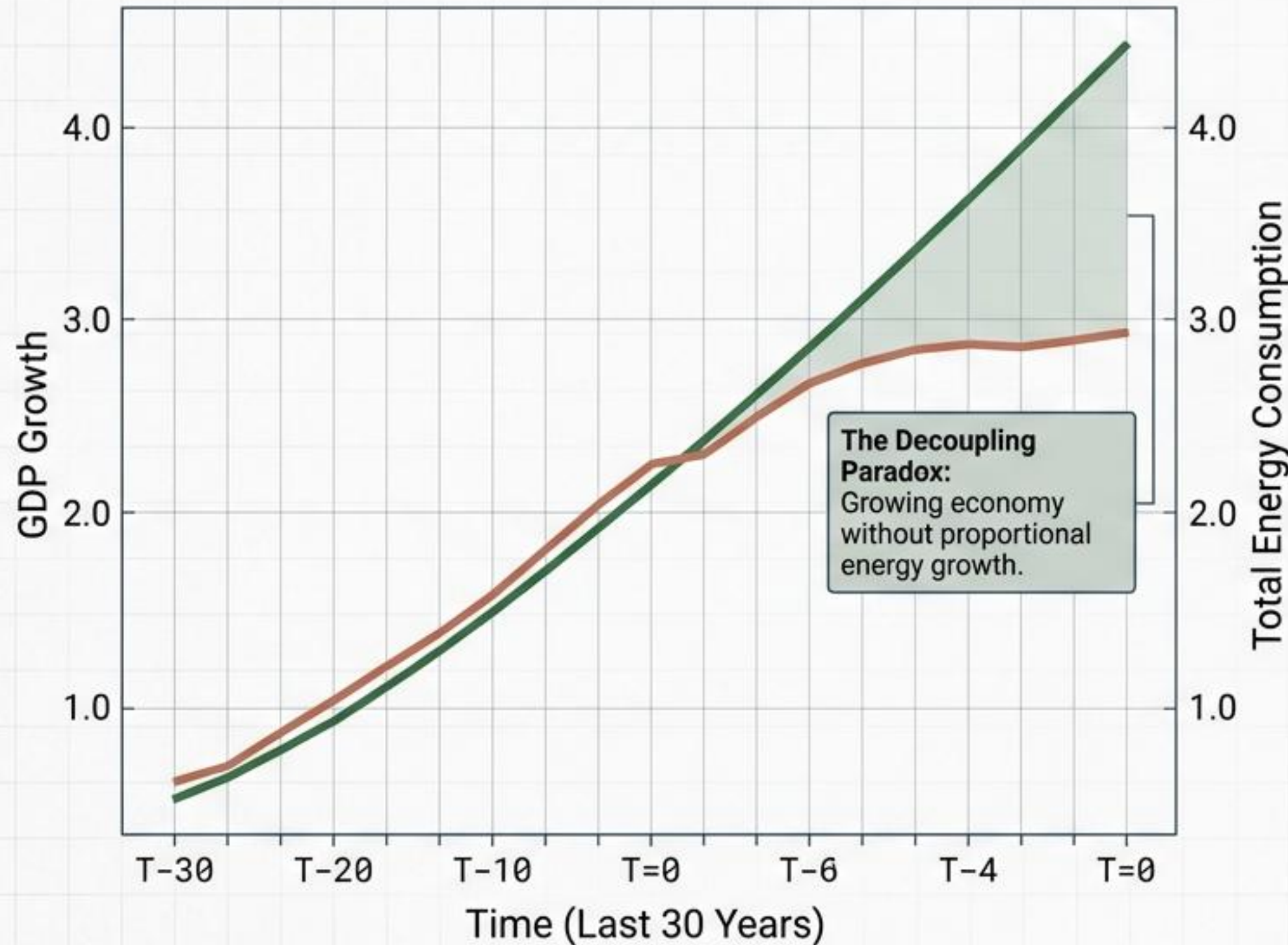
Sustainable Energy Development, Security,
and Conservation | Module 1

Course:	Energy Conservation and Audit
Department:	Electrical and Electronics Engineering
Presenter:	Dr. Sathish K. R., Assistant Professor
Institution:	ATME College of Engineering



DECENTRALIZED
SMART CITY &
RENEWABLE
ENERGY SYSTEMS

Escalating Demand Challenges the Energy Landscape



The Growth Engine



Energy availability drives GDP, rapid industrialization, and urbanization. Quality of life correlates directly with per capita energy use.

Global & Indian Context



India is the 3rd largest global energy consumer. The grid relies heavily on coal imports, though renewable capacity is scaling exponentially amidst geopolitical competition.

The Engineering Challenge



Balancing increased energy access for poverty alleviation against severe environmental limits.

Diagnostic Classification of Energy Resources

Top: Renewable (Replenishing) | Renewable
Bottom: Non-Renewable | Non-Renewable (Finite)



Solar Farms, Large Hydro, Commercial Wind
Critical for sustainable industrial economies.



Sustainably Gathered Firewood, Agro-waste
Crucial for rural survival but technologically inefficient.



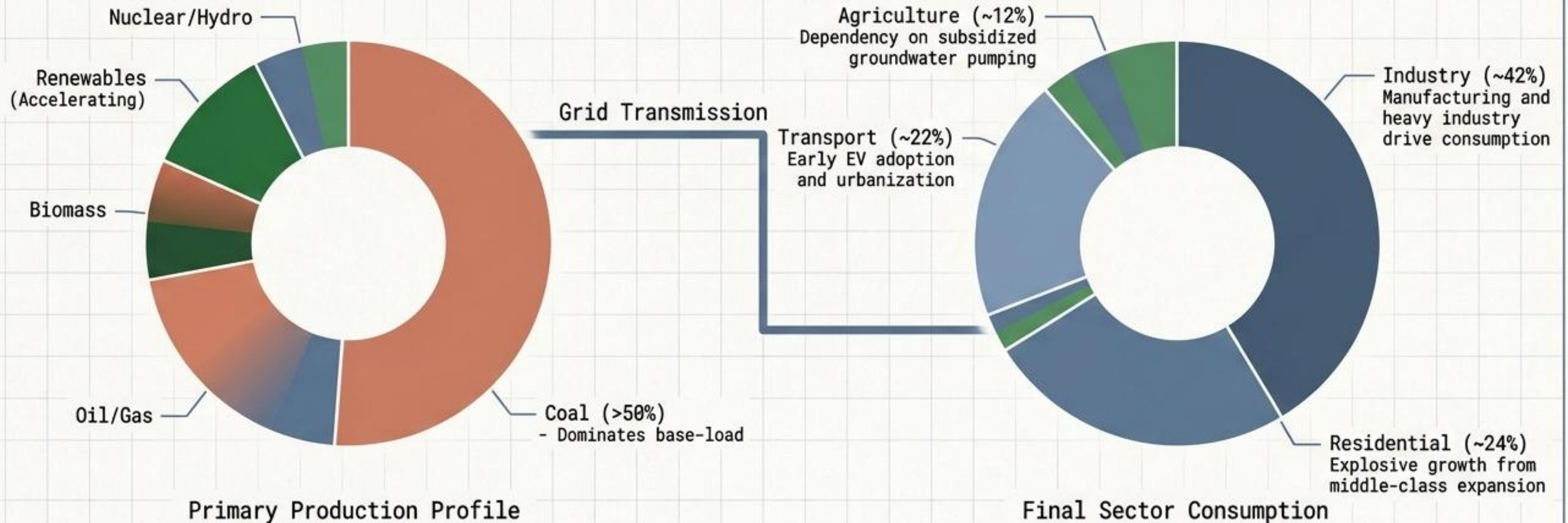
Coal Plants, Oil, Natural Gas, Grid Electricity.
High emissions, depleting reserves.



Coal Scavenging, Unregulated Peat Extraction
Environmentally damaging, informal sector.

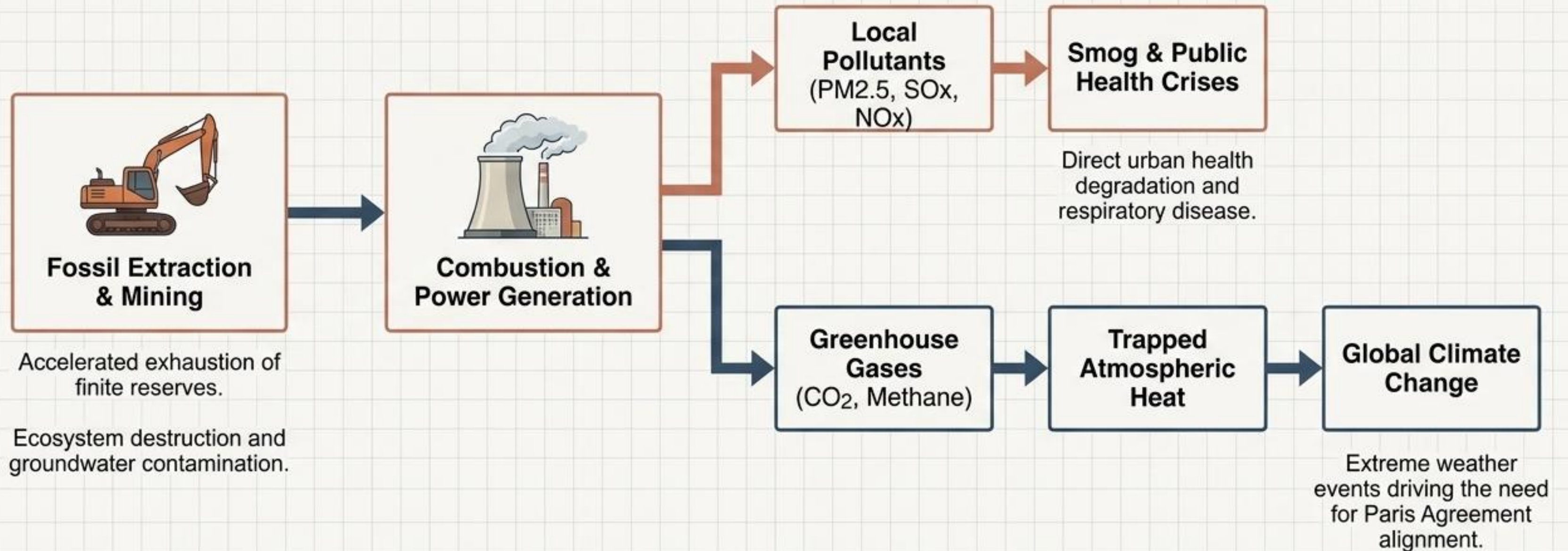
Left: Commercial (Market-Priced, Grid) | Right: Non-Commercial (Unpriced, Gathered)

Structural Dynamics of Energy Production and Final Consumption

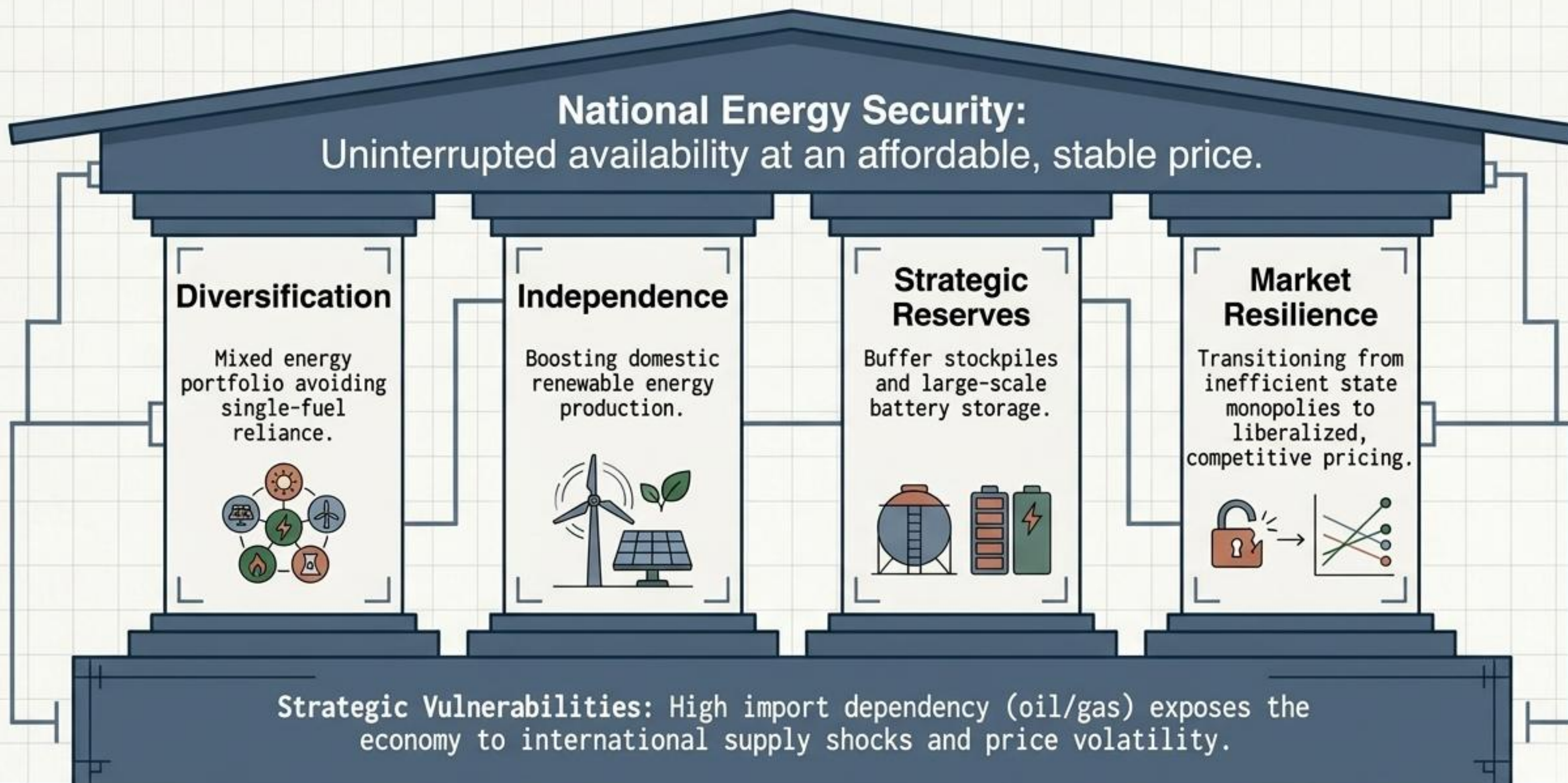


Targeting Interventions: Understanding where energy flows dictates where conservation policies must be targeted. Heavy industry requires the most structured legislation.

The Chain of Consequence: From Extraction to Climate Impact



Achieving Energy Security Requires Structural Market Reforms



Demand-Side Management: Conservation vs. Efficiency

**Supply Side:
Building New Capacity**



Requires massive capital infrastructure and generates proportional emissions.

The Economic Multiplier Effect:

Due to generation and transmission losses,
1 Unit Saved at the consumer level =
1.2 Units Generated at the power plant.

Demand-Side Management



1. **Energy Efficiency:** Engineering upgrades (e.g., using an LED instead of incandescent).
2. **Energy Conservation:** Behavioral changes (e.g., turning off the LED when leaving).

The Energy Conservation Act (2001) Establishes a Regulatory Baseline

Core Objective: Shift from a supply-increasing strategy to a statutory demand-managing strategy to reduce economic energy intensity.

Standards & Labeling

Mandatory energy performance standards for household and commercial appliances.

Designated Consumers

Legal consumption limits enforced on heavy industries.

ECBC

Energy Conservation Building Code setting minimum efficiency standards for new commercial buildings.

EC Act, 2001

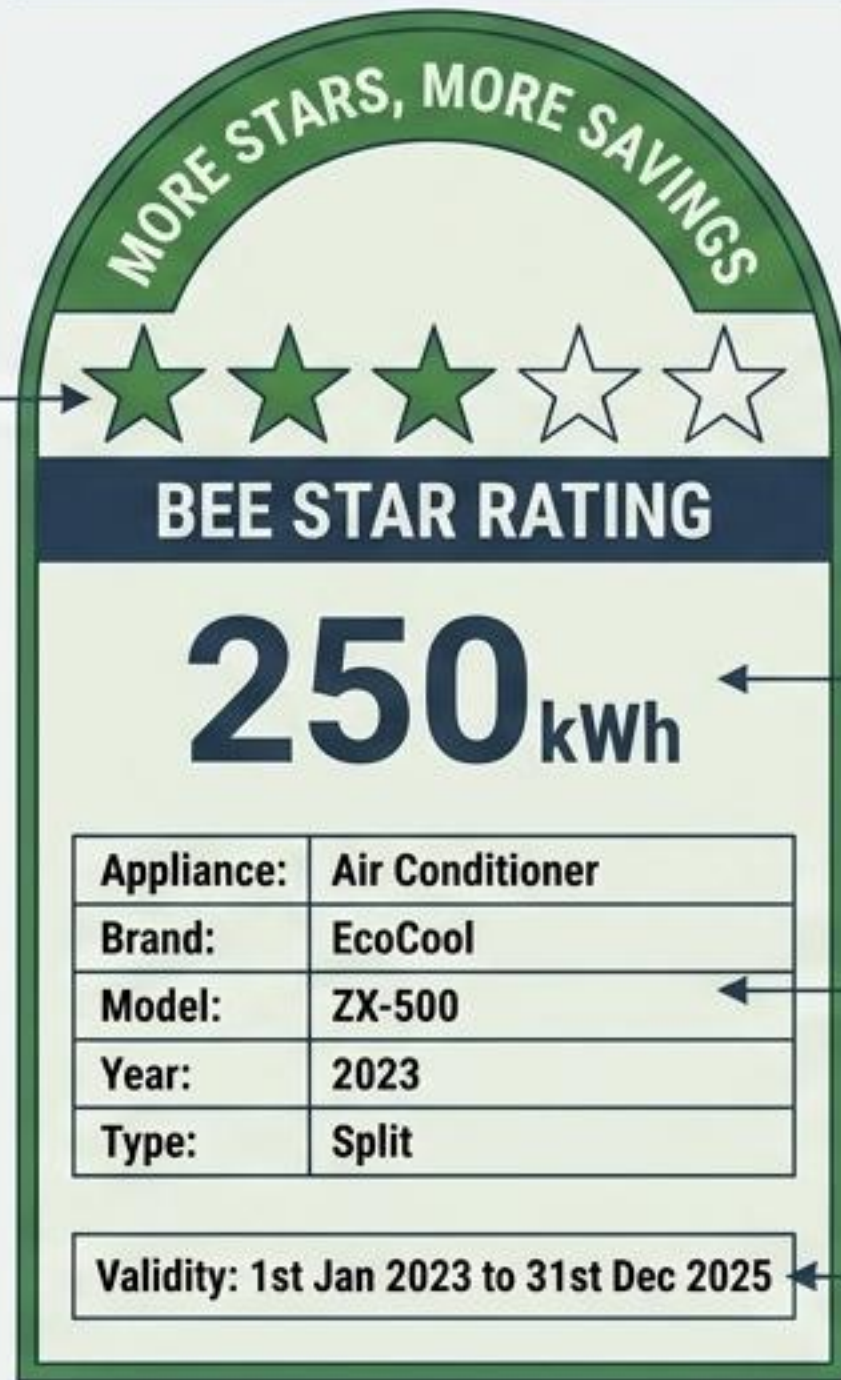
Institutional Setup

Formation of the Bureau of Energy Efficiency (BEE) to oversee nationwide compliance.



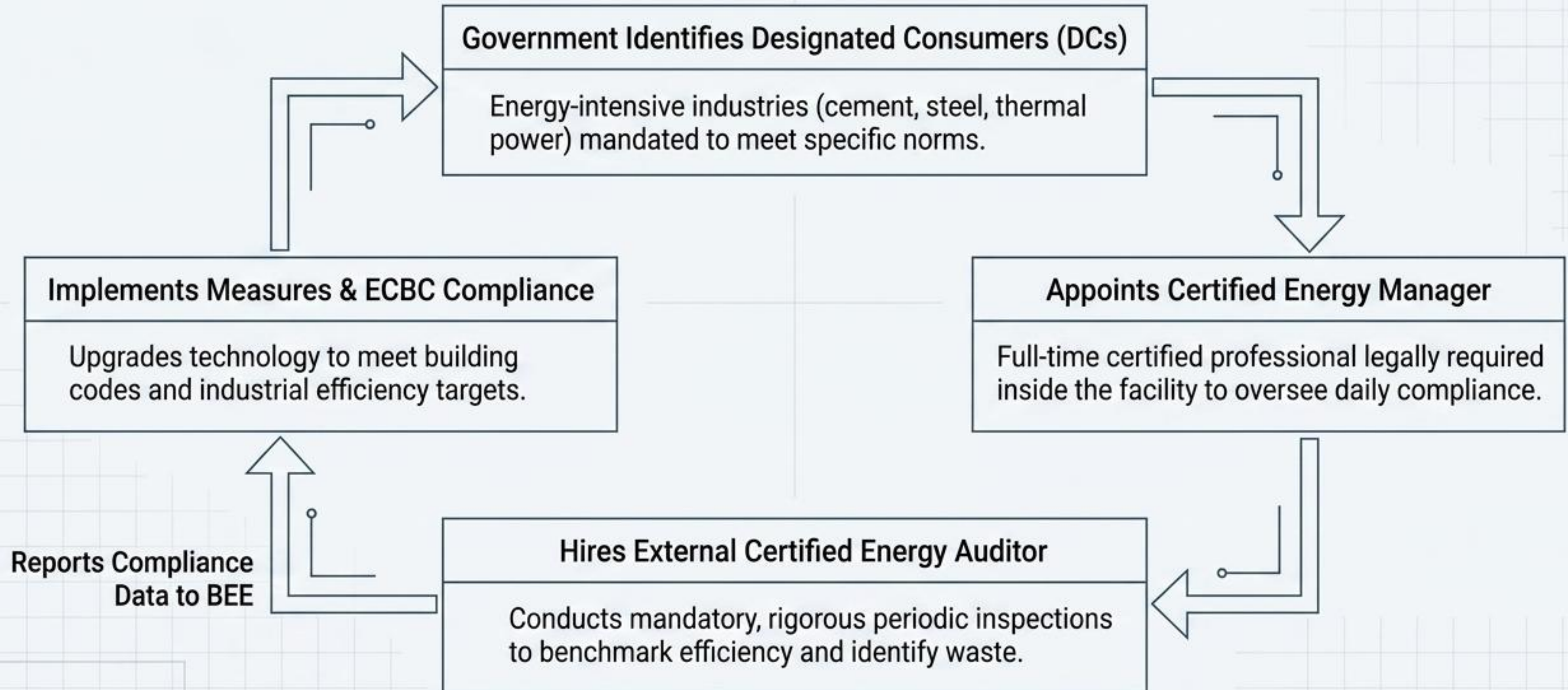
The Bureau of Energy Efficiency (BEE) Drives Market Transformation

Star Rating:
Visual indicator of
efficiency (1 to 5 Stars)



- **Establishment:** Created in March 2002 as the statutory body under the EC Act, 2001.
- **Core Mission:** Develop policies with a strong thrust on self-regulation and market principles.
- **Market Impact:** The Standards & Labeling program successfully empowers consumers to make informed financial choices, completely transforming the household appliance market.

Mandatory Compliance Mechanics for High-Intensity Consumers

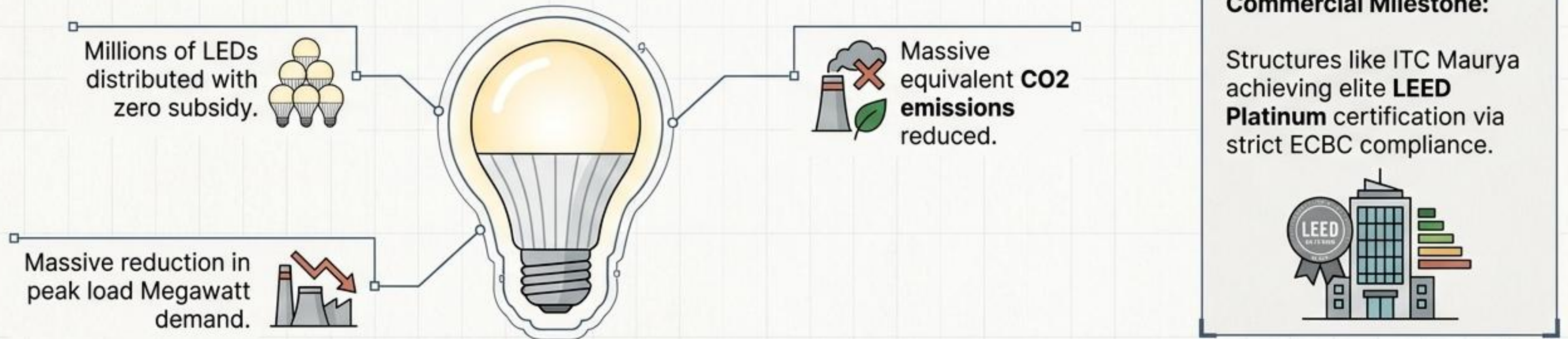


Real-World Implementation: Industrial and Domestic Success

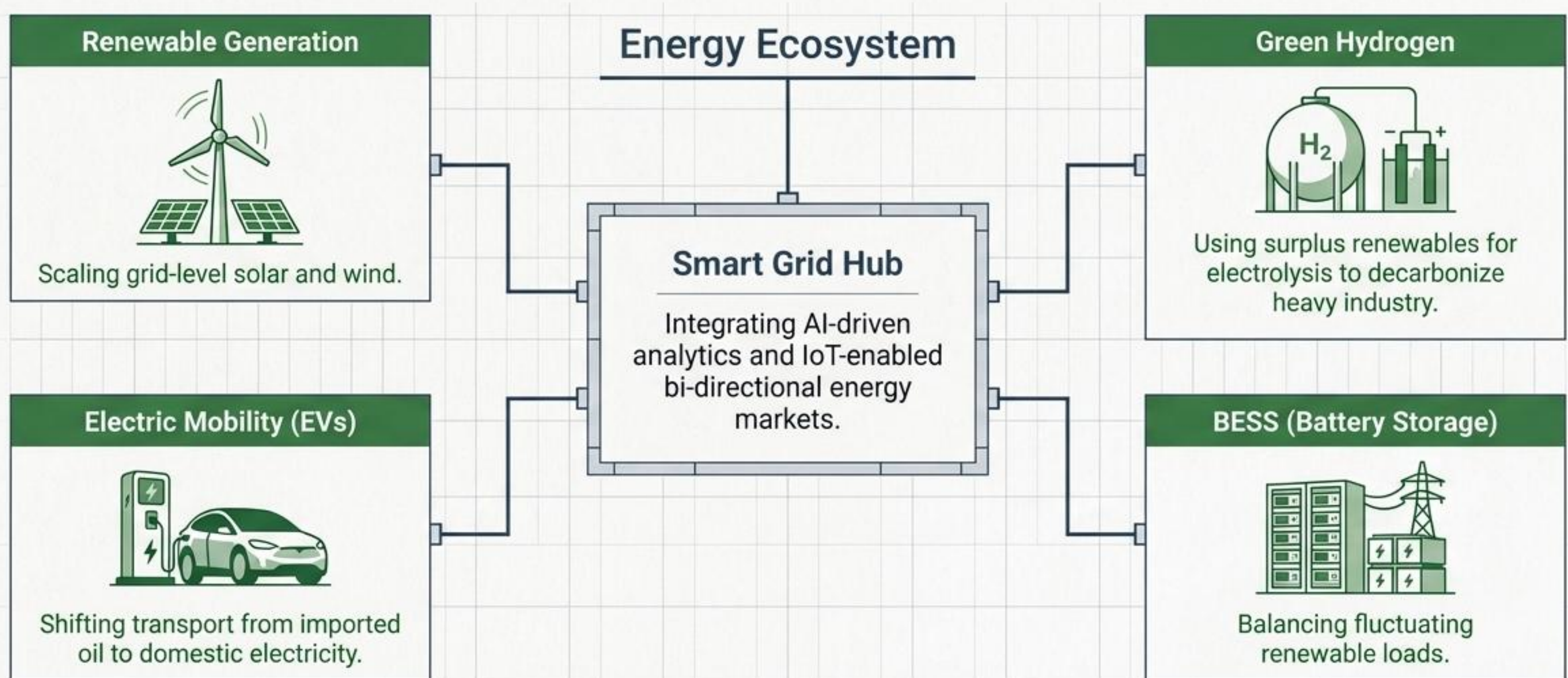
Perform, Achieve and Trade (PAT) Scheme & Co-generation



UJALA Scheme & Commercial Efficiency

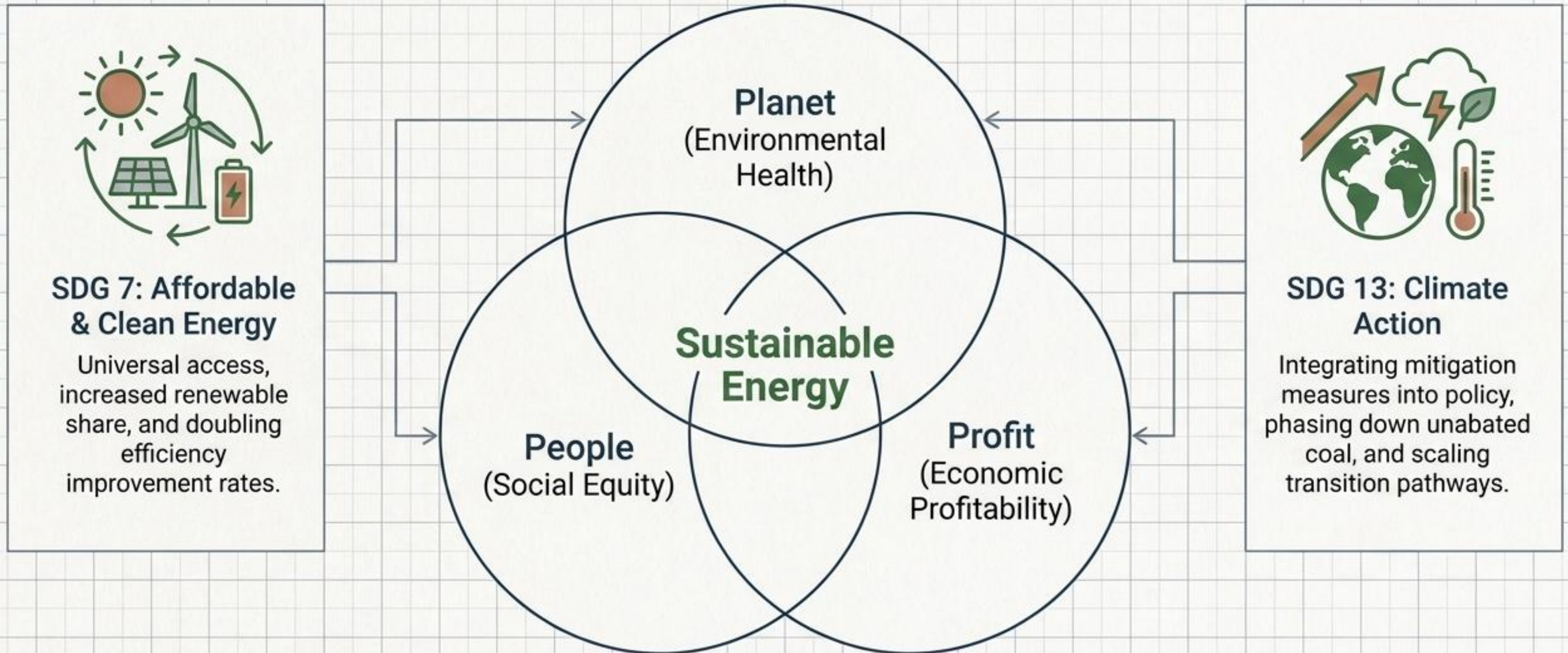


Emerging Technologies Will Restructure the Grid



The ultimate engineering requirement: **Scaling these technologies to meet India's definitive commitment to Net-Zero carbon emissions by 2070.**

National Strategies Must Align with Global SDGs

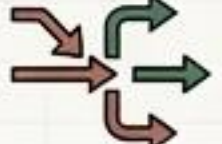


Core Analytical Frameworks and Examination Focus

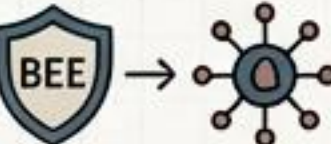
1. Resource Typology

- ☐  Master differences: Commercial vs. Non-Commercial.
- ☐  Differentiate Energy Conservation (behavioral) vs. Energy Efficiency (technological).

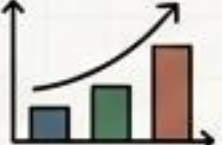
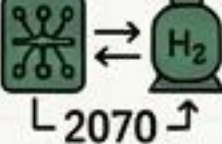
2. The EC Act, 2001

- ☐  Understand the shift to a demand-managing strategy.
- ☐  Detail the scope, objectives, and legal enforcement mechanisms across industries.

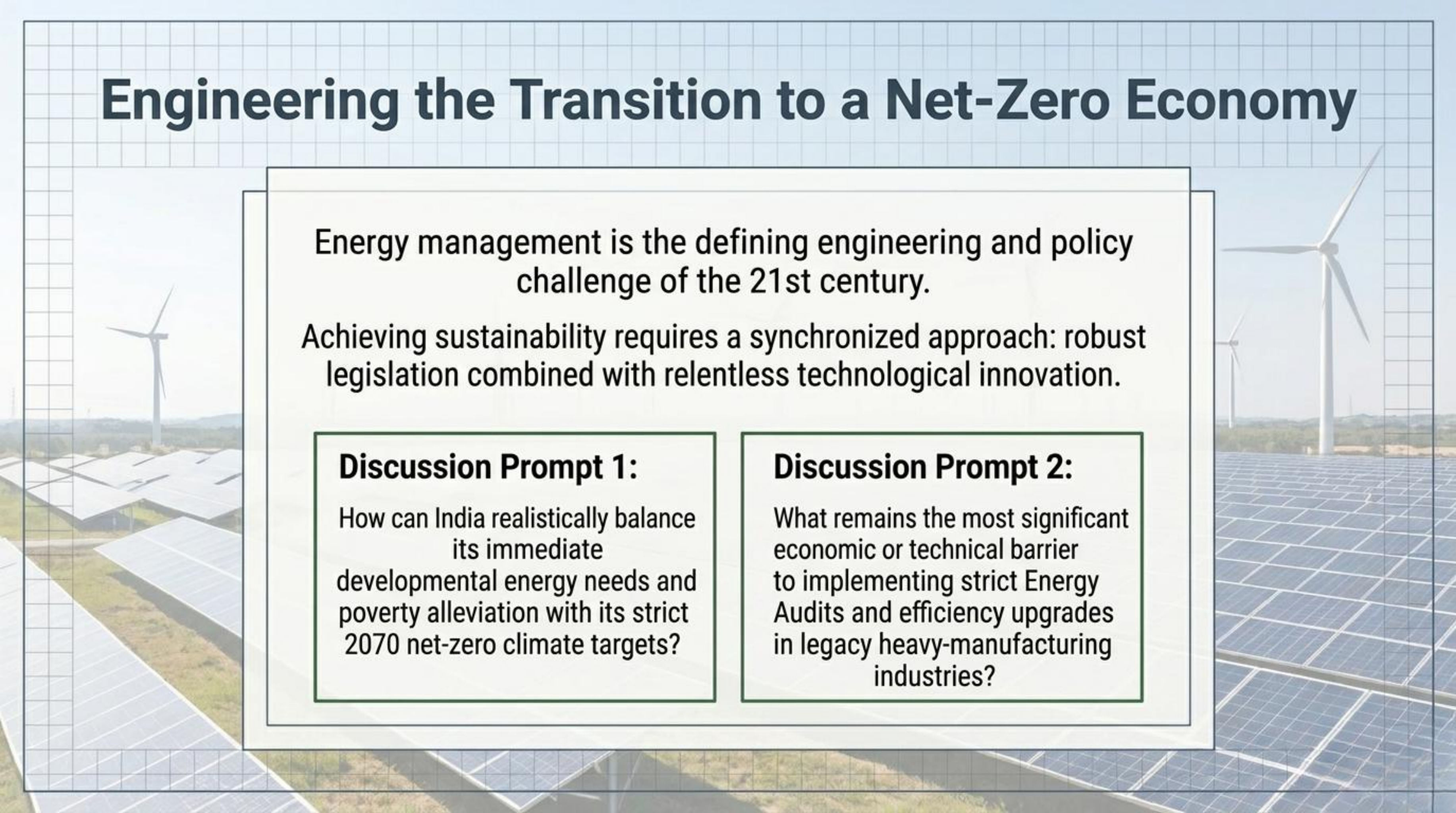
3. Regulatory Mechanisms

- ☐  Define the functional roles of the BEE.
- ☐  Explain compliance loops for Designated Consumers.
- ☐  Understand Certified Energy Audits and ECBC.

4. Macro Trends & Security

- ☐  Articulate India's energy security vulnerabilities.
- ☐  Explain market reforms and transition pathways.
- ☐  Connect smart grids and green hydrogen to Net-Zero 2070 goals.

Engineering the Transition to a Net-Zero Economy

The background of the slide features a large-scale renewable energy installation. In the foreground, there are rows of solar panels laid out on the ground. In the background, several wind turbines are visible against a clear sky. The entire scene is overlaid with a light blue grid pattern.

Energy management is the defining engineering and policy challenge of the 21st century.

Achieving sustainability requires a synchronized approach: robust legislation combined with relentless technological innovation.

Discussion Prompt 1:

How can India realistically balance its immediate developmental energy needs and poverty alleviation with its strict 2070 net-zero climate targets?

Discussion Prompt 2:

What remains the most significant economic or technical barrier to implementing strict Energy Audits and efficiency upgrades in legacy heavy-manufacturing industries?