



# Technology Options for Sustainable Development

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**(TERI)**

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# The Energy & Resources Institute (TERI)

An independent, not-for-profit research organization, advancing innovative solutions in energy, environment, climate change and sustainable development

## Mission:

To usher transitions to a cleaner and sustainable future through the conservation and efficient use of energy and other resources, and innovative ways of minimizing and reusing waste.

## Thematic Areas:

- ✓ Sustainable Agriculture
- ✓ Energy
- ✓ Environment
- ✓ Sustainable Habitat
- ✓ Health & Nutrition
- ✓ Resources and Sustainable Development



# Drivers for Sustainable Development of India

Exploring Technology for Sustainable Development Goals



**Economic  
Security**



**Energy  
Security**



**Food &  
Nutritional  
Security**



**Environmental  
Security**



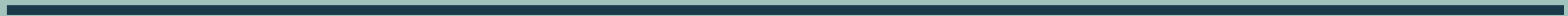
**Biodiversity  
and Ecosystem  
Conservation**



**Natural  
Resource  
Management**



**Optimisation of  
Inclusive  
Growth and  
Social Equity**



# TARGETS FOR SUSTAINABLE TECHNOLOGY DEVELOPMENT IN INDIA

## Developed India @ 2047



- Economy to increase by 10 folds
- Per capita income to increase by 6 fold
- Development to be inclusive

### TOP 10 DRIVERS FOR SUSTAINABLE TECHNOLOGIES IN INDIA (2025)

	Policy & Regulatory Framework	★★★★	⚠️⚠️⚠️
	Cost Efficiency & Economic Viability	★★★★	⚠️⚠️⚠️
	Environmental & Climate Urgency	★★★★	⚠️⚠️⚠️
	Technological Advancement & Digitalisation	★★★★	⚠️⚠️⚠️
	Infrastructure & Ecosystem Capacity (incl. finance, skills)	★★★	⚠️⚠️⚠️
	Green Finance & Investment Access	★★★★	⚠️⚠️⚠️
	Business Model & Value Chain Innovation	★★★	⚠️⚠️⚠️
	Market Demand & Stakeholder Expectations	★★★	⚠️⚠️⚠️
	Social Awareness & Behaviour Change	★★★	⚠️⚠️⚠️
	Global Trade & Supply Chain Dynamics	★★★	⚠️⚠️⚠️

## Climate Resilient India

### Panchamrit



- Reach 500GW non-fossil energy capacity by 2030
- 50 per cent of its energy requirements from RE by 2030
- Reduction of total projected carbon emissions by one BT by 2030.
- Reduction of the carbon intensity of the economy by 45 per cent by 2030, over 2005 levels
- Achieving the target of net zero emissions by 2070.

# SUSTAINABLE TECHNOLOGIES FOR THE ENERGY SECTOR



## Renewable Energy Generation (Technologies)

- **Solar Photovoltaics (PV)**  
Rooftop solar, Floating solar, agrovoltaics
- **Wind Energy**  
Onshore & offshore, blade, All based optimization
- **Small Hydropower**  
Run-of-river systems, minimizing ecosystem
- **Biomass & Biogas**  
Waste-to-energy, bio-CNG, biofuels

### EXAMPLES

- Renew Power, Tata Power Solar  
NTPC Green Energy Ltd in digital grid



## Energy Storage & Battery Technologies (Transitional)

- **Lithium-ion & Sodium-ion batteries**  
For EVs and grid stabilization
- **Flow batteries & Hydrogen storage**  
Long-duration backup for renewables
- **Thermal storage, molten salt** for solar thermal power

### DRIVERS

- Reliance Energy Storage (factory (Equus))
- IIT Madras sodium-ion prototype (2024)



## Clean & Efficient Fossil Technologies (Transitional)

- **Supercritical & Ultra-supercritical boilers**
- **Carbon Capture, Utilisation & Storage**
- **Coal gasification & co-firing with biomass**

### DRIVERS

- India's continued coal dependence focus on efficiency
- Government target of 5-10% biomass co-firing in all thermal



## Smart Grids & Digital Energy Systems (Economics)

- **Smart meters, IoT-enabled grids**  
AI for demand forecasting
- **Blockchain-based energy trading**
- **Digital twin simulations** for grid operations

### DRIVERS

- Smart meter rollout across Delhi (Tata Power-DDL)
- Blockchain pilot in Uttar Pradesh



## Decentralised & Off-grid Solutions (Economics)

- **Microgrids and solar home systems**
- **Hybrid wind-solar systems** with storage
- **Solar-powered cold chains** and water pumps

### DRIVERS

- Electrification of remote villages under Saubhgya and NUSUM Schemes
- Demand for rural livelihood energy solutions



## Circular & Waste-to-Energy Technologies (Examples)

- **Municipal waste-to-energy**
- **Industrial waste heat recovery**
- **Biofuel and RDF-based generation**

### DRIVERS

- Swachh Bharat Mission 2.0
- Circular economy frameworks
- Urban waste management targets

# SUSTAINABLE TECHNOLOGIES FOR THE AGRICULTURE SECTOR (India)

**Water-Efficient Irrigation & Management**

**Technologies:** Drip & precise prefriize with soil motature.  
Ar based inigation  
uresspressing systetrimio

**Drivers:** Micro catchment

**Examples:** zain Irrigation: Netafim India  
KisanHub moisture monhoring

**Soil Health & Nutrient Management**

**Technologies:** Soil sensors for 1-kimc nutrient profiling. Duforsilizers, organic inpute, hdno ovea

**Drivers:** Precision nutrient-application using drones & GPS mapping

**Examples:** IFFCD Nano, 'unea, Aqlreat soil health analytics

**Precision & Digital Agriculture**

**Technologies:** Drones. AI & GIS mapping for groantiontoring a post detection

**Drivers:** IbT, based farm management playionns

**Examples:** Remote sensing & predictive analytics for ylaid forecasting  
Robotics & autonomous tractors

**Climate-Resilient Crops & Farming Systems**

**Technologies:** Draughi -- flood- and heat-toterant seed varieties  
Integrated pest management ring

**Drivers:** Agroforestry & regenerative agnculture

**Examples:** Protected cultivation (polyhouses, shade hydroponics)

**Renewable Energy in Agriculture**

**Technologies:** Solar powered irrigation pumps (SPIPS), Blogas plants

**Drivers:** Solar drivers; sulamem-Sve/ post atorge

**Examples:** Agri-iesh prirdeo entgid rural rorming cluster  
Eab LM satim-mplerentions

**Post-Harvest & Value Chain Technologies**

**Technologies:** Solar-powered cold storage units

**Drivers:** Av driven supply chain ltraceability  
Food processing using low-carbon Tesh

**Examples:** Blockchain for farm-to-fork transparency

**India's Sustainable Agriculture Technology Drivers (2025)**

Goal	Key Initiative	Drivers	Exampels
Water Efficiency	PMKSY Soil Health Carrd	Soil Health Card Digital Agri Mission	Digital AgriStock KisenGPT Type advisory moweels
Soil Health	Digital Agri	NMSA	Private AgriTech-scurefste
Digital Agri	Climate Resilience	PM-KUSUM AIF	KisanGPTType advisory

# SUSTAINABLE TRANSPORT TECHNOLOGIES

## Electric Mobility

- EVs (2W, 3W, 4W, buses)
- Fast charging & swap
- Vehicle-to-grid (V2G)



## Public Transport Modernisation

- Metro & e-bus fleets
- Smart ticketing (AI/IoT)
- Solar charging depots



## Low-Carbon Fuels

- Bio-CNG, E20, biodiesel
- Waste-to-fuel systems



## Freight & Logistics

- Electric / LNG trucks
- AI route optimisation



## Hydrogen & Fuel-Cells

- Fuel-cell buses/trucks
- Green hydrogen electrolysers



## Active Transport

- E-bike sharing
- Walkable city planning



## Smart Infrastructure

- Smart signals & EV roads
- GIS mobility planning

# Sustainable Manufacturing Technologies

## Smart factories, Renewable Energy Integration, Waste Reduction Techniques, Advanced Automation, and Energy Management systems

### Smart Factories and Digital Innovations

- Smart factories powered by Industrial IoT (IIoT) networks,
- AI-driven predictive analytics,
- Digital twins for process optimization

### Renewable Energy and Energy Efficiency

- High-efficiency motors, LED lighting
  - variable frequency drives (VFDs) further minimizes energy usage.
- Energy management systems provide real-time monitoring and control, driving even greater efficiency

### Lean Manufacturing and Process Optimization

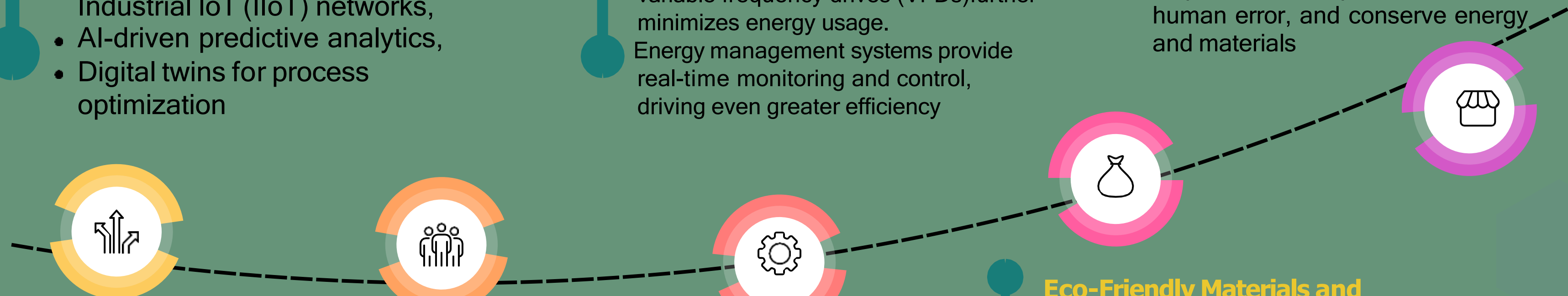
- Eliminating waste in all forms and optimizing production systems for minimal resource use
- Advanced robotics and automation help streamline operations, reduce human error, and conserve energy and materials

### Waste Reduction and Circular Economy

- Robust recycling and upcycling programs
- Designing products for easy disassembly and material recovery
- Circular economy principles encourage the reuse and recycling of resources throughout supply chains
- Reducing landfill and conserving valuable assets

### Eco-Friendly Materials and Packaging

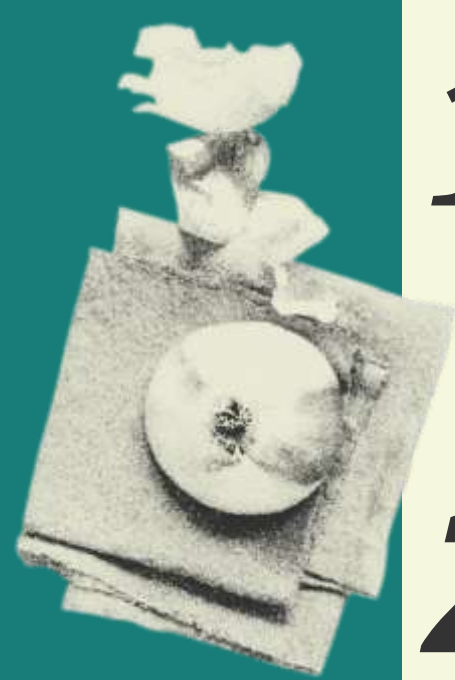
- Use of non-toxic, plant-based, or recycled materials for products and packaging
- Reuse and recycling, including biodegradable and compostable solutions





# Sustainable Waste Management Technologies

*to reduce landfill usage, recover resources, minimize pollution, and transition towards circular models that reuse and recycle materials*



**1**

## Smart Waste Collection and Sorting

- Sensor based waste collection and management
- Robotics and AI Powered System for waste segregation and recycle

**2**

## Waste-to-Energy Technologies

- Incineration, anaerobic digestion, pyrolysis, and gasification to convert mixed solid wastes into energy

**3**

## Recycling and Circular Economy Innovation

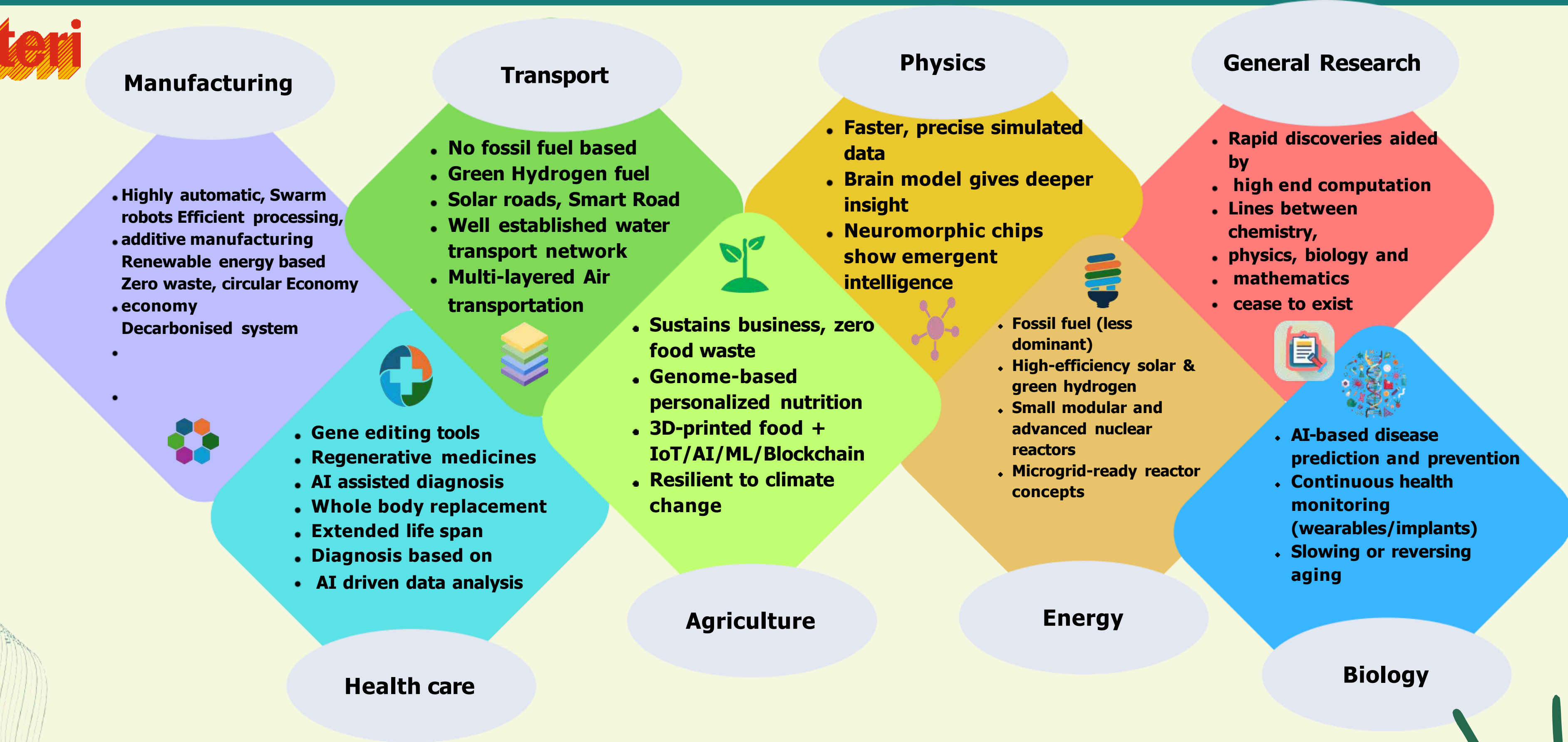
- Recycling of waste through chemical and biological route towards conversion to new valuable products
- Recycling of e waste promotes value addition and reduce environmental degradation

**4**

## Digital Tools and Zero Waste Strategies

- AI, robotics, and blockchain platforms provide efficient tracking, sorting, and verification of waste disposal and recycling streams.
- Zero waste facilitates reuse of waste and repurposed.





# Future Technology Trends under different sectors

# FINAL WORDS

**Technology must be affordable, eco-friendly, socially relevant, easy to adopt, economically beneficial, and policy aligned**



# Thank You

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