

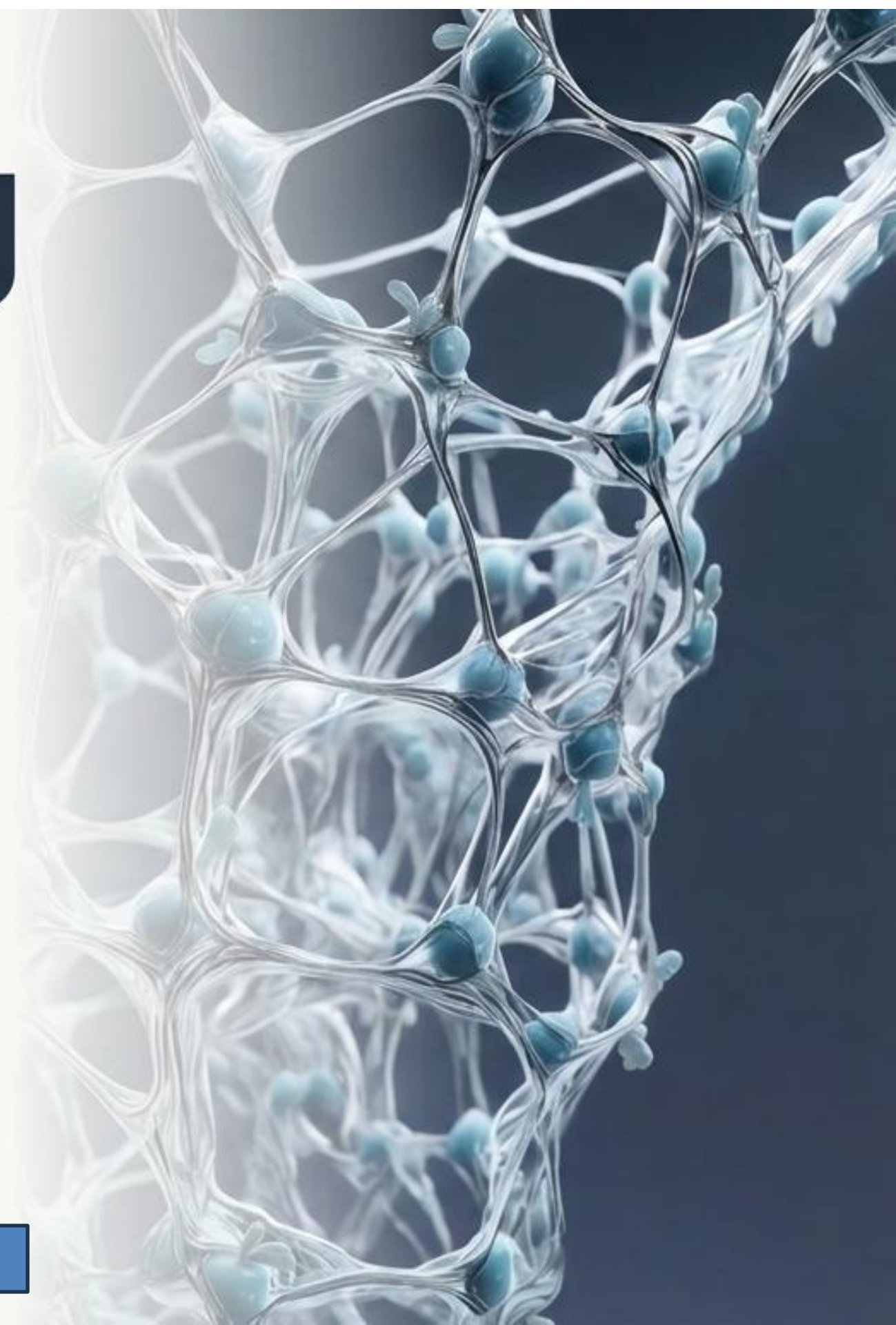
# Top 10 Emerging Technologies of 2025

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A Strategic Foresight Briefing on the Innovations Redesigning Global Systems.

SYNTHESIZED FROM THE WORLD ECONOMIC FORUM  
& DUBAI FUTURE FOUNDATION FLAGSHIP REPORT.

Presented By: Dr.M.Muzamil

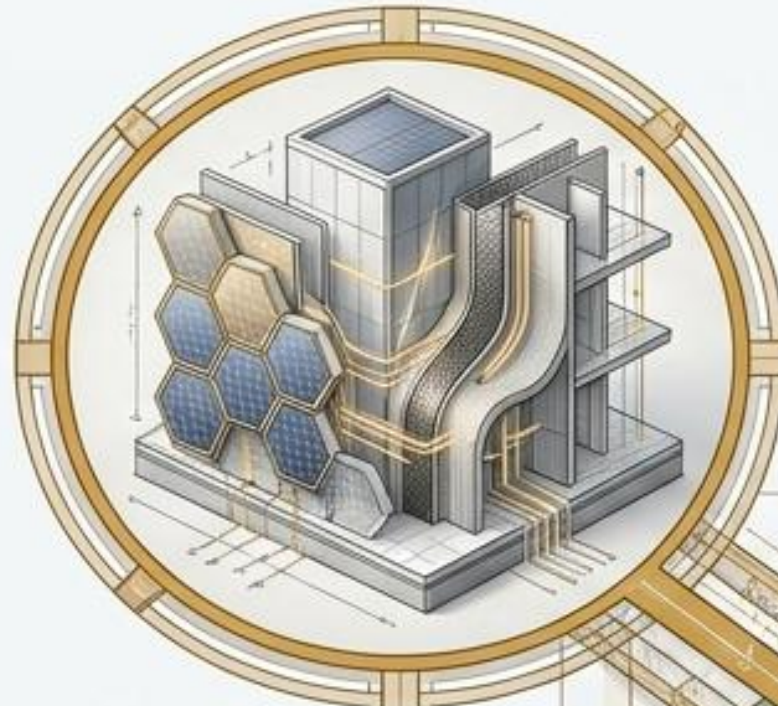


# The 2025 Innovation Landscape: Four Forces of Convergence

Breakthrough innovations no longer emerge in isolation. The most profound transformations happen at the intersection of disciplines, requiring leaders to shift from tracking singular technologies to understanding systemic convergence.

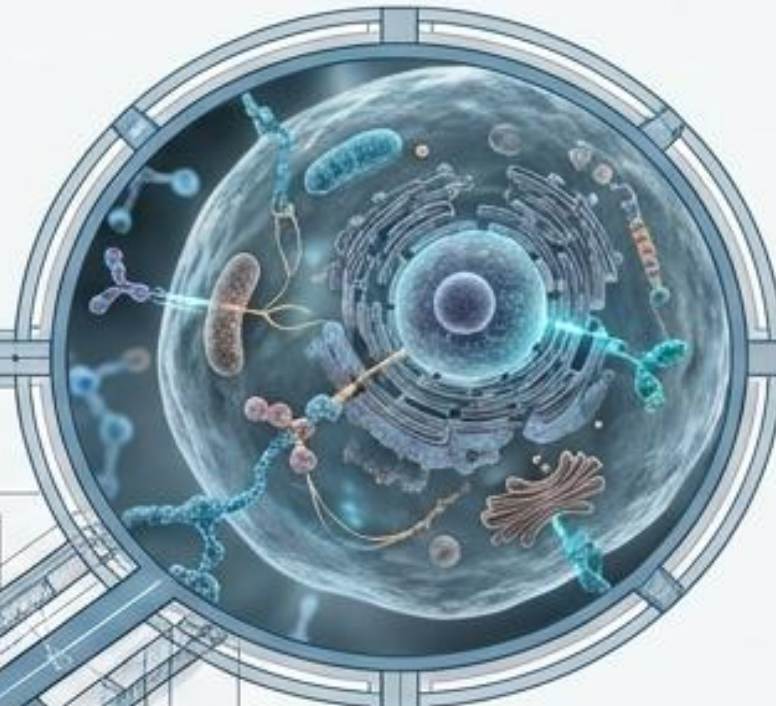
## Energy & Materials

Redesigning physical infrastructure to merge structural integrity with active power generation.



## Biology & Health

Shifting from external pharmaceutical manufacturing to engineering the human body as its own therapeutic factory.



## Industrial Redesign

Replacing century-old, carbon-heavy chemical processes with bio-inspired, decentralized manufacturing.



## Digital Trust

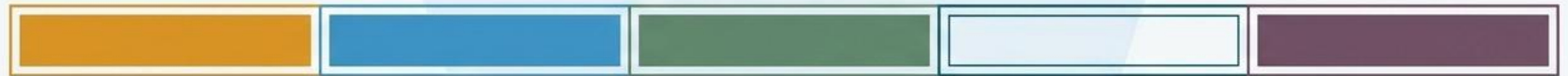
Embedding immutable authenticity and collaborative intelligence into our physical and digital networks.



# The Ecosystem Readiness Framework

Technological brilliance is insufficient for scale. Widespread adoption requires navigating complex interactions across five systemic dimensions. Each technology in this briefing is evaluated on a 4-point scale.

## STEEP Sparkline



S

T

E

E

P

### **S - Social**

Public awareness, cultural acceptance, and education.

### **T - Technological**

Maturity of underlying research and supply chain readiness.

### **E - Economic**

Market demand, business model viability, and investment trends.

### **E - Environmental**

Resource sustainability and alignment with emission regulations.

### **P - Policy**

Regulatory frameworks, international alignment, and trade barriers.

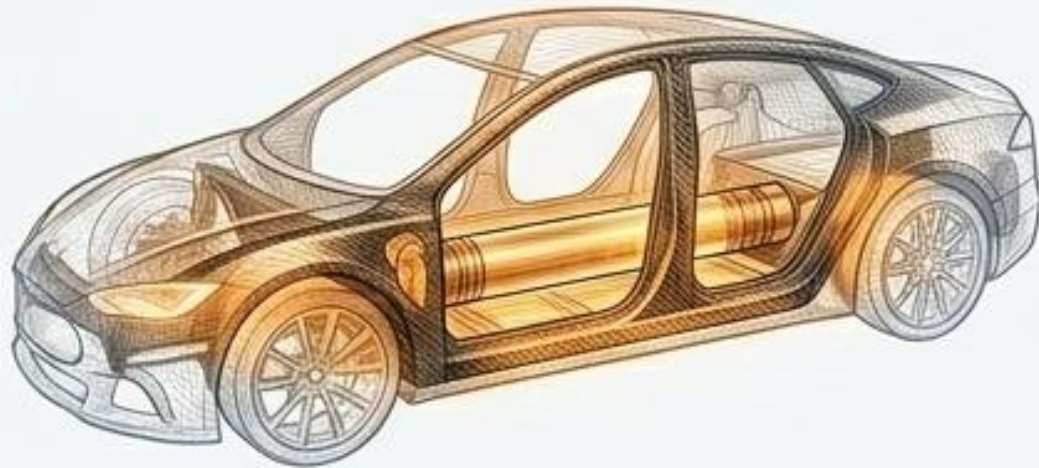
# Structural Battery Composites: Engineering Massless Energy

## Technical Mechanism

Traditional EV



SBC Vehicle



SBCs integrate load-bearing mechanical components with rechargeable energy storage. Woven from carbon fiber and epoxy resin, these 3D-printed composites eliminate the dead weight of traditional battery casings.

## Strategic Impact

**Automotive:** A 10% reduction in vehicle weight increases EV range by 70% and improves fuel efficiency by 6-8%.

**Aviation:** Potential fuel efficiency improvements of 15% over a 1,500 km flight.

**Geopolitical:** Diversifies supply chains away from current bottlenecks (85% of lithium is refined by just three countries).



**Policy Bottleneck:** Building codes and safety standards require a complete overhaul for dual-function materials.

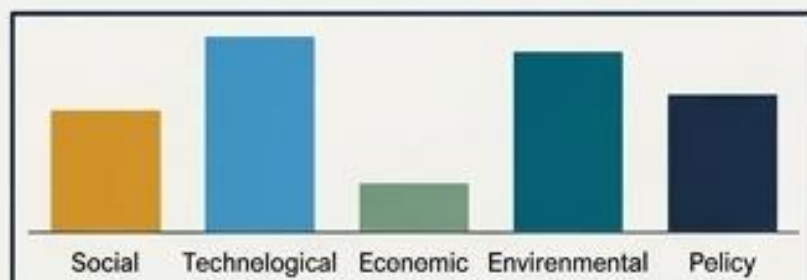
# Next-Generation Generation: Salinity Gradients and Modular Fission

## Osmotic Power



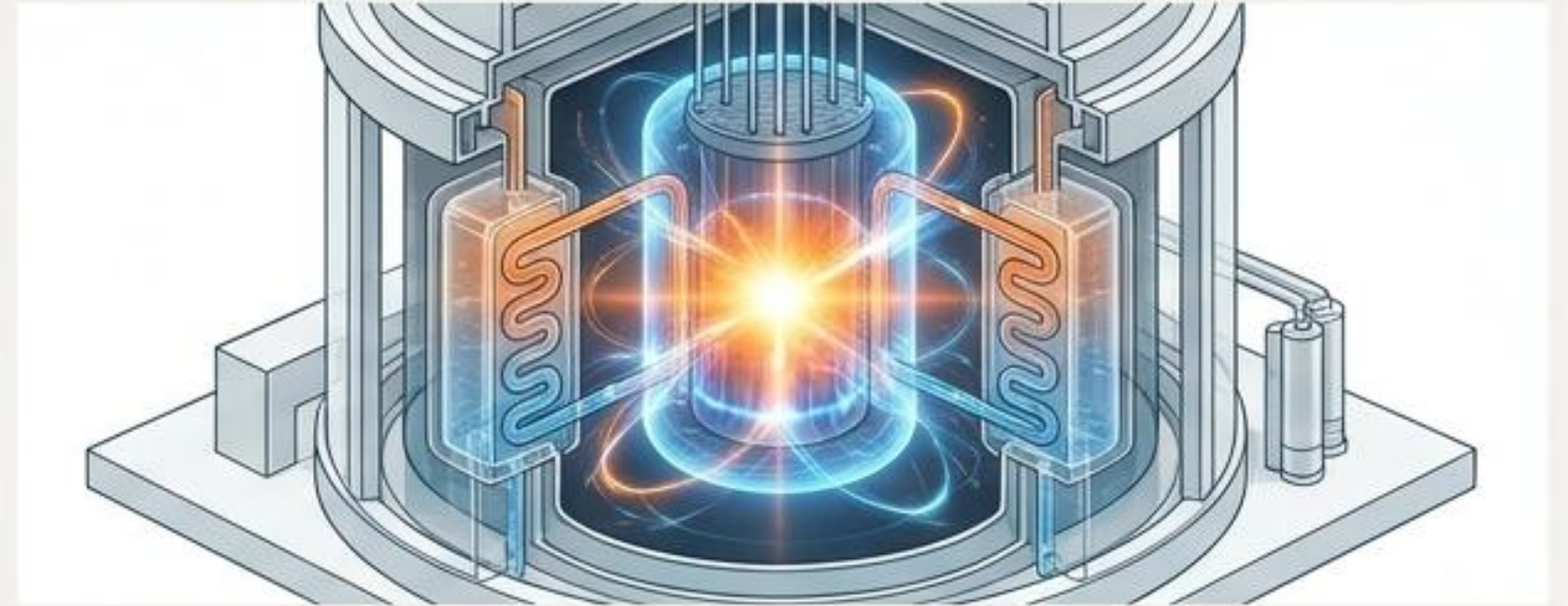
**Mechanism:** Pressure Retarded Osmosis (PRO) and Reverse Electrodialysis (RED) generate steady, base-load power from salinity differences.

**Strategic Impact:** Potential to generate 5,177 TWh annually (nearly 20% of global electricity needs). Transforms desalination plants from energy sinks into hybrid resource generators, recovering critical minerals like lithium during water treatment.



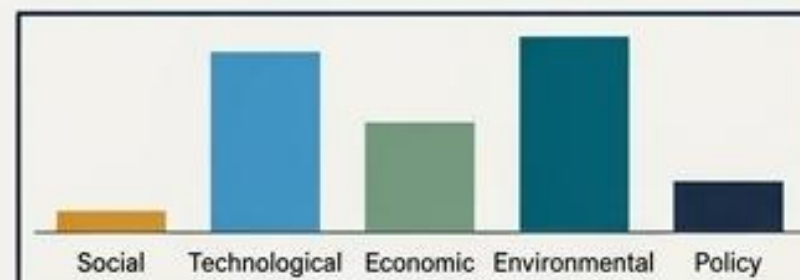
Requires heavy Infrastructure investment.

## Advanced Nuclear



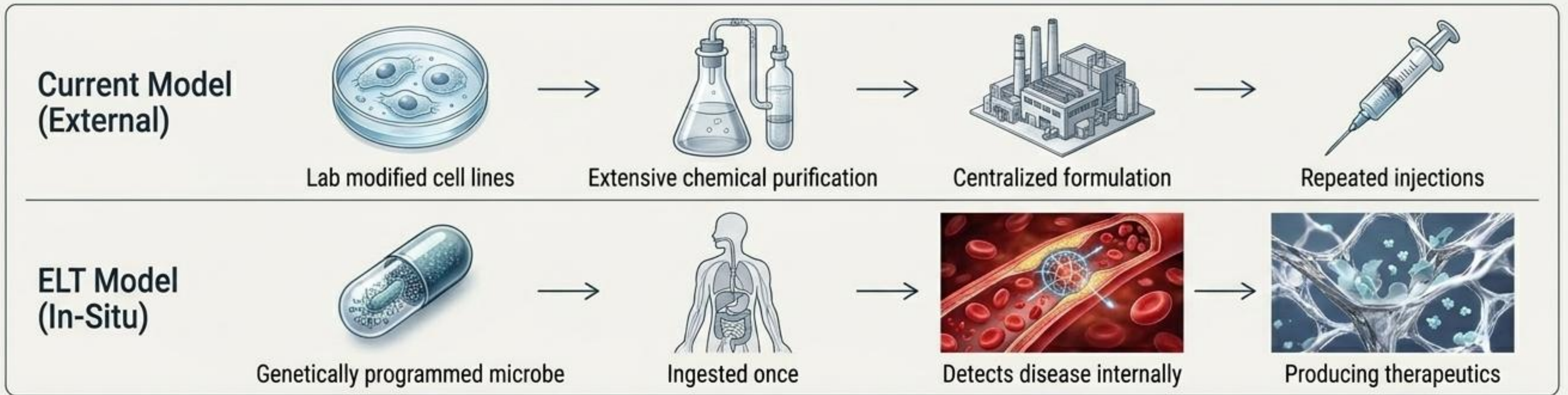
**Mechanism:** Generation IV Small Modular Reactors (SMRs) and gas-cooled reactors utilize alternative coolants (molten salts/helium), operating safely at higher temperatures and lower pressures.

**Strategic Impact:** Gas-cooled reactors provide 600-950°C process heat, unlocking decarbonization for heavy industry and hydrogen production (sectors responsible for 15% of global CO2 emissions).



Social trust hurdles remain high.

# Engineered Living Therapeutics: The Body as a Biomanufacturing Facility



## Strategic Impact



Economic

Eliminates downstream purification and processing, which currently account for 70% of traditional biopharmaceutical production costs.

## Supply Chain



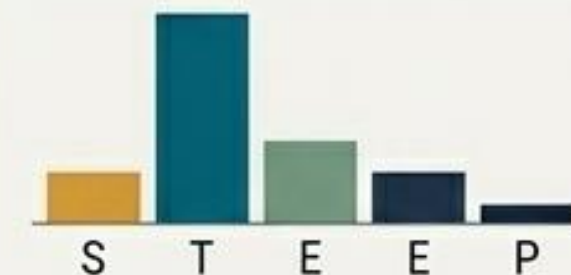
Decentralizes production, utilize bypassing fragile global transport constrained regions.

Decentralizes production, bypassing fragile global supply chains and expanding access in resource-constrained regions.

## Safety Innovation

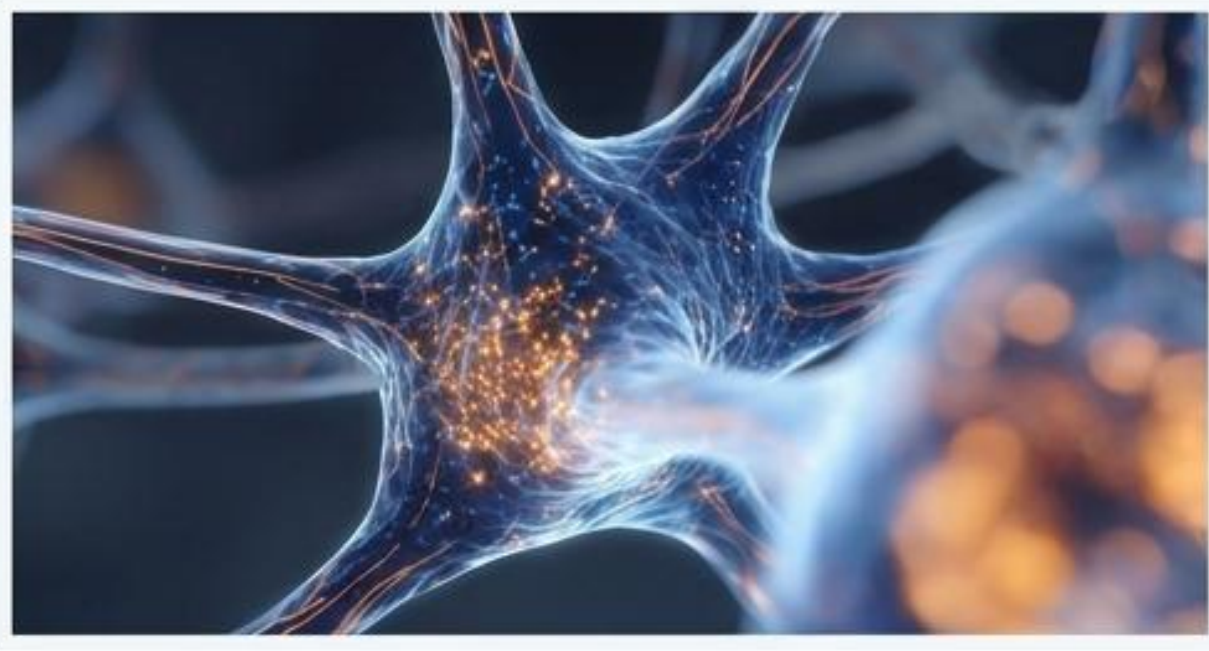


Development of light-responsive bacterial systems and programmed metabolic kill-switches to prevent



Requires novel regulatory sandboxes for living organisms.

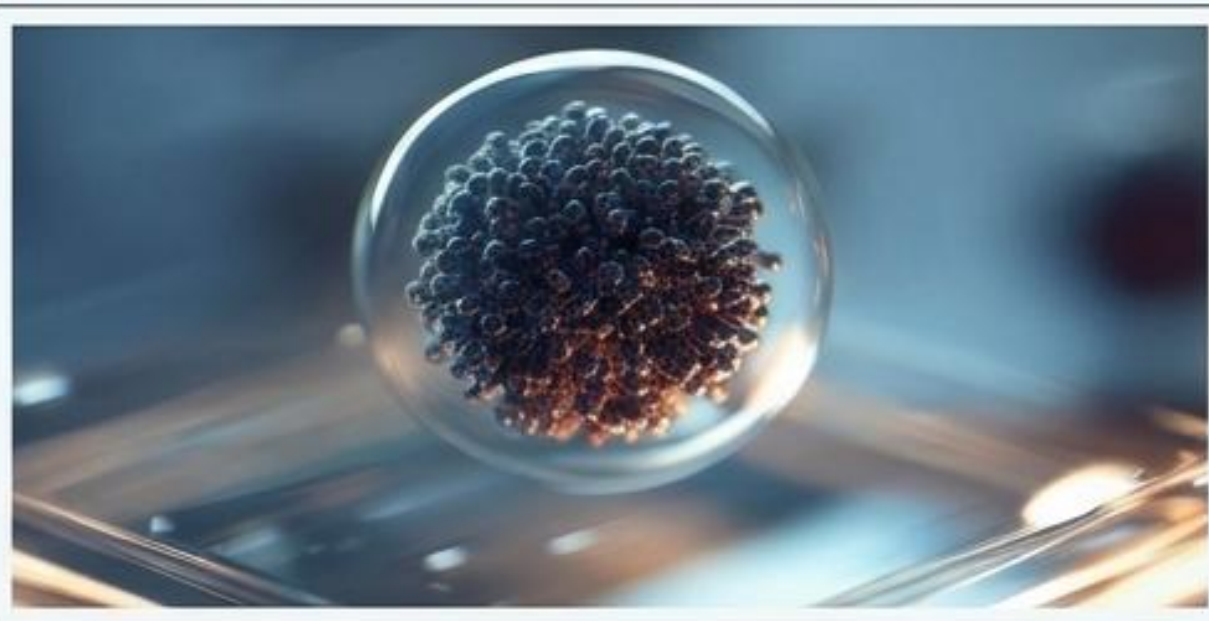
# Precision Biology: Neurological Intervention and Continuous Telemetry



## GLP-1s for Neurodegenerative Disease

**Insight:** Originally designed for obesity and type 2 diabetes, [GLP-1 receptor agonists](#) cross the blood-brain barrier. They provide neuroprotection by reducing inflammation, clearing toxic proteins, and enhancing brain cell energy regulation.

**Impact:** Targets the root causes of [Alzheimer's and Parkinson's](#) (55 million affected globally). Shifts eldercare from late-stage symptom management to early-stage disease modification. \$55.7B market projected by 2031.




## Autonomous Biochemical Sensing


**Insight:** Moving beyond single-use tests to [continuous, self-sustaining telemetry](#) via wireless capability, energy harvesting, and microbial whole-cell biosensors.


**Impact:** Transforms reactive healthcare and environmental sampling into [proactive early-warning networks](#). Detects food toxins 1,000x more sensitively in under 60 seconds, drastically reducing global supply chain recalls.

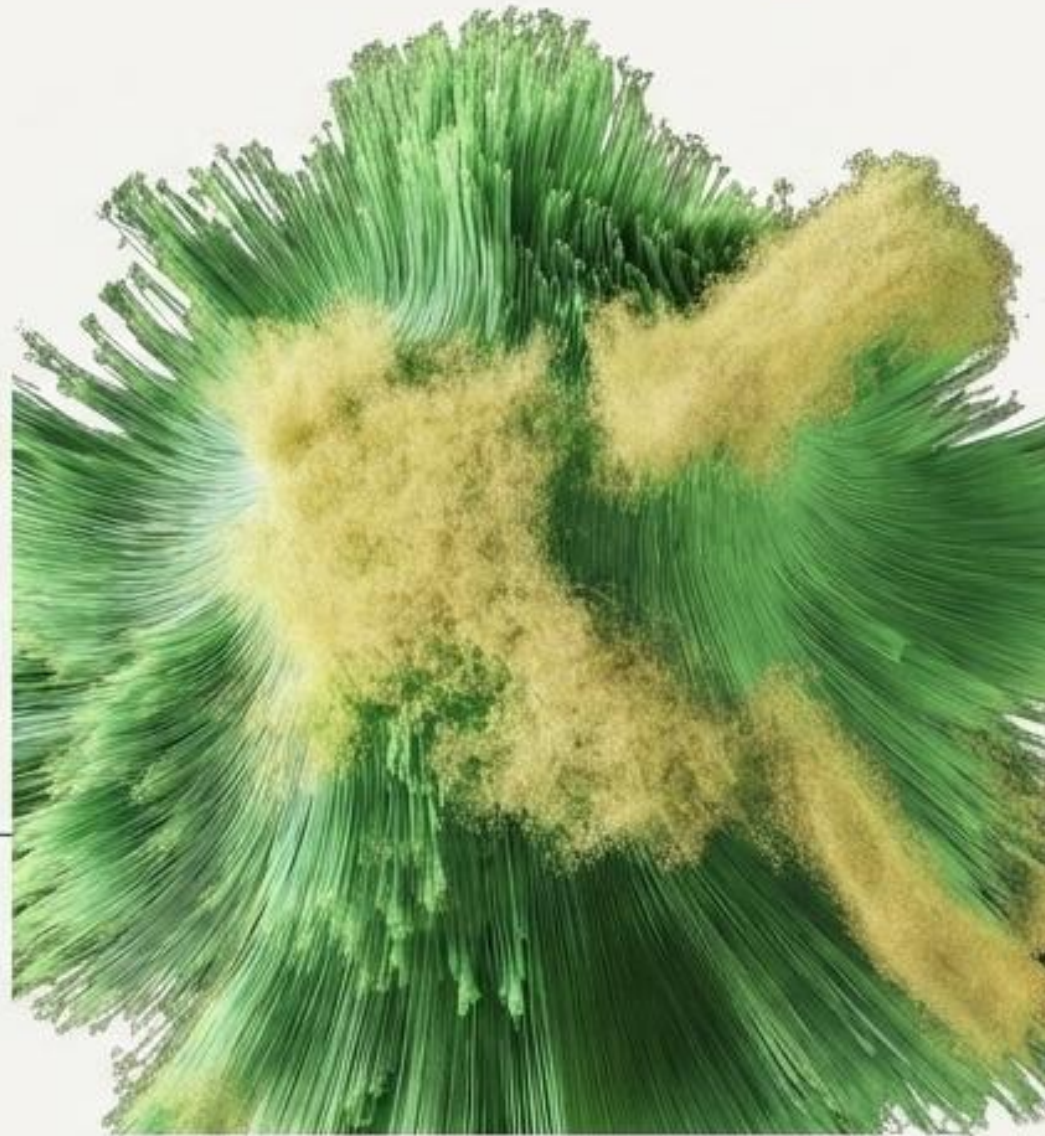
# Green Nitrogen Fixation: Decarbonizing the Foundation of Agriculture

## The Haber-Bosch Paradigm


 Requires Natural Gas + 400-500°C Heat + 150x Atmospheric Pressure


 Produces Centralized Ammonia

 Emits 2.4 tons CO2 per ton, consuming 1-2% of global energy.



## The Green Nitrogen Paradigm

 Requires Air + Water + Renewable Electricity (via Lithium-mediated electrochemistry or bio-engineered enzymes)

 Produces Decentralized Ammonia

## Strategic Impact

### Food Security

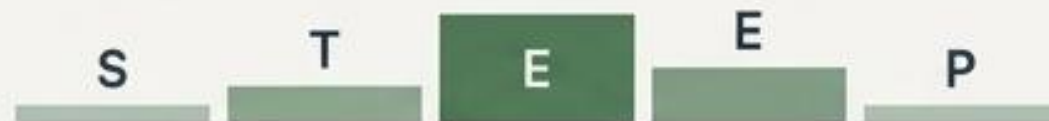
Empowers regions to produce fertilizer locally, breaking dependency on imported agricultural chemicals.

### Global Security

Ammonia is emerging as a versatile energy carrier with storage costs 30x lower than liquid hydrogen. Projected to comprise 30% of global

### Energy Transport

Ammonia is emerging as a versatile energy carrier with storage costs 30x lower than liquid hydrogen. Projected to comprise 30% of global marine fuel by 2050.



Economic viability is scaling fast, but efficiency parity with Haber-Bosch remains the primary technical hurdle.

# Nanozymes: Outperforming Nature's Catalysts

Nanozymes are laboratory-produced nanomaterials (metals, metal oxides, carbon) that mimic the catalytic properties of natural biological enzymes, but engineer away their fragility.

Dimension	Natural Enzymes	Nanozymes
Production Cost	High, requires complex biological synthesis	Low, highly scalable
Environmental Stability	Fragile, degrades outside narrow pH/temp ranges	Robust, operates in extreme pH and high temperatures
Catalytic Efficiency	Baseline biological limits	Up to 21x greater efficiency than biological counterparts

## Strategic Impact

- **Healthcare:** Targets tumor cells directly and kills 99.99% of drug-resistant bacteria in wounds without triggering microbial resistance.
- **Market Trajectory:** The global nanozyme market is projected to surge from \$5.13B in 2024 to \$57.95B by 2034.



# Collaborative Sensing: From Isolated Data to Autonomous Urban Systems



Moving from isolated sensors to Vehicle-to-Everything (V2X) ecosystems. Powered by 5G (enabling 0.1-meter accuracy with 99.9% reliability) and multi-modal edge AI, platforms dynamically share environmental context without human intervention.

## Urban Safety

Full V2X integration demonstrates up to a 77% crash avoidance rate for turning vehicles, and a 78% overall drop in collisions.

## Supply Chain Efficiency

Enables automated truck platooning, reliably reducing freight fuel consumption by 5-10%.

Technology



Economic



Heavily constrained by infrastructure needs; only 55% of the globe currently has baseline 5G access.

# Generative Watermarking: The Architecture of Digital Provenance

As synthetic media becomes indistinguishable from reality, invisible markers are shifting from optional safeguards to mandatory digital trust infrastructure, enforced by emerging global regulations with massive non-compliance penalties.



## How it Works (The Dual Mechanisms)

### Text-Based (e.g., SynthID)

Substitutes specific, narrow subsets of words randomly throughout a text. It appears perfectly natural to a human reader but leaves a distinct mathematical fingerprint visible to algorithms.

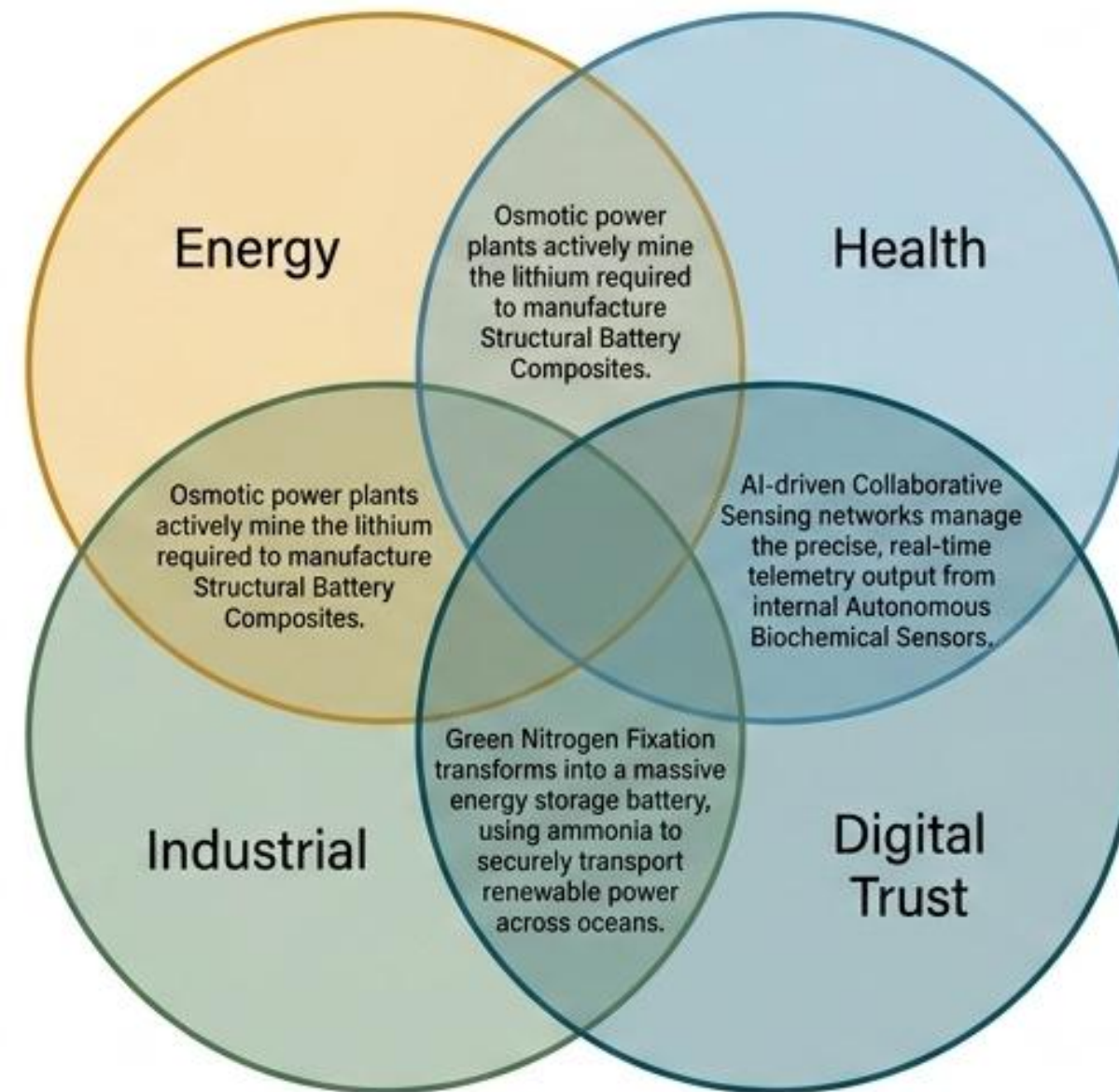
### Visual/Video (e.g., VideoSeal)

Introduces imperceptible pixel-level alterations that survive resizing, cropping, and compression algorithms.

## Strategic Impact

Establishing these standards is a race for platform dominance. The systems that successfully integrate with verifiable blockchain networks will shape the legal, financial, and insurance rules of the synthetic media economy.

# The Convergence Effect: Technologies Do Not Operate in Silos

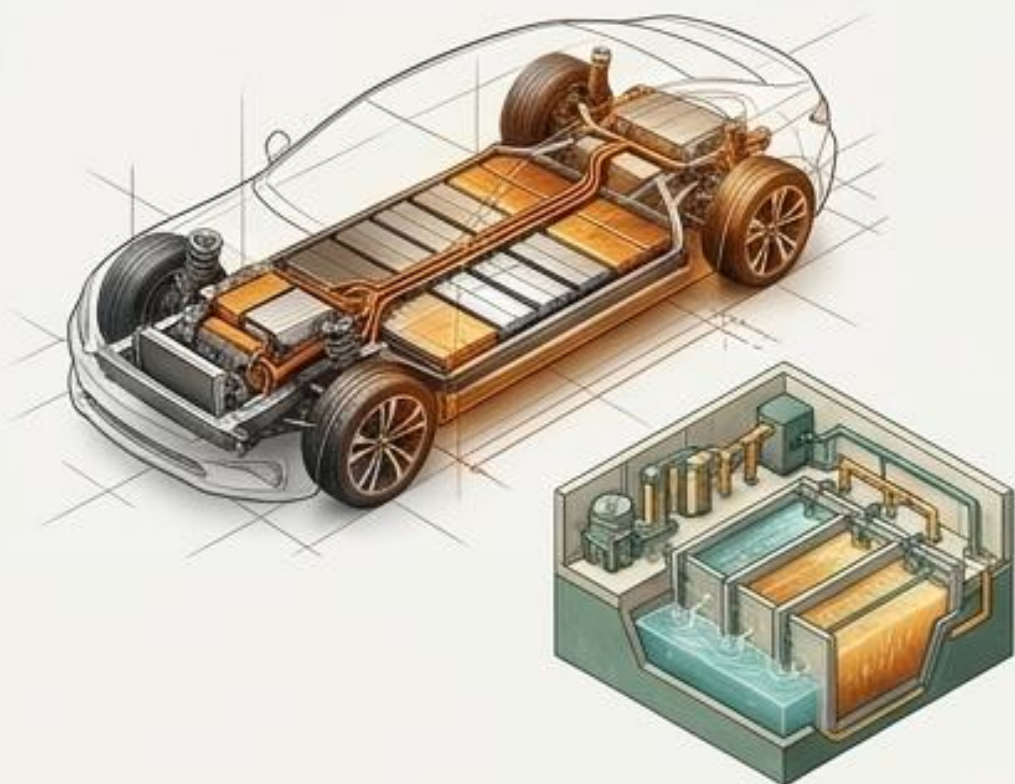


**The highest strategic value over the next decade lies not in owning a single technology, but in commanding the intersections where these domains overlap.**

# Strategic Imperatives for Leadership

## 1. Redesign for Dual Functionality

Stop building single-purpose infrastructure. Whether designing EVs (Structural Batteries) or water treatment plants (Osmotic Power), competitive advantage now belongs to assets that simultaneously generate energy and perform structural or industrial tasks.



## 2. Decentralize Critical Supply Chains

Leverage bio-manufacturing (Engineered Therapeutics) and renewable electrochemistry (Green Nitrogen) to move production directly to the point of need, breaking dependence on fragile, centralized global supply nodes.



## 3. Pioneer Regulatory Sandboxes

The readiness heatmap proves policy is the universal bottleneck. Leaders must proactively partner with bioethics and regulatory bodies to create controlled testing environments for living therapeutics and AI watermarking, rather than waiting for outdated laws to adapt.



The future belongs to those who view technology not as isolated tools, but as an integrated, *synthetic ecosystem*.