Resource Technology

Sector Definition and Framework

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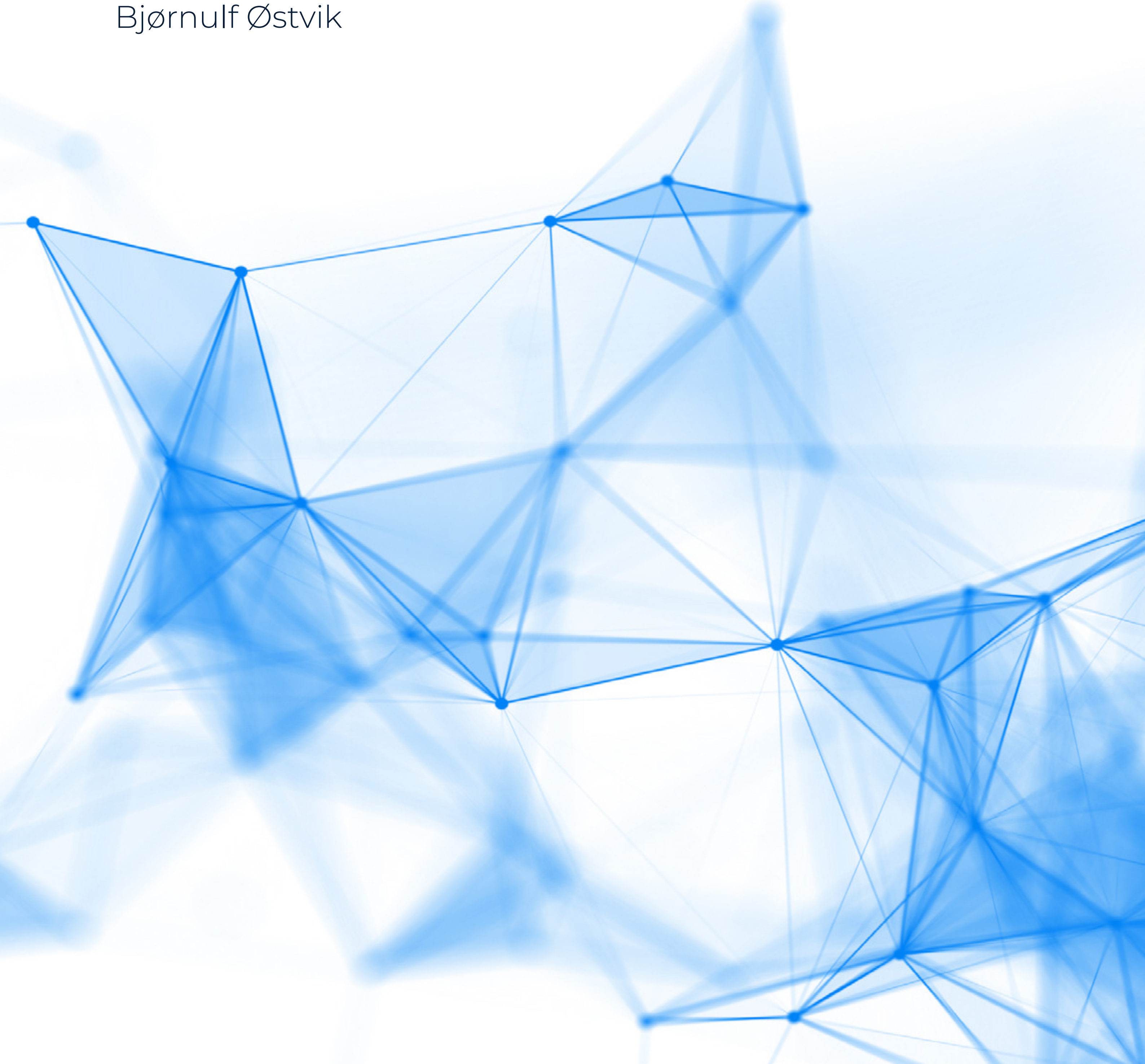

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Introduction

The Rise of Resource Technology

The global economy contains a system larger than finance, energy, or transportation — yet it has never been named as such. The flows of physical matter that underpin every industry — petroleum, chemicals, mining, metals, cement, timber, plastics, water — exceed $15 trillion annually today. But these flows are analyzed and financed through fragmented categories created by historical happenstance. The result is structural inefficiency on a multi-trillion-dollar scale: capital is misallocated, substitution pathways are overlooked, and resources are systematically under-optimized.

> ***Correctly framing this system is not just a matter of taxonomy — it is one of the largest unrealized opportunities for wealth creation and strategic advantage in the 21st century.***

Technology is rapidly transforming the industries that comprise the world's physical resource base and is altering fundamental structural assumptions. This convergence is driven by market-led innovation, not regulatory mandates, unlocking new value conventional and emerging feedstocks. Petroleum, for example, has long been viewed through the prism of energy and transportation demand. Yet between 2019 and 2024, 95% of oil demand growth came from petrochemicals, overwhelmingly as inputs for plastics. Forward growth in petroleum is overwhelmingly as a materials input, not as a fuel.

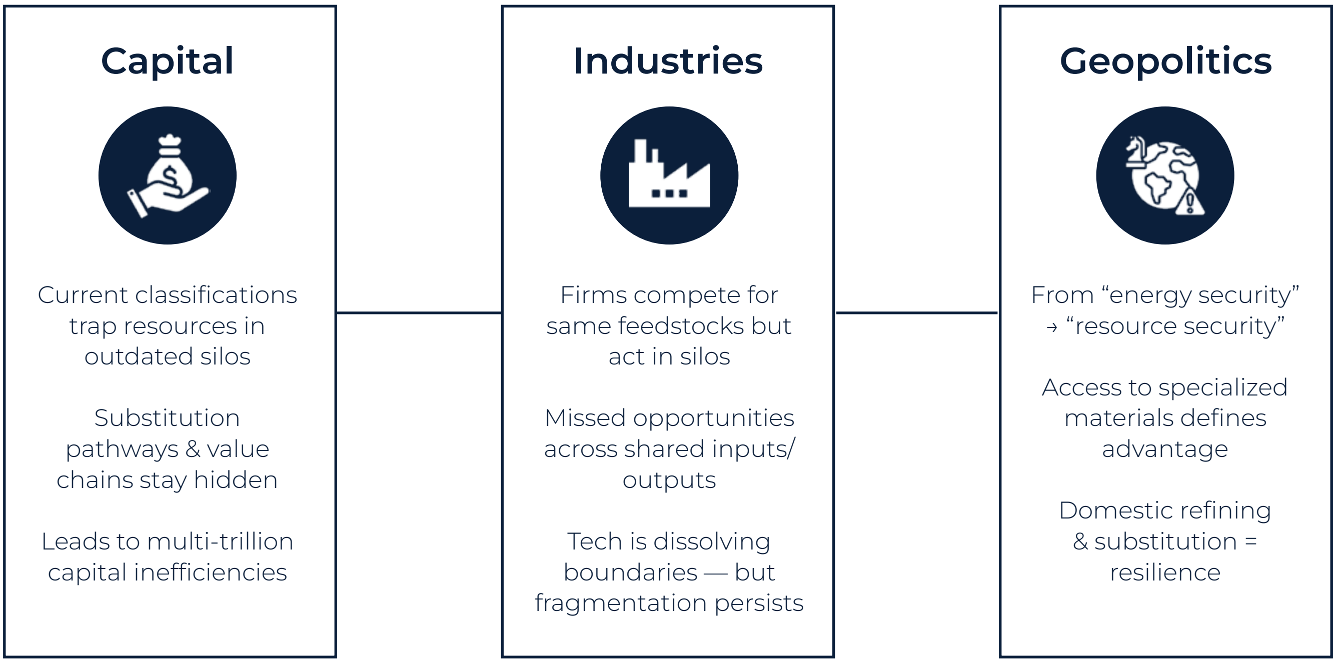
These shifts extend beyond feedstocks and reveal a broader system, as materials science and digital innovation reshape how resources are managed and transformed. The historic distinction between subsurface and surface carbon sources is rapidly fading as materials sciences advances enable new substitution pathways. Similarly, the unprecedented demand for rare earth minerals is driving shifts from not only new exploration toward necessary recovery and reuse. Equally critical, advances in conversion technologies are redefining how matter is upgraded across industries (e.g., electrochemical synthesis for battery materials or biocatalysis for polymers). Digital systems, like real-time traceability and decentralized resource registries, enable new investment opportunities by making material flows tradable and financeable, unlocking significant capital efficiency.

These are only illustrations, but they underscore a broader truth: structural shifts are underway that remain obscured until we recognize the common system uniting these industries. Doing so is not an exercise in terminology — it is the key to unlocking trillions in value creation, improving capital efficiency, and positioning both firms and nations for strategic advantage.

That system is Resource Technology (RT) — a term introduced here to describe the unified sector of physical matter flows. (The author, Bjørnulf Østvik, first began articulating this sector name in 2023–2024.)

Resource Technology (RT) = the sector that integrates feedstocks, processes, and systems to transform matter — whether extracted, grown, recovered, or synthesized — into higher-value materials, products, and fuels. It encompasses the industrial processes, enabling infrastructure, materials science and digital & market systems that together raise the productivity of matter and enable substitution, reuse, and reconfiguration at scale.

Recognizing Resource Technology as a sector reveals opportunities and risks that are invisible when these industries are treated in isolation — with major implications for **capital, industry,** and **geopolitics.**



Capital

Current sector classifications **lead market participants** — investors, analysts, and policymakers alike — to analyze resource flows through outdated silos. Petroleum is classified within energy, plastics are grouped under chemicals, cement within construction materials, waste within environmental services, and so forth. The absence of a coherent sector lens obscures substitution pathways, masks emerging value chains, and leads to persistent capital inefficiency across feedstocks, value chains, and technologies.

Industries

Operators that in practice compete for the same feedstocks rarely view themselves as part of one system. Oil, gas, and chemical producers; cement producers; timber companies; metals and mining firms; agricultural processors; and waste management and recycling businesses continue to make strategic decisions within their own verticals, missing opportunities to optimize across shared inputs and outputs. Most are unaware of how these industries relate—yet they are increasingly bound by a common thread: advances in process, materials, and data that make inputs and outputs fungible across sectors. The irony is that competition for the same feedstocks is intensifying even as organizational silos persist. This fragmentation imposes inefficiency and competitive weakness precisely when technological change is dissolving the boundaries between industries.

Geopolitics

What is often described as “energy security” is increasingly better thought of in the context of **resource security**—that is, reliable access to critical inputs (for example, semiconductors’ feedstocks such as high-purity silicon, SiC, and gallium; battery materials such as graphite and phosphates; rare earths; advanced polymers; and key construction materials). In the Second World War, advantage rested on rapid industrial mobilization, with raw materials secured through stockpiles, rationing, substitution (e.g., synthetic rubber), and global supply lines. Today, advantage turns on access to specialized materials and the processing, refining, and synthesis capabilities to produce and substitute them domestically—making a Resource Technology lens essential for economic and strategic resilience.

In short, defining Resource Technology as a sector brings clarity to one of the largest systems of the global economy and provides a framework for more efficient capital deployment, corporate strategy, and national resilience.

Resource Technology

Sector Scope and Boundaries

Scope (what RT covers)	Boundaries (what RT does not cover)
Feedstocks. Hydrocarbons; minerals/metals; timber/biomass; engineered inputs; recovered surface carbon and qualified industrial by-product streams — treated **feedstock-agnostically** where techno-economic substitution exists.	**Pure power generation and grid operations** (Energy sector), except where directly integral to a material conversion asset.
Conversion & synthesis. Thermal/chemical, electrochemical, biological, and hybrid pathways; plus materials processing/finishing (e.g., refining, calcination, polymerization, sintering, compounding).	**Environmental services** (compliance, remediation, or byproduct disposal)
Outputs. Fuels (when produced via material conversion), polymers/composites, structural materials (e.g., cement substitutes, steels/alloys), and functional/specialty materials.	**General logistics** not tied to material transformation or identity.
Enabling systems. Supply prep & dedicated logistics for transformation; storage/distribution tied to material identity; materials-science and processing/refining/synthesis capabilities; quality/traceability; market mechanisms (offtake, pricing, contracting).	**Retail/consumer services** (with no transformation/upgrading of material properties)
Return loops. Economically motivated reclamation, reprocessing, repolymerization, and remanufacturing that yield specification-grade inputs or higher-value product.	

Adjacencies

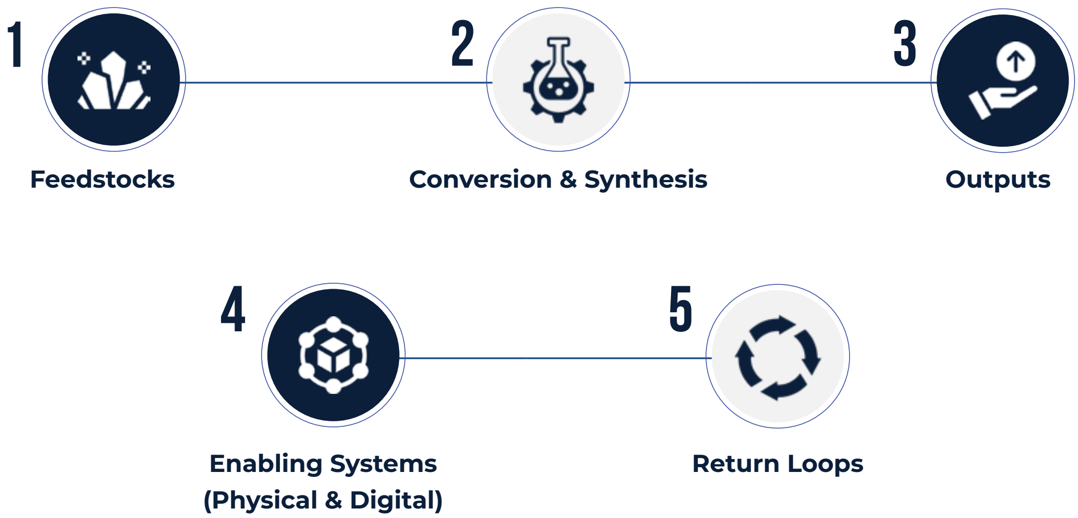
RT sits **parallel to Energy** (power flows) and interfaces with **Manufacturing/Construction—including Consumer Goods** (end-markets), **Transportation & Mobility** (lightweighting, batteries, composites), **Agriculture/Forestry** (biogenic feedstocks), **Defense/Space** (high-spec materials & supply assurance), and **Environmental Services & Resilience** (management of externalities and disaster debris; intersects with RT only when streams are upgraded into qualified feedstock).

Analytical unit. Matter is evaluated on **function-normalized economics:** \$/ton when mass governs, or **property-normalized** metrics (e.g., \$/kN load capacity, \$/m^2 at target stiffness, \$/kWh-lifetime)—not power.

Sector

Taxonomy

With scope and boundaries defined, the sector maps into **five core elements:**



1. Feedstocks (inputs of matter)

Hydrocarbons; minerals/metals (incl. critical minerals); timber/biomass; engineered inputs; recovered surface carbon and qualified industrial by-product streams—treated feedstock-agnostically where techno-economic substitution exists.

2. Conversion & Synthesis (transformations)

Thermal/chemical (e.g., cracking, gasification, calcination); electrochemical (e.g., electrolysis, molten-salt routes); biological (e.g., fermentation, enzyme/biocatalysis); hybrid integrated systems; materials processing/finishing (polymerization, sintering, compounding).

3. Outputs (usable matter)

Fuels (when produced via material conversion); polymers/composites; structural materials (cement substitutes, steels/alloys); functional/specialty materials (e.g., battery anodes/cathodes, engineered fibers/fillers, advanced ceramics).

4. Enabling Systems — Physical & Digital

- **Physical:** supply preparation & dedicated logistics for transformation; storage/distribution tied to material identity; materials-science and processing/refining/synthesis capabilities; process–energy integration (e.g., low-cost heat/power siting, co-generation, waste-heat utilization) where it shifts conversion economics.
- **Digital & Market Systems:** sensing/QA; digital identity & traceability for materials; registries; standardized contracts/offtake; marketplaces enabling aggregation and fungibility; settlement/risk products and other market infrastructure.

This layer links matter flows to capital formation by making materials identifiable, financeable, and tradable.

5. Return Loops (economics-driven)

Reclamation, reprocessing, repolymerization, and remanufacturing that yield specification-grade inputs or higher-value product where economics warrant.

Analytical

Foundations of Resource Technology

Foundational premises

- Matter is finite; demand is rising.
- Power increasingly decouples from matter (nuclear/solar/wind), shifting the constraint to materials availability and performance.
- The economy's base therefore has two flows: power (Energy) and matter (Resource Technology).

Sector principles

- **Feedstock-agnostic substitution:** technology enables hydrocarbons, minerals/metals, biomass, and engineered inputs to compete for the same outputs.
- **Materials-first economics:** value creation comes from configuring/upgrading matter, not combusting it.
- **Energy-separate but coupled:** energy prices/heat conditions set conversion economics; matter remains the object of analysis.

Implication: RT is not a relabel—it is the **unified industrial system** for managing the world's matter flows.

Illustrative Convergence Signals

Why the examples matter. Many of the signals below appear plant-level or "technical," which is precisely why they're often overlooked. Their effects are foundational: they reset feedstock choices, reconfigure asset footprints, and shift where margins accrue. For example, the shift to ethane-heavy steam cracking in the U.S. reduced propylene co-production and drove investment in on-purpose propylene (PDH) capacity. What reads as a process detail is, in practice, a supply-chain redesign that anchors incremental hydrocarbon demand in materials end-markets rather than fuels and opens new substitution pathways across feedstocks.

1. **Oil → Plastics:** U.S. ethane-heavy cracking reduced propylene co-production, triggering a build-out of on-purpose propylene (PDH) capacity—an upstream feedstock shift that rewired downstream assets.
2. **Coal → Olefins (CTO/MTO):** China converts coal to methanol, then to olefins (plastics). Coal competes with naphtha/ethane to make the same polymers.
3. **Ammonia's two markets:** The same NH_3 system is fertilizer and a maritime fuel/hydrogen carrier—shared molecules, diverging end uses, one infrastructure base.
4. **Phosphate:** Phosphate rock is a shared constraint for fertilizers and LFP battery cathodes—agriculture and batteries now draw from the same feedstock base.
5. **Graphite anodes from oil:** Synthetic graphite for batteries is made from petroleum needle coke—battery supply chains hinge on refining choices.
6. **Graphene/Carbon Fiber precursors:** Coal tar pitch (and other carbon-rich streams) can feed advanced materials—high-performance outputs from unexpected inputs.
7. **GaN/SiC vs silicon:** Power electronics increasingly use gallium nitride/silicon carbide; upstream gallium & silicon carbide supply becomes as strategic as chips.
8. **Cement substitutes as performance materials:** Calcined clays, slag, and other SCMs replace clinker—not "green talk," but strength/cost/performance optimization with new feedstocks.
9. **Engineered wood vs petrochem resins:** OSB/MDF adhesives (formaldehyde/phenolic resins) tie building materials directly to petrochemical monomers—construction depends on chem feedstocks.
10. **Methanol's many hats:** Methanol swings between fuel, chemical feedstock, and shipping fuel—one molecule, multiple markets, driven by relative feedstock economics.

Conclusion and Actions

The signals are already present; the technologies to unlock value are operating at plant scale. What has been treated as scattered industries is a single, investable system. The work now is to recognize the sector, standardize the measures, and align capital and strategy to the productivity of matter. Resource Technology is here.

What to do next

Capital
Create RT coverage, indices, and vehicles aligned to matter-flow economics.

Industry
Plan across shared feedstocks and substitution pathways, not vertical silos.

Policy
Build materials / security strategies anchored in RT metrics.

Resource Technology is the lens for matter-flow economics. Recognize it. Measure it. Allocate to it.

About the Author

Bjørnulf Østvik is an independent industrial strategist focused on energy, materials, and capital markets. He introduced the “Resource Technology” sector framing in 2023–2024 and writes the Resource Tech Edge series.

He is the founder of Ecogensus, a technology company that converts underutilized carbon-rich streams into fuels and engineered materials. Previously, he architected a new technology-and-markets organization at a major defense contractor. He is a named inventor on 100+ patents across G20 markets, founded and exited a water-focused engineering firm, and has published in economics and policy.

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Prepared in a personal capacity; views are the author’s own