



THE SUSTAINABLE SUPPLY CHAIN IMPERATIVE: A STRATEGIC WAKE UP CALL FOR PHARMA OPERATIONS

BUILDING THE BUSINESS, TECHNOLOGY, AND
MATURITY CASE FOR SCOPE 3 LEADERSHIP

Executive Summary

The pharmaceutical supply chain is under mounting pressure to deliver medicines efficiently while cutting its environmental footprint. For years, cost and sustainability were treated as competing priorities. That framing no longer holds, and the organizations still operating on it are the ones falling behind.

This revised edition builds on our original assessment of the problem and answers the four questions that matter most to a Board or CFO: What is the Infosys Consulting point of view, beyond restating industry data? Who has actually done this, and what did it cost them? What is the financial case, in numbers a CFO can defend? And which technologies deliver the outcome, deployed how, by whom, already?

We add seven things to the original paper: a distinctive point of view grounded in Infosys' own ESG research and enterprise sustainability practice; four publicly documented case studies from AstraZeneca, Novo Nordisk, Sanofi, and the MediLedger Network, each cited to primary sources; a financial business case built on published McKinsey, BCG EcoVadis, and Infosys Knowledge Institute research rather than internal assumption; a fully worked investment, savings, payback, and ROI scenario for an illustrative US\$5B revenue manufacturer; a five-stage sustainability maturity model that lets any organization locate itself and plan its next move; a "How Infosys Helps" section with a four-layer reference architecture mapping named Infosys platforms and pharma-specific assets to each stage of the

roadmap; and two anonymized Infosys client engagements, with the transferable lesson from each drawn out explicitly for a pharmaceutical context.

For readers who want the financial headline first: applying the published benchmark ranges in this paper to an illustrative US\$5B revenue manufacturer produces a three-year programme investment of approximately US\$25M against cumulative savings of approximately US\$85M a 3.4x gross return, payback at roughly month 20, and a Year-3 exit run-rate of approximately US\$63M per annum recurring, alongside an 18 22% Scope 3 reduction. The full model, with every assumption stated, appears in the Financial Business Case section.

The core diagnosis is unchanged and, if anything, more urgent: healthcare accounts for 4.4% of global greenhouse gas emissions, pharmaceutical supply chains account for 70 71% of that healthcare footprint, and Scope 3 supplier-side emissions outside a company's direct control makes up 79% of the industry's indirect emissions. What has changed is the evidence that acting on this is financially rational, not just reputationally prudent. BCG and EcoVadis, drawing on 133,000 supplier carbon scorecards, find that companies decarbonizing their supply chains generate a 3-to-6x return on that investment.[41] Separately, Infosys' own research across senior executives found that 90% report their ESG spending delivered moderate-to-significant financial returns, with two-thirds seeing that return within three years.[42] The business case and the sustainability case are, at this point, the same case.

The Problem: A Supply Chain Built for a Different World

The modern pharmaceutical supply chain was engineered for throughput, not sustainability. Decades of cost arbitrage, globalization, and just-in-time inventory logic have made it extraordinarily effective at moving molecules from synthesis to patient. By any credible environmental measure, that same architecture is extraordinarily costly to the planet.

Healthcare as a sector account for 4.4% of global greenhouse gas emissions enough, if healthcare were a country, to rank fifth in the world by output. Within that footprint, pharmaceutical supply chains carry a disproportionate share: an estimated 70 71% of all healthcare-sector emissions trace back to production, distribution, and the logistics infrastructure connecting them (ISPOR, 2023).[7]

A 2025 ScienceDirect study tracking global pharmaceutical GHG output between 1995 and 2019 found the industry's footprint grew 77% over that period nearly doubling within a generation.[2]

The composition of those emissions matters as much as their scale. My Green Lab's 2024 industry-wide Carbon Impact Report, drawing on data from 928 companies, confirmed that Scope 3 emissions represent 79% of indirect emissions in pharma; in some organizations, more than 90% of the total footprint sits with suppliers.[6] Internal decarbonization renewable energy, retrofitted facilities, optimized owned logistics is necessary but structurally insufficient on its own. The point of the problem is the supply chain itself.

The Numbers in Context

In 2019, the pharmaceutical industry produced approximately forty-nine tons of CO2 equivalent for every US\$1 million in revenue generated (ISPOR, 2023).[7] The global pharma GHG footprint grew 77% between 1995 and 2019, driven primarily by rising pharmaceutical expenditure in emerging markets and a stalling of efficiency gains after 2008 (ScienceDirect, 2025).[2] These are not projections they are the documented legacy of how the industry has been run.

Regulation is catching up. The EU's Corporate Sustainability Reporting Directive, effective from 2024, mandates comprehensive ESG disclosure including Scope 1, 2, and 3 emissions for large pharmaceutical companies and their EU-facing suppliers.[11] The US SEC has introduced parallel climate-disclosure requirements, and India's Business Responsibility and Sustainability Reporting framework is embedding similar expectations for listed pharmaceutical companies.[12] Ernst & Young's Global ESG Report puts 89% of pharmaceutical companies under mandatory ESG reporting in at least one major jurisdiction.[14] Voluntary sustainability reporting, as an era, is over.

Compliance on its own, however, is the wrong ambition. Companies that treat ESG as a reporting exercise rather than a strategic transformation will get neither competitive advantage nor meaningful environmental impact. The organizations gaining ground have understood a subtler point: the same supply chain interventions that cut carbon also cut cost, build resilience, and deepen supplier loyalty. The triple bottom line isn't a negotiated compromise between three goals it's a reconciliation of one.

The Infosys Consulting Point of View

Most of what has been published on pharma supply chain sustainability including the first version of this paper is strong on diagnosis and thin on a distinctive answer to "so what should a leadership team actually do differently on Monday." Our point of view, developed across enterprise sustainability engagements, is that pharma companies fail at Scope 3 not because the target is unclear, but because the capability sits in the wrong place.

ESG in most pharma organizations, still reports through a sustainability function with no authority over procurement contracts, capital allocation, or plant-level operating decisions the three levers that move Scope 3. Infosys' own cross-industry research found that 90% of senior executives report their ESG investment delivered moderate-to-significant financial returns, and 66% saw that return inside three years but the same research is explicit that returns depend on treating ESG as an operating-model change, not a reporting overlay.[42] Our broader work embedding sustainability into enterprise processes points to the same structural fix: organizations need a data backbone that makes supplier-level emissions visible at the product level, a process layer that turns that visibility into procurement and operational decisions, and an execution layer that acts on it without waiting for the annual ESG report to catch up.[44]

Applied to pharma supply chains specifically, this reframes the original paper's "three enablers" data infrastructure, supplier integration, embedded accountability from a list of good ideas into a sequencing problem. You cannot embed accountability into procurement incentives you cannot measure against; you cannot measure what your suppliers haven't disclosed; and you cannot get disclosure without a collaborative program, not an annual survey. That sequencing is what the maturity model in the next section makes explicit.

The second half of our point of view concerns pace. Boards continue to ask whether to move now or wait for standards, technology, and supplier readiness to mature further. The evidence says waiting is the more expensive option: BCG and EcoVadis find that fewer than 10% of companies assessed on their platform currently have Scope 3 reduction targets in place, which means the 3-to-6x ROI on early decarbonization action is currently being captured by a small minority of first movers.[41] In a sector facing CSRD, SEC, and BRSR disclosure deadlines simultaneously, first-mover advantage in supplier data infrastructure is also a compliance advantage the two are no longer separable.



The Sustainability Maturity Model

Academic and industry maturity models for supply chain sustainability consistently structure progress around the same underlying question: has sustainability moved from a reporting activity into an operating capability?[46][48] We have adapted that literature into a five-stage model calibrated specifically to pharma supply chains, mapped against the three enablers introduced above data infrastructure, supplier integration, and embedded accountability.

Infosys Consulting Pharma Supply Chain Sustainability Maturity Model

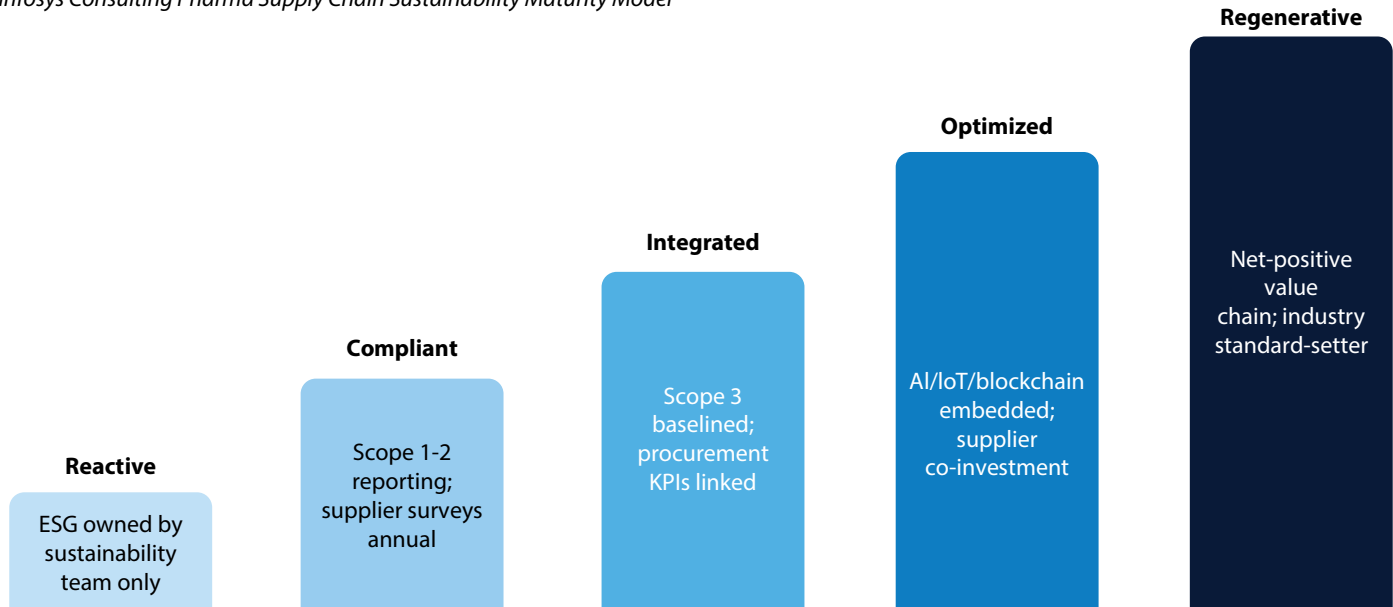


Figure 1. Infosys Consulting Pharma Supply Chain Sustainability Maturity Model adapted from published supply chain maturity model research.[46][47][48]

Stage	Data Infrastructure	Supplier Integration	Embedded Accountability
1. Reactive	No product-level emissions data; annual CSR report only	Ad hoc supplier surveys, low response rates	ESG owned solely by sustainability team
2. Compliant	Scope 1 2 tracked; Scope 3 estimated using spend-based averages	Top suppliers asked to disclose via EcoVadis or equivalent	ESG reporting mandated but not linked to incentives
3. Integrated	Product carbon footprints baselined for top 20 suppliers by spend	Joint improvement plans with top 10 suppliers by spend	Procurement scorecards include a carbon or ESG criterion
4. Optimized	AI/IoT/blockchain embedded into planning, cold chain, and traceability	Co-investment in supplier renewable energy and process upgrades	Capital allocation and executive compensation linked to Scope 3 KPIs
5. Regenerative	Real-time, audited, product-level carbon visibility across tier 1 2	Suppliers treated as strategic partners in shared decarbonization economics	Company publishes independently verified Scope 3 data and shapes industry standards

Model adapted by Infosys Consulting from published supply chain sustainability maturity model research and industry practice.[46][47][48]

Most large pharmaceutical companies we observe in the public record sit at Stage 2 or the early part of Stage 3: Scope 1 2 performance is strong and well-reported, supplier engagement exists but is survey-based rather than collaborative, and accountability has not yet moved into procurement or capital planning. AstraZeneca and Novo Nordisk, profiled below, are among the clearest public examples of organizations operating at Stage 3 moving into Stage 4. No pharmaceutical company we are aware of has publicly reached Stage 5. That gap is the opportunity this paper is about.

Leading Practice: What Stage 3 4 Actually Looks Like

The following four examples are publicly documented, independently reported initiatives at named pharmaceutical and life sciences organizations. We use them here as industry benchmarks illustrating what the maturity stages above look like in practice, not as Infosys Consulting client engagements.

AstraZeneca Ambition Zero Carbon

Maturity stage: 3 → 4 | Focus: Own operations decarbonization plus supplier engagement at scale

Launched in 2020, Ambition Zero Carbon targets a 98% reduction in Scope 1 2 emissions by 2026 against a 2015 baseline; by the end of 2024 the company had achieved a 77.5% reduction.[22] The company has invested up to \$1 billion in the programme including \$175 million specifically in natural-resource efficiency projects since 2015 and has moved 97% of its electricity consumption to renewable sources.[21][23]

The more relevant part for a Scope 3 strategy is the supplier layer: AstraZeneca has set a goal that 95% of its key suppliers and partners hold verified science-based targets, and it uses CDP Supply Chain membership to gain consistent, comparable visibility into supplier-level emissions rather than relying on each supplier's self-reported totals.[24] "Our Scope 3 footprint is more than 20 times greater than our Scope 1 and 2 footprint," notes Jenny Perrie, AstraZeneca's Scope 3 lead, "and our ambitions will only be achieved through close collaboration with our supply chain partners." [24]

Sources: AstraZeneca Sustainability Data Annex 2024; AstraZeneca UK; Ambition Zero Carbon Infographic 2023; CDP.[21][22][23][24]

Novo Nordisk Circular for Zero and Suppliers for Zero

Maturity stage: 3 → 4 | Focus: Circular design plus structured supplier decarbonization

With more than 95% of its environmental impact sitting in its supply chain and over 60,000 suppliers globally, Novo Nordisk built its Circular for Zero strategy around eliminating waste at the design stage rather than treating it after the fact including PenCycle and ReMed take-back programmes addressing roughly 600 million injection pen devices produced annually.[27][28]

In 2025 the company extended this into Suppliers for Zero, a structured programme spanning climate, nature, and plastics that does not impose uniform requirements but instead builds joint improvement plans with suppliers and CMOs ready to commit to Novo Nordisk's environmental priorities, supporting a targeted 33% Scope 3 reduction by 2033 en route to net zero by 2045.[25][26] "With more than 95% of our environmental impact coming from our supply chain, working closely with our suppliers and CMOs is essential," said Dorethe Nielsen, Novo Nordisk's VP for environment, nature, and climate.[25]

Sources: Novo Nordisk corporate disclosures; Sustainability Magazine; The Sustainable Innovation; Copenhagen Life Science.[25][26][27][28]

Sanofi AI-Driven Demand and Supply Planning

Maturity stage: 4 | Focus: AI embedded directly into planning operations

Sanofi's internally built "plai" platform, originally deployed for R&D use cases, was extended into biopharma supply chain planning, where it analyzes global inventory, production schedules, and demand signals to flag looming shortages before they occur predicting roughly 80% of low-inventory positions ahead of time. [35] Kartik Pant, Sanofi's Head of Data & AI for Manufacturing & Supply Chain, oversees a portfolio of more than 15 AI applications across the function with an estimated cumulative operational impact exceeding \$200 million.[36]

The relevant lesson for other pharma organizations is architectural rather than algorithmic: Sanofi's gains came from building a supply chain control tower that unifies demand signals, inventory position, and product flow into one view, then layering predictive and generative AI on top not from a single point forecasting tool bolted onto an existing planning process.[36]

Sources: Sanofi corporate disclosures via Intuition Labs; Emerj AI Research interview with Sanofi leadership.[35][36]

MediLedger Network Blockchain for Track-and-Trace Compliance

Maturity stage: 3 (compliance-driven, scaling toward 4) | Focus: Cross-industry consortium infrastructure

MediLedger is a permissioned blockchain network formed by a consortium of pharmaceutical manufacturers, distributors, and dispensers to meet the US Drug Supply Chain Security Act's interoperability requirements, which reached final enforcement in November 2024.[31][34] Its FDA-reviewed pilot project concluded that a well-designed, industry-led blockchain platform could meet the required transaction throughput, speed, and cost efficiency, using shared data standards that let trading partners verify products without exposing proprietary business data to competitors.[29][33] By late 2024, the network's manufacturer participants represented roughly 80% of US prescription drug volume, according to industry reporting.[34]

MediLedger is instructive precisely because it started as a narrow compliance solution saleable returns verification and expanded from there once the underlying trust infrastructure was in place, evidence for the point made earlier: compliance investment and commercial capability are not separate budgets when the underlying data architecture is designed correctly.[30]

Sources: FDA MediLedger DSCSA Pilot Project Final Report; PR Newswire; PMC; Wireless-Life Sciences Alliance; ColdChainCheck.[29][31][32][33][34]

Emerging Technology: Implementation, Not Just Intention

AI, IoT, and blockchain appear in almost every pharma sustainability paper, usually as a bullet list of buzzwords. The case studies above show three specific, already-proven applications. This section sets out how each is implemented and what it delivers, so the roadmap in the next section can sequence them correctly rather than attempting all three simultaneously.

AI for demand forecasting and inventory optimization

Implementation approach: the pattern that works, based on Sanofi's build-out, is to first establish a unified data layer inventory, production schedule, and demand signal in one place before introducing predictive models. Point-solution forecasting tools deployed on top of fragmented data consistently underperform. The second step is a phased rollout: pilot on one product line or therapeutic area, validate forecast accuracy against the legacy method, then extend the control tower across the portfolio.

Benefits observed: industry reviews of pharma AI deployments report 25-30% reductions in forecast error compared with legacy statistical methods, and elimination of up to 80% of previously unavoidable stockouts in pilot deployments.[45] Organizations with the most digitally mature, AI-enabled planning functions report inventory levels averaging 35% lower alongside 15% lower logistics costs, without a reduction in service levels.[45] Lower inventory and fewer emergency shipments both translate directly into avoided waste and avoided emissions the same lever serves the cost case and the carbon case simultaneously.

IoT for cold chain integrity

Implementation approach: Pfizer's COVID-19 vaccine distribution requiring continuous -70°C integrity is the clearest large-scale reference case. The company paired GPS-enabled thermal sensors from IoT partner Controlant with a central control tower, giving real-time visibility into location and temperature for every shipment, 24 hours a day, and partnered with UPS, DHL, FedEx, and Marken to execute multimodal distribution at pace.[37][38][39] The approach generalizes: instrument high-value, temperature-sensitive shipments first, route sensor data

into a control tower with defined excursion thresholds, and build the alerting logic to trigger intervention before product is compromised rather than after.

Benefits observed: the World Health Organization estimates that cold chain failures cause up to 25% of vaccines worldwide to be wasted, and UNICEF data suggests more than 37% of vaccines in some regions arrive with reduced potency.[40] Real-time IoT monitoring converts this from an after-the-fact write-off into a preventable event the difference between discovering spoiled product on arrival and rerouting or re-icing a shipment mid-transit.

Blockchain for traceability and compliance

Implementation approach: MediLedger's build-out is the template for a multi-party pharma blockchain start with a single, well-defined compliance requirement (in this case, DSCSA saleable-returns verification), build the network as a consortium with shared governance rather than a single company's proprietary system, and use a permissioned architecture with privacy-preserving verification so competitors can transact on shared infrastructure without exposing commercial data.[30][32] Only after that trust layer is proven does the network scale into broader use cases.[30]

Benefits observed: a shared, tamper-evident verification layer that lets a trading partner confirm product authenticity in near real time rather than through a manual, multi-day trace-back investigation; a system architecture that raises the cost of introducing counterfeit product into the legitimate supply chain; and once the network exists reusable trust infrastructure that could, in principle, carry supplier emissions data with the same integrity guarantees it currently applies to product provenance.[30][32]

The sequencing implication for the roadmap below: AI and IoT deliver measurable value within a single fiscal year and largely self-fund through waste and cost reduction; blockchain requires multi-party governance and is best pursued through an existing industry consortium (such as MediLedger) rather than built proprietary, unless the organization has scale to anchor a network on its own.

The Financial Business Case

The original paper asserted that sustainability and cost reduction are reconcilable. This section quantifies that claim using published, independently sourced figures rather than internal assumptions, so the numbers can be defended in a capital allocation committee without a caveat.

What investment requires

McKinsey's assessment of API manufacturing decarbonization finds that roughly 5-10% of total emissions can be cut through process-efficiency measures such as heat integration to reduce energy waste that are cost-effective and regulation-compliant with limited capital outlay.[43] The same analysis estimates that API manufacturers can reduce approximately 90% of total emissions by 2040 through a full sequence of decarbonization levers, but notes that fewer than 20% of manufacturers currently have implementation plans that account for abatement cost and feasibility trade-offs most have only set targets.[43] The gap between target-setting and funded implementation plan is, in our experience, the single most common reason Scope 3 programmes stall after a strong public launch.

What the return looks like

BCG and EcoVadis's Carbon Action Report 2025, built on 133,000 carbon scorecards across 83,000 companies, finds that early supply chain decarbonization measures can be pursued at low net cost while delivering 3-to-6x returns on the initial investment driven primarily through supplier engagement, longer-term low-carbon contracts, and targeted co-investment in supplier abatement projects.[41] Separately, Infosys Knowledge Institute research across senior executives globally found that 90% report their ESG investment delivered moderate-to-significant financial return, with 66% of respondents realizing that return within three years.[42]

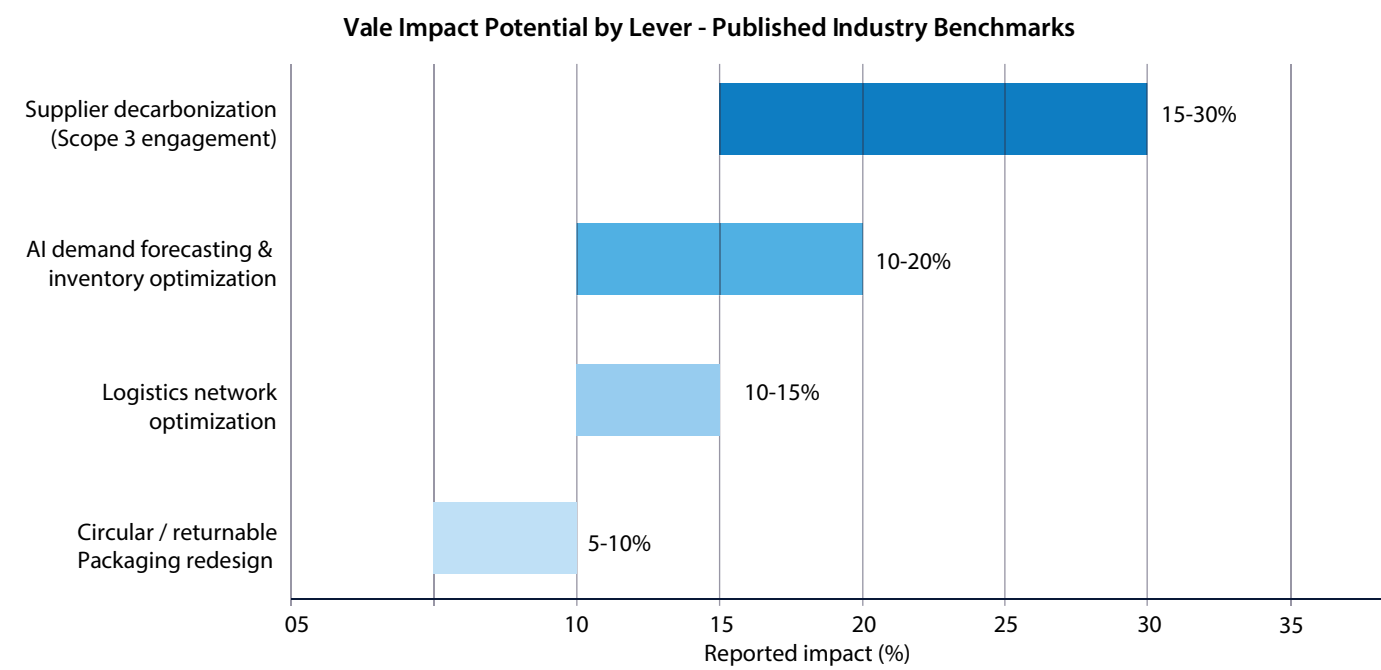


Figure 2. Reported impact ranges by lever, based on published industry case data.[3][17][41][45]

How the levers differ in payback profile

Not every lever pays back on the same timeline and treating them identically is a common planning error. Circular packaging redesign and AI-driven inventory optimization are typically self-funding within 12-24 months, because the savings come from waste and overproduction the company was already paying for. Logistics network optimization sits in a similar window. Supplier decarbonization is different: it carries the largest potential impact (15-30% of Scope 3, per published case data) but frequently requires co-investment shared financing of supplier-side renewable energy or process upgrades because the abatement cost sits on the supplier's balance sheet, not the

buyer's.[41] Sequencing the self-funding levers first builds the internal credibility and cash flow to fund the harder, higher-impact supplier work later.

Quantified scenario: what this looks like on a P&L

Ranges are useful for orientation but insufficient for capital requests. The model below applies the published benchmark ranges above to a single illustrative organization so that investment, savings, payback, and ROI can be examined as a coherent set of numbers rather than four disconnected statistics. It is a worked example built from public benchmarks, not a client result the assumptions are stated explicitly so any leadership team can substitute its own baselines.

Illustrative Case Parameters

Global pharmaceutical manufacturer. US\$5B annual revenue; COGS approximately 30% of revenue; roughly 2,000 tier-1 suppliers; inventory carried at approximately 16% of revenue; logistics spend approximately 4% of revenue; packaging spend approximately US\$90M annually. Organization assessed at Maturity Stage 2 at programme start, targeting Stage 4 by month 36.

Investment profile (three-year programme)

Investment area	Investment area	Investment (US\$M)
1. Diagnose & Baseline (0 6 mo)	Scope 1 3 emissions mapping, PCF baselining to PAS 2090, EcoVadis audit of top 20 suppliers, ESG data platform stand-up	2.5
2. Redesign & Pilot (6 18 mo)	AI demand forecasting deployment (one business unit), IoT cold chain instrumentation, circular packaging pilot, SBTi target validation	8.0
3. Scale & Embed (18 36 mo)	Portfolio-wide rollout, supplier co-investment fund, blockchain traceability onboarding, internal carbon pricing mechanism	14.5
Total	Three-year programme investment	25.0

Investment phasing aligned to the roadmap in this paper. Illustrative allocation for a US\$5B revenue organization.

Savings profile at steady state

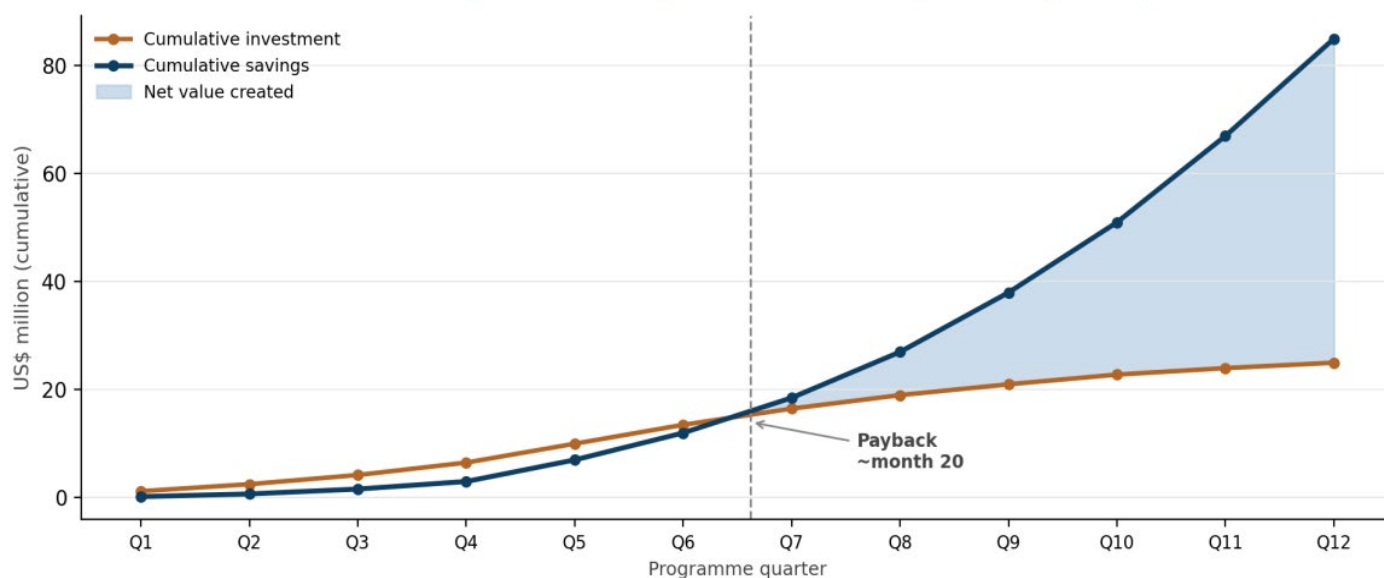
Value lever	Mechanism	Benchmark applied	Year-3 run-rate (US\$M)
Inventory optimization	AI demand forecasting reduces safety stock and expedites freight	10 20% inventory reduction [45]	16.0
Waste & overproduction	Reduced destruction of expired and obsolete inventory	Overproduction 4.5% → 3.0% of COGS	18.0
Logistics optimization	Network redesign, consolidated lanes, modal shift	10 15% logistics cost reduction [3]	15.0
Cold chain excursion loss	IoT monitoring enables in-transit intervention before spoilage	20 25% reduction in excursion write-offs [40]	7.5
Circular packaging	Returnable transport items, reduced material weight	5 10% packaging cost saving [3] [17]	6.3
Total	Recurring annual benefit at Year-3 exits run-rate	—	62.8

Each lever applies a published benchmark range to the illustrative baseline above. Conservative end of each range used where ranges are wide.

Resulting financial case

Metric	Value	Note
Three-year investment	US\$25.0M	Phased per roadmap; front-loaded on data foundation
Cumulative three-year savings	US\$85.0M	Ramped: ~US\$3M Year 1, ~US\$24M Year 2, ~US\$58M Year 3
Net three-year benefit	US\$60.0M	Cumulative savings less cumulative investment
Gross ROI (three-year)	3.4x	Within the 3 6x range reported by BCG EcoVadis[41]
Payback period	~20 months	Crossover during Phase 2 pilot scale-up
Year-3 exit run-rate	US\$62.8M p.a.	Recurring, before Phase 4 portfolio effects
Scope 3 emissions reduction	18 22%	Within the 15 30% supplier decarbonization band [41]

Illustrative Investment vs. Savings Profile — US\$5B Revenue Pharma (3-Year Programme)



Illustrative model. Assumptions and benchmark sources shown in accompanying table — not actual client results.

Figure 3. Illustrative cumulative investment against cumulative savings, showing payback crossover at approximately month 20.

Two features of this profile matter more than the headline multiple. First, the curve is deliberately unflattering in Year 1: a programme that baselines properly before deploying technology will show cost with little return for four to six quarters, and leadership teams that are not prepared for that shape tend to cancel the programme precisely when the foundational work is nearly complete. Second, the savings curve steepens rather than plateaus, because each phase compounds on the data and supplier relationships established by the previous one which is why the sequencing discipline, not the technology selection, is the primary determinant of whether the 3.4x is achieved or missed.

The honest caveat: these are ranges drawn from published aggregate industry data, not a guarantee for any specific organization. Actual results depend heavily on current maturity stage (see the model above), baseline data quality, and the strength of supplier relationships. A Stage 2 organization attempting a Stage 4 initiative say, supplier co-investment without first having product-level emissions data should expect materially worse returns than the ranges cited here, which is precisely why the maturity model and the phased roadmap exist as a sequencing discipline, not a menu.

Three Tensions the Industry Must Resolve

1. Cost: The Efficiency Myth

The most persistent barrier to sustainable supply chain transformation in pharma is the belief that green operations are inherently more expensive. Some initiatives clean energy adoption, green chemistry, sustainable packaging does require upfront investment, but this view misreads the long-term economics.

At scale, sustainable models tend to reduce costs rather than increase them. Circular designs, where waste is minimized, materials are reused, and reverse logistics is built in from the outset, outperform linear models over time. Closed-loop packaging in cold chain logistics lowers per-shipment cost once return infrastructure exists; predictive demand analytics cuts both overproduction and the cost of destroying expired inventory. Digital transformation reinforces the same advantage AI-driven inventory optimization, IoT-enabled cold chain monitoring, and blockchain-based traceability reduce waste and manual verification overhead simultaneously, as the case studies above demonstrate directly.

2. Care: Patient Access Is Not Negotiable

Any sustainability framework that increases drug shortages, reduces product quality, or raises the cost of essential medicines to patients has failed not despite being sustainable, but because of how it was implemented. This is the most important guardrail in the conversation, and the industry has, at times, been right to invoke it.

The NHS estimates that medicines account for 25% of its total carbon emissions. A naive decarbonization approach might target that figure by cutting procurement volumes or switching to lower carbon but clinically inferior formulations. The correct approach optimizes the supply chain delivering those medicines reducing cold chain energy consumption, eliminating unnecessary transportation legs, redesigning packaging to cut material

weight, and shifting toward suppliers with demonstrably lower manufacturing emissions, without touching clinical formulation or availability.

The Sustainable Markets Initiative Health Systems Task Force, formed at COP26 with AstraZeneca, GSK, Novo Nordisk and others, released joint minimum climate and sustainability targets for suppliers in 2023, designed explicitly to drive decarbonization without compromising patient access.[9] That is the model collaborative, science-based, and patient-centered from the outset.

3. Carbon: Where the Real Opportunity Lies

Of the twenty largest pharmaceutical companies, nineteen have committed to GHG reduction; ten have set carbon neutrality targets and eight are pursuing net zero between 2025 and 2050 (SCI Chemistry & Industry, 2024).[8][1] Progress on Scope 1 and 2 has been real six of those companies cut Scope 1 emissions by more than 20% from baseline, and eight cut Scope 2 by more than 30%.[8] But these gains address, at most, 21% of the industry's total emissions footprint. The 79% sitting in Scope 3 remains where most companies have made the least structural progress.

Three named industry initiatives are working to close that gap: Converge, engaging suppliers on renewable energy adoption; Activate, working with manufacturing partners on operational efficiency; and Energize, focused on sustainable laboratory practices across R&D supply networks.[13] The GLEC Framework and the emerging PAS 2090 pharma-specific standard are giving procurement teams the tools to demand supplier-level emissions transparency not a supplier's self-reported total, but a product carbon footprint traced to the specific materials and processes generating it. That granularity, combined with the AI, IoT, and blockchain infrastructure described above, is what makes Stage 4 and 5 maturities achievable rather than aspirational.



The Impact Framework: From Commitment to Capability

Sustainable transformation requires moving from commitments to capabilities. The three enablers below introduced earlier as the structural logic behind the maturity model determine whether that move succeeds.

Data infrastructure granular, product-level carbon visibility. Collecting and validating emissions data at the supplier and product level is the foundational requirement; nothing downstream works without it.

Supplier integration is moving from transactional relationships to strategic partnerships. Decarbonization is a collaborative endeavor, not a compliance exercise; every study above confirms

that partners outperform auditors.

Embedded accountability ESG baked into procurement, operations, and capital allocation. Sustainability that lives only in the ESG team will not transform the supply chain, regardless of how well-resourced that team is. Organizations that build these three capabilities early create structural advantage not because they emit a press release sooner, but because supplier relationships, data infrastructure, and internal procurement processes all take years to mature and cannot be compressed under regulatory deadline pressure.

How Infosys Helps

The preceding sections set out what needs to happen and what it is worth. This section sets out the capability required to execute it, and where Infosys brings assets that shorten the path. The distinction matters because the constraint in most Scope 3 programmes is not strategic clarity, it is the absence of a data foundation capable of supporting supplier-level decisions, and the absence of an operating model that acts on that data once it exists.

Infosys’ position on this is not purely advisory. The firm reached carbon neutrality in 2020, thirty years ahead of the 2050 timeline embedded in most corporate commitments, and now brings that operational experience to client engagements alongside technology delivery.[49][54] Sustainability capability is supported by more than fifteen Centers of Excellence and over 120 global

sustainability certifications including GRI, GHG Protocol, LEED, and TCFD.[50] Constellation Research has assessed Infosys as delivering a wide range of ESG capabilities across the sustainability services portfolio.[52]

Reference architecture

The architecture below organizes the capability set into four layers. It is deliberately structured bottom-up: each layer is a precondition for the one above it, which maps directly onto the maturity model and the phased roadmap set out earlier in this paper. An organization cannot operate the Intelligence Layer without the Data & Traceability Layer beneath it, which is the technical restatement of why Stage 4 initiatives fail when attempted from Stage 2.



Figure 4. Infosys Consulting reference architecture for sustainable pharma supply chain transformation, mapped to named Infosys platforms and assets.[49][50][51][53][55][56][57]

Capability mapping by layer

Layer	What it delivers	Infosys assets applied
Foundation	Cloud platform, ERP and SAP integration, supplier master data and onboarding, security and data residency	Infosys Cobalt (cloud services, solutions and platforms); Digital Supply Chain; SAP and Oracle ecosystem practices [51][53]
Data & Traceability	Product-level carbon footprints to PAS 2090, tier 1 2 supplier emissions data, serialization and track-and-trace, IoT cold chain telemetry	Infosys Pharma Supply Chain Distributed Application (pre-configured blockchain network for pharma track-and-trace); Serialization Track & Trace Solution Suite with SAP ATTP accelerators; IoT Services [55][56][57]
Intelligence	AI demand forecasting, network and route optimization, supplier emissions analytics, cold chain excursion prediction	Infosys Topaz (AI-first offering using generative AI); Applied AI; Infosys Sustainability Cloud, powered by Cobalt and Topaz [50] [51][58]
Value & Governance	CSRD, BRSR and IFRS S1 S2 aligned disclosure, internal carbon pricing, procurement scorecards, board-level KPI reporting	Infosys Consulting ESG and sustainability advisory; assessment and benchmarking methodology; Supply Chain Advisory [49] [52][54]

Capability mapping compiled from Infosys published service and platform documentation.[49] [58]

Where the pharma specificity sits

Generic sustainability tooling stops being useful at the point where pharma-specific constraints begin GxP validation, serialization mandates, cold chain integrity, and the patient-access guardrail set out earlier in this paper. Two assets are directly relevant. The Infosys Pharma Supply Chain Distributed Application is a pre-configured blockchain-powered network built specifically for pharmaceutical supply monitoring, establishing package-level provenance for specialty drugs and supporting targeted inventory and recall management.[55] The Infosys Serialization Track & Trace Solution Suite provides accelerators for SAP ATTP configuration and migration, with pre-designed solution architecture and ready-to-use regulatory reporting templates.[57] Both matter for the Scope 3 argument in this paper for the reason established in the MediLedger case study: the traceability infrastructure built for compliance is the same infrastructure that can subsequently carry supplier emissions data at product-level granularity.

Supporting this is the Infosys Life Sciences Centre of Excellence, whose regulatory and research work spans the serialization frameworks of Argentina, Brazil, China, the EU, France, India, South Korea, Turkey, and the United States the jurisdictional spread that a global pharmaceutical supply chain has to satisfy simultaneously. [56] On the supplier side, Infosys' Sustainable Supply Chain solution set includes an Ethical Supplier Network and sustainable sourcing offerings aimed at building transparent and circular supply chains rather than assessing them retrospectively.[53]

Infosys in practice: two client engagements

The case studies earlier in this paper are industry benchmarks publicly reported initiatives at AstraZeneca, Novo Nordisk, Sanofi, and across the MediLedger consortium. The two engagements below are different: they are Infosys client deliveries, published by Infosys in anonymized form. Neither client is a pharmaceutical manufacturer; both are included because the capability problem they solved is the same one this paper argues sits at the centre of pharma's Scope 3 challenge, and because the transferability is specific rather than rhetorical.



Engagement 1 Scope 3 visibility across 10,000+ suppliers

Client: a global equipment provider in the north-eastern United States, published anonymously by Infosys.[50]

The problem: the organization could not audit or see commodity-level emissions across a supplier base exceeding 10,000 suppliers and 1,500 commodities and relied on manual processes to identify and track supplier emissions precisely the condition this paper describes as Maturity Stage 2.

What Infosys delivered: a digital GHG platform on Infosys Sustainability Cloud that aggregated high-volume supplier and product-level transaction data, automated collection through a digital Product Carbon Footprint survey, applied data quality and authenticity checks, and established a systematic, auditable framework for engaging suppliers at scale.

Outcome: emissions data systematically collected from more than 10,000 suppliers across multiple product lines and commodities; clear visibility into supply chain emissions; gaps within the Scope 3 dataset identified; and an aggregated, holistic view of Scope 3 replacing fragmented manual effort.

Why it transfers to pharma: the PCF-survey-plus-data-quality approach is agnostic to what is being manufactured. A pharmaceutical manufacturer running Phase 1 of this paper's roadmap faces an identical problem supplier breadth, commodity-level opacity, manual collection and the auditability bar is, if anything, higher under CSRD assurance than in the client's own regulatory context.

Engagement 2 Blockchain based footprint traceability

Client: an international food security agency operating in southern Europe, published anonymously by Infosys.[50]

The problem: the agency could not reliably monitor GHG emissions and water usage across a distributed farm network. Manual processes introduced errors, local variability in emission factors complicated tracking, and audit and compliance costs were rising as a direct consequence of fragmented data.

What Infosys delivered: a blockchain-based system for capturing and storing carbon and water footprint data across supply chain touchpoints, digitizing the calculation methodology and enabling consistent, tamper-evident reporting against carbon-neutrality goals.

Outcome: simplified data collection, calculation and secure storage; clear visibility and accountability for footprint metrics; and the commercially significant result reduced audit and compliance expenditure through automated, tamper-proof records.

Why it transfers to pharma: this is the MediLedger thesis demonstrated on an Infosys delivery. The traceability infrastructure was justified by compliance and audit cost, and the emissions-data capability arrived with it rather than requiring separate funding. For a pharmaceutical organization already obligated to build serialization and track-and-trace infrastructure under DSCSA or the EU FMD, that adjacency is the most under-exploited economic argument available in the Scope 3 business case.

A third Infosys engagement, with a global organization in western Europe, is worth noting briefly for the accountability argument made earlier: the reported outcome included reduced emissions across the supply chain achieved specifically through supplier engagement, alongside improved readiness for EU Deforestation Regulation reporting.[50] The pattern across all three is consistent the emissions reduction followed the supplier relationship and the data foundation, not the other way round.



Consulting insight:
what we observe across these engagements

Three observations recur across Infosys sustainability engagements and are worth stating plainly, because they are the failure modes a pharma leadership team is most likely to walk into.

Data quality is the bottleneck, not data volume. In the supplier-visibility engagement above, the deliverable that mattered was not collection but the quality and authenticity checks applied to what suppliers reported. Organizations consistently underestimate this: a Scope 3 figure that cannot survive assurance is not a baseline, it is an estimate with a governance problem attached. Validation deserves budget as a first-class workstream, not as a downstream check.

Compliance-funded infrastructure is the cheapest route to capability. Both engagements above were initiated against a regulatory or audit-cost driver, and both produced a capability that outlived the compliance requirement. In pharma, serialization and track-and-trace obligations already fund a data layer capable of carrying emissions provenance. Organizations that treat the two as separate budgets pay twice for one architecture.

Supplier engagement outperforms supplier assessment. The engagement that produced measurable supply chain emissions reduction did so through supplier alignment work, not through scoring. This is the operational restatement of the point made throughout this paper partners outperform auditors, and it is why Phase 2 of the roadmap is built around joint improvement plans with the top ten suppliers by spend rather than a broader, shallower survey exercise.

Infosys' position in this space has been independently assessed. Everest Group's PEAK Matrix 2025 positions Infosys as a Leader in Net Zero Consulting Services, and the HFS Horizons Report 2024 names Infosys a Market Leader in Sustainability Services.[59][60] The Value Chain Navigator developed with Economist Impact as an open digital platform specifically for understanding, managing and reducing Scope 3 emissions received the World Media Award Grand Prix in 2024 and applies directly to the supplier-side problem this paper addresses.[61]

Engagement model against the roadmap

Roadmap phase	Infosys role	Primary assets
1. Diagnose & Baseline	Assessment and benchmarking; materiality and gap analysis; emissions baselining and PCF methodology; supplier audit design	Consulting ESG advisory; Sustainability Cloud; 15+ Centres of Excellence
2. Redesign & Pilot	Solution selection and implementation; AI forecasting pilot; IoT cold chain deployment; SBTi target structuring	Infosys Topaz; Applied AI; IoT Services; Cobalt]
3. Scale & embed	Portfolio rollout; traceability extension to tier 2; internal carbon pricing design; CSRD-aligned reporting integration	Pharma Supply Chain DApp; Serialization Suite; Sustainability Cloud
4. Lead & Influence	Assurance-ready Scope 3 reporting; consortium and regulator engagement support; methodology publication	Consulting advisory; ESG certification base; partner ecosystem

The value of sequencing an engagement this way is that each phase produces an auditable artefact, a baseline, a validated pilot, and an integrated disclosure rather than a report. That distinction is what separates the organizations that convert ESG spend into the returns documented earlier from those that accumulate commitments without capability.



Phased Roadmap

The roadmap below sequences the maturity model, the technology deployments, and the financial case into a single 36-month-plus programme. Each phase corresponds to a maturity stage transition described earlier.

Phase	Maturity Transition	Timeline	Key Actions	Owner
1. Diagnose & Baseline	Reactive → Compliant	0-6 months	Map end-to-end Scope 1-3 emissions. Audit top 20 suppliers via EcoVadis or equivalent. Establish product carbon footprint baselines using PAS 2090. Identify highest-impact emission nodes.	Supply Chain + Sustainability
2. Redesign & Pilot	Compliant → Integrated	6-18 months	Launch a supplier decarbonization programme for the top 10 suppliers by spending. Pilot circular packaging on one product line. Deploy AI demand forecasting in one business unit. Implement IoT-based cold chain monitoring. Set science-based targets through SBTi.	Procurement + Operations
3. Scale & embed	Integrated → Optimized	18-36 months	Roll circular economy model across the portfolio. Co-invest in renewable energy with key CDMOs. Embed CSRD-aligned ESG data into annual reporting. Launch internal carbon pricing. Extend blockchain-based traceability to tier-2 suppliers, ideally via an existing consortium such as MediLedger.	Executive + All Functions
4. Lead & Influence	Optimized → Regenerative	36+ months	Share methodology with industry consortia. Engage regulators on science-based procurement standards. Publish independently audited Scope 3 reduction data. Position as preferred partner for sustainability-mandating buyers.	C-Suite + External Affairs

Key Performance Indicators

Sustainable transformation without measurement is aspiration. The KPI set below provides a balanced scorecard across environmental, operational, and financial dimensions. Organizations should establish baselines in Phase 1 before setting reduction targets.

Environmental & Operational KPIs

KPI	Baseline Source	Target	Review Frequency
Scope 3 GHG emissions (tCO ₂ e)	Phase 1 audit	30% reduction by Year 3	Quarterly
Supplier ESG score (EcoVadis avg.)	Phase 1 audit	>55/100 by Year 2	Semi-annual
% packaging material recyclable	Product audit	80% by Year 3	Annual
Cold chain energy intensity (kWh/shipment)	IoT baseline	36+ months	Monthly
Drug waste / overproduction rate	Inventory data	<3% by Year 2	Monthly
CSRD disclosure completeness	Gap assessment	100% by 2025 filing	Annual
% tier-1 suppliers on SBTi pathway	Supplier survey	60% by Year 3	Annual

Financial KPIs

KPI	Baseline Source	Target	Review Frequency
Cost to serve (\$/unit shipped)	Finance baseline	15% reduction by Year 2	Quarterly
Logistics cost as % of revenue	P&L baseline	<8% by Year 2	Quarterly
Sustainable sourcing cost premium	Procurement data	<5% vs. conventional by Year 3	Semi-annual
Green capex as % of total capex	Finance plan	>25% by Year 3	Annual
ROI on sustainability initiatives	Project accounting, benchmarked to BCG 3-6x range [41]	Positive by Year 2	Annual

Operating Model Implications

This is a learning system, not a static framework, each phase generates data that sharpens the next. Supplier scorecards from Phase 1 feed preferred-supplier incentives in Phase 3. Packaging pilots in Phase 2 build the cost and emissions case for portfolio-wide rollout in Phase 3.

Leaders in this space are not those with the largest budgets; they are those that start earliest, measure rigorously, and collaborate openly with suppliers rather than auditing them from a distance. The maturity model, case studies, and financial case in this paper are intended to compress the time it takes a leadership team to move from Stage 2 to Stage 4 the range where the return evidence is strongest and the competitive gap is still open.

Conclusion

Sustainable pharma supply chains are not a future concern they are a present-tense operational and strategic challenge. With 70 71% of healthcare emissions originating in the supply chain and Scope 3 accounting for 79% of indirect pharmaceutical emissions, the window for voluntary, unhurried action has closed.

The question now is how methodically, how collaboratively, and how ambitiously organizations choose to act and, as this revised paper sets out, with which sequence of technology, supplier engagement, and capital. Companies that treat sustainable supply chains as a compliance burden will spend the next decade managing cost. Those that treat it as a strategic transformation, backed by the maturity discipline and financial evidence set out here, will spend it building advantage.

Leading Practice Snapshot AstraZeneca's ESG Roadmap

Target: Net zero by 2045. Focus: Scope 3 emissions.

Actions: supplier engagement programmes, renewable energy partnerships, digital emissions tracking. Reported impact: measurable reduction in supply chain emissions, improved regulatory positioning, and a strengthened supplier ecosystem.[21][23][24] In our assessment, AstraZeneca's Scope 3 programme is among the clearest public demonstrations that supplier-led decarbonization can be both scalable and economically viable.

In the next decade, supply chain sustainability will determine not just how pharma operates, but who is allowed to operate.



References & Sources

All sources cited in this paper are peer-reviewed publications, company disclosures, regulatory documentation, or reports published by recognized industry and consulting bodies. Every reference below is a live, publicly accessible link at the time of writing.

Academic & Peer-Reviewed Research [1] [5]

[1] Booth, A. et al. (2023). Climate change targets, GHG emissions and strategies of the twenty largest pharmaceutical companies. International Journal of Environmental Research and Public Health, 20, 3206. <https://www.mdpi.com/1660-4601/20/4/3206>

[2] Wilms, R. et al. (2025). Greenhouse gas emissions of pharmaceutical consumption and production: An input-output analysis over time and across global supply chains. ScienceDirect / The Lancet Planetary Health. <https://www.sciencedirect.com/science/article/pii/S2542519625000282>

[3] Muñoz-Torres, M. et al. (2024). A roadmap towards circular economies in pharma logistics based on returnable transport items enhanced with Industry 4.0 technologies. ScienceDirect. <https://www.sciencedirect.com/science/article/abs/pii/S092134492400209X>

[4] Kerr, D. et al. (2020). Can we create a circular pharmaceutical supply chain (CPSC) to reduce medicines waste? NCBI / PMC <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7712437/>

[5] Tetteh, E. & Xu, M. (2025). The carbon footprint of pharmaceutical logistics: Calculating distribution emissions. Sustainability, MDPI, 17(2), 760. <https://www.mdpi.com/2071-1050/17/2/760>

Industry Reports & Regulatory Bodies [6] [15]

[6] My Green Lab (2024). The Carbon Impact of Biotech and Pharma: Crossing the Tipping Point of Industry Transformation <https://mygreenlab.org/the-beaker-blog/the-carbon-impact-of-biotech-and-pharma-crossing-the-tipping-point-of-industry-transformation/>

- [7] ISPOR (2023). The Pharmaceutical Industry's Carbon Footprint and Current Mitigation Strategies: A Literature Review. <https://www.ispor.org/heor-resources/presentations-database/presentation/intl2023-3669/126398>
- [8] SCI Chemistry & Industry (2024). Greener Pharma: Industry Progress on Decarbonization. <https://www.soci.org/chemistry-and-industry/cni-data/2024/2/greener-pharma>
- [9] Nexia Projects / Consultancy.eu (2026). Building ESG and Human Rights Across the Pharma Supply Chain. <https://www.consultancy.eu/news/amp/13514/building-esg-and-human-rights-across-the-pharma-supply-chain>
- [10] Climate Action Accelerator (2024). Pharmaceuticals: Reducing the Impact of Procurement. <https://climateactionaccelerator.org/solutions/pharmaceuticals/>
- [11] European Commission (2023). Corporate Sustainability Reporting Directive (CSRD). Official Journal of the European Union. <https://www.bioxconomy.com/finance-and-accounting/esg-reporting-for-pharma-in-an-evolving-regulatory-environment>
- [12] PharmaRegulatory.in (2025). ESG Reporting and Pharma Regulations Explained. <https://www.pharmaregulatory.in/esg-reporting-and-pharma-regulations-explained-complete-guide-to-compliance-sustainability-and-global-standards/>
- [13] Neuland Laboratories (2025). ESG in Pharma: How CDMOs Strengthen Sustainable Supply Chains. <https://www.neulandlabs.com/en/insights/stories/esg-pharma-how-cdmos-drive-sustainable-supply-chains>
- [14] Ernst & Young (2025). Global ESG Report: Pharmaceutical Sector Compliance Overview. <https://www.laboratoriosrubio.com/en/esg-pharma/>
- [15] International Sustainability Standards Board (2023). IFRS S1 and S2 Climate-related Disclosures. <https://www.ifrs.org/issued-standards/ifrs-sustainability-standards-navigator/>

Industry Commentary & Practitioner Sources [16] [20]

- [16] Illumine (2024). Reducing Carbon Footprints in Pharmaceutical Supply Chains. <https://illuminem.com/illuminemvoices/reducing-carbon-footprints-in-pharmaceutical-supply-chains>
- [17] Pharma Manufacturing (2024). Pharma's Shift Towards a Circular Economy. <https://www.pharmamanufacturing.com/facilities/op-ex-lean-six-sigma/article/11291585/pharmas-shift-towards-a-circular-economy>
- [18] Supply Chain Wizard (2025). Building a Resilient Pharma Supply Chain through ESG-Driven Digital Transformation. <https://supplychainwizard.com/building-a-resilient-pharma-supply-chain-through-esg-driven-digital-transformation/>
- [19] ISPE (2024). Supply Chain Resiliency and Sustainability: Transforming Pharma at the 2024 ISPE Annual Meeting. Pharmaceutical Engineering. <https://ispe.org/pharmaceutical-engineering/ispeak/supply-chain-resiliency-and-sustainability-transforming-pharma>

- [20] Underdeliver / OnDrugDelivery (2024). Pioneering Pharmaceutical Packaging: A Push for Decarbonization and Circularity. <https://www.ondrugdelivery.com/pioneering-pharmaceutical-packaging-a-push-for-decarbonisation-and-circularity/>

New: Case Studies, Technology & Financial Evidence [21] [45]

- [21] AstraZeneca (2025). Sustainability Data Annex 2024. <https://www.astrazeneca.com/content/dam/az/Sustainability/2025/pdf/Sustainability-Data-Annex-2024.pdf>
- [22] AstraZeneca UK (2026). Sustainability Ambition Zero Carbon progress update. <https://www.astrazeneca.co.uk/sustainability>
- [23] AstraZeneca (2024). Ambition Zero Carbon Infographic 2023. <https://www.astrazeneca.com/content/dam/az/Sustainability/2024/pdf/Ambition-Zero-Carbon-Infographic-2023.pdf>
- [24] CDP (2024). AstraZeneca: Using purchasing power to accelerate action. <https://www.cdp.net/en/insights/astrazeneca-using-purchasing-power-to-accelerate-action>
- [25] Sustainability Magazine (2025). Inside Novo Nordisk's 'Suppliers for Zero' Climate Campaign. <https://sustainabilitymag.com/news/inside-novo-nordisks-suppliers-for-zero-climate-campaign>
- [26] Novo Nordisk (2025). Suppliers for Zero. <https://www.novonordisk.com/sustainable-business/zero-environmental-impact/suppliers-for-zero.html>
- [27] The Sustainable Innovation (2026). Novo Nordisk Sustainability. <https://thesustainableinnovation.com/novo-nordisk-sustainability/>
- [28] Copenhagen Life Science (2023). Novo Nordisk: Circular for Zero. <https://www.copenhagencilifescience.com/healthy-weight-blog/circular-for-zero>
- [29] MediLedger Project / PR Newswire (2020). MediLedger DSCSA Pilot Project Final Report submitted to the FDA. <https://www.prnewswire.com/news-releases/leaders-from-24-companies-in-the-us-pharmaceutical-supply-chain-collaborate-to-submit-the-mediledger-dcsa-pilot-project-final-report-to-the-fda-proposing-blockchain-for-an-interoperable-track-and-trace-system-for-us-prescription-301008871.html>
- [30] DrugPatentWatch (2026). Real World Blockchain Uses in the Pharmaceutical Industry. <https://www.drugpatentwatch.com/blog/real-world-blockchain-uses-in-the-pharmaceutical-industry/>
- [31] Wireless-Life Sciences Alliance (2025). Blockchain track-and-trace in pharma: reality or hype? <https://wirelesslifesciences.org/2025/05/blockchain-track-trace/>
- [32] PMC / National Library of Medicine (2024). Blockchain Applications in the Pharmaceutical Industry. <https://pmc.ncbi.nlm.nih.gov/articles/PMC11073477/>
- [33] FDA (2020). MediLedger DSCSA Pilot Project Final Report industry pilot findings. <https://www.fda.gov/media/168283/download>
- [34] ColdChainCheck (2026). MediLedger Blockchain DSCSA 2026 Network Compliance Overview. <https://coldchaincheck.com/news/how-mediledger-blockchain-is-transforming-pharmaceutical-supply-chain-compliance>

[35] IntuitionLabs (2026). AI at Scale in Pharma: Sanofi's AI Strategy Explained. <https://intuitionlabs.ai/articles/ai-at-scale-pharma-sanofi-strategy>

[36] Emerj Artificial Intelligence Research (2025). Driving Manufacturing, Supply Chain, and Marketing Synergies with AI Sanofi. <https://emerj.com/driving-manufacturing-supply-chain-and-marketing-synergies-with-ai-kartik-pant-shreyas-becker-sanofi/>

[37] FreightAmigo (2026). Case Study: Pfizer's COVID-19 Distribution. <https://www.freightamigo.com/en/blog/logistics/case-study-pfizers-covid-19-distribution/>

[38] Escatec (2025). Turning up the volume for Pfizer: transforming cold chain logistics during Covid-19. <https://www.escatec.com/blog/cold-chain-logistics-covid-19>

[39] BioPharm International / PharmTech (2026). Accelerating Technology Adoption to Track the Cold Chain. <https://www.biopharminternational.com/view/accelerating-technology-adoption-to-track-the-cold-chain>

[40] Aeologic (2025). IoT Cold Chain Monitoring for Vaccines: Pharma Logistics Guide. <https://www.aeologic.com/blog/iot-based-vaccine-cold-chain-monitoring-guide/>

[41] Boston Consulting Group & EcoVadis (2025). Carbon Action Report 2025 / Liability to Advantage: Decarbonizing the Supply Chain. <https://www.bcg.com/publications/2025/liability-to-advantage-decarbonizing-supply-chain>

[42] Infosys Knowledge Institute (2022). ESG Redefined: From Compliance to Value Creation. <https://stocktitan.net/news/INFY/infosys-research-nine-out-of-ten-executives-report-esg-delivers-wcs88q1eyv3d.html>

[43] McKinsey & Company (2024). API manufacturing: The cost of decarbonization. <https://www.mckinsey.com/industries/life-sciences/our-insights/decarbonizing-api-manufacturing-unpacking-the-cost-and-regulatory-requirements>

[44] Infosys (2024). Embed Sustainability in Business Processes With ESG Integration. <https://www.infosys.com/iki/perspectives/embed-sustainability-business-processes.html>

[45] IntuitionLabs (2026). AI in Pharma Supply Chain: Forecasting and Logistics. <https://intuitionlabs.ai/articles/ai-pharma-supply-chain-forecasting-logistics>

New: Sustainability Maturity Model Research [46] [48]

[46] MDPI Sustainability (2020). Proposal for a Maturity Model in Sustainability in the Supply Chain. <https://doi.org/10.3390/su12229655>

[47] Supply Chain Digital (2023). A manufacturers' maturity model for supply sustainability. <https://supplychaindigital.com/sustainability/a-manufacturing-model-for-supply-chain-sustainability>

[48] ResearchGate (2023). Supply Chain Sustainability: A Model to Assess the Maturity Level. https://www.researchgate.net/publication/368471351_Supply_Chain_Sustainability_A_Model_to_Assess_the_Maturity_Level

New: Infosys Capabilities, Platforms, Assets & Client Engagements [49] [61]

[49] Infosys. Sustainability Consulting and Advisory Services assessment, benchmarking and roadmap methodology. <https://www.infosys.com/services/sap/offerings/sustainability-consulting.html>

[50] Infosys. Sustainability Cloud 2025 powered by Infosys Cobalt and Infosys Topaz; 15+ Centres of Excellence and 120+ sustainability certifications. <https://www.infosys.com/services/sustainability-services/insights/sustainability-cloud-2025.html>

[51] Infosys. Infosys Cobalt cloud services, solutions and platforms. <https://www.infosys.com/services/cloud-cobalt/overview.html>

[52] Infosys. Sustainability Services including Constellation Research assessment of Infosys ESG capabilities. <https://www.infosys.com/services/sustainability-services.html>

[53] Infosys. Drive Sustainability and ESG with SAP Solutions Sustainable Supply Chain solutions, Ethical Supplier Network and sustainable sourcing. <https://www.infosys.com/services/sap/offerings/drive-sustainability-and-esg.html>

[54] Infosys. Solutions to Enable Climate Change Action Among Clients carbon neutrality and client sustainability offerings. <https://www.infosys.com/about/esg/environmental/emission/solutions-enable.html>

[55] Infosys. Infosys Pharma Supply Chain Distributed Application pre-configured blockchain network for pharmaceutical supply chain track-and-trace. <https://www.infosys.com/services/blockchain/offerings/pharma-supply-chain.html>

[56] Infosys Life Sciences Centre of Excellence. Pharmaceutical Serialization Track and Trace multi-jurisdiction regulatory framework review. <https://www.infosys.com/industries/life-sciences/features-opinions/Documents/pharmaceutical-serialization.pdf>

[57] Infosys. Serialization Track and Trace Solution Suite SAP ATTP configuration, migration and testing accelerators. <http://www.infosys.com/industries/life-sciences/industry-offerings/Pages/serialization-track-trace.aspx>

[58] Infosys. Supply Chain Consulting offerings Supply Chain Advisory and value chain transformation. <https://www.infosys.com/services/consulting/offerings/supply-chain-operations-processes.html>

[59] Everest Group (2025). PEAK Matrix 2025 Infosys positioned as a Leader in Net Zero Consulting Services. <https://www.infosys.com/services/sustainability-services/analyst-reports/net-zero-consulting-services.html>

[60] HFS Research (2024). HFS Horizons Report Sustainability Services 2024: Infosys recognized as a Market Leader. <https://www.infosys.com/services/sustainability-services/analyst-reports/sustainability-services-2024.html>

[61] Economist Impact & Infosys (2023). Value Chain Navigator open digital platform for managing and reducing Scope 3 emissions. <https://www.infosys.com/newsroom/press-releases/2023/launch-value-chain-navigator.html>

About the Authors



Soumyadeep Nag (Analyst – Business Consultant), IC MFG

Soumyadeep Nag is an Analyst at Infosys Consulting with over four years of experience across knowledge management, secondary research, market compliance, and business transformation support. He specializes in translating industry and operational research into whitepapers, executive insights, RFP inputs, and reusable knowledge assets.

An avid musician and biker, he does track days & also produces and composes music in his free time. His interests include sustainable supply chains, AI-enabled knowledge management, responsible Generative AI adoption, content governance, and workflow automation.



Dr. Sapna Bhardwaj (Senior Consultant) IC LS

Sapna Bhardwaj is a Senior Consultant at Infosys Consulting with over 11 years of experience in life sciences, specializing in R&D, pharmacovigilance, clinical research, and regulatory affairs. She works closely with pharmaceutical organizations to drive innovation, improve operational efficiency, and strengthen capabilities across the drug development lifecycle. With expertise in project and quality management, data analysis, and computer system validation (CSV), she has delivered impactful outcomes in safety, clinical, and compliance domains. She is particularly passionate about leveraging Artificial Intelligence to enable responsible, data driven transformation and accelerate innovation in the life sciences industry.



Karthik Lakshminarasimha (Senior Principal) IC MFG

Karthik Lakshminarasimha (M.L. Karthik) works as a Senior Industry Principal with Infosys Consulting, bringing over two decades of global experience in leading medium- to large-scale SAP transformation programs across diverse industry sectors. His expertise spans SAP-enabled business transformations, IT strategy execution, carve-outs and divestitures, data strategy and migration, package evaluations, operating model design, and complex enterprise transformation initiatives.

Beyond his professional accomplishments, Karthik is an accomplished Carnatic classical vocalist with a distinguished musical journey. He has secured top ranks in prestigious music examinations, won numerous awards and accolades at state and national level competitions, and delivered performances extensively across India and the United States. His unique blend of consulting leadership and artistic excellence reflects a rare combination of strategic thinking, discipline, and creativity.



Divik Bansal, Senior Principal Consultant , Tech Transformation Advisory

Divik Bansal is a Senior Principal at Infosys Consulting with over 25 years of experience leading complex M&A, divestiture, carve-out, and IT transformation programs for global enterprises. He specializes in TSA design and execution, IT separation, program governance, operating model transformation, and value realization. Having led large-scale cross-border engagements involving executive stakeholders, multimillion-dollar portfolios, and global teams, he is recognized as a trusted advisor who helps organizations navigate complex transactions and accelerate business outcomes through technology-enabled transformation.

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For more information, contact consulting@infosys.com

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