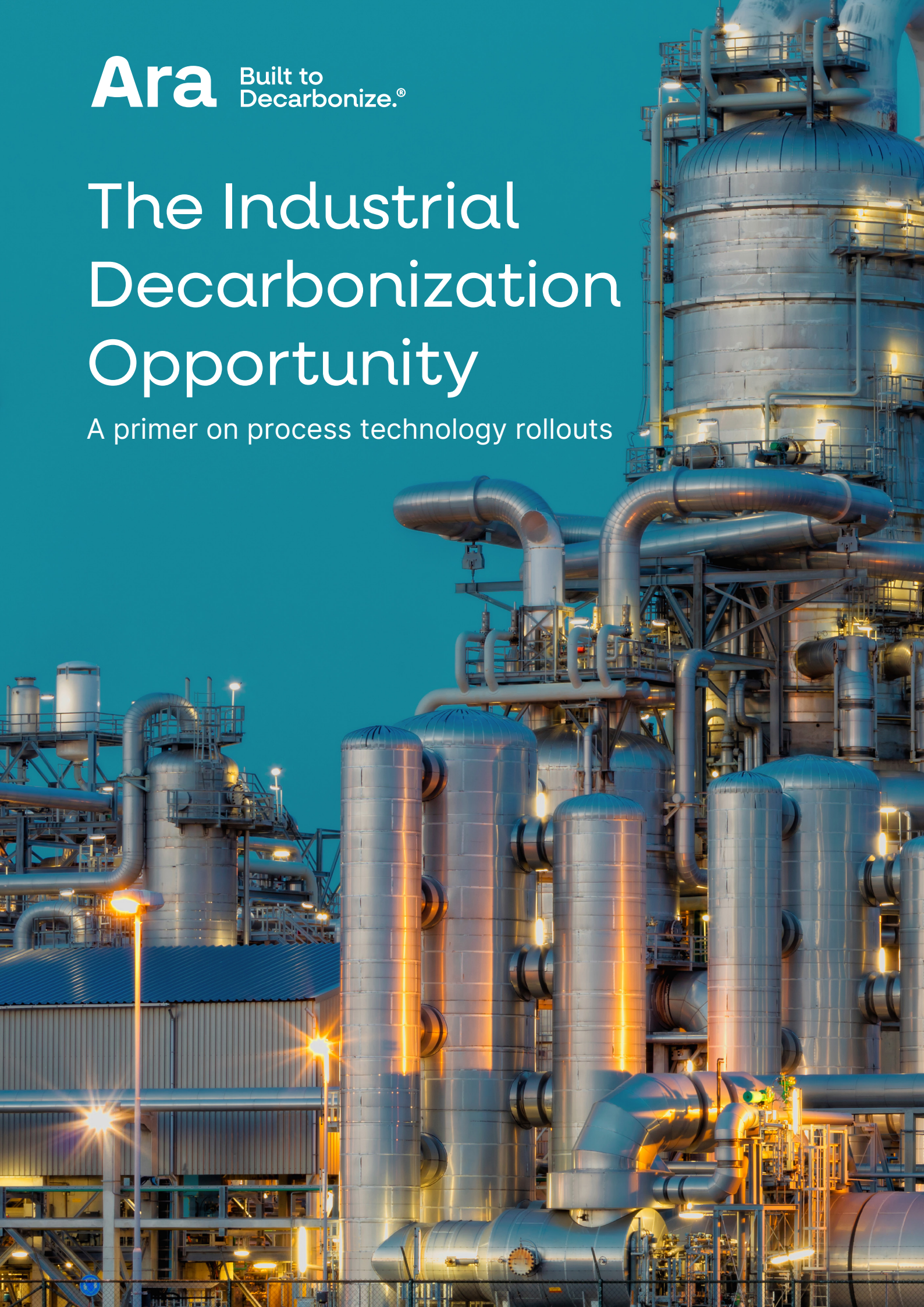


Ara Built to
Decarbonize.®

The Industrial Decarbonization Opportunity

A primer on process technology rollouts



About the authors

Ara brings a distinctive track record in delivering Process Technology Rollouts (PTRs) at a pace and scale that is rare in industrial decarbonization.

Ara is currently supporting more than 40 active projects with total installed costs ranging from \$5 million to \$1.1 billion each, representing roughly \$4.3 billion of development CapEx across ~30 portfolio companies.

Our team has collectively executed over 400 industrial projects, giving Ara deep, practical experience in turning first-of-a-kind plants into commercial scale companies.



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Introduction

The scale of the industrial decarbonization landscape is vast, representing a multi-trillion-dollar generational investment opportunity.

Energy security, reshoring, and value-chain resilience are catalyzing a new wave of reindustrialization across power, fuels, materials, and advanced manufacturing. Buyers want reliable supply, investors want competitive unit economics, and communities want durable jobs. The plants that win will sit at the nexus of returns, reliability, and decarbonization. Lower-carbon processes improve energy efficiency, diversify feedstocks, and unlock policy advantages that strengthen cost and supply security.

Translating that mandate into metal means building new process units, retrofits, and enabling infrastructure at a scale not seen in decades. Much of the capacity build will replace high-emissions processes with lower-emissions alternatives and restore domestic supply chains for critical materials. Independent estimates put the required capex in the multi-trillion-dollar range over the coming decades; the platforms that can deploy lower-carbon capacity systematically will capture a disproportionate share of that spend.

Capital spending on decarbonization systems in a net-zero transition totals to

\$275 trillion

through 2050, or about

\$9.2 trillion

per year on average¹

Even with the right technology and market, scaling is hard. Permitting, engineering, supply-chain, and construction risks intensify when projects must be repeated across many sites—one reason promising platforms stall after a plant or two. Closing this gap requires capital and a builder's toolkit that covers selection, engineering, delivery, commercialization, and compliance.

Process Technology Rollouts (PTRs) industrialize that toolkit. A PTR standardizes site selection, engineering, contracting, permitting, procurement, financing, and offtake so capacity can be deployed repeatedly, turning one-off projects into a program. Early plants validate performance and economics; later plants reuse and refine the package, compressing timelines and costs while improving reliability and quality.

The goal isn't a single facility; it's a scalable platform—designed once, repeated many times—so reindustrialization produces plants that earn competitive returns, strengthen domestic supply security, and reduce embodied emissions. PTRs are especially effective in process industries, like cement, fuels, and chemicals, where replication and standardization drive both cost improvement and emissions reduction, particularly in North America and Europe where policy, capital depth, and industrial bases are aligned.

¹ McKinsey

The value of Process Technology Rollouts (PTRs)

When a PTR achieves scale, returns compound across a suite of plants generating substantial value for investors.

PTRs are extremely valuable because they sit at the intersection of a vast market opportunity, attractive plant-level economics, high barriers to entry, and strong cash flow generation with exceptional growth prospects that can run for decades. They create value in two steps.

> **Step one:** build the first commercial plant and drive it to stable cash flow. At that point, the technology has moved beyond pilot stage into a live, operating asset with customers, stable operating data, and a clear economic profile. The first plant shows that the process works, that costs and performance are within expectations, and that customers will buy the output at attractive terms.

> **Step two:** turn that initial success into a pipeline of shovel-ready projects in a large addressable market. In many Ara focus areas, the potential is fifty or more plants globally. A well-designed PTR unlocks that large TAM with a practical plan: standardized designs, repeatable contracting structures, known supply chain partners, and a clear, staged sequence of sites. Each subsequent plant is built faster, cheaper, and with lower risk.



² Plant pictures: Cycle, Divert, Petainer, and VAC plants built with Ara Partners' PTR model

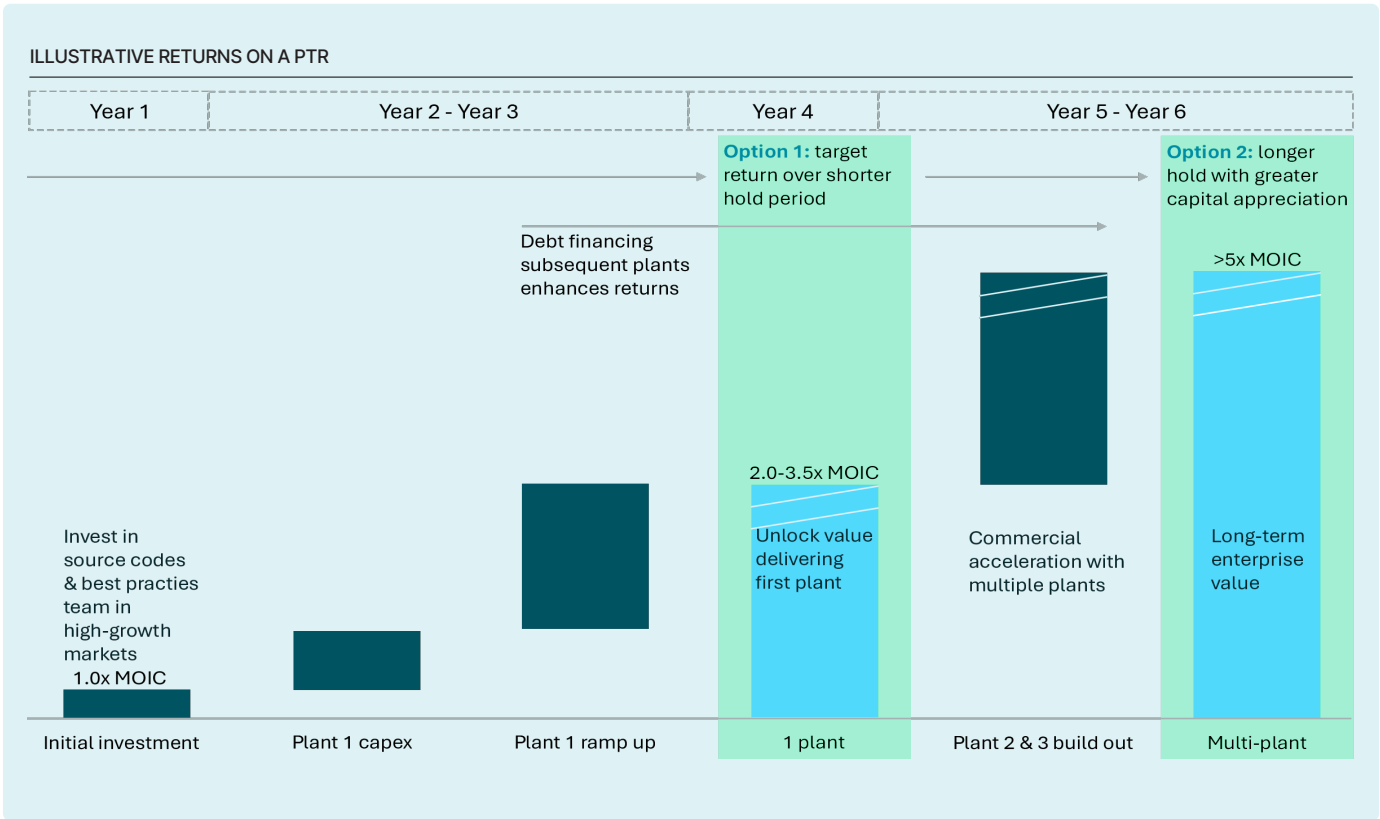
The value of Process Technology Rollouts (PTRs)

When a platform reaches progresses to step two, valuation moves materially higher.

Scalable, lower-carbon platforms with robust growth visibility, strong unit economics, and credible emissions impact can command premium exit multiples, especially in high growth markets where the expansion pipeline is clear. Strategic and financial buyers will often pay significant value for the development pipeline alone. At that stage, the buyer universe becomes broad: strategics, generalist private equity, and infrastructure investors with lower costs of capital all compete for exposure to these assets.

PTRs are the mechanism Ara uses to build such businesses—from first plant, to formula, to a portfolio of plants that throws off durable cash flows, and ultimately to a successful exit that reflects the full value of the growth platform.

The following analysis underscores why PTR investing can be so attractive from a value creation perspective.



The missing middle: funding and execution gap

There is a vast funding gap for building plants 1-3 across the industrial decarbonization landscape.

The funding gap

Venture capital firms fund technology start-ups while infrastructure investors fund de-risked assets. PTRs sit in the gap in between—capital-intensive builds with early operating risk.

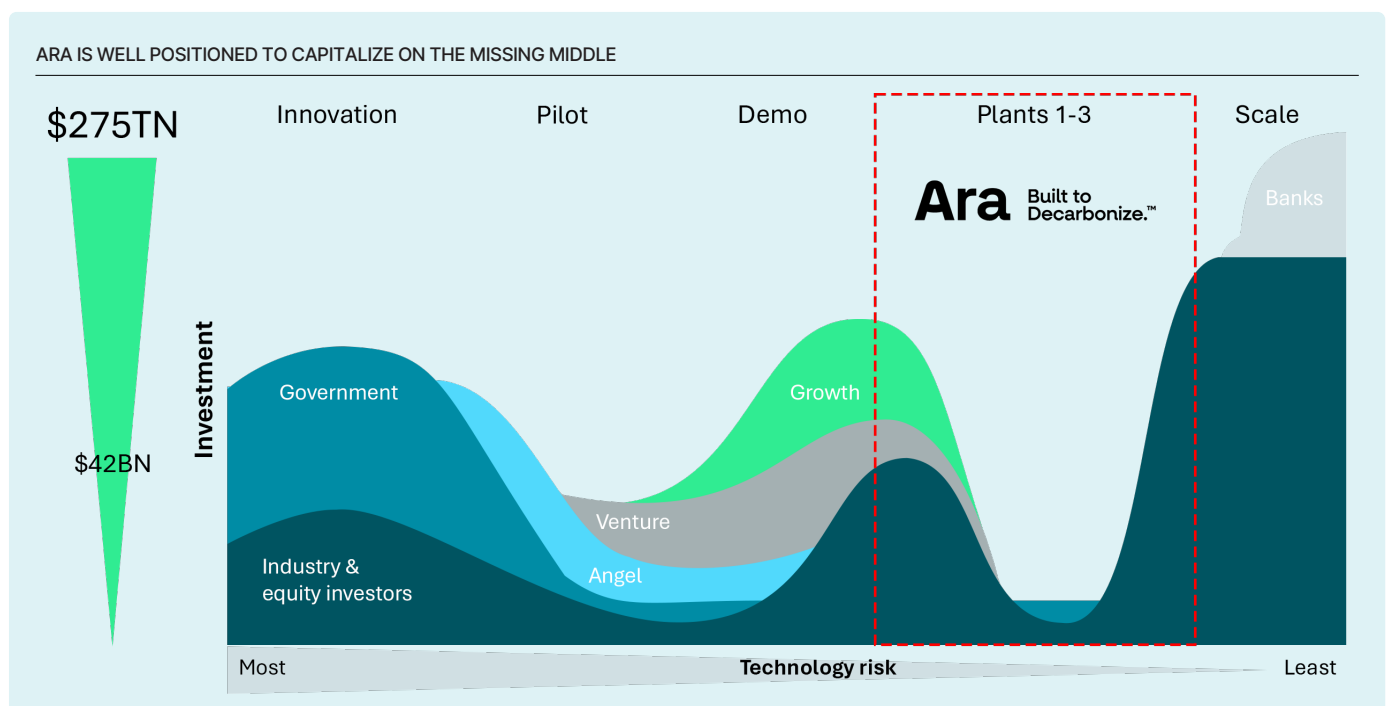
PTRs need capital that is comfortable with construction and growth stage risks but still focused on building a portfolio of long-lived assets. That pool is much thinner than the headline numbers on “climate capital” would suggest.

The execution gap

Many companies can marshal internal resources to deliver a single “strategic project.” Far fewer have the systems, people, and governance to run a pipeline of similar projects across multiple sites and over many years.

A well-structured PTR program needs:

- > Defined selection criteria
- > Stage gate decision making process
- > Transparent feedback loop
- > Substantial engineering and project management capacity to run several builds simultaneously
- > Commercial and policy capabilities that can support multiple offtake, feedstock, and incentive negotiations
- > Excellent commissioning, operational safety capabilities
- > A management team with an exceptionally clear vision and that is strong at raising capital
- > A sponsor with deep pockets



Traveling from desert to oasis

PTRs are about planning that crossing between first plant and many plants deliberately.

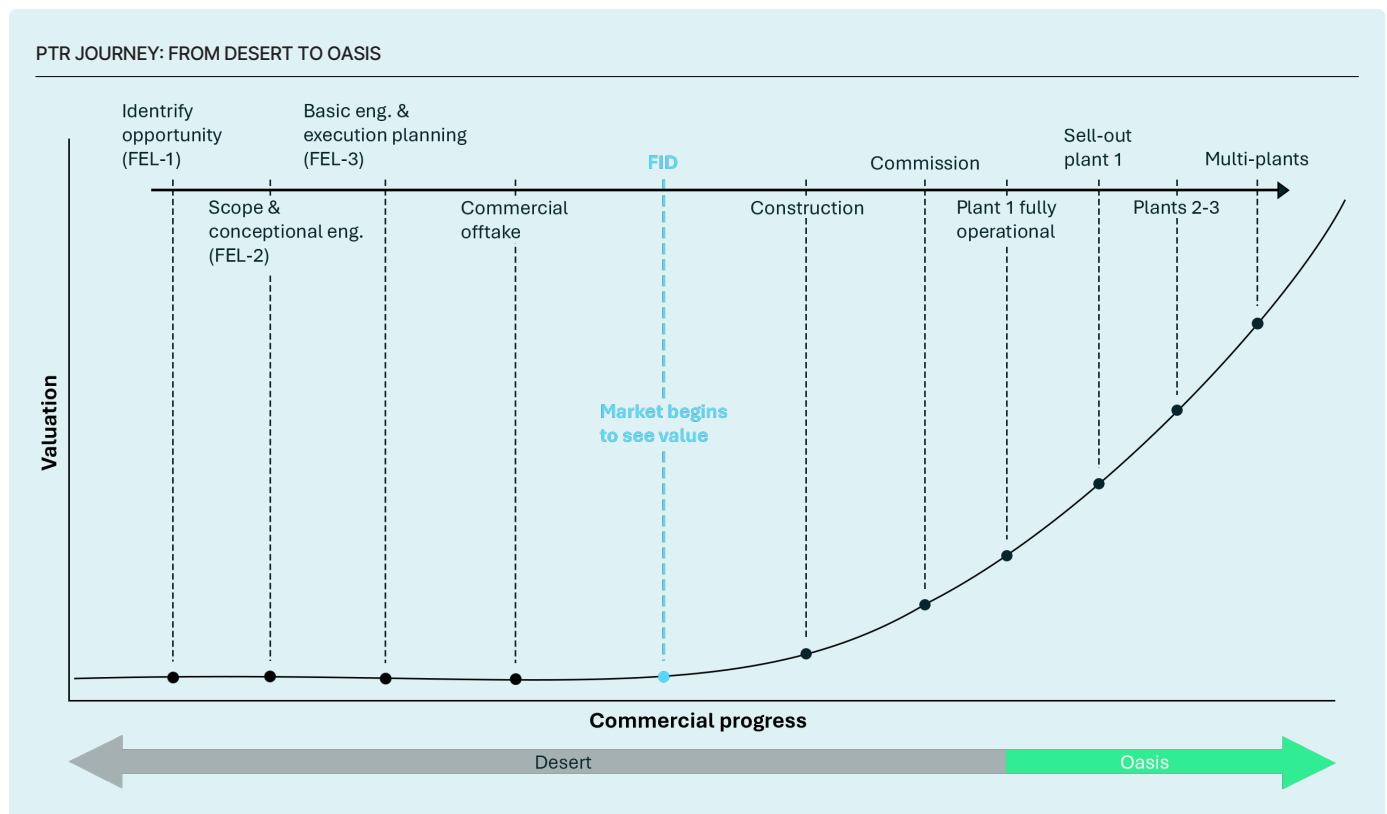
Most industrial decarbonization stories follow the same arc: promising pilot on one side and multi-site fleet on the other with a brutal 'desert' in between.

Ara's definition of the "oasis" is concrete. It has three elements:

- > A successful first plant that is online, generating strong and predictable cash flow
- > A "rinse and repeat" model centered on cost extraction that allows plants two, three, and four to be built faster and cheaper using a standard design and delivery approach
- > A deep pipeline of shovel-ready projects, backed by a strong commercial pipeline of customers seeking long-term offtakes

Most decarbonization platforms never reach that point. They struggle to fund second and third plants, re-engineer every project from scratch, and move slowly from one site to the next. PTRs are about planning that crossing deliberately. The first plants are designed not just to operate, but to serve as blueprints. Commercial efforts focus not only on offtake for the first plant, but on building multi-site relationships. Engineering and permitting are managed with reuse in mind, rather than one-time success.

Done this way, the desert becomes a sequence of planned steps rather than a long, uncertain trek.



The Ara advantage

Ara's unique experience gives us pattern recognition of which PTRs work best, where customer demand is strongest, and how best to structure them for scale.

Ara has built a portfolio that is focused squarely on industrial decarbonization, including energy efficiency, low carbon fuels, circular materials, and process improvements. Our senior investment professionals have on average 25+ years of investing experience and have evaluated thousands of deals across the decarbonization landscape, backing multiple PTR platforms such as late-stage municipal waste to value and cement decarbonization businesses.

Where most firms advise, Ara builds—bringing unmatched industry depth and hands-on portfolio leadership to every investment. Ara Portfolio Services (APS) functions work in lockstep to provide project execution and operational optimization, commercial and policy expertise, and rigorous carbon accounting to unlock growth for the portfolio at an industrial scale.

ARA PARTNERS AT A GLANCE

Private equity

Infrastructure

Energy



Project execution
& operations



Decarbonization



Government
affairs



Ara insights

The Ara advantage

Ara brings a distinctive track record in delivering PTRs at a pace and scale that is rare in industrial decarbonization.

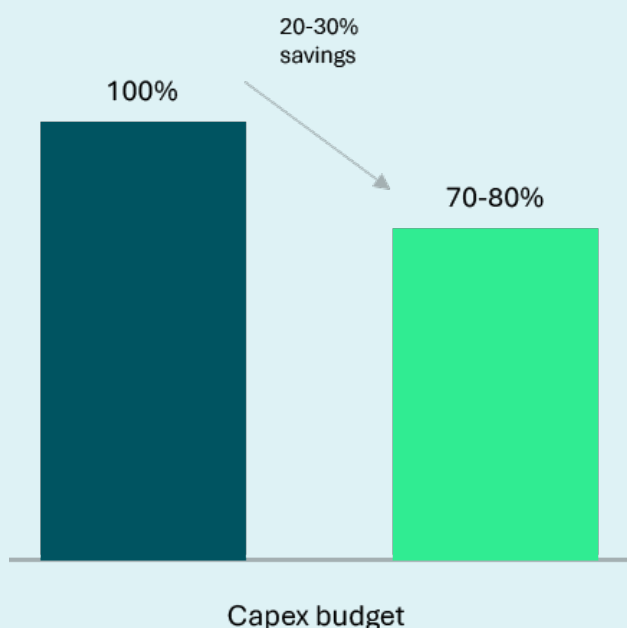
Project execution and operations

The Ara project execution and operations (APEX) group oversees capital project delivery and is a catalyst for project and operational maturity. APEX helps portfolio companies design and run capital projects using a standardized toolkit, from pre-deal cost and schedule analysis through commissioning. APEX's objective is straightforward: achieve commercially modeled capacity in the fastest and most cost-efficient way possible. For Nth-of-a-Kind (NOAK) plants, Ara targets 20-30% CapEx savings.

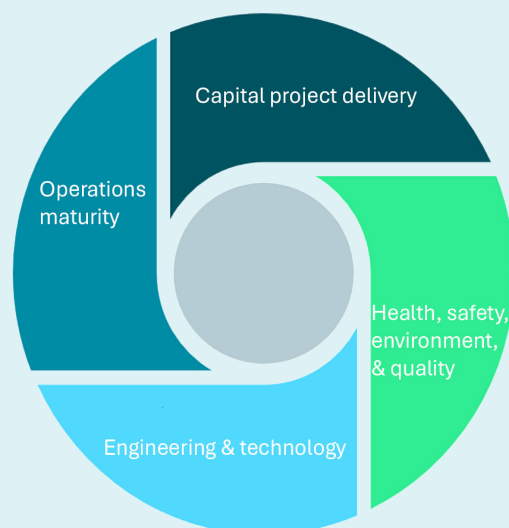
The team brings deep experience in project development, EPC, operational readiness, safety, and systems. It has overseen about \$4.3 billion of development CapEx across 29 portfolio companies, with more than 400 industrial projects delivered.

This on-the-ground activity, spread across sectors and geographies, gives Ara a practical base from which to run and refine PTR programs at pace and scale.

BUILD FASTER, BUILD FOR LESS: TARGET APEX CAPEX SAVINGS



CORE APEX FOCAL AREAS



The Ara advantage

Ara brings the complete resources of the firm to ensure each PTR is successful—a support system that is differentiated and rare in private equity.

Decarbonization

Our decarbonization team ensures that assets deliver measurable emissions reductions and helps portfolio companies turn that impact into revenue. In addition to robust baselining and monitoring, reporting, and verification, we help identify and monetize environmental attributes in both voluntary and compliance carbon markets. That can unlock an incremental, recurring, high-margin revenue stream through carbon credits or other instruments that reflect the emissions performance of the plants. When structured correctly, this revenue improves project economics and can make lower-carbon products more competitive against fossil incumbents.

Commercialization services

Ara's commercialization support is built around partnerships, not just transactions. We help portfolio companies:

- > identify and engage strategic commercial partners
- > set up customer and industry advisory councils to accelerate traction and strengthen the brand
- > sharpen product market fit, route to market, and pricing strategies
- > structure and negotiate offtake agreements that support financing and leave room for multi-plant growth

The aim is to move from one-off sales to durable commercial relationships that support the entire PTR roadmap.

Ara insights

Ara Insights is our market intelligence and thought leadership engine. It tracks industry trends, regulatory and policy shifts, competitive dynamics, M&A activity, and technology developments across our focus sectors.

These insights help portfolio companies and deal teams anticipate where demand is likely to grow, where incumbents or new entrants may pose threats, and where new policy or market structures create opportunities. They inform which PTRs to prioritize, which markets to enter first, and how to position platforms relative to evolving industry narratives.

Government affairs

Ara's government affairs capability identifies and capitalizes on relevant policies, tax incentives, subsidies, grants, and regulatory opportunities, and integrates them into project design, siting, workforce development, and financing structures. This speeds up incentive capture, reduces permitting risk, and makes it easier to replicate structures across multiple projects and jurisdictions. Access to non-dilutive capital enhances Ara's returns.



³ Plant picture: Genera plant built with Ara Partners' PTR model

PTR investment framework

Platforms that meet Ara's PTR criteria demonstrate explosive growth potential with good risk-adjusted returns.

Ara applies a consistent set of criteria when choosing which technologies and businesses to back as suitable platforms.

Platforms that meet these criteria are able to support successful PTR programs: an excellent management team, a first plant that works well and economically, a formula for repetition that drives down cost and timeline, and a market large enough to make that repetition worthwhile to drive outsized private equity returns.

WHAT ARA LOOKS FOR IN PTRS



Real decarbonization impact at competitive cost

- > Substantial emissions reduction potential at the product, service, or asset level
- > A path to cost parity or better versus fossil incumbents as the PTR matures



Best in class management

- Teams with a track record of:
- > Building and running industrial assets
 - > Can operate across multiple sites and jurisdictions



Feedstock and demand security

- Ample, reliable feedstock supply with:
- > Workable logistics and strong end market demand
 - > Supported by long-term offtake agreements



Platform maturity

- A business that:
- > Moved beyond lab and small pilots
 - > Is at, or close to, a first commercial plant
 - > Technology is fully de-risked



Large, clear TAM

- > Multi-billion dollar market with room for fifty or more plants globally
- > Strong customer pull anchored by multi-year contracts



Attractive plant economics and fast cycle time

- > Attractive unlevered project returns
- > Short duration and construction periods from investment decision to FID
- > Strong free cash flow generation

Ara's stage gate process

Ara's scalable stage-gate process mitigates risks and improves project quality, reduces the likelihood of late stage surprises, and makes it easier to standardize designs and practices across a PTR program.

A disciplined stage gate framework underpins our project development. Gates function as critical check points before moving to the next stage or committing more capital.

We use a five stage gate framework across the project lifecycle:

> **Stage 1 (FEL 1) Feasibility:** Determine if an opportunity should be pursued. Identify alternatives and establish evaluation criteria for Stage (FEL) 2.

Gate 1: Endorses initial project objectives and strategies and determines early basic design scope.

> **Stage 2 (FEL 2) Select:** Decide if a project is viable and if the selected alternative should be developed. Start conceptual design and select concept.

Gate 2: IC approves release of advanced funding for work and purchases during Stage (FEL) 3. Steering committee endorses Go/No-Go decision for selected concept.

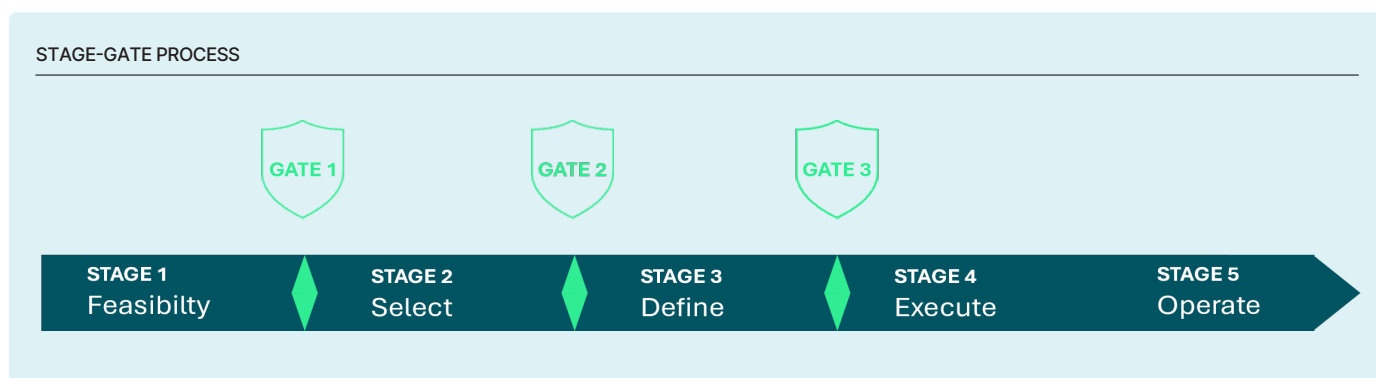
> **Stage 3 (FEL 3) Define:** Optimize the scope of the project and start front end engineering design (FEED). Demonstrate readiness to advance to execution.

Gate 3: IC approves full funding for the project. Steering committee endorses transition to execution.

> **Stage 4 Execute:** Complete detailed design, procure material, construct, and commission the facility. Ensure the project is ready to operate.

> **Stage 5 Operate:** Efficiently ramp operations to nameplate capacity. Closeout project contracts and activities. Document lessons learned and appraise performance.

This structure improves project quality, reduces the likelihood of late-stage surprises, and makes it easier to standardize designs and practices across a PTR program. Standardization is essential to driving down cost in subsequent plant builds.



Step change in value creation: build for less

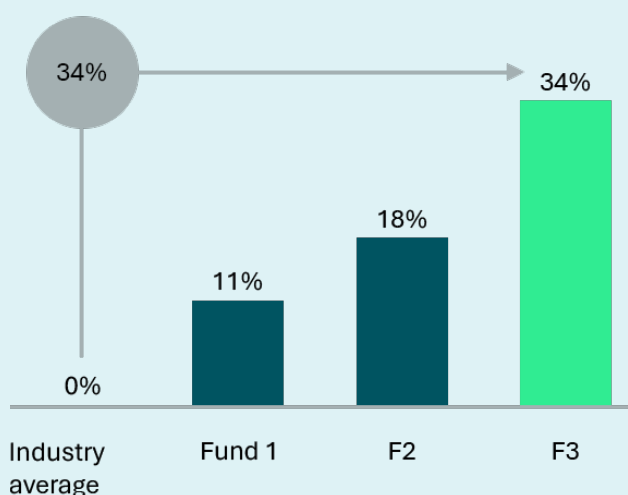
Ara's approach combines traditional industrial levers with newer tools to deliver significant time and cost savings on future plants.

A central promise of PTRs is that subsequent plants should be cheaper and better than earlier ones. Ara PTRs are delivered 34% faster and 37% less expensive than industry benchmarks. Ara's approach combines traditional industrial levers with newer tools to deliver that step change.

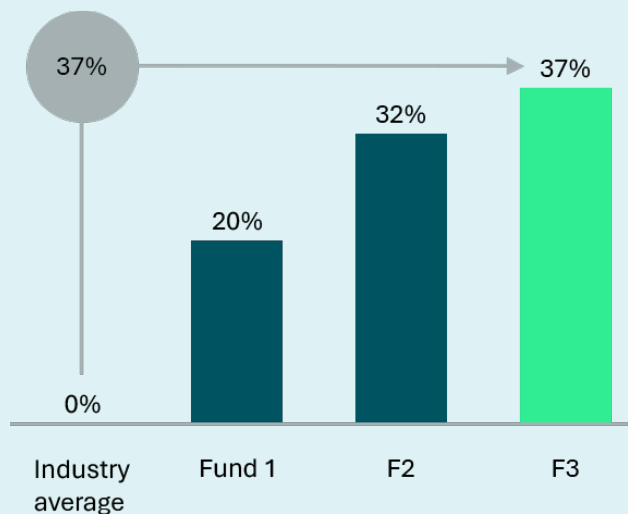
- > **Lower unit CapEx:** on the design side, we use Nth-of-a-Kind (NOAK) work and iterative engineering to reduce CapEx and OpEx between first and later plants, including simplifying flowsheets, shortening process steps, and shrinking plant footprints where possible.
- > **Improved performance:** on the technology and operations side, we increasingly use AI and automation for process optimization, advanced controls, and predictive maintenance, which can improve yields, reduce energy use, and shorten ramp up times. We also use data tools to streamline engineering workflows and document management.
- > **Better supply chain terms:** on the commercial and supply chain side, PTR scale allows us to negotiate better terms with vendors, standardize equipment packages, and optimize logistics. Larger and more predictable order books support more efficient manufacturing, shipping, and inventory strategies.
- > **Greater operating leverage:** finally, as platforms grow, operating leverage increases. Shared functions, common systems, and teams experienced with the technology allow each additional plant to be run with proportionally less overhead.

The combination of lower unit CapEx, improved performance, better financing terms, and higher operating leverage is what makes PTRs not just repeatable, but increasingly strategic and attractive as they scale—generating strong interest from corporate strategics, generalist private equity, and infrastructure funds.

ARA'S PROJECT TIME SAVINGS VS. INDUSTRY AVERAGE



ARA'S PROJECT COST SAVINGS VS. INDUSTRY AVERAGE



Commercial progress: from early adopters to long-term, take-or-pay contract structures

Ara's role is to help portfolio companies move along this curve faster and with fewer missteps.

Early adopters

Commercial progress in PTRs typically starts with a few early adopters who are willing to support the first plants. The work begins even earlier, though, by systematically identifying and prioritizing prospects in large addressable markets—segmenting customers by scale, emissions footprint, product needs, and willingness to pay for lower-carbon solutions. From there, the commercial pipeline must be high-graded around the most bankable counterparties, the best sites, and the clearest paths to replication, rather than a long tail of speculative opportunities. Early adopters that fit this profile and support the first plants can then become anchors for additional sites and large volumes, often across multiple geographies.

Long-term, take-or-pay contracts

As more plants come online and performance data accumulates, lower-carbon products can move from small volumes to standard offerings. At that point, the focus shifts from spot or short-term sales to negotiating long-term, take-or-pay and other bankable contract structures that match the scale and tenor of the capital being deployed. Strong demand pull from customers, reinforced by quality and supply chain security needs, buyer decarbonization commitments, and investor expectations, can support multi-year offtake frameworks that underwrite both growth and financing.

Ara's role is to help portfolio companies move along this curve faster and with fewer missteps: from prospect identification to a high-graded commercial pipeline, from early adopter wins to long-term take-or-pay programs, and ultimately from isolated plants to dominant market positions in large, growing end markets.



⁴ Plant pictures: Aloxe, Puraglobe, Sedron, and Blue Whale Materials plants built with Ara Partners' PTR model

Conclusion

Reindustrialization, supply security, and decarbonization are driving a multi-trillion-dollar build-out. The winners will be the teams that can turn proven technologies into repeatable fleets of plants—deploying new capacity systematically, at competitive cost, and with reliable execution. The bottlenecks are capital and scaled delivery.

Process Technology Rollouts (PTRs) address that bottleneck. A PTR defines a repeatable model—site selection, engineering, contracting, permitting, financing, and commercial terms—and applies it across multiple sites. A disciplined stage gate and feedback loop make later plants faster, cheaper, and lower risk than the first.

Ara focuses on the “missing middle” of funding and execution. Using tight investment criteria and the capabilities of Ara Portfolio Services—APEX (capital projects), Government Affairs, Decarbonization, and Insights—we help portfolio companies design and run PTRs, reach modeled capacity on time and on budget, and build pipelines that support bankable offtake and financing.

The objective is clear: replace high emissions processes with cost-competitive alternatives and build durable, lower-carbon industrial platforms at scale—delivering meaningful emissions reductions and substantial value creation for our investors while ensuring critical supply chains.





About Ara Partners

Founded in 2017, Ara Partners is a global private markets firm focused on decarbonizing the industrial economy. We invest in the middle market across three strategies: Private Equity, Infrastructure, and Energy. We scale commercially demonstrated decarbonization solutions, support the businesses and infrastructure that enable their adoption, and reduce emissions at the source across the conventional energy value chain. Our model combines investing, market and policy expertise, project execution and operational optimization, and rigorous carbon accounting to reduce emissions economically and unlock growth at an industrial scale. Ara operates from Houston, Boston, Dublin and Washington D.C.