

The Digital Backbone Behind the World's Most Ambitious Carbon Removal Mission

How Climeworks is creating the engineering rigor needed to deploy carbon removal on a planetary scale



Climeworks is pioneering a new class of industrial infrastructure: large scale direct air capture plants (DAC) that permanently remove carbon dioxide from the atmosphere. As the first company in the world to operate a commercial direct air capture and storage facility, Climeworks is scaling from two pioneering direct air capture plants in Iceland to a global pipeline of projects across North America, Europe and the Middle East. The ambition is immense, with clear plans to build in modular phases, and test, learn and optimize while building. The company remains focused on developing technology that brings down costs, uses less energy, and captures CO₂ more efficiently.

This scale necessitates strong engineering rigor, repeatability and life cycle control. To industrialize a technology that must operate reliably for up to 25 years in extreme and varied environments, Climeworks needed a digital foundation capable of supporting rapid innovation, modular design, global collaboration and long term lifecycle management.

Challenge: Unprecedented Demands of Engineering Discipline and Diversity

We're building a new class of industrial plants," explained Kyle Allen, Senior Manager - System Integration and Validation at Climeworks. "There's no equivalency in the current marketplace, so we're breaking new ground in how this should be done in the most cost effective manner. We remove carbon from the air, but to scale that mission globally, we needed the right digital backbone."

As Climeworks moved from its early plants to its next generation of industrial deployments, its former engineering and data management systems became a constraint. The company's previous PLM environment lacked configuration control, change management and the ability to support modular variants required for global deployment.

"We reached the limits of our old system," said Allen. "For the entire second generation plant, we had no real change management. Given increasing complexity and our need to scale, we needed to adapt our systems as well."

Environmental diversity added further complexity. Climeworks' plants operate in ambient conditions, including extreme cold and high heat as well as high humidity in some locations, alongside sand, dust, salt fog from shorelines and other harsh conditions.

The company also made a strategic decision to rebuild its IT infrastructure from the ground up, adopting a cloud first strategy to support speed, scalability and global collaboration.

"You're exposed to whatever surrounds you," Allen said. "Designing for Iceland is not the same as designing for a desert or a coastal site. We needed

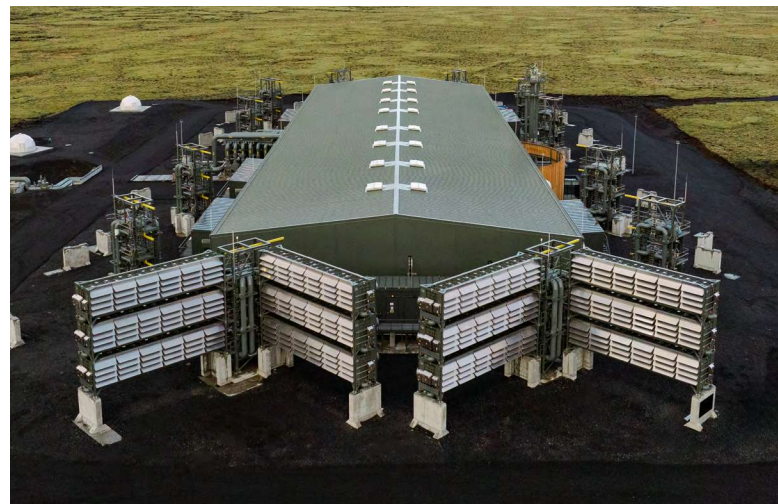
a way to manage variants without losing control. We deliberately chose a greenfield approach. We didn't want to migrate old problems into a new system."

As the company grew to more than 300 employees across multiple continents, the need for a single, reliable source of truth became urgent.

Solution: Building a Cloud First Digital Backbone for Rapid, Reliable Innovation

Climeworks selected PTC's Windchill+, as its SaaS PLM solution, following a competitive evaluation in late 2024. The decision aligned with the company's cloud first strategy and its need for a scalable, low overhead system that could support rapid growth.

The team adopted a phased, out of the box approach to accelerate time to value.



"We prefer SaaS solutions," Allen explained. "We want to reduce the overhead of maintaining systems and focus on using them. Windchill+ fit perfectly. We also wanted to start small and go fast. Using the product largely 'as is' helped us avoid long customization cycles and get immediate traction."

Windchill+ now provides Climeworks with a single, cloud based source of truth for product data, CAD models, documentation and configuration control. Engineers, project managers, and cross functional teams can access the latest designs in real time, even without CAD software.

"Every user can open and inspect 3D models directly in the browser," added Allen. "Team members no longer need to ask designers to measure something or check how a part fits. That alone has been a huge advantage."

The system also supports modular design and variant management, which are essential for adapting plants to different climates and environmental conditions. The SaaS architecture ensures that innovation continues uninterrupted.

"We're building a standardized core product with add on variants. Windchill+ helps us manage those configurations cleanly," said Allen. "It was important that designers didn't step into a system full of bugs or delays. Windchill+ allowed us to roll out a robust foundation without slowing engineering."

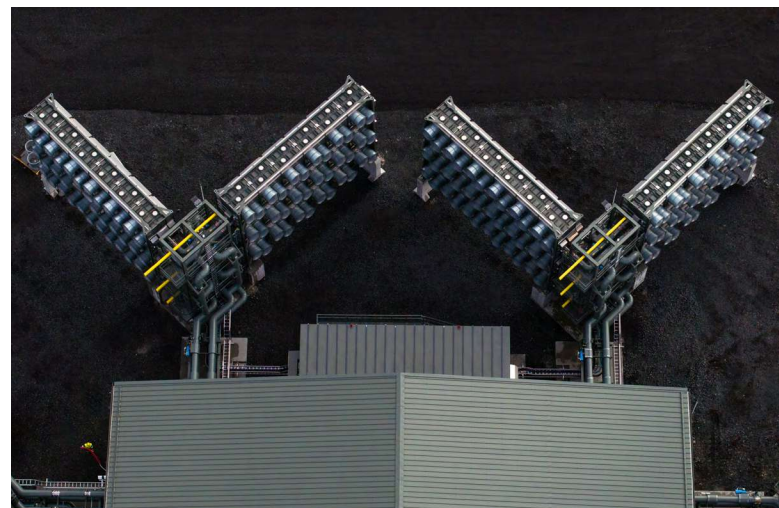


It's not just a PLM system, it's the strategic backbone that turns breakthrough engineering into a repeatable, global climate solution."

Kyle Allen, Senior Manager - System Integration and Validation, Climeworks

Results: Faster Design, Fewer Delays and Repeatable Global Deployment

Windchill+ has transformed how Climeworks collaborates, innovates and prepares for global scale. The most immediate impact has been the shift from delayed, manual design review to real time collaboration.



"Before, it could take days to review a design," said Allen. "Now our team members get a link, open it instantly and can give feedback right away. The speed and effectiveness of design review has increased dramatically."

This acceleration has reduced the day to day slips that previously slowed innovation.

"Day for day slips are the biggest impact to product delays," he added. "Anything that slows design review slows innovation. And anything that speeds up design review, such as data accessibility, makes us better as a company. In the old system, unless you were a CAD user, everything was just tables. Now you see the actual 3D design. It's a completely different experience."

The benefits extend into manufacturing and commissioning. As Climeworks moves toward standardized, repeatable modules, the company has already seen faster build and commissioning cycles with an estimated thirty percent reduction in commissioning time. Windchill+ also supports better preparation for field operations.

"What you see on the screen should match what's in the field," added Allen. "You don't want to arrive on site expecting one pump and find a completely different one. Having accurate, up to date models is essential."

While Climeworks is still early in its digital journey, the foundation is already enabling more predictable operations, fewer late surprises and less rework.

"We're definitely trending toward less rework and more predictable outcomes," added Allen. "That's exactly what we need as we scale. The sooner you can reduce uncertainty, the better off you'll be. Windchill+ helps us do exactly that."

"To scale carbon removal from pioneering plants to a global industrial network, we need a digital foundation as resilient and future proof as the technology itself. Windchill+ gives us the configuration control, clarity and speed to industrialize direct air capture at scale. It's not just a PLM system, it's the strategic backbone that turns breakthrough engineering into a repeatable, global climate solution."

Looking Ahead: A Digital Thread for the Next Generation of Global Direct Air Capture

Climeworks is now preparing for its next wave of global deployments, including projects in the United States, Canada, Saudi Arabia and the United Kingdom. The company plans to expand its digital thread over time, integrating ECAD, manufacturing BOM management, deeper SAP connectivity and long term lifecycle and service processes. Windchill+ will remain the backbone of this evolution. The company's long term ambition is not only to scale carbon removal but to do so profitably.



"Windchill+ is the digital foundation that will support our growth," added Allen. "As we scale, we need a system that can replicate complex, modular industrial systems consistently and reliably. Having the right foundation is essential."

As Climeworks continues to industrialize one of the most important climate technologies of the century, PTC will help ensure that innovation, quality and scalability move in lockstep. In the coming months, Climeworks will also deploy Codebeamer to manage systems engineering workflows, bringing requirements, validation and risk management into a single environment that strengthens traceability and supports the development of increasingly complex DAC systems.

"To remove carbon at the scale the planet demands, we need industrial systems that evolve as fast as the climate challenge itself. By unifying our digital foundation, we're creating the clarity, speed and control required to build the next generation of global carbon removal infrastructure," concluded Allen.

Benefits

- **Real time Collaboration, Faster Design, Fewer Delays** - Instant access to the latest 3D models, eliminating days long review cycles and accelerating innovation across globally distributed teams.
- **Single Source of Truth, Stronger Configuration and Change Control** - Unified, cloud based PLM foundation manages modular variants, environmental adaptations, and long term lifecycle changes with confidence and consistency.
- **Increased Data Accessibility, Better decisions without CAD bottlenecks** - Teams across engineering, manufacturing and operations can inspect, measure and interrogate designs directly in the browser, reducing dependency on specialist tools and freeing designers from constant requests.
- **Modular Scalability, Standardized Core with Site Specific Variants** - Supports strategy of building a repeatable core product with add on variants for extreme climates, enabling global deployment without losing control of complexity.
- **Reduced Commissioning Time, Faster Build and Deployment Cycles** - Estimated 30% reduction in commissioning time, improving speed to operation for new plants.
- **Improved Field Readiness, Accurate, Up To Date Models for On site Work** - Accurate digital models ensure what teams see on screen matches what they encounter in the field, reducing rework and improving operational reliability.
- **Cloud First Scalability, Lower IT Overhead, Faster Time to Value** - Aligns with cloud first strategy, minimizing maintenance burden, avoiding heavy customization, and enabling rapid rollout with limited resources.

Customer Overview | Climeworks

Industry	Industrial Climate Technology
Headquarters	Zurich, Switzerland
Employees	300+ globally
Website	climeworks.com
PTC Products	Windchill+ with Codebeamer deployment to follow