CLIMATE IMPACT REPORT 2024

Deep tech can radically increase the pace and effectiveness of climate solutions—which are inextricable from industrial re-shoring and resilience across the free world—while dramatically reducing their cost.

DCVC is deep tech venture capital.

JAN–DEC 2024

DCVC is the world's largest pure-play deep tech venture capital firm, with more than $4 billion under management. Alongside our work in computing, industrial transformation, human health, and aerospace and defense, we've been investing in climate tech in the service of resilience and abundance for the free world since the early days of the firm. But in 2023, with encouragement from our limited partners, we established our first dedicated climate fund, DCVC Climate. With this fund we focus on identifying and supporting deep tech innovators who are technically and commercially prepared to solve the world's toughest climate challenges. That includes helping the world meet exploding energy demand while hastening the clean energy transition, decarbonizing high-emitting industries, transforming value chains, and advancing climate change mitigation and adaptation technologies.

This is the second annual impact report for DCVC Climate. Our goal in this publication is to offer a transparent look at how we work and how our portfolio companies are performing. We also hope to exemplify and advance best practices in climate impact reporting.

We all understand the dire imperative to rapidly reduce greenhouse gas emissions in order to have any hope of limiting atmospheric warming to manageable levels. The good news is that most of the technologies we need to reverse upward trends in GHG emissions are already here; they're just not adequately distributed. A 2023 analysis by McKinsey suggests that existing or emerging technologies would have the potential to reduce global greenhouse gas emissions by as much as 90 percent, if only they were deployed at scale. Furthermore, technologies that are good for the climate also tend to boost U.S. competitiveness and energy independence. As we said in our most recent Deep Tech Opportunities Report: "We see an inextricable link between deep tech innovation that bolsters American resilience and innovation that saves the environment."

And that's where DCVC Climate comes in. The fund specializes in identifying companies between the early stage and the growth stage that are using computational approaches to transforming high-emitting industries such as power generation. Then we help them cross the wide and hazardous gap between the pilot phase and successful commercialization.

We're confident we know how to do this in the world of climate tech both because we've been investing in this space since 2012, and because we've been doing it in other industries ever since our firm was founded. We partner with companies using AI, machine learning, and other forms of advanced computing to solve hard problems in industries that have traditionally resisted change—and the 33 climate-tech companies we'd backed with $566 million as of December 31, 2024 (by August 2025 these numbers had grown to 35 companies and $611 million) take the same approach to economic resilience and abundance, with the emergent property of a cleaner, better, more sustainable planet. We have hard-earned insight into how to deliver venture-scale outcomes, by focusing on what works in climate tech and applying our experience scaling within other deep tech sectors.

One example from our portfolio prior to the creation of DCVC Climate is Oklo [NYSE: OKLO]. We first invested in the advanced fission nuclear reactor company in 2018. Founded by a group of nuclear engineers from MIT, the company is adapting a liquid sodium cooled fast reactor technology that operated safely for decades at Idaho National Laboratory to build small modular reactors. The reactor design is self-stabilizing and cooled by natural forces, meaning it's walk-away safe.

Oklo's Aurora power plants are designed to provide 15 to 75 megawatts of electricity—perfect for data centers, factories, industrial sites, defense facilities, and small communities. Of all the nuclear companies working with the U.S. Department of Energy on spent fuel recycling, Oklo is one of the furthest along. Recycling spent fuel holds the promise of powering U.S. nuclear plants for over a century and materially decreasing the volume and radioactivity of the spent fuel, while also reducing the need for new uranium mines.

In 2024, Oklo went public through a merger with a special-purpose acquisition company formed by OpenAI CEO Sam Altman and Churchill Capital. It has dozens of gigawatts in its pipeline, including an agreement signed in December with data center operator Switch to provide the company with up to 12 gigawatts of capacity through 2044. It's companies like Oklo—those that are finding safe, elegant, scalable, affordable, zero-carbon ways to generate power—that will help meet exploding demand for electricity while at the same time pushing forward the energy transition.

Another signal climate-tech investment for DCVC is Pivot Bio, which is helping American farmers grow clean, healthy food while removing the worst impacts of the production of synthetic nitrogen fertilizer and its (literal) downstream effects. The traditional Haber-Bosch process for converting atmospheric nitrogen into ammonia for fertilizer uses an immense amount of electricity, accounting for about 2 percent of global CO_2 emissions, and overall the production, transport, and use of these fertilizers is responsible for more than 5 percent of greenhouse gas emissions. Using advanced computing, Pivot identified bacterial strains that make natural ammonia fertilizer from the air and formulated them into crop additives that can allow farmers to dramatically reduce their use of synthetic fertilizer (and their exposure to volatile fertilizer prices) while also improving yields and lowering emissions of the incredibly potent greenhouse gas N_2O. Pivot has created a nitrogen credit "inset" system that allows companies that use crops like corn to pay farmers for verifiable reductions in synthetic fertilizer use—and *Time* magazine named the novel program one of the best inventions of 2024.

DCVC Climate's goal is to find more companies like Oklo and Pivot across sectors such as energy generation, energy/grid management, supply chain reinvention, agriculture, and water, and to use our climate-tech expertise to help these companies build strong networks, scale effectively, and retire industrialization and commercialization risks early. We feel privileged to work with such ambitious and dedicated entrepreneurs, and we are grateful for your partnership in supporting them.

TABLE 1

PATHWAY	COMPANY	TECHNOLOGY	2024 MILESTONES
ENABLING SYSTEMS	Equilibrium Energy	Smarter real-time energy portfolio management to mitigate emissions and grid volatility	Managed top-performing grid-scale battery in ERCOT, expanded from Texas into California
DECARBONIZATION	Fervo	Enhanced geothermal systems to provide reliable, baseload, carbon-free energy	Continued construction of Cape Station project (expanded to 500 MW and fully contracted as of April 2025), closed $244 million funding round and $100 million loan, secured financing of $255 million
	Radiant Industries	Carbon-free nuclear energy using gas-cooled fission microreactors small enough to transport by road, rail, or air	Raised $100M in Series C funding, completed passive cooldown test and Conceptual Safety Design Report, 32 reactors pre-ordered
	Twelve	E-Jet SAF (sustainable aviation fuel) made from CO_2, green energy, and water, with up to 90 percent lower emissions than conventional petroleum-based fuel	Continued construction of AirPlant One facility with production capacity of 1 metric ton of SAF per day, signed contracts to deliver SAF to two additional major airline groups
	Unspun	Automated 3D garment weaving to significantly reduce overproduction and carbon footprints in the fashion industry	Completed Series B funding round, signed manufacturing agreements with Walmart and Decathlon
	Verdigris	Circuit-level insight into electricity usage in data centers and telecom, industrial, and commercial buildings, enabling smarter management and massive energy savings	Saved 114.4 gigawatt-hours of electricity for clients such as Amazon, T-Mobile, and Verizon, and moved aggressively into the data center market
RESILIENCE	ZwitterCo	Fouling-resistant zwitterionic membranes for industry and agriculture to affordably filter and convert unconventional water sources into clean water	Raised $58.4 million in Series B funding, installed base reached 10 million gallon per day of filtration capacity

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The climate-tech landscape is a barbell. There are plenty of venture funds willing to make early-stage bets on young entrepreneurs going after bold, risky, transformative ideas for decarbonizing the global economy. And there's even more capital eager to finance de-risked projects from growth-stage climate-tech companies that have already demonstrated the commercial feasibility of their ideas and now simply need to wrest as much of the market from incumbents as possible.

What's in short supply is capital and support for the companies in between: those who have largely retired their technical risk and are actively bridging the gap between the pilot phase and commercialization. These are exactly the companies building the technologies we will need to halt increases in global greenhouse gas emissions and turn them toward net zero.[1]

What's needed is smart capital familiar with the challenges of deep tech. Capital that knows how to build industrial-scale companies—and understands the difficult science and engineering work that goes into solving trillion-dollar problems, displacing wasteful, polluting, locked-in incumbents, and creating cleaner, more CapEx- and OpEx-efficient alternatives. Since 2010, DCVC has been building the in-house expertise in AI, big-data computation, materials science, and related fields that makes us experts in deep tech investing.

That's why, two years ago, we felt the time had come to launch a fund to squarely seize the "missing middle" opportunity in climate investing. DCVC Climate seeks to lock arms with a small number of like-minded entrepreneurs to help bridge this gap—to **help bend the emissions curve with differentiated capital reserved for mid-stage rounds at climate-tech companies building first-of-a-kind projects and facilities who need our help scaling up.** We supplement that capital with the technical and industry expertise needed to address scaling and strategy challenges, access to an extensive network of partners and coinvestors, and business operations and advisory services.

When our companies succeed, they not only generate profits for us and our limited-partner investors, but also directly contribute to objectives laid out in international social and environmental frameworks such as improving energy efficiency; avoiding or reducing greenhouse gas emissions; conserving land and water; making industries more resource-efficient; and strengthening resilience and adaptation efforts.

DCVC CLIMATE TEAM

To support the entrepreneurs pursuing market-transforming deep tech innovations with funding from DCVC Climate, we've assembled a standout team of investors with deep experience in industry, government, academia, and finance.

ZACHARY BOGUE is co-founder and managing director of DCVC. He brings to bear over 20 years in Silicon Valley as an entrepreneur, venture capitalist, adviser, and angel investor. His investments on behalf of the firm span nuclear energy, agricultural biotech, and applied AI for global-scale climate impact, including areas such as methane abatement and carbon transformation.

The World Economic Forum has named Zack a Young Global Leader in recognition of his leadership at the intersection of transformative technology and urgent global issues. His previous venture investments include Square, AngelList, and Uber. Zack received a bachelor's degree with honors in environmental science and public policy from Harvard University and a JD with honors from Georgetown University's law school.

MATTHEW OCKO is also co-founder and managing director of DCVC. He has been building tech to advance the security and prosperity of the United States since 1983. His current investments on behalf of the firm range from energy, manufacturing, and agriculture to synthetic biology, robotics, applied AI, and national defense.

Many of Matt's prior investments were in companies that either enjoyed large IPOs or were acquired to become core capabilities of companies like Illumina, Cisco, Google, IBM, Amazon/AWS, Broadcom/VMware, Salesforce, and Akamai. His venture investments prior to DCVC include Zoom, Fortinet, D-Wave Systems, Uber, AngelList, XenSource, and Facebook. He holds a degree in physics from Yale University, and he is an inventor on over 50 granted or in-process patents in areas as diverse as computer systems virtualization, fraud detection, and AR.

MILO WERNER joined DCVC as a general partner in June 2024. She focuses on identifying and nurturing deep tech ventures with the potential to go beyond emissions reduction to revolutionize value chains, decarbonize high-emitting industries, and advance mitigation and adaptation efforts.

Before taking a leading role at DCVC Climate, she held partner positions at MIT's The Engine Ventures, Ajax Strategies, and Khosla Ventures. Her operating experience includes many years leading new product introductions at Tesla Motors and Fitbit, and she was also a vice president of engineering at solar battery startup Zola. She holds a bachelor's degree in geology and civil and environmental engineering from the University of Vermont, and a master's degree in engineering and an MBA from MIT.

DR. RACHEL SLAYBAUGH is a partner at DCVC focused on climate, sustainability, and energy investments.

Before joining DCVC, Slaybaugh was a tenured associate professor of nuclear engineering at the University of California, Berkeley, and also a division director at Lawrence Berkeley National Laboratory, where she ran the Cyclotron Road division, the hard-tech innovation fellowship program. She served as a program director at the Department of Energy's ARPA-E, where she created the nuclear fission program and managed the agriculture portfolio as well as solar and virtual reality teams. She has a bachelor's degree in nuclear engineering from Pennsylvania State University, where she served as a licensed nuclear reactor operator, and a master's degree and PhD in nuclear engineering and engineering physics from the University of Wisconsin-Madison.

KRISTEN ROCCA is a principal at DCVC. She focuses on climate and industrial innovation, investing in technologies that reduce emissions, enable adaptation, and modernize foundational industries. Before joining DCVC, Rocca led frontier-tech investing at Unovis Asset Management in Amsterdam and Atlantic Labs in Berlin.

Prior to investing, Rocca worked across the energy sector in operations and product development for the nuclear, utility, and automotive industries, spent several years in operations and sustainability consulting for international corporations, and led growth strategy and fundraising efforts for Novameat, a Barcelona-based startup focused on advancements in tissue engineering for the alternative protein sector. She holds a bachelor's degree in chemical engineering from McMaster University with a specialization in polymer materials and manufacturing, and an MBA from IESE Business School in Barcelona.

Rocca guest lectures at IESE Business School and is a mentor at several climate-related startup accelerators.

GREGG ROTENBERG is an operating partner at DCVC, helping the firm's climate, energy, and related portfolio companies align their customer needs, go-to-market approach, talent, and investor expectations. Before joining DCVC, he led several climate-tech companies and ran the Renewable Power Group at Chevron, where he achieved 300 percent above-target earnings and 30 percent annual investment returns while leading the development and investment of 200 MW of utility-scale solar and geothermal projects.

Gregg developed much of his go-to-market expertise at Keystone Strategy, a consulting firm founded by Harvard Business School professors, where he led strategy engagements for many of the world's most recognized technology brands. He earned a bachelor's degree from the Wharton School at the University of Pennsylvania and an MBA from Northwestern's Kellogg School.

DCVC'S CONTRIBUTIONS TO THE CLIMATE INVESTING ECOSYSTEM

DCVC is represented on the steering committee of the Venture Climate Alliance, which provides investing partners across the industry with tools for capitalizing on the opportunities in climate investing, and our individual partners and principals participate in other relevant industry groups.

ZACHARY BOGUE has long advocated for economically compelling technologies that will reduce greenhouse gas emissions while also buying time for the planet and society to develop long-term, large-scale climate solutions. He leads DCVC's year-round participation in the World Economic Forum, where our partnership showcases deep tech's role in bringing the world greater prosperity, equity, and resilience. A longtime advocate for nuclear energy, he produced the award-winning 2022 Oliver Stone documentary 'Nuclear Now.'

MATTHEW OCKO is a veteran deep tech investor who believes that large-scale positive societal impact, sustainability, and healthy investment returns can—and must—go hand in hand. He sees the best climate investments as engines of systemic resilience and resource abundance and has driven impact through supporting and advising companies such as Pivot Bio, which helps farmers grow more food, more sustainably while delivering outsized environmental benefits.

MILO WERNER co-founded the NextGen Industry Group, which supports the advanced manufacturing revolution in the United States by tracking startup activity in the field and organizing gatherings that bring together leaders, operators, experts, and capital providers to share best practices, influence policy, and create partnerships.

DR. RACHEL SLAYBAUGH created Good Energy Collective, a policy research organization building the case for advanced nuclear energy. She founded and organized the Nuclear Innovation Bootcamp, a summer workshop that introduces students and early-career professionals to advanced nuclear energy, and participates in various review activities and independent studies such as the Commission on the Scaling of Fusion Energy.

KRISTEN ROCCA is a member of the World Economic Forum's Global Future Council on Energy Technology Frontiers, which focuses on accelerating progress on energy systems that are adaptable, inclusive, and forward-looking.

GREGG ROTENBERG built up a climate-tech track record in multiple roles, including CEO at Insight M, a leader in high-frequency aerial methane detection, and CEO and president at Smart Wires, a maker of grid-enhancing technologies.

DCVC CLIMATE PORTFOLIO AT A GLANCE

TABLE 2 — ALL FIGURES AS OF DECEMBER 31, 2024

Dollars invested

$142 million

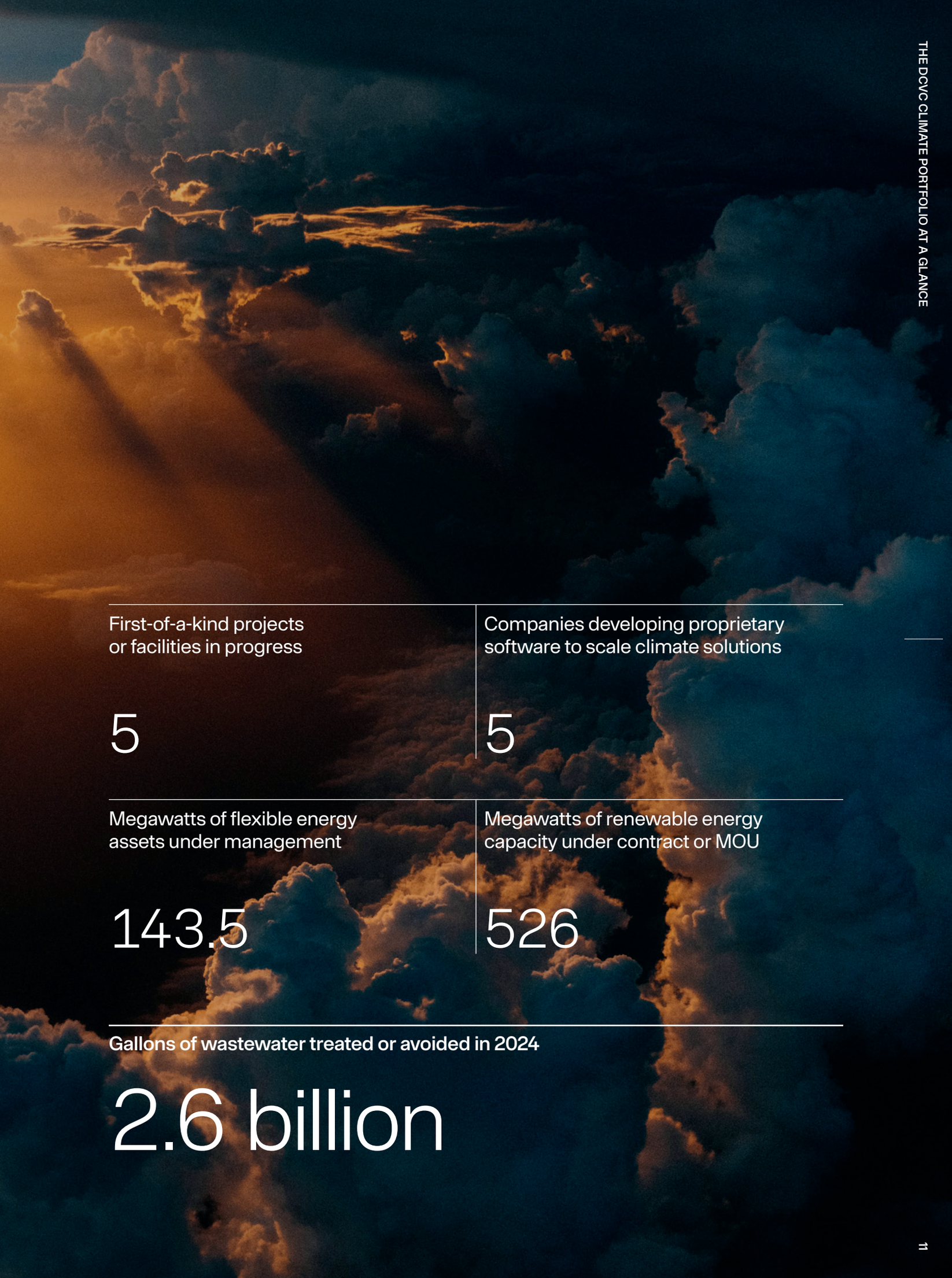
Number of investments

7

DECARBONIZATION pathway investments	RESILIENCE pathway investments	ENABLING SYSTEMS pathway investments
5	1	1

Metric tons of CO_2e emissions avoided

48,911



First-of-a-kind projects or facilities in progress

5

Companies developing proprietary software to scale climate solutions

5

Megawatts of flexible energy assets under management

143.5

Megawatts of renewable energy capacity under contract or MOU

526

Gallons of wastewater treated or avoided in 2024

2.6 billion

The exercise of assembling this second annual DCVC Climate Impact Report has left us with a mixture of satisfaction about our portfolio companies' achievements so far, respect for the scale of the challenges ahead, and cautious optimism for a future with widespread equity and resilience and a stable climate. Across the fund, we're starting to see exactly the kinds of changes and impacts we'd hoped for when we began making investments in 2023.

From demonstration to commercialization

DCVC intentionally targets climate-tech companies that are ready to make the leap from prototype to commercial scale-up, and where we can help supply the capital, operational expertise, and industrial know-how needed for them to do so. A majority of our portfolio companies are successfully building out their technologies and hitting their commercialization milestones. Fervo Energy drilled 15 additional geothermal wells in 2024, with tests demonstrating record flow rates and drill times. Equilibrium Energy demonstrated the best performance of battery management in the ERCOT grid and expanded its offerings to virtual power purchase agreements. Radiant Industries completed key steps toward the licensing and testing of its pioneering microreactor design. Twelve continued construction of its first commercial AirPlant for conversion of biogenic CO_2 streams into sustainable aviation fuel and is on track to bring it online in 2025. Unspun deployed its first Vega 3D weaving machine at a partner factory. ZwitterCo reached a total water-filtration capacity of 10 million gallons per day.

Building first-of-a-kind projects and facilities

DCVC has over a decade of experience working with companies building first-of-a-kind facilities and leveraging our deep knowledge to help them seize opportunities such as meeting exploding energy demand while still lowering emissions. Fervo's 3.5-megawatt Project Red facility demonstrated the viability and efficiency of its enhanced geothermal drilling techniques, and its 500-megawatt Cape Station project will bring clean power to the grid in 2026. Radiant's gas-cooled Kaleidos microreactor is on track to be tested at the world's first fission microreactor test bed at Idaho National Laboratory in 2026. Twelve's AirPlant in Moses Lake, Wash., will be the first air-to-jet sustainable aviation fuel plant in North America. Unspun demonstrated automated 3D weaving technology for on-demand clothing manufacturing at its micro-factory in Emeryville, Calif. ZwitterCo opened an innovation center in Woburn, Mass., where it is exploring new applications for its novel zwitterionic filtration membranes.

Scaling up

Climate solutions are only as effective as their level of adoption. In 2024 our portfolio companies continued to secure major contracts, offtake agreements, and partnerships with strategic industry players. Fervo grew its contracted generating capacity from 373 megawatts in 2023 to 500 megawatts by the end of 2024. Equilibrium signed several new battery offtake tolling agreements, bringing its total contracted battery tolls to 260 megawatts. Radiant signed memorandums of understanding with six microreactor customers for a total of 32 reactors. Twelve won contracts to sell its E-Jet sustainable aviation fuel to two new airlines, including a 14-year, 260-million-gallon contract with the European aviation group IAG. ZwitterCo quintupled its base of awarded or installed commercial projects, to 60 projects across 15 countries.

DCVC'S CLIMATE IMPACT MANAGEMENT SYSTEM

Well before we began fundraising for DCVC Climate or making investments from the fund, we set out to define a unique impact thesis (described on page 7) that would shape our investment strategy and differentiate the fund from the broader impact investing market. We also created an impact assessment framework that would guide us in evaluating, quantifying, measuring, and reporting on the progress and effectiveness of the companies we back and the climate solutions they're developing.

The outcomes we seek—in addition to profits for our limited partners—are directly measurable in terms of variables such as greenhouse gas emissions avoided or reduced, water and land conserved or sustainably managed, and adaptive solutions implemented. A focus on impact is integrated throughout our investment process—we source, screen, and invest in companies that align with our impact thesis and assessment framework.

Once we've invested in a company, we continuously assess the changes our capital and expertise are bringing about. We look for those changes in one of three categories or pathways.

1 DECARBONIZATION

The **decarbonization pathway** is the one most of our climate portfolio companies are in. Companies in this category, such as Fervo, Radiant, and Twelve, are working to replace fossil-based, carbon-emitting incumbent technologies with cleaner ones that reduce or avoid greenhouse gas emissions, which is the key to arresting and eventually reversing global warming. These companies are transforming industrial processes or changing the way energy is harnessed, stored, distributed, and used—and we believe their solutions are mutually reinforcing, all contributing to a sustainable energy system.

The effectiveness of individual companies in the decarbonization pathway can usually be measured directly in terms of GHG emissions reduced or avoided. More on this below, where we explain our approach to calculating each company's emissions reduction potential.

2 ENABLING SYSTEMS

Companies in the **enabling systems pathway** are building new elements of the technological infrastructure needed to speed the climate transition, fostering further climate innovation and transformational change. Our portfolio company Equilibrium Energy, for example, is optimizing energy flows around the grid, helping energy portfolio managers understand and manage their assets and reducing the grid's overall emissions intensity.

The progress of companies in the enabling systems pathway can be gauged in qualitative terms, by seeing how they've transformed their target markets, or by gathering industry-specific data that demonstrates the additional capacity generated (such as the expansion of grid storage capacity, in the case of Equilibrium).

3 RESILIENCE

Companies in the **resilience pathway** are working to reduce the impact of climate change through adaptation measures and/or improve the strength and resiliency of the ecosystems in which they are embedded, such as fresh water supply systems. For example, improving wastewater treatment and recycling, as ZwitterCo is doing, is an important way to protect industry, agriculture, and human communities.

The technologies being built by companies in the resilience pathway may not reduce emissions directly, but their outputs still help save the planet and can be measured against the status quo. These outputs might look like the volume of water recycled or processed, the amount of waste reduced or managed, the area of land sustainably managed, or the percentage of pollutants reduced.

We gather and track impact indicators at the company level, the pathway level, and the fund level, aligning with industry frameworks such as IRIS+ where possible to increase comparability and transparency. This enables consistent accounting of portfolio performance internally within DCVC, externally for our limited-partner investors, and publicly through reports like this one.

In 2023 we partnered with Tideline, a leading global impact investing consultancy, to create an impact management system for DCVC Climate, and today Tideline supports DCVC's annual effort to gather standardized impact data and qualitative progress reports. First, they meet with the companies to align on the appropriate data to track and set targets for scale and impact, as well as to discuss key updates to each company's business, strategy, and impact. The Tideline team then supports companies through the annual data collection process. They update data collection templates and engage in follow-up conversations and reviews to ensure accurate reporting and transparency in methodology and assumptions for calculating impacts.

Our data collection and impact monitoring practices are aligned with (and to a large extent drawn from) the Operating Principles for Impact Management (OPIM), a framework of best practices for impact investors developed by the International Finance Corporation of the World Bank.[2] To build our impact management system, we've also drawn from standards and frameworks such as the Impact Management Project (IMP), IRIS+, the United Nations Sustainable Development Goals, Project Frame, and the Venture Climate Alliance's Climate Solutions Framework.

Calculating emissions reduction potential

By design, we channel our capital at DCVC Climate toward companies that are just beginning to scale up their climate solutions. This means that the bulk of the impact of these solutions lies in the future. It's important for us to quantify that potential impact and how it might change over time, since this not only helps us allocate our capital wisely, but also allows us to track whether our portfolio companies are progressing toward their goals.

Specifically, Tideline and DCVC use the emissions reduction potential methodology defined by Project Frame, an effort organized by the nonprofit Prime Coalition to demystify climate investing and standardize emissions impact measurement and management.[3] The emissions reduction potential analysis focuses on quantifying each company's planned impact—the emissions it expects will be avoided as a result of its products or services over a 10-year period (with year zero being the year of DCVC's investment)—using expected commercial volumes, and compared to a baseline scenario in which the company does not exist. For 2024 we calculated emissions reduction potential for all of the companies in the decarbonization pathway, meaning five of the seven companies in our portfolio.

Let's walk through the process step by step, using as an example the enhanced geothermal energy developer Fervo Energy (as we did in our 2023 Climate Impact Report).

❶ The first step in quantifying emissions reduction potential is to find the **emissions intensity** or **unit emissions** for the solution and the baseline, in terms of the quantity of carbon dioxide or carbon-dioxide equivalent emitted per unit of energy—in this case, per kilowatt-hour (kWh). The National Renewable Energy Laboratory carried out a thorough lifecycle analysis of geothermal energy in 2021 and pegged this number at 0.037 kg CO_2e/kWh.[4] For the baseline scenario, Fervo obtained data on the hourly power mix of the grid where the company is currently providing energy; that grid's unit emissions are 0.432 kg CO_2e/kWh, which is slightly below the unit impact for natural gas of 0.44 kg CO_2/kWh (the number used in last year's report). The unit emissions of the baseline solution is expected to decrease over time as renewable energy deployment increases, and this is factored into our model.

❷ The next step is to subtract the solution's unit emissions from the baseline's unit emissions. The difference is called the **unit impact**. In the case of Fervo's geothermal energy vs. the local grid, the unit impact is (0.432-0.037)=0.395 kg CO_2e/kWh.

❸ The third step is to estimate the scale or expected **commercial volume** the company could realistically achieve given the boundaries of their technologies and target markets. In Fervo's case, we worked with the company to produce estimates for the total megawatts electric (MWe) the company expects to install over the first 10 years (with 2023, the year of our first investment, as year zero). Assuming a capacity factor of about 90 percent, which is typical for geothermal plants and is the capacity at which Fervo expects to operate future plants, we were able to forecast power generation in terms of megawatt-hours per year (MWh/yr). In 2024 Fervo had 3.5 MWe of geothermal capacity under management, which would generate 27,610 MWh/yr at expected capacity. By year 10, it expects to have 1,000 MWe under management with a total expected renewable generation of 7,884,000 MWh/yr.

❹ The final step is to multiply the net unit impact by the commercial volume, to obtain the estimated emission reduction per year. This is called the **planned impact**. For Fervo in 2024, this number was calculated as 0.395*27,613=10,904 metric tons of CO_2e avoided if all assumptions held true. But as we just mentioned, these numbers assume that wells operate at 90 percent capacity. We learned in interviews with Fervo that their first plant, Project Red, is being run in 2024 and 2025 by an external partner and is therefore operating at lower output. Taking that difference into account, Fervo's **realized impact** in 2024, or the amount of emissions that were actually avoided, was 4,770 mt CO_2e. We estimate that by 2033 Fervo's average unit impact will be 0.373 kg CO_2e/kWh (a decrease from 2024 due to a larger share of renewables in the energy mix) and that commercial volumes will grow to 7.9M MWh/yr, so the planned impact will grow to (0.373 kg CO_2e/kWh)*(7.9M MWh*1,000)/1,000=2,943,850 mt CO_2e avoided annually, for a 10-year cumulative total of 11,557,000 mt CO_2e.

Just as DCVC pushes boundaries by supporting game-changing companies, we hope to advance the state of climate impact reporting in the investing world through our avoided emissions calculations. It's important to note that the climate-tech companies DCVC funds are, almost by definition, developing emerging, often first-of-a-kind technologies that are only beginning to reach their intended commercial markets. The emissions reduction potentials and other forward-looking data we share here (with the exception of realized impact) are *projections only*. The quantities that go into our calculations, such

Emissions reduction potential for the DCVC Climate decarbonization pathway companies*

TABLE 3

			↓ 10 YEARS AFTER FIRST DCVC INVESTMENT ↓		
COMPANY	BASELINE SOLUTION	EMISSIONS INTENSITY IMPROVEMENT	ESTIMATED SCALE	ANNUAL REDUCTION POTENTIAL	CUMULATIVE REDUCTION POTENTIAL
FERVO	Local power grid	**91.4%**	**1,000 MWe** renewable energy capacity	**2.9M mt** CO_2e	**11.5M mt** CO_2e
TWELVE	Traditional jet fuel	**93.3%**	**421,378,048** gallons E-Jet, **105,344,512** gallons E-Naphtha per year	**5.0M mt** CO_2e	**10.7 mt** CO_2e
VERDIGRIS	Traditional HVAC and building energy management systems	**12.2%** (5-30% depending on client type)	**23,684 GWh** (gigawatt-hours) energy managed	**1.8M mt** CO_2e	**4.4M mt** CO_2e
RADIANT	Diesel generators	**98.8%**	**50** nuclear reactors deployed	**200k mt** CO_2e	**552k** mt CO_2e
UNSPUN	Traditional garments	**42.9%** (43-93% depending on energy mix)	**105,000,000** sustainably produced garments per year	**63,000 mt** CO_2e	**221k mt** CO_2e
AVERAGE/TOTAL		**67.7%**		**9.98M mt** CO_2e	**27.4M mt** CO_2e

Reducing CO_2e emissions by 1 million metric tons is equivalent to taking about 217,000 cars off the road for a year; 1.2 million acres of forest can sequester that much carbon in one year.

as expected commercial volumes, are based on conservative assumptions. But they're still subject to change in future impact reports as companies learn more about the markets in which they operate and the strengths and limitations of their technologies and alter their forecasts accordingly. The core commitment in all of our impact reporting is to share this information with candor, transparency, and consistency. We intend to calculate realized impact for each company annually to ensure accurate reporting to LPs and to improve the accuracy of our forward-looking calculations.

* Estimated scale and avoided emissions data are based on available data and conservative estimates and are subject to change. The figures in this table are not guaranteed or attributable to DCVC, and are intended for illustrative purposes only.

PART I

DECARBONIZATIO

COMPANIES: Fervo | Radiant Industries | Twelve | Unspun | Verdigris

N

PATHWAY

FERVO ENERGY

Delivering 24/7 carbon-free geothermal energy

"Fervo is a typical DCVC company in that they have an industry-leading team applying a brilliant but straightforward engineering insight to create a product that can immediately help to solve a trillion-dollar problem."

Zachary Bogue and Matt Ocko
Founders and managing partners, DCVC

Market & technical challenge

The Earth's core, mantle, and crust store immense amounts of heat. Much of it is left over from when the planet first accreted, and the rest comes from friction (as denser core material sinks) and the decay of radioactive isotopes of uranium, thorium, and potassium. Convection carries some of this heat toward the surface, where it warms up rock as well as the salty water filling its fractures and pores. One MIT study estimated that the theoretically extractable portion of this heat, given then-current and foreseeable technologies, was about 200,000 exajoules—enough to "supply a substantial portion of U.S. electricity needs for centuries," in the words of the report.[5]

So why hasn't the whole planet copied Iceland, which generates about a quarter of its electricity using steam and hot water from geothermal wells? The problem is that until recently, most geothermal reservoirs outside of volcanic hot spots like those in Iceland were considered either too deep for conventional drilling technology to reach or too impermeable, meaning they didn't contain enough water to transport the heat to the surface. Government-sponsored fieldwork on geothermal drilling began in the mid-1970s, but the art and science of geothermal exploration stagnated after that due to a lack of investment and policy incentives. As a result, geothermal heat today makes up only 0.4 percent of the U.S. energy supply (though that number is 6 percent in California and 8 percent in Nevada).

The scale of the untapped opportunity is huge, since geothermal wells are around-the-clock, zero-emissions energy sources that could easily complement intermittent, weather- and sunlight-dependent sources such as wind and solar. But the industry never managed to scale up—again, partly because shallow and permeable heat reservoirs were hard to find, and partly because drilling was slow, expensive, and risky (about 30 percent of wells came up dry).

Solution & impact

Enter enhanced geothermal—essentially, injecting liquid underground to get heat out of the rocks. Fervo's most important innovation, on top of this, was to adopt hydraulic fracturing and horizontal drilling techniques from the U.S. oil and gas industry to geothermal drilling. Few observers believed this could be done, since the rocks where geothermal heat is found are generally harder and hotter than those oil and gas producers encounter. But Fervo has now proved that it can create fractures in hot rock where they didn't exist before, inject fluid when there isn't enough already, and reliably pump hot fluid back to the surface to power steam generators.

This technology, together with sophisticated sensing, data collection, and modeling techniques, is allowing Fervo to reach previously inaccessible heat reservoirs and reduce the risk of failed wells to zero. The company has put itself on a steep learning curve. It took Fervo 72 days to drill its first test well in Nevada in 2022. But with innovation and continuous learning, they've been able to reduce drilling times radically. At Fervo's second facility, Cape Station in southwest Utah, their current record to drill a new well is just 17 days.

At its first commercial plant, Project Red, which supplies 3.5 MW of power to a Google data center in Nevada, Fervo achieved a world-record flow rate of 63 liters of water per second. In effect, that project derisked much of Fervo's technology, showing that the company could indeed drill sideways in hot granite, achieve crossflow from an injection well to a second production well, and produce power. By the end of 2024, the company had drilled 20 wells, generating 3.5 megawatts of renewable power, with another 500 megawatts contracted. At Cape Station, its first greenfield, utility-scale generation project, Fervo plans to start feeding power to the grid in 2026.

When geothermal energy is used to decarbonize power grids, it often does so by replacing natural gas, and Fervo calculates that the energy supplied to Google in 2024 resulted in 4,770 metric tons of avoided CO_2e emissions. Its target for avoided emissions in 2025 is in the same range, and by 2030, with a forecasted 500 MWe under management, the company's avoided emissions will have increased significantly. Fervo uses closed-loop, low-emissions organic Rankine cycle (ORC) turbines to convert heat from geothermal sources into electricity, which means it can easily cool and reinject the geothermal fluid, reducing water use. It's also working to electrify its drilling operations at Cape Station, which will reduce its reliance on diesel generators.

FERVO ENERGY

Milestones & future growth

DCVC led Fervo's $110 million Series C fundraising round in 2022 and participated in its $244 million Series D round in February 2024 as well as an additional $255 million in financing in December 2024. Both of the 2024 rounds contributed to progress on the Cape Station development project. We've championed Fervo by introducing company leaders to key policymakers, helping it professionalize its corporate governance by chairing the company's People and Culture Committee, and helping to guide its growth through our seat on its board of directors. We're especially pleased that Fervo has secured more leases on desirable land (with proven geothermal resources) than any other industry incumbent or startup, giving the company a vast arena for expansion.

The geothermal sector, while still small today, has the potential to provide a large and predictable source of clean energy. Fervo, drawing from oil and gas talent seeking to join the clean energy transition, has built an industry-leading team of experts in drilling, reservoir engineering, geoscience, and energy project development—and they're already accelerating the transition to a decarbonized future with abundant, affordable, clean, reliable power.

KEY METRICS

4,770 mt CO_2 emissions avoided in 2024	3.5 MWe generation capacity under management	500 MWe generation capacity contracted

Fervo's emissions reduction potential

91.4%

emissions intensity improvement vs. local grid

91.6%

emissions intensity improvement vs. natural gas

2.9M mt

CO_2e annual reduction potential by 2033

"They have a long project pipeline, with a big jump on lease holding—which is great, because now a lot of people are trying to get geothermal leases. Piece after piece, they're doing the things they said they were going to do."

Dr. Rachel Slaybaugh
Partner, DCVC

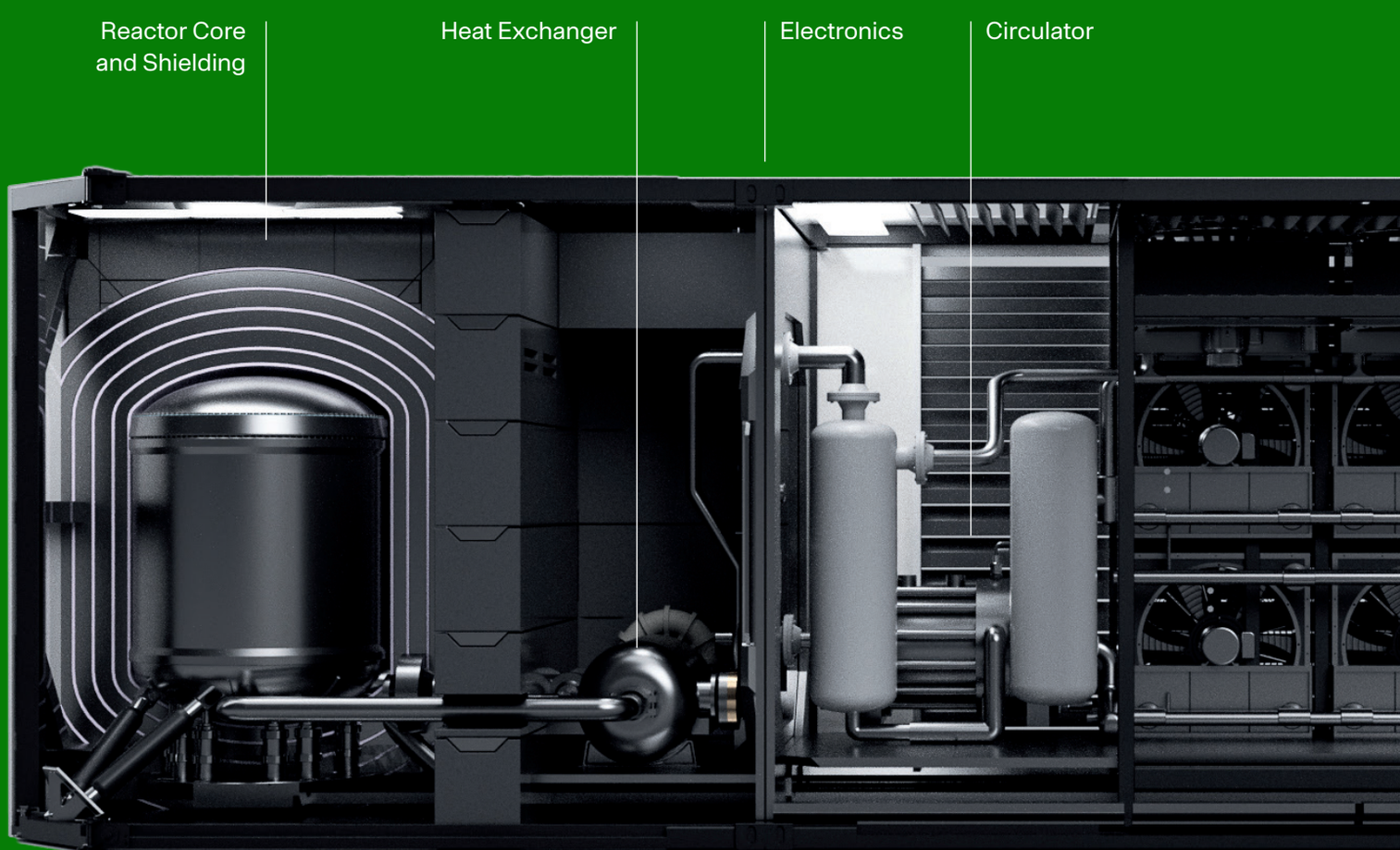
KEY ASSUMPTIONS

- Average U.S. grid emissions intensity = 0.39kg CO_2e/kWh, decreasing each year as renewables make up more of the grid.
- Natural gas emissions intensity = 0.44kg CO_2e/kWh, held constant over time.
- Emissions intensity of Fervo's energy is based on a publicly available Life Cycle Assessment (LCA) of geothermal energy and is assumed to be 0.04kg CO_2e/kWh.
- Fervo will reach 1,000 MWe of capacity by 2033.
- Fervo's wells will operate at ~90 percent capacity going forward, in line with market expectations for geothermal plants. Current production capacity at the Project Red test site is lower.
- Baseline scenario is a combination of the average emissions intensity of grids in the U.S. and the emissions intensity of natural gas power. The emissions intensity of the U.S. grid will decrease over time due to increased renewable deployment.

RADIANT INDUSTRIES

Building a portable nuclear microreactor that replaces diesel generators

KALEIDOS REACTOR BREAKDOWN



Market & technical challenge

Often, the only practical way to power a remote, off-grid facility such as a village hospital or military base is to bring in a noisy and polluting diesel generator. An average-sized unit, such as the MEP-PU-810 from PD Power Systems, generates 840 kilowatts and burns 60 gallons of JP-8 diesel per hour (fuel that must itself be transported to the generator site). The emissions intensity of diesel is about 10.2 kilograms of CO_2 per gallon, so if an MEP-PU-810 operates for a year at 75 percent capacity, 4,000 metric tons of CO_2 is released into the atmosphere.

But there is, in principle, a zero-carbon alternative: a microreactor generating power through nuclear fission. The ideal unit would produce on the order of 1 megawatt of power, in contrast to the 1,000 or more megawatts generated by a conventional utility-scale fission plant. It would also not need water to provide a cooling heat sink. Thanks to recent developments in modeling and simulation, controls, and materials, microreactor designs are emerging that can not only meet these conditions, but also be cost-competitive with diesel generators. As a result, microreactors are poised to offer the reliability and resilience of diesel generators, without the air pollution and complexity of periodically delivering diesel fuel—a major concern in remote locations.

Solution & impact

At Radiant Industries, a team including former SpaceX employees is using extensive digital twinning and other computational methods to rethink fission reactor design from the ground up. Traditional utility-scale fission reactors are several stories tall and are equipped with elaborate water-based cooling systems to carry heat away from the core and provide reactor physics functions. Radiant's Kaleidos microreactor, by contrast, is powered by robust and durable TRISO (TRI-structural ISO-tropic particle) fuel, which is made up of poppyseed-sized kernels of uranium, carbon, and oxygen encased in multiple layers of carbon and ceramic. Heat is carried from the reactor to the power generation loop by a continuously circulating flow of helium gas; the helium never becomes radioactive, which minimizes the impact of leaks. The heat from the core is exchanged with an air cooling system, which means the reactor requires zero water on site. The whole assembly fits inside a semitrailer, which means it can be deployed rapidly by road, rail, or air.

The company expects to conduct fueled tests of Kaleidos at Idaho National Laboratory's Demonstration of Microreactor Experiments (DOME) facility in 2026 and to deliver its first commercial reactor by 2028. By 2034 the company hopes to have 50 reactors in the field, each producing 1 MWe of power and delivering a dramatic savings in greenhouse emissions. Radiant's lifecycle emissions are 98.8 percent below those of diesel generators, which we estimate will allow organizations using Kaleidos microreactors to avoid 3,973 metric tons CO_2e emissions in 2028 and 199,000 metric tons by 2034, or 552,000 metric tons cumulatively from 2028 to 2034.

"I think this will ultimately be a game changer. We'll be able to bring reliable zero-emissions power to remote locations and emergency situations, creating tremendous flexibility that's never been possible before."

Dr. Rachel Slaybaugh
Partner, DCVC

RADIANT INDUSTRIES

Milestones & future growth

In 2024 Radiant raised $100 million in DCVC-led Series C funding. DCVC has a seat on the company's board and provides nuclear expertise as well as help with hiring, factory build-out, and connections to government agencies, strategic partners, and other investors, all the way through the required licensing and cost-down steps.

Also in 2024, Radiant completed two of the five steps that the U.S. Department of Energy requires before a fueled test at Idaho National Laboratory: approval of (1) the Conceptual Safety Design Report and (2) the Preliminary Design Report. They have also completed the Nuclear Quality Assurance Audit. Radiant expects to work through the remaining milestones in the first half of 2026. Radiant is the only reactor developer to hold to its original schedule since inception, and it already has signed agreements to supply reactors to six customers.

Decarbonization of energy production will be hardest in out-of-the-way locations where renewable sources are too expensive or unreliable to deploy. It's going to take bold, creative thinking and hard work like Radiant's to push first-of-a-kind demonstrations of technologies like microreactors all the way through the required safety and licensing steps. But once the technology comes online, it will make an important contribution to the diversity of the U.S. energy mix.

KEY METRICS

32 microreactors contracted	**Completed** Passive cooldown test
50 microreactors deployed by 2034	**Completed** Conceptual safety design report

Radiant's emissions reduction potential

98.8%

emissions intensity improvement vs. diesel generators

198,663 mt

CO_2e annual reduction potential by 2034

KEY ASSUMPTIONS

- Emissions intensity of Radiant's energy is based on a publicly available Life Cycle Assessment (LCA) for small modular nuclear reactors, and is assumed to be 0.008 kg CO_2e/kWh.
- Emissions intensity of diesel fuel is assumed to be 0.728 kg CO_2e/kWh.
- Radiant will begin deploying reactors in 2028, and will reach 50 reactors deployed by 2034.
- Radiant's microreactors are assumed to operate at an average of 65 percent capacity.

TWELVE

Using biogenic CO_2 to make sustainable hydrocarbon fuels and materials

Market & technical challenge

In 2023, the aviation industry added 950 million metric tons of CO_2 to the atmosphere, or about 2.5 percent of global CO_2 emissions.[6] Unfortunately, this is one part of the economy that may never be fully decarbonized. For long-distance air travel (and for rocket travel to orbit, for that matter) the energy density of hydrocarbon fuels is unmatched; there is no substitute. Something similar is true in durable-goods manufacturing, where hydrocarbons have a unique ability to form light, strong, moldable organic polymers—that is, plastics.

It may be possible, however, to phase out fossil-based jet fuel and plastic in favor of carbon-neutral versions made using carbon from other sources. One idea, called Power-to-Liquid, is to use electricity from renewable sources to turn biogenic CO_2 into the building blocks of e-fuels and plastics.

THE CENTRAL REACTION IS:

$$CO_2 + H_2O + \text{electricity} = CO + H_2 + O_2$$

The combination of CO and H_2 is called synthesis gas, or syngas, and it can be transformed into a huge range of products, from plastics to green fuels. The challenging part is creating syngas from biogenic CO_2 efficiently, and at scale.

Solution & impact

Twelve, founded in 2015, invented a membrane electrode assembly called the Leaf which contains a novel catalyst that reduces CO_2 and water into syngas. This syngas is then turned into fuels such as Twelve's E-Jet Sustainable Aviation Fuel (SAF) and chemicals such as E-Naphtha, a building block for plastics. There are other ways to make SAF, including gasification of carbon-based waste and conversion of waste oils and crop ethanol, but the electrolysis-based Power-to-Liquid approach uses far less land and water, and has a significantly smaller carbon footprint.

Throughout 2024, Twelve focused on developing and testing the large-format electrolyzers that are slated to become the workhorses at AirPlant One, the company's first Power-to-Liquid plant, which is nearing completion in Moses Lake, Wash. With the new plant, Twelve will be able to fulfill the contracts it has signed to supply E-Jet to customers such as Microsoft, Shopify, Alaska Airlines, and IAG (the holding company for five European airlines including British Airways and Iberia).

DCVC has participated in every funding round for the company since Twelve's 2018 seed round, and it has provided the company with connections to potential customers and investors, as well as communications strategy support, talent strategy and benchmarks, and policy strategy.

TWELVE

Milestones & future growth

When it comes online in late 2025, the AirPlant One facility will be able to transform one metric ton of CO_2 per day into fuels and feedstocks. The company's target for 2026 is to produce 45,000 gallons of E-Jet and 11,000 gallons of E-Naphtha.

Every gallon of E-Jet or E-Naphtha produced represents a substantial reduction in carbon emissions. The lifecycle emissions of conventional jet fuel are about 11.9 kg CO_2e per gallon, while the lifecycle emissions of E-Jet is 0.8 kg CO_2e per gallon, according to a lifecycle analysis conducted by Twelve. That's a 93 percent reduction in emissions per gallon, and it means that by 2033, if Twelve hits its E-Jet production targets, the company will be helping its customers avoid 4.7 million metric tons of CO_2e emissions annually compared to traditional jet fuel.

E-Naphtha, which can substitute for fossil naphtha in plastics, rubber, resins, and cleaning agents, is even more carbon-negative. It has a lifecycle impact of -2.6 kg CO_2e per kg of E-Naphtha, compared to 0.5 kg CO_2e per kg of fossil naphtha. By 2033 we expect Twelve to be producing 105.3 million gallons of E-Naphtha per year, mitigating 327,000 metric tons of CO_2e emissions annually.

Full decarbonization is a pipe dream. We live on a planet where fossil hydrocarbons have fueled transformative leaps in health, mobility, and prosperity, and few people would choose to turn back the clock. That said, replacing fossil feedstocks with renewable carbon could eliminate more than 10 percent of global CO_2 emissions virtually overnight, while transforming a harmful waste product into a resource.[7]

KEY METRICS

2 new
client contracts signed in 2024

80 mt
of CO_2 transformed, cumulatively

Twelve's emissions reduction potential

93.3%

emissions intensity improvement vs. conventional jet fuel

326,568 mt

CO_2e annual emissions reduction potential for E-Naphtha by 2033

4,677,296 mt

CO_2e annual emissions reduction potential for E-Jet by 2033

5,003,864 mt

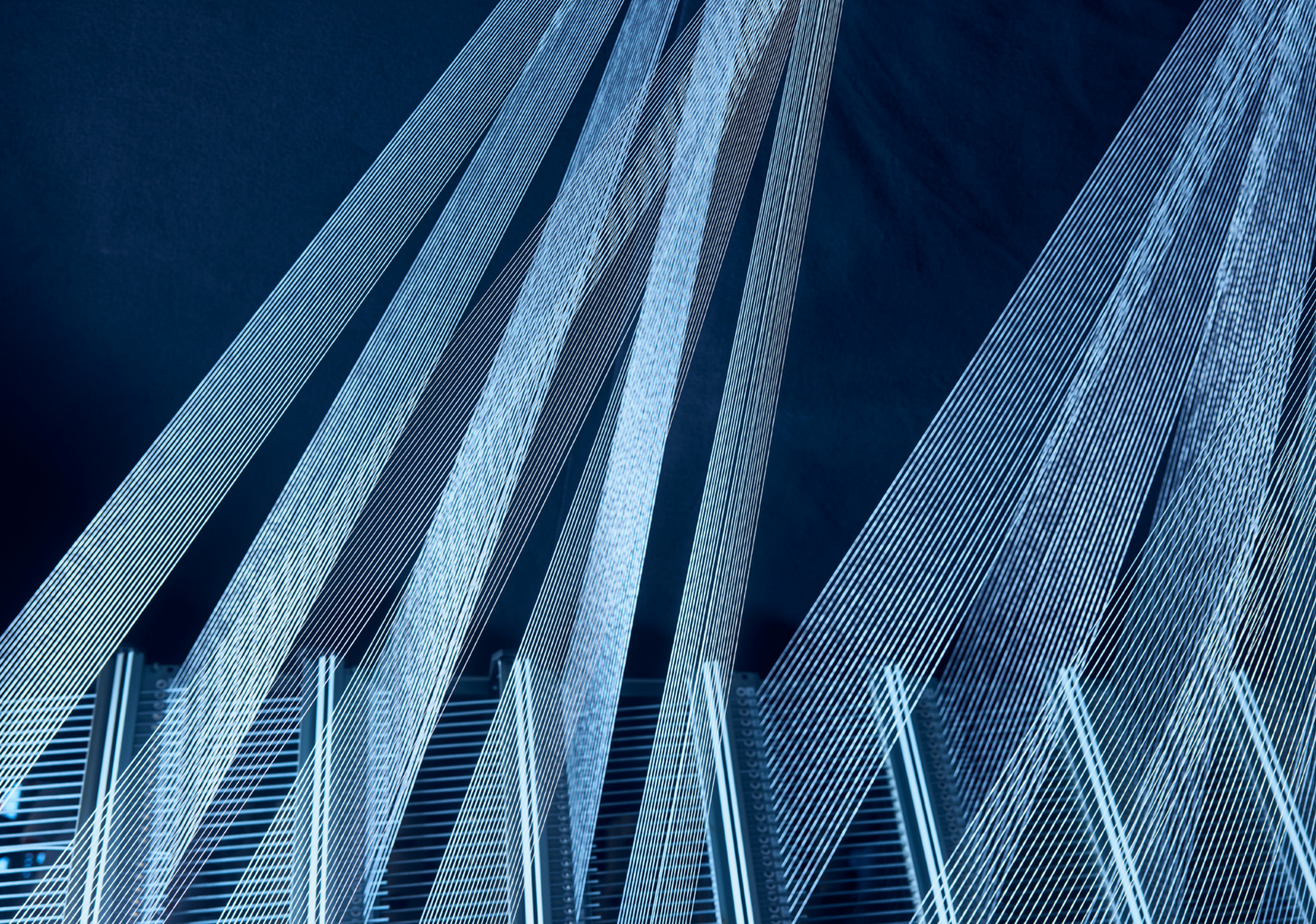
CO_2e combined annual emission reduction potential by 2033

KEY ASSUMPTIONS

- Lifecycle emissions of conventional jet fuel are approximately 11.9 kg CO_2e per gallon.
- E-Jet fuel has a lifecycle emissions value of 0.8 kg CO_2e per gallon (lifecycle analysis conducted by Twelve).
- E-Naphtha emissions are cradle-to-gate carbon negative, with a total lifecycle impact of -2.6 kg CO_2 per kg of naphtha, compared to 0.5 kg CO_2 per kg of fossil naphtha (lifecycle analysis conducted by Twelve).

> Twelve is scaling because it makes critically important drop-in replacements that are as easy to use as they are beneficial.

ZACHARY BOGUE
MANAGING PARTNER, DCVC



UNSPUN

Automated 3D garment weaving to reduce textile waste and overproduction

Market & technical challenge

If we aim to stop adding greenhouse gases to the atmosphere, one of the many sub-tasks along the way will be refitting the global garment industry to be less wasteful and polluting. The fashion business today is responsible for about a gigaton of CO_2e emissions per year, or about 2 percent of global emissions, according to researchers at the World Resources Institute and the Apparel Impact Institute.

A big part of the problem is clothing deadstock. As many as 60 billion garments per year (up to 40 percent of the total made) are never sold or worn and end up in incinerators and landfills. That's because most garments are made in Asia and new fashions take so long to thread their way through the global supply chain that by the time they show up at stores, nobody wants to buy a lot of them. Lack of customization, too, drives waste: customers return about 20 percent of all garments they buy online, mostly due to poor fit.

Solution & impact

Historically, reshoring or nearshoring clothing supply chains hasn't been economically feasible. But manufacturing garments closer to the point of sale, or even making them on demand, would be an important step toward reducing overproduction and transport emissions, and in the process result in clothes that fit customers better.

Unspun is making this vision a reality. Its FitOS 3D body-scanning technology enables precise fits and its Vega 3D weaving machines create garments directly from yarn. The machines are designed to be installed in factories located in the same regions with retail stores.

When clothing is made based on actual customer measurements, garment returns are lower. When multiple manufacturing steps such as patterning, shaping, and assembly can be combined into one machine, the supply chain is condensed and delivery times are drastically reduced. And when items are made closer to the final retail location, overstock becomes a thing of the past. (Stores can easily restock styles that sell out, which means they can order only what they need.)

A life-cycle analysis completed by environmental sustainability consultancy Quantis showed that garments made using Unspun's technology generate 43 to 93 percent less emissions per garment than traditional garments, depending on the energy mix used, while also requiring less land for factories and less water. If scaled up, these process innovations could help the fashion industry operate both profitably and sustainably.

UNSPUN

Milestones & future growth

In 2024 Unspun completed a Series B financing round, led by DCVC, to accelerate production of the Vega weaving machine. Our role at the company has been to provide access to our strong industry networks and deep tech expertise, as well as guidance in navigating commercialization and operational scale-up. Also in 2024, Unspun released its FitOS platform, which uses smartphone-based body scans that recommend optimal sizes to consumers and help brands create clothing grounded in real measurements. And it reached manufacturing agreements with two major partners, Walmart and Decathlon.

Unspun is expanding rapidly from its prototyping phase. By 2029, it expects to have more than 450 Vega machines in operation, producing 19 million garments, conserving 2.67 million cubic meters of water, and avoiding 11,441 metric tons of CO_2e emissions. It aims to have roughly 2,500 machines in operation by 2034, making 105 million garments per year, saving more than 14.7 million cubic meters of water, and avoiding 63,000 mt of CO_2e emissions annually.

We see Unspun as part of a larger trend in manufacturing and supply chain management toward "only moving the molecules that people are actually using," as DCVC general partner Milo Werner puts it. "Unspun is reinventing the entire apparel supply chain. Through advances in automation, the company is onshoring clothing manufacturing and cleaning up a massively wasteful industry. Unspun is part of a broader global trend in which advances in computation and controls are enabling the reindustrialization of major global economies."

KEY METRICS

140 garments sold in 2024	19.6 m^3 of water conserved in 2024	0.084 mt of CO_2e emissions avoided in 2024

Unspun's emissions reduction potential

43-93%

emissions intensity improvement compared to traditional garments

63,000 mt

CO_2e annual reduction potential by 2034

"By delaying the configuration of materials—weaving clothes closer to the retailer, in this case—you're eliminating waste throughout the whole supply chain."

Milo Werner
General partner, DCVC

KEY ASSUMPTIONS

- Emissions intensity improvements depend on the location of production and the energy mix used.
- Unit impact estimate is based on a lifecycle analysis conducted for Unspun by Quantis.
- We used a conservative unit impact estimate for Unspun's production process based on an average global energy mix (as opposed to the mix at Unspun's demonstration facility, which primarily uses renewable energy).
- 2,000 garments produced per shift per day per Vega machine.
- 2,500 Vega machines deployed by 2034.

VERDIGRIS

Providing circuit-level insight into energy usage in data centers and telecom, industrial, and commercial buildings

Market & technical challenge

The most basic thing modern humans do—living and working inside buildings—is also one of the biggest sources of anthropogenic greenhouse gas emissions. Building operations (primarily heating, cooling, lighting, and appliance use) are responsible for 26 to 28 percent of energy-related CO_2 emissions globally. That's more than any other sector, including industry, transportation, and agriculture. There is no pathway to slowing global warming that does not involve measuring, moderating, and decarbonizing building energy use on a massive scale.

The problem is that most building owners and managers don't know where to start. Their electrical meters are technologically outdated, and therefore they get inaccurate data, or no data at all, about how much energy the machines under their roof are using and when. The utility meters on the periphery of an industrial building are usually cryptic, hard to read, and meant primarily for billing, not resource management.

The rise of the internet of things (IoT) seemed to promise a new way of gathering machine-level and appliance-level energy usage for a whole building. But in practice, implementing this approach requires a major new investment in distributed sensors and wired or wireless communications networks. A truly affordable energy-monitoring technology would be small, centralized, self-contained, and easy to install. But it would still give building managers more of the information they need to track their "scope 2" emissions (those associated with the purchase of electricity and other forms of energy); identify inefficiencies and schedule maintenance before equipment breaks down; and even automate heating and cooling to optimize for changes in weather or electricity prices.

Solution & impact

As it turns out, there's a lot of useful information flowing through a building's existing electrical box, if you know how to look for it. Verdigris invented a sampling device that can be placed on selected wires in an electrical box—say, the ones controlling power to the HVAC system, the elevators, the lights, or the EV chargers in the parking lot. The device measures the current flowing through each wire 8,000 times per second (20 times as often as conventional energy meters) and sends the information through a wireless energy data gateway connected to the company's cloud storage and processing engine.

At 8 kHz, each machine and appliance throughout a building has its own unique electrical fingerprint, which Verdigris' machine-learning algorithms can quickly identify and sort. Suddenly a building owner can see exactly how much power each piece of equipment is using—and can also see when the energy fingerprint is deviating from normal, indicating a fault or a looming problem. And whereas it takes a couple of days to install a new building energy meter from scratch, Verdigris' sensors and data gateway can be installed in a couple of hours, for a quarter to a third of the cost. Once installed, Verdigris' built-in AI detects and explains equipment failure modes, cutting through alert fatigue. The Verdigris system can also integrate with equipment and HVAC controls to manage energy use. Building owners equipped with these new tools can reduce energy costs and increase reliability at the same time, with the option to automate their buildings to shave demand when electricity is most expensive.

VERDIGRIS

Milestones & future growth

Today Verdigris' energy meters monitor 17.68 million square feet of building space—about two-thirds of which is AI-first data centers and telecom operators, plus industrial space and commercial real estate. The company estimates that the average customer saves 12 percent on their energy bill, and that the total energy savings from Verdigris technology in 2024 amounted to 114.4 gigawatt hours (GWh)—making it the biggest electricity saver in the DCVC Climate portfolio. With T-Mobile, Amazon, and Verizon already among its clients, the company is pushing aggressively into the energy-intensive data center sector, where its circuit-level insights can deliver the greatest value.

Verdigris does not generate zero-carbon energy (like, say, Fervo), but is drastically reducing emissions by giving customers the granular data they need to reduce their energy consumption. Looking a decade out, we believe the company has the potential to bring as much as 24,000 GWh of power consumption under management, with an annual emissions reduction potential in year 10 of 1.8 million metric tons of CO_2e and a cumulative 10-year reduction of 4.4 million metric tons CO_2e.

The data center industry is exploding, as the operators of today's frontier AI models chase after the compute they say they'll need to achieve artificial general intelligence. One forecast, from the Center for Strategic and International Studies, projects that U.S. electrical demand will grow from 4,000 annual terawatt-hours (TWh) in 2023 to 4,745 TWh by 2034, with data centers and building and industrial electrification accounting for about half of that growth. To reduce the strain on the grid, save money, and ultimately rein in overall electrical demand and greenhouse emissions, big electricity customers will need an energy-management platform like Verdrigis', which combines high-fidelity energy data, predictive analytics, and simplicity of deployment.

KEY METRICS

44,141 mt

CO_2 emissions avoided in 2024

17.68 million SQ. FT

of building space monitored

Verdigris' emissions reduction potential

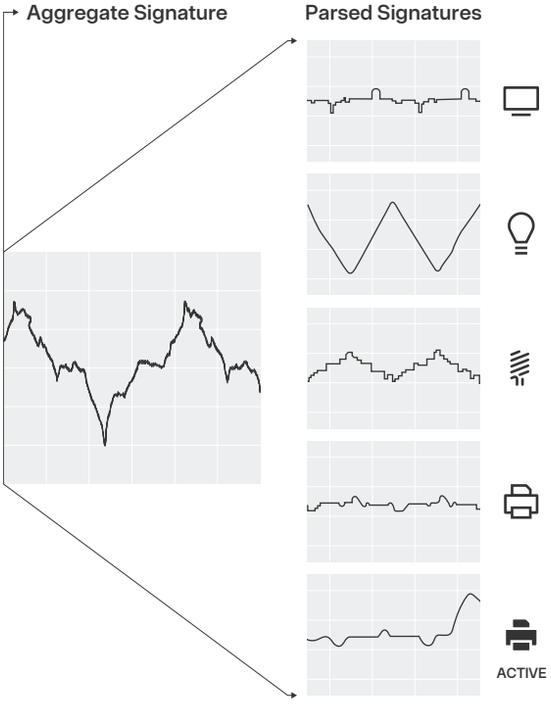
12.2%

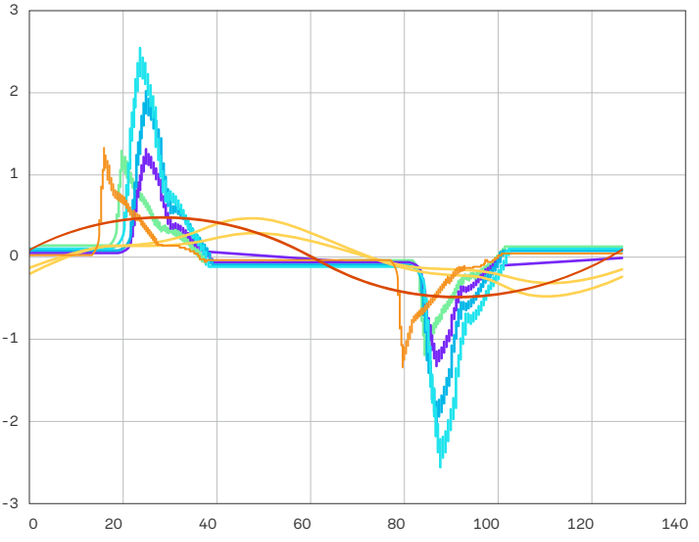
average customer energy savings

1,765,610 mt

CO_2e annual reduction potential by 2033

Device Level Accuracy





KEY ASSUMPTIONS

- Verdigris' scale of total energy managed is assumed to grow linearly for the next three years, then continue to gain market share of the U.S. data center market following a typical S-curve, reaching approximately 5 percent of the market, or ~23,684 GWh of energy managed annually.
- Verdigris saves customers an estimated 5-15 percent of energy usage for commercial building customers and 10-30 percent for data centers. Average customer energy savings is expected to increase over time as the company grows into the data center market.
- The energy Verdigris is saving in the baseline scenario is assumed to reflect the average emissions intensity of the U.S. grid, currently 0.386 kg CO_2e/kWh but expected to decrease over time.

PART II

ENABLING SYSTEM

COMPANY: Equilibrium Energy

MS

PATHWAY

EQUILIBRIUM ENERGY

Smarter real-time grid management to mitigate emissions and volatility

Market & technical challenge

The days when electrical grids were built around large centralized generation facilities powering stable, predictable loads are coming to an end. It's not just that electrical demand from data centers, factories, and EV charging stations is growing rapidly, putting extra stress on the grid, or that the nation needs to keep building terawatts of new solar, wind, battery storage, and other (inherently distributed and intermittent) renewable sources to hasten the transition to zero- or low-carbon energy. It's also that climate change is bringing more frequent storms and extremes of heat and cold, often challenging grid managers to keep up.

The big challenge for sub-utility-scale players is finding project financing for projects such as solar farms and grid-scale batteries, and managing them efficiently and profitably once they're up and running. Make no mistake, these projects are getting built—the U.S. added 50 gigawatts of solar capacity and 10.4 gigawatts of battery capacity in 2024 alone, accounting for 84 percent of new generating capacity added to the grid, mostly in Texas and California. But the key to making these investments pay off is having real-time signals about market pricing and asset performance, so that renewable or stored energy can be bid into the wholesale markets at the most useful times of the day and the year.

Solution & impact

Equilibrium Energy was founded after a devastating cold snap that hit Texas in February 2021 forced natural gas power plants offline, leaving millions without electricity for days and causing 246 deaths, mostly from hypothermia. The company was built on a vision of aggregating the data and developing the predictive tools to stabilize an increasingly volatile grid. Its initial push was to create an electricity-trading platform that would be the framework upon which other products would be built. This required building an effective digital twin of the grid and testing predictive models of how electricity supply and demand would evolve, which the company used to generate revenue in the near term.

The next piece of the Equilibrium platform was a new type of contract called a tolling agreement that would function like the power purchase agreements common in the wind and solar industries, giving builders and operators of grid-scale lithium-ion batteries a more predictable and profitable market for the power they store and helping strengthen the grid against future disruptions. To make it all work, Equilibrium had to build advanced data-management capabilities unifying fragmented systems, AI-based predictive analytics to create forecasts for each hour of the day, and a virtual energy-trading platform informed by real-time market pricing.

At its core, what Equilibrium Energy has built is "the digital backbone of a next-generation utility," in the words of Samuel Suskind, a principal at Valo Ventures, which invested alongside DCVC in Equilibrium's $39 million Series B round in 2023. The company quickly showed that it was able to meet and exceed management standards for grid-scale batteries in Texas. In 2024 its first asset under management there achieved higher revenue per megawatt than any other similarly sized battery.

"Technology that's great for the planet can also be great for American resilience and prosperity. Clean capitalism is smart capitalism. Equilibrium is a great case study in that fact."

Matt Ocko
Managing partner, DCVC

EQUILIBRIUM ENERGY

Milestones & future growth

After its success in Texas, Equilibrium has expanded to manage more batteries in more markets, and to offer similar services such as virtual power purchase agreements to help customers meet their renewable energy goals. The company is swiftly bringing more power generation and storage assets onto its platform.

Over time, the emissions impact of smarter enterprise energy portfolio management can be substantial. Equilibrium aims to have 670 megawatts of flexible energy assets under management by the end of 2025, and to supply 397,000 megawatt-hours of renewable power, contributing to the mitigation of an estimated 0.2 million tons of CO_2 emissions through direct and enabling effects. By 2030 it expects to have 17,520 megawatts of flexible energy assets under management across 50 battery projects, and 11,250 megawatts of renewable assets supplying almost 14 million megawatt-hours of power, contributing to the mitigation of an estimated 31.6 million tons of emissions.

"As the power industry continues to transition to clean energy in the face of climate change, we expect a new class of power companies will be necessary to support society's march towards net zero," says DCVC partner Dr. Rachel Slaybaugh. "We are impressed with Equilibrium's first principles approach to building such a next-generation power company, one designed from the ground up to fight climate change. We're optimistic about their prospects to bend the climate curve, and excited about their impressive and growing commercial traction."

KEY METRICS

140 MW

flexible capacity under management

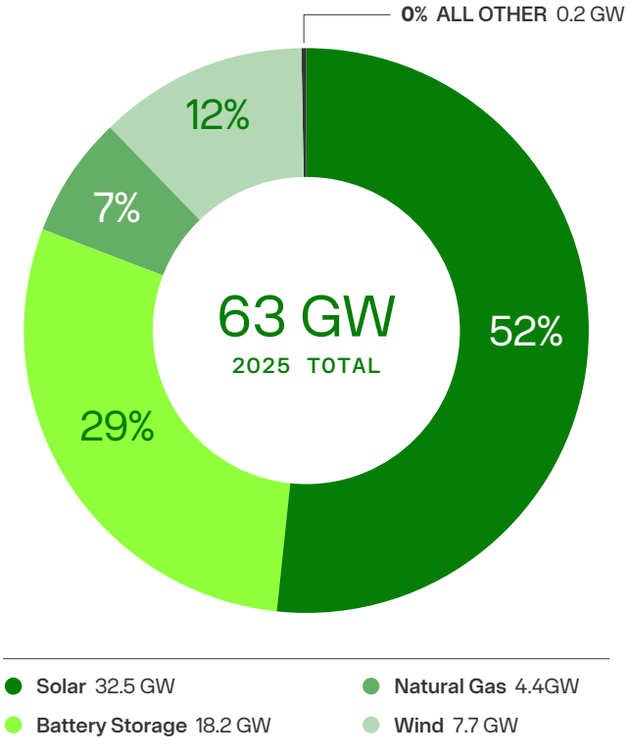
3

New tolling agreements totaling 160 MW

260 MW

total contracted physical operations

U.S. planned utility-scale electric-generating capacity additions 2025

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PART III

RESILIENCE

COMPANY: ZwitterCo

PATHWAY

ZWITTERCO

Using advanced zwitterionic materials to create fouling-resistant water-filtration membranes for industry and agriculture

"From industrial wastewaters to challenging surface waters and process streams, ZwitterCo's membranes make it practical and economical to tap into underutilized resources, providing a lifeline for industries and communities facing water scarcity in a world where easy water is becoming a thing of the past."

Jason Pontin
General partner, DCVC

Earl Jones
Operating partner, DCVC

Market & technical challenge

Whether it's destined for factories, farms, data centers, or whole cities, clean fresh water is a limiting factor in economic growth and human flourishing. Roughly half of the world's population experiences water scarcity for at least part of the year, according to a 2024 report from the United Nations.[8] In many regions, the most traditional and cheapest sources of fresh water—aquifers, lakes, and rivers—are being depleted faster than they can be recharged, even as climate change increases the risk of punishing droughts and violent storms.

One way to make existing water supplies go farther is to filter dirty water at the point of use and channel it back into industrial or agricultural processes—but that means making the filtration process more cost-effective. The main problem is that conventional filtration membranes get clogged or "fouled" by waste, especially organic and biological waste, and frequently must be taken out of service to be cleaned, often using chemicals that harm the filters themselves or the environment.

Solution & impact

ZwitterCo, founded in 2018, has built its filtration technology around the insight from researchers at Tufts University that zwitterionic copolymers—molecules with equal numbers of positively and negatively charged side chains—are good at attracting water molecules while repelling whatever is in that water, especially fats, oils, grease, protein, and the like. The result is a filter that's far less likely to foul than filters made from conventional materials, can stay in service far longer between cleanings, and can be cleaned for reuse using gentle chemicals and less water.

The upshot is that ZwitterCo's membranes last for years in waste streams that destroy traditional membranes in hours or days, and make it possible to purify wastewater containing up to 10,000 times more organic waste—levels that simply could not be treated in the past. The company makes different grades of filters that can be used for reverse-osmosis purification of surface water, brackish water, or landfill leachate; superfiltration of wastewater from meat or poultry processing; or ultrafiltration in plants working with whey proteins, vegetable proteins, or gelatins.

Many companies that switch to ZwitterCo's products see a 98 percent water recovery rate, a 50 percent reduction in cleaning frequency and intensity, and a 50 percent reduction in wastewater operating expenses. A landfill leachate treatment site in France that had been cleaning its old filters every other day was able to drop to just 35 cleanings per year. A dairy processor in Wisconsin was able to reduce water use by 40 percent.

ZWITTERCO

Milestones & future growth

In 2024, ZwitterCo reached a cumulative filtration capacity of 10 million gallons per day and treated (or helped customers avoid treating) some 2.6 billion gallons of water, across 60 separate industrial and agricultural projects in 15 countries. Six of the 60 projects were in countries or regions experiencing water stress. The company's goal is to add another 8 million gallons per day of filtration capacity in 2025, bringing its total to 18 million gallons per day, and to build toward a goal of 200 million gallons of capacity across 2,000 projects by 2030, saving 100 billion gallons of water per year, or enough to supply every household in California for 25 days.

In 2023, ZwitterCo completed a 30,000-square-foot technology-development facility in Woburn, Mass., where it can speed up product-development cycles and qualify its manufacturing process and quality program. *Fast Company* named ZwitterCo one of its Most Innovative Companies in 2024.

DCVC participated in ZwitterCo's $58.4 million Series B funding round in 2024, helped to identify other investors, and has provided strategic and operational support. It's difficult to calculate how much more water can now be treated or recycled thanks to ZwitterCo's membranes, but customers report that about 75 percent of the water they treat comes from existing waste streams, while the other 25 percent is from new sources that would have been inaccessible before. The main idea is to help big water users unlock new water management strategies that save water, increase circularity, and improve the efficiency of existing separation processes.

In a far-future world with cheap and abundant electric power, it may become feasible to extract and desalinate as much water as we need from the Earth's oceans. Meanwhile, though, global fresh water demand is expected to exceed supply by 40 percent by 2030.[9] If we don't learn to treat and reuse as much industrial and agricultural wastewater as possible, we'll see rising costs and falling productivity—problems that fundamental materials science innovation like ZwitterCo's can prevent.

KEY METRICS

10 million GAL/DAY filtration capacity delivered in 2024	2,600 Mgal wastewater treated or avoided in 2024	10% of projects in water-stressed countries or regions


APACHE
ZWITTERCO

The cumulative, 10-year emissions reduction potential for the seven companies in the current DCVC Climate portfolio is 27.4 million metric tons CO_2e (SEE TABLE 3). That's small compared to the 50-plus billion metric tons of CO_2e humanity dumps into the atmosphere each year. On the other hand, it's equivalent to removing 6 million cars from the road for a year, or avoiding 17 million roundtrip transatlantic flights, or growing 33 million acres of forest to sequester carbon. And it is not the full story of their impact. If these companies succeed, they will be very profitable, and they will catalyze changes that help all industries radically reduce emissions.

What's clear is that the energy, transportation, and manufacturing infrastructure we've inherited from the past is not capable of delivering the emissions reductions the world needs over the next 25 years while also supporting economic growth. This infrastructure must be rebuilt piece by piece around principles of efficiency, affordability, and scalability, from which dramatically reduced CO_2 emissions flow as an emergent property. That's a classic deep tech challenge of the sort DCVC has been helping its portfolio companies tackle since 2010. We're proud to see the small but growing group of DCVC Climate companies achieving early wins and advancing their solutions toward the market. And as they grow and develop in the coming years, we'll continue to monitor and report on their progress.

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DCVC Climate principal Kristen Rocca

DCVC Climate operating partner Gregg Rotenberg

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Data collection and analysis Tideline

Design One Design Company

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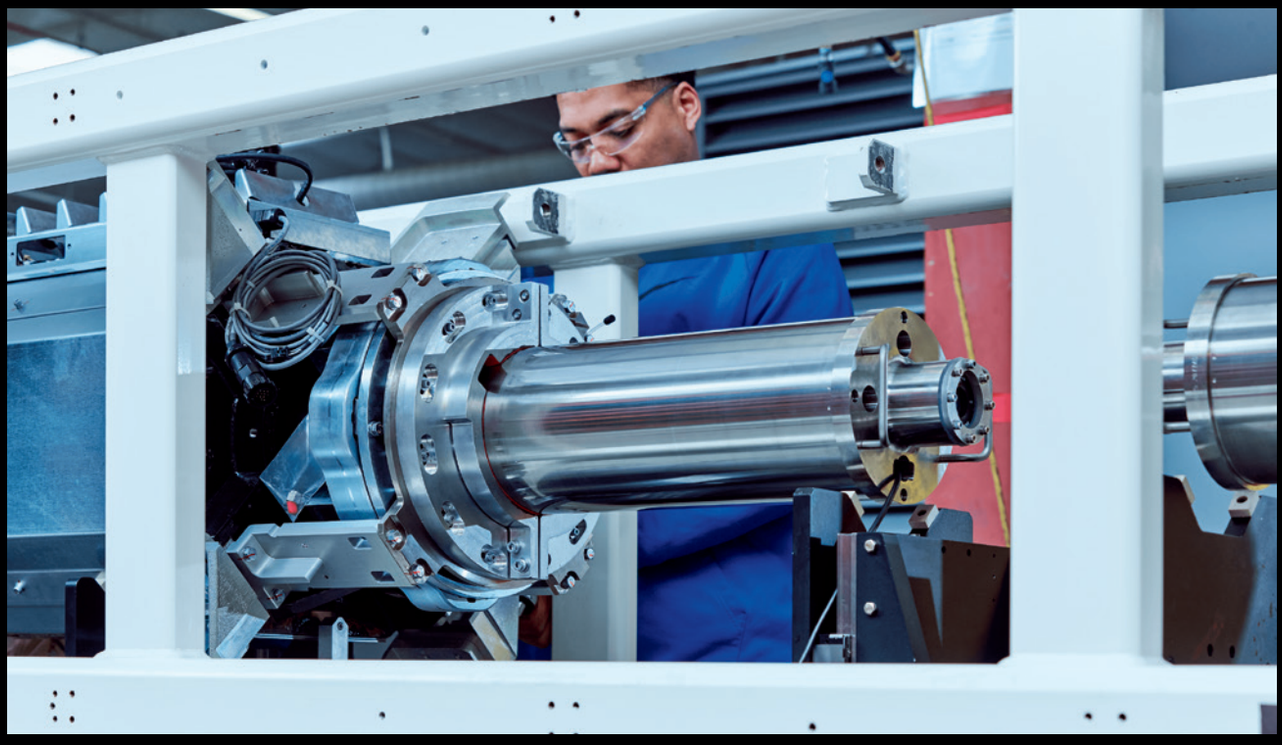


Mainspring Energy
Flexible, low-carbon power

—

DCVC Climate continues to grow, investing in promising companies that fit with our vision of a world made cleaner and more resilient by deep tech entrepreneurs. One 2025 investment that we look forward to describing in more detail in the next edition of this Climate Impact Report is Mainspring Energy, a California-based company delivering innovative fuel-flexible linear generators to big electricity customers running facilities such as data centers, hospitals, wastewater treatment plants, commercial and residential developments, cold storage, and EV charging microgrids. These customers want on-site generating capacity that can keep equipment running when the grid goes down, stabilize intermittent power from renewables, and offset high electricity costs at peak hours.

Mainspring's high-efficiency, non-combustion linear generators offer a superior alternative for customers considering on-site power generation. These generators can run on a variety of clean fuels, supplying instantly dispatchable power in 250-kilowatt increments all the way up to 100 megawatts or more, improving sustainability and enabling growth through rapid deployment of new power capacity.

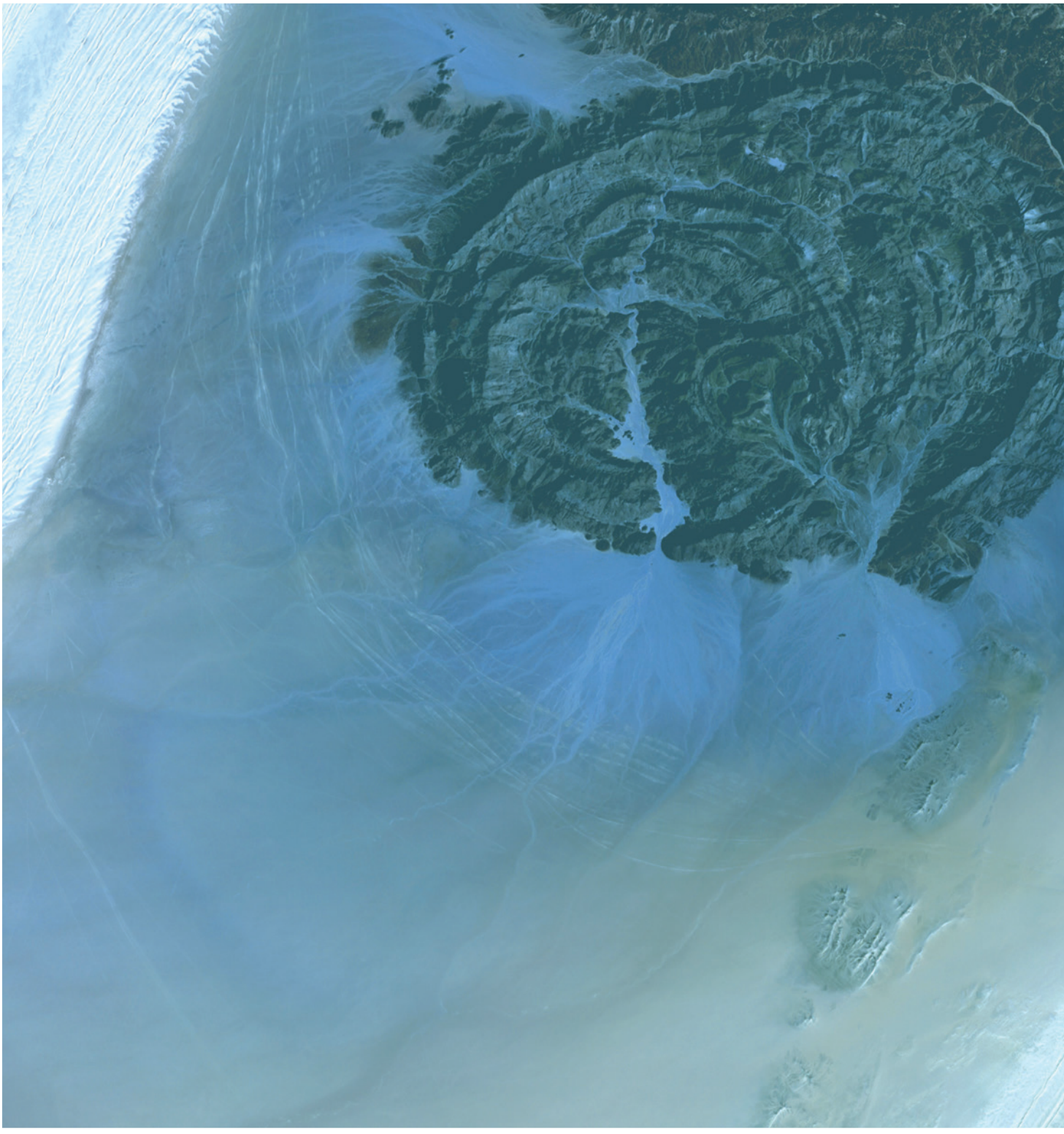
The company's sweet spot is delivering clean, reliable, low-emissions power to supplement the grid or, in some cases, supply prime power in situations where diesel generators would be hard to permit due to their noise and pollution. The Mainspring linear generator—which relies on a breakthrough design and adaptive control software to achieve high efficiency—can adjust for different types of gaseous fuels, including natural gas, propane, biogas, hydrogen, ammonia, and more. It's flameless, has only two moving parts, and operates at temperatures below that at which nitrous oxides form, meaning it can meet the most rigorous air quality standards.

In April 2025 the company secured $258 million in Series F financing to expand manufacturing and sales, in a round led by General Catalyst that also included DCVC Climate, Amazon's Climate Pledge Fund, Temasek, Marunouchi Innovation Partners, M&G Investments, Pictet Group, and Mainspring's earlier investors, including Lightrock and LGT Bank, Khosla Ventures, and Gates Frontier, among others. With hundreds of megawatts in the field and $800 million in total financing secured, Mainspring is in position to help electricity customers keep growing while cutting emissions significantly. That's the kind of innovation we always seek, and we can't wait to tell you more about their progress.

CLIMATE IMPACT REPORT

2024

2024



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