

Understanding Capital Scarcity in the Climate Finance Ecosystem

CREO Advisory

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Acknowledgements

This research was carried out by CREO Advisory. All opinions, analysis, and conclusions stated in this report are solely those of CREO. The research was commissioned Featherlight, a private investment firm co-Founded by Rowan Finnegan, Patrick Lynch, and Tom Rotherham-Winqvist that helps climate-specialist private markets managers scale and commercialize proven climate solutions and grow their businesses.



Approach and data sources

- Any analysis completed is as good as the **data** on which it is based. Every effort has been made to ensure that the best available data was used in the completion of the report and, where possible, multiple data sources were consulted and cross-referenced to increase confidence in the analysis. Data on private companies and funds is notoriously difficult to source, often incomplete, and sometimes unreliable. It is, therefore, important to acknowledge that the data is unlikely to be perfect and the results of analyses should be viewed as directional and used to inform rather than a source of truth
 - The **macro analysis** included in the Global Climate Finance Landscape is based primarily on research and data provided by the **Climate Policy Initiative** (CPI) that has been comprehensively tracking global climate finance since 2011
 - Data for the **Climate Funds** analysis was obtained from **CREO** and **Pitchbook**, and selectively checked against the **Phenix** database. All 728 funds tracked by CREO are 100% climate focused while the Pitchbook data reflects a stated (and Pitchbook verified) investor preference to focus on the Clean Tech, Ag Tech, and Climate Tech Verticals. The Pitchbook data set used contains 2,261 funds covering the period from 2010 to 2023. Analysis was completed using all the Pitchbook identified funds and 219 of the CREO funds where the time-series was sufficient for inclusion, for a total sample size of 2,480. Select analyses were completed for the period 2018-2023 using CREO data on 728 funds and Pitchbook data on 1,465 funds. Not all the investments in the funds identified by Pitchbook are guaranteed to be climate focused, but 18% of these funds have more than half their portfolios in climate.
 - **Pitchbook** was the source for **company and deal information**. The dataset of 8,700 companies and related deals was created using the pitchbook verticals CleanTech, AgTech and Climate Tech and manually excluding companies not deemed climate-relevant. The companies were categorized into climate sectors using keywords and company descriptions. Only deals greater than \$3m in size and completed January 2014 onwards were included.
- This document provides a **high-level overview of the conclusions** from the work and includes a **few selected pages** showing key analyses and is not a complete record of CREO's work. A detailed (120+ page) "fact pack" of the work is available from the Featherlight team upon request

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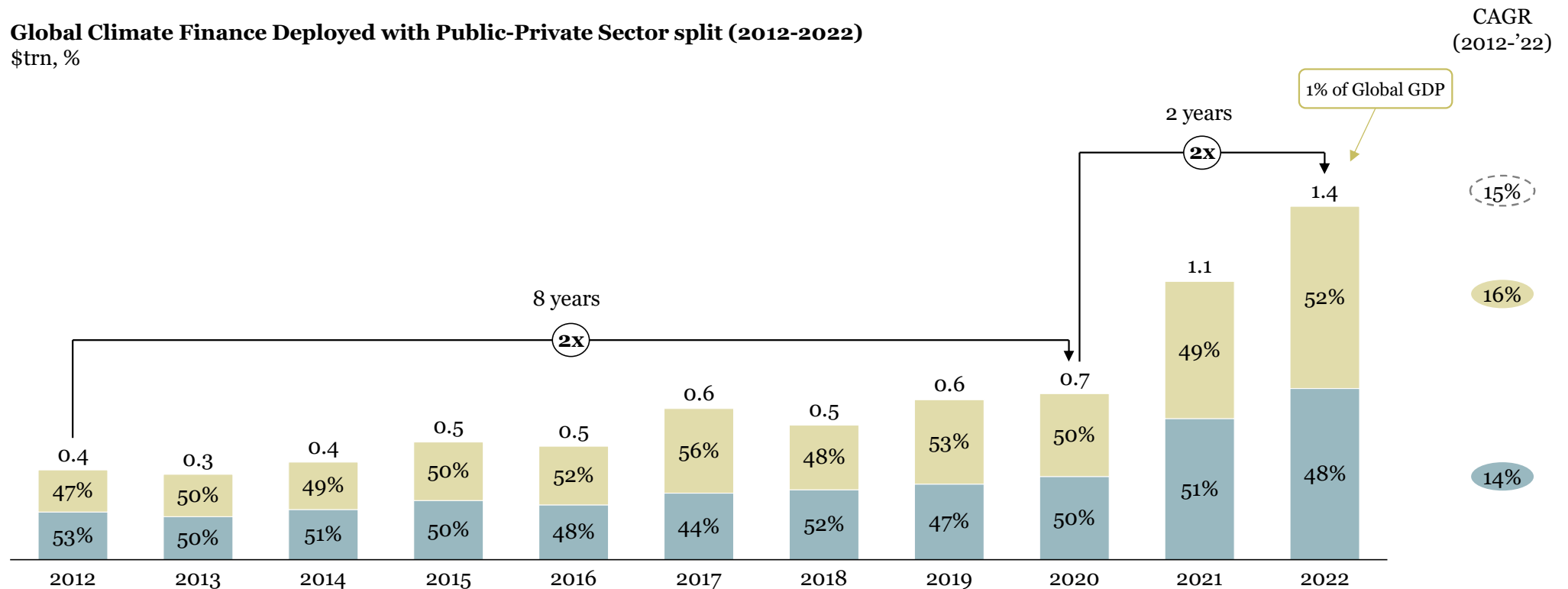
The Global Climate Finance Challenge

- Global climate finance has experienced robust growth after a slow start. After doubling in the eight years from 2012, it doubled again from 2020 to 2022 to reach \$1.4trn annually, or 1% of global GDP
- Despite this progress, a significant gap remains with an average annual climate finance need of \$8.6trn until 2030, increasing to \$10.7trn from 2031 to 2050
- The public and private sectors contribute equally to overall climate finance, but regional differences are significant
 - In North America and Western Europe, the private sector leads, providing 73% and 59% of the funding respectively
 - In contrast, public sector funding dominates in Asia with 62% of all capital, largely driven by China's substantial investments and encouragement of private capital deployment into production assets in the energy and transport sectors, particularly solar panel plants and electric vehicle (EV) manufacturing supply chains
- Policy and public sector capital play a pivotal role in catalyzing climate investment by de-risking investments, opening new markets to attract further private capital
- However, the public sector alone cannot bridge the \$7.2trn gap in annual finance needed through to 2030. Private investment is key to accelerating the deployment of innovative climate technologies across sectors

After a slow start, climate finance doubled from 2020 to 2022, to surpass \$1trn annually

Public Sector Private Sector

Global Climate Finance Deployed with Public-Private Sector split (2012-2022)
\$trn, %



Note: CPI estimates annual climate finance needed to keep global temperature below 1.5°C range as \$5.4 -11.7trn until 2030, and \$9.3-12.2trn from 2030 to 2050. On average, this equates to \$9.7trn per year from 2023 to 2050. These needs are dwarfed by the estimated economic cost under business-as-usual scenarios of \$1,266trn and will worsen the longer action is delayed.

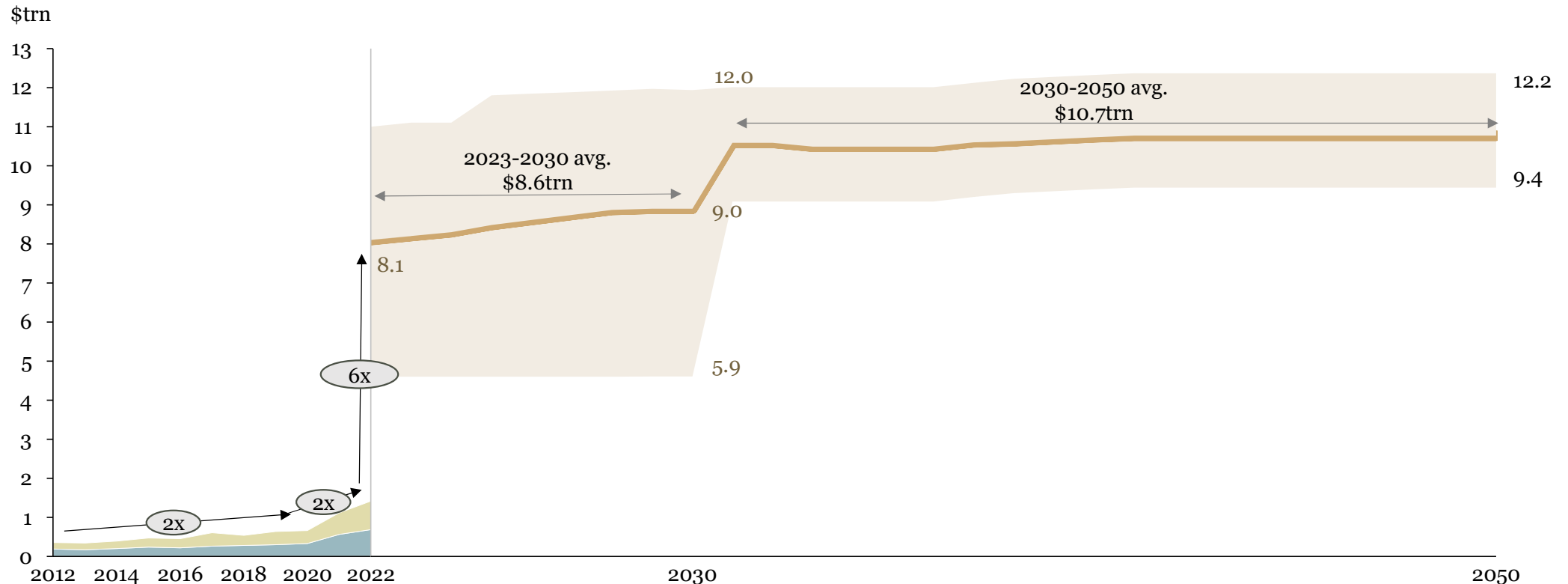


Source: CPI (2023) Global Landscape of Climate Finance; CPI (September 2023) How Big is the Net Zero financing Gap?; WRI (2023) State of Climate Action; IMF World Fuel Subsidies

A six-fold increase in annual average climate funding until 2030 is required to achieve the net zero targets

— Average Needs — Needs Range — Public — Private

Global Climate Finance: Historical (2012 - 2022) and Need (2023 – 2050)



Note: CPI estimates annual climate finance needs to keep global temperature below 1.5°C range as \$5.9-12trn until 2030, and \$9.4-12.2trn from 2030 to 2050. On average, this equates to \$9.7trn per year (\$266trn total) from 2023 to 2050. These needs are dwarfed by the estimated economic cost under business-as-usual scenarios of \$1,266trn and will worsen the longer action is delayed.

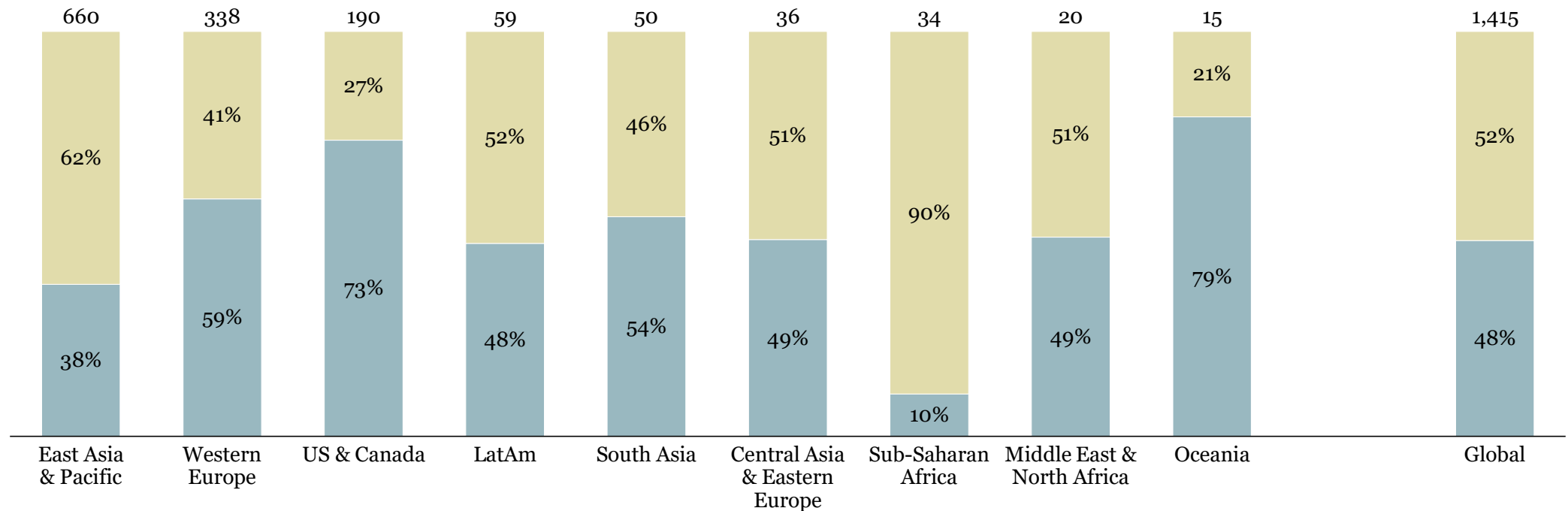
Source: CPI (2023) Global Landscape of Climate Finance; CPI (September 2023) How Big is the Net Zero financing Gap?; Swiss Re Institute (2021)

Public-private funding split globally but private capital leads in North America and Western Europe

Public Sector Private Sector

Climate Finance Deployed by Destination Region with Public-Private Sector split (2022)

\$bn, %



Note: Climate Policy Initiative (CPI) has data gaps in tracking sectors including industry and land use, particularly in private finance flows. Nuclear, CCUS, and private industry are added later in the analysis;

Source: CPI (2023) Global Landscape of Climate Finance; CPI (2022) Global Landscape of Climate Finance: A Decade of Data

Policy and public sector capital play a pivotal role in catalyzing climate investment



The **Inflation Reduction Act** is the largest investment in climate and energy initiatives in U.S. history.

Estimates of 10-year federal spending could reach **\$1trn**



The **European Green Deal** is the most comprehensive package of climate policy initiatives globally.

The **Sustainable Europe Investment Plan** will mobilize at least **€1trn** over the next decade.



China's **Emissions Trading Scheme** is the world's largest in terms of covered emissions (~5 GtCO₂ and over 40% of CO₂ emissions).

Green bond insurances to be used to finance **~\$21trn** to reach net zero targets

2 Climate Finance Needs Across Sectors

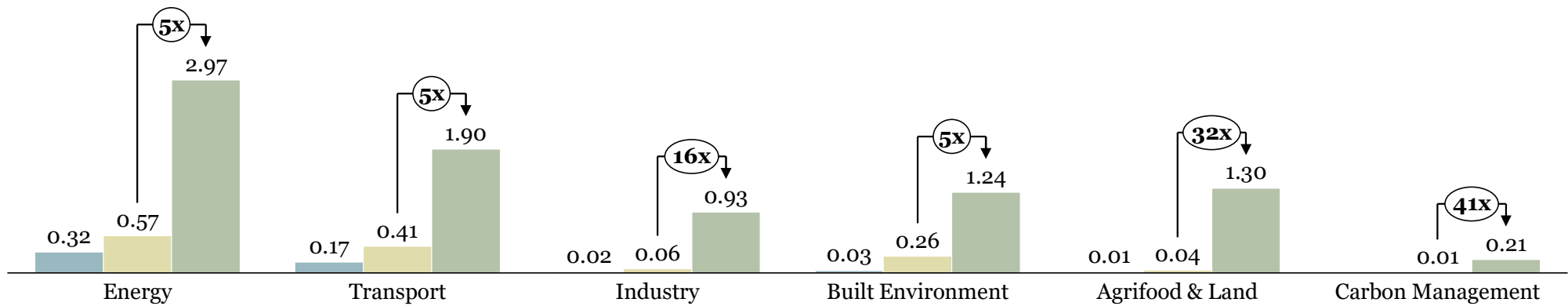
- There is a need for capital in each of the six climate sectors analyzed
- Fortunately, mitigation options and technologies have been identified and the combined mitigation potential of these solutions across sectors exceeds the total abatement required by 2030, suggesting multiple pathways to achieve this target
- Achieving the full mitigation potential is highly uncertain and dependent on catalyzing the market to rapidly adopt new clean technologies to replace existing ones
- Currently, only about 35% of the mitigation potential identified for 2030 comes from technologies that are already cost-competitive with existing solutions
- Driving down the cost of clean technology solutions requires innovation and widespread commercial adoption. CREO analysis, and work completed by Systemiq, shows that the development of key climate technologies follows the classic “S-curve”, and costs decrease rapidly after reaching tipping points
- Solar, wind, and electric vehicles have already reached this tipping point and benefit from significant cost reductions and widespread market uptake. In contrast, other critical climate technologies still face challenges in transitioning from the lab to mass deployment
- IEA tracks over 550 clean technologies that contribute to achieving net zero and believes that about one-third are ready to scale

Significant increase in climate finance required across sectors

Global Climate Finance by Sector: Historical (2019 and 2022) and Need (2023 – 2030)

\$trn

2019 2022 Need through 2030



Share of Mitigation Potential

2030 2050



Investment dollars required per CO2e mitigation potential (\$ / tCO2e)

2030



Note: Excludes an estimated additional \$212bn in adaptation finance needed by developing countries up to 2030 (CPI); Excludes Waste & Wastewater; Carbon management refers to carbon removals and negative emissions (e.g., CCUS, DACS, BECCS); Given the multiple sources and lack of harmonized methodologies, the data can only be indicative of the size and pattern of investment gaps.

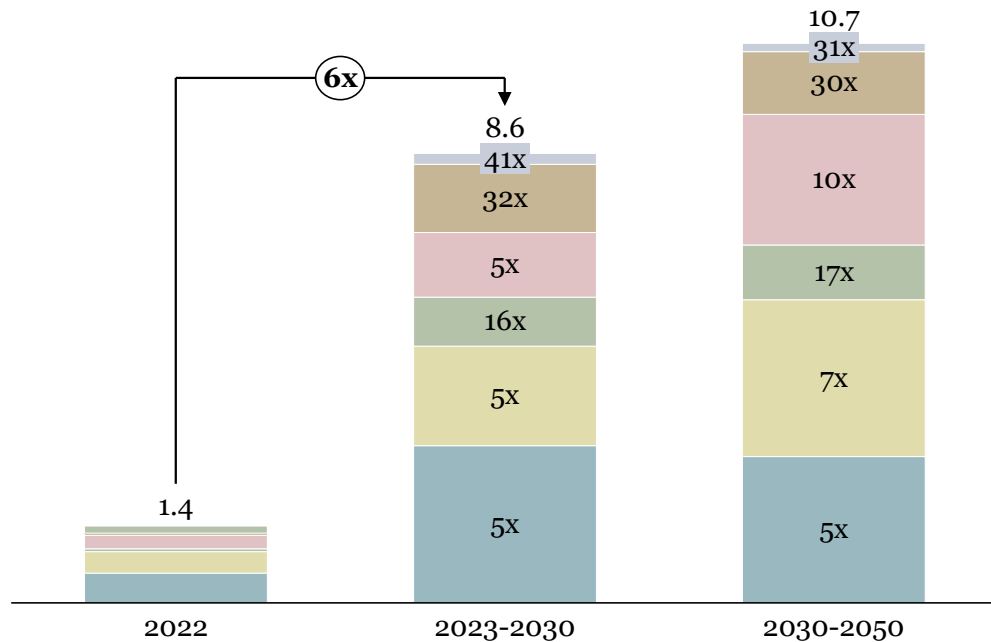


Source: CPI (2023) *Global Landscape of Climate Finance*; CPI (September 2023) *How Big is the Net Zero financing Gap?*; WRI (2023) *State of Climate Action*; IPCC (2021) *Sixth Assessment Report*; BloombergNEF (2023) *Energy Transition Investment*; CPI (2023) *Landscape of Climate Finance in Agrifood Systems*; CREO analysis

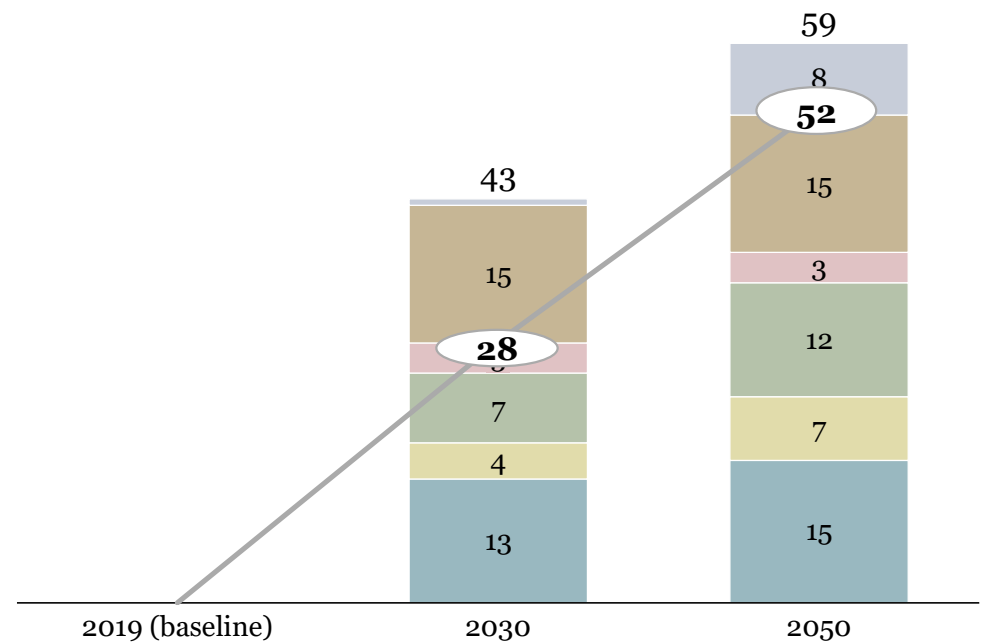
Mitigation potential across technologies exceeds required abatement

Required abatement Energy Transport Industry Built Environment Agrifood & Land Carbon management

Climate Finance Historical and Need by Sector
\$trn, x-fold increase



Mitigation Potential by Sector
GtCO₂e



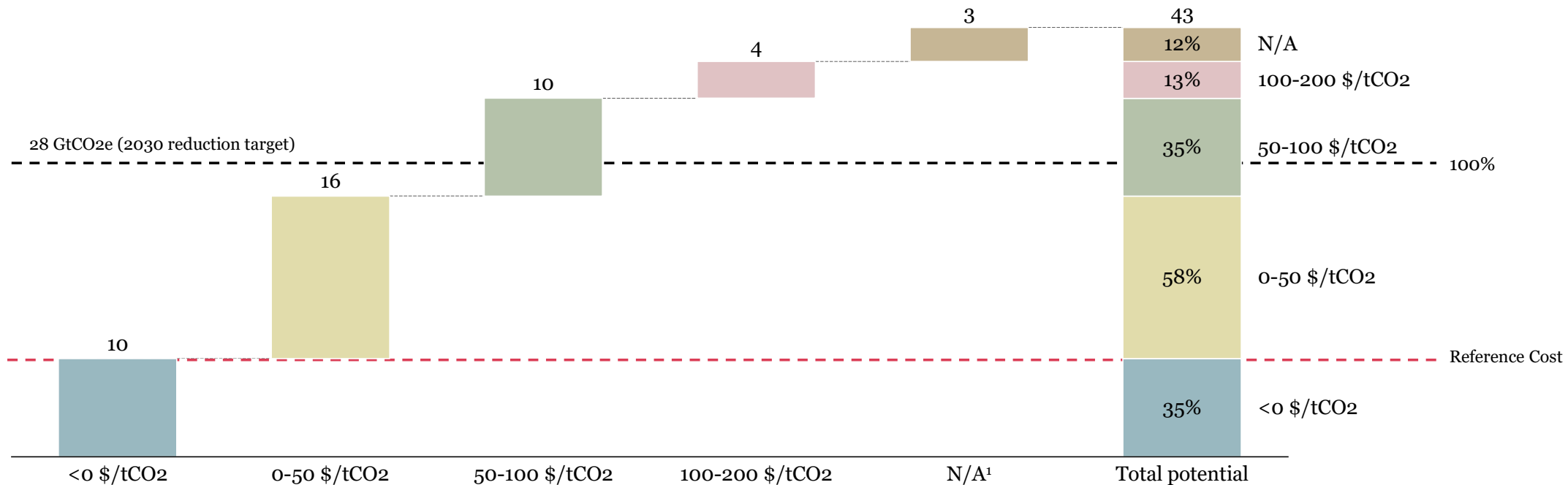
Note: Excludes an estimated additional \$212bn in adaptation finance needed by developing countries up to 2030 (CPI); Industry includes Waste & Wastewater for mitigation, excluded from investment requirement;
 Source: CPI (2023) *Global Landscape of Climate Finance*; CPI (2023) *How Big is the Net Zero financing Gap?*; CPI (2023) *Landscape of Climate Finance in Agrifood Systems*; WRI (2023) *State of Climate Action*; IPCC (2021) *Sixth Assessment Report*; BloombergNEF (2023) *Energy Transition Investment*; McKinsey (2023) *Accelerating toward net zero: The green business building opportunity*; Pitchbook Data, Inc.; CREO analysis



35% of mitigation technologies are below current reference technology costs

Mitigation Potential by Net Lifetime Cost of Options Relative to a Reference Technology (2030)

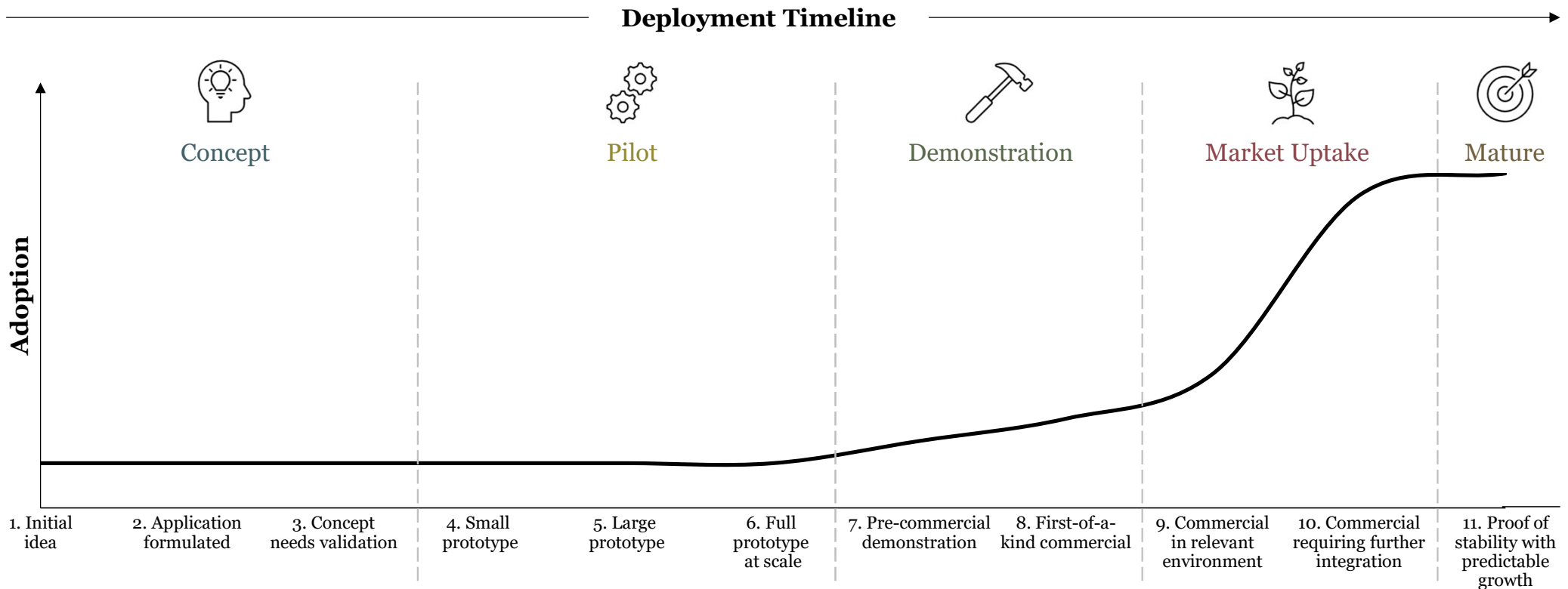
GtCO₂e p.a.



CREO Note: Waste & Wastewater included in Industry; 1. Costs not allocated due to high variability or lack of data
Source: IPCC (2021) *Sixth Assessment Report*;

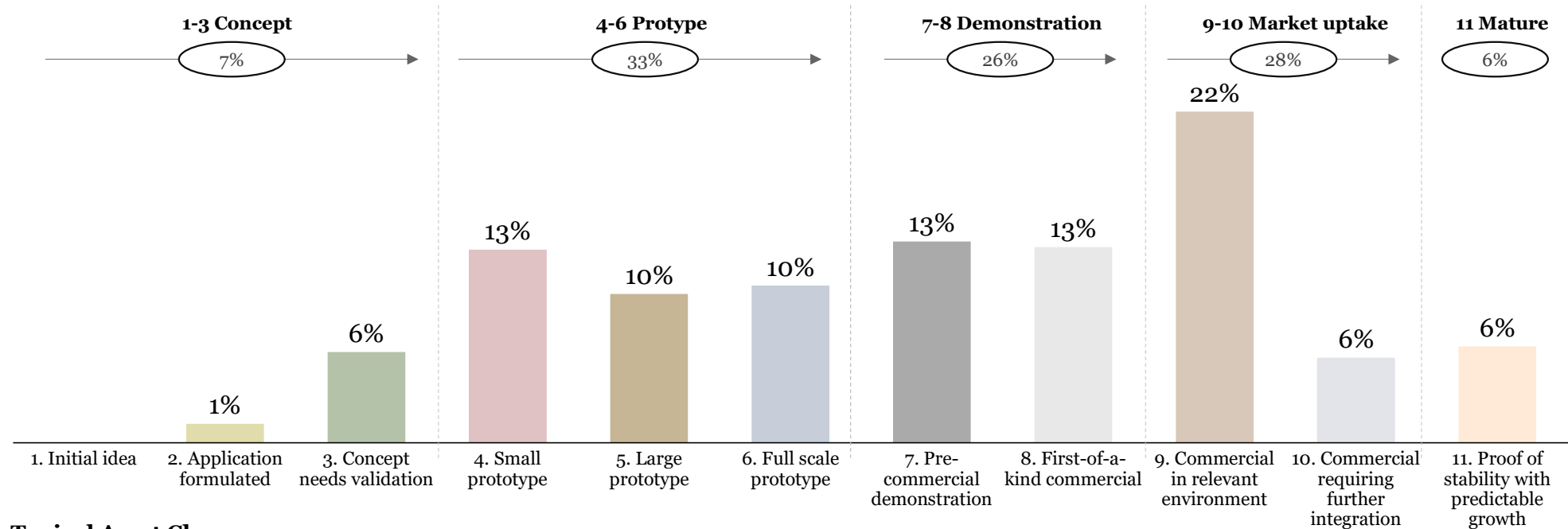
Development of successful technologies often follow "S-curves", with eleven discrete stages of technical maturity

After a slow start, successful new technologies hit a tipping point, typically once 5-10% market share is gained. After this adoption rapidly increases, quickly propelling them to high market share



One-third of critical clean technologies are ready for scaling

Technology maturity levels (TRL) in 2023 of 551 clean technologies contribute to achieving the goal of net-zero emissions



Typical Asset Class

Venture Capital

Growth

Private Equity & Infrastructure



Note: Slide 30 overlays asset class against TRL Level
Source: IEA (2023), ETP Clean Energy Technology Guide;

3 Private Capital Flows to Climate

Ten insights that can inform climate investments:

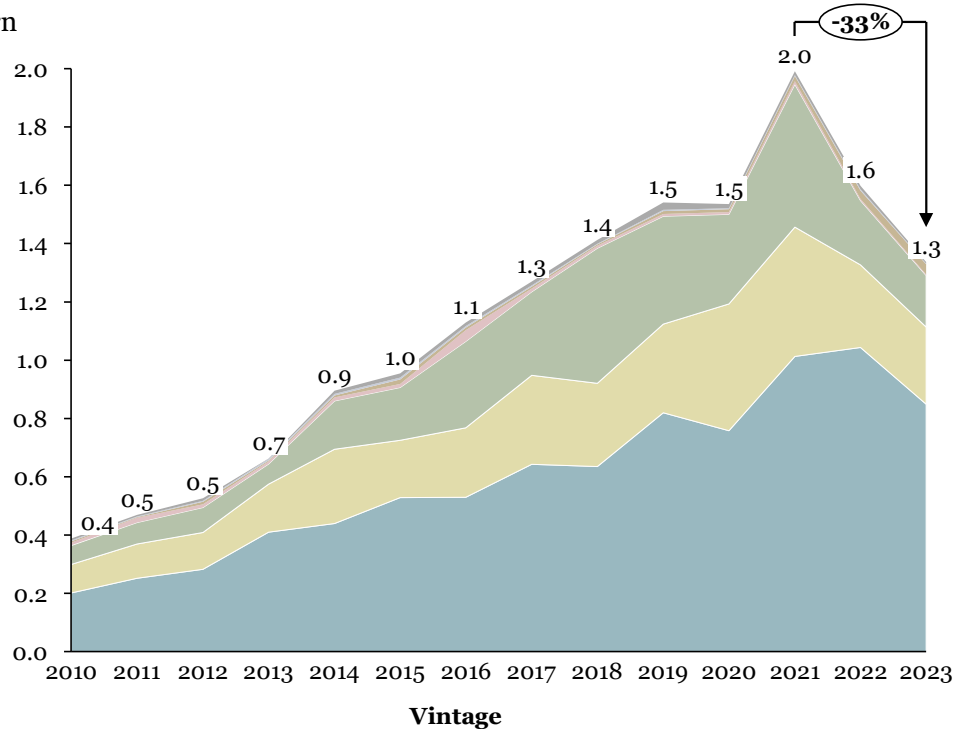
1. Climate fundraising and investing have shown steady growth and resilience
2. Climate investing is growing faster than the global market across all investment stages
3. Climate is attracting significant venture funding globally
4. The "missing middle" financing gap also exists in climate
5. Large asset owners are increasingly entering the climate space
6. Mega funds dominate climate investing
7. Indications of a capital deployment mismatch
8. Capital is flowing to opportunities offering the greatest returns, not mitigation potential
9. Increasing capital flow to new climate fund managers
10. Climate fund returns align with the broader market

1. Climate fundraising has shown greater resilience than the broader market

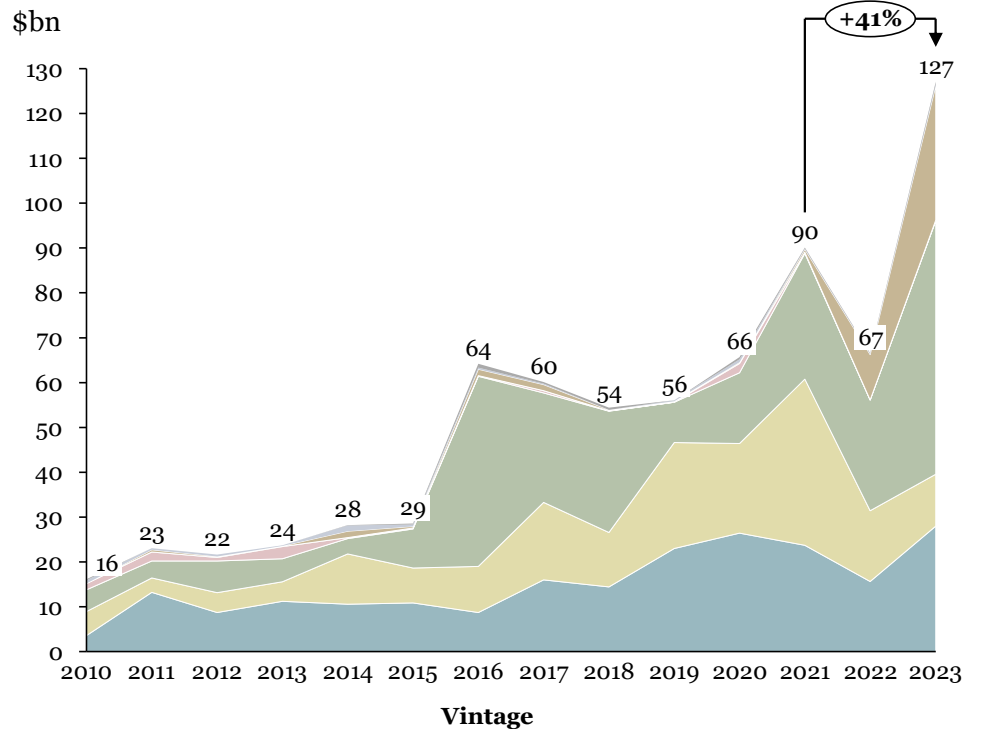
X% Absolute Change US & Canada Europe Asia Americas¹ Middle East Africa Oceania

Total Capital Raised by Fund Region

All industries \$trn



Climate \$bn



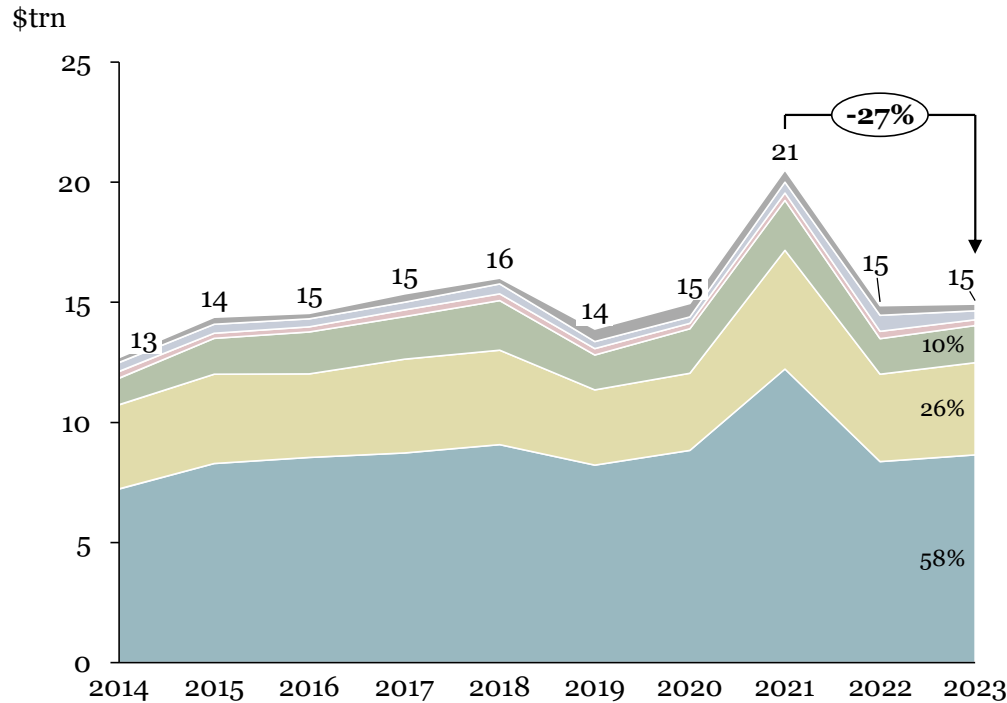
1. Americas includes Central and South America
Source: Pitchbook Data, Inc.; CREO analysis

1. Climate investing has grown faster than the broader market and the post pandemic decline is less pronounced

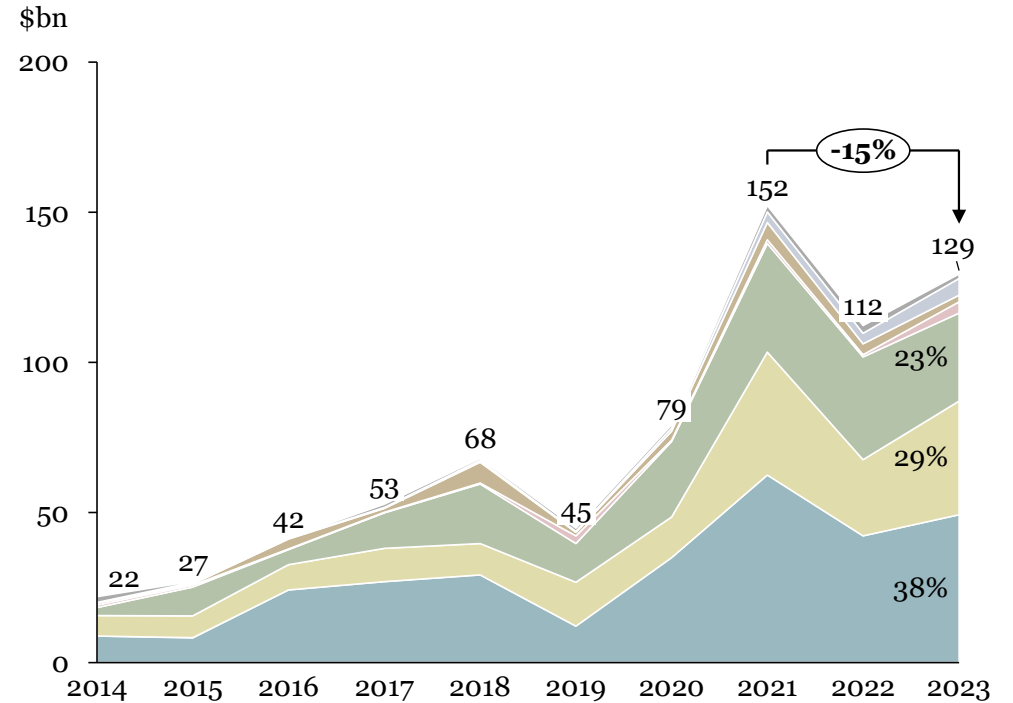
X% Absolute Change US & Canada Europe Asia Latam Canada Oceania Africa & Middle East

Global VC, Growth Equity and PE Private Capital Invested across Regions

All industries



Climate



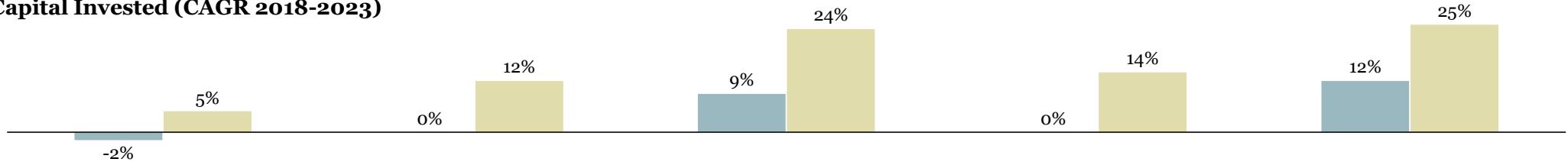
CREO Note: Excludes deals <\$3m, cancelled / failed deals.
Source: Pitchbook Data, Inc.; CREO analysis

2. Climate investing is outpacing the market across all investment stages

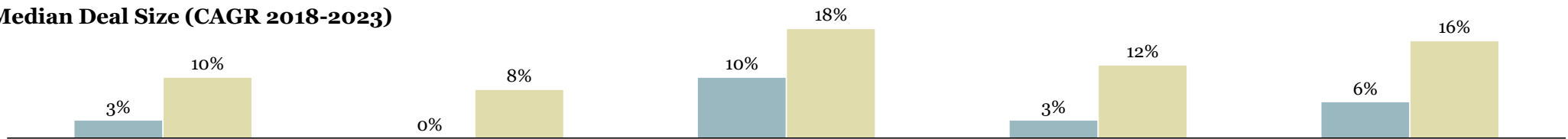
Global Climate VC, Growth Equity, PE Investing across stages

All industries Climate

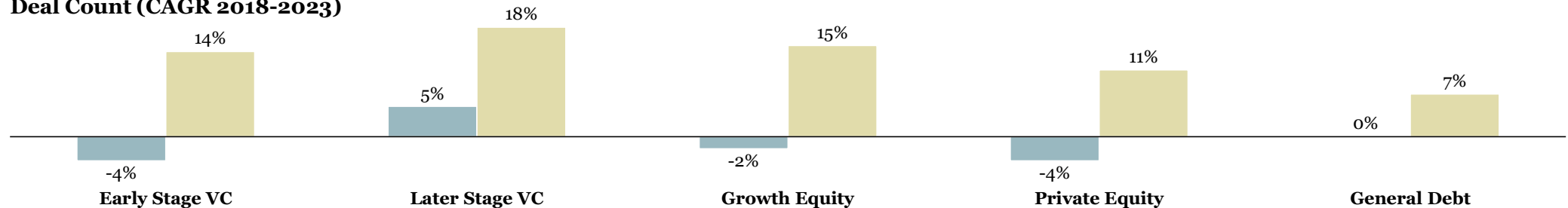
Capital Invested (CAGR 2018-2023)



Median Deal Size (CAGR 2018-2023)



Deal Count (CAGR 2018-2023)



Note: Excludes deals that are <\$3m
Source: Pitchbook Data, Inc.; CREO analysis

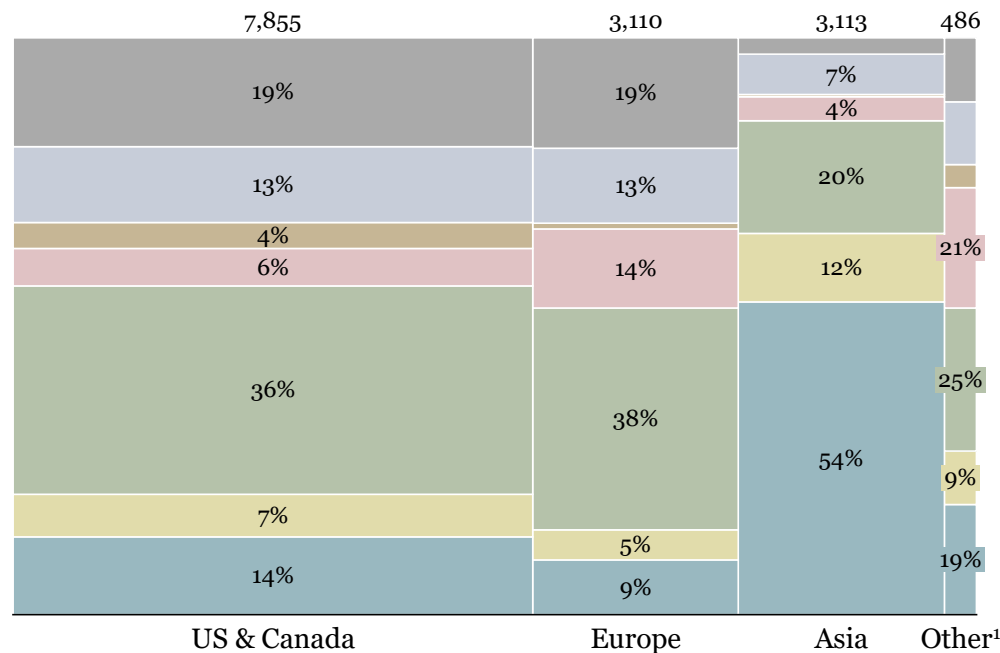
3. Infrastructure funds dominate in Europe, while VC funds raise the highest amounts in Asia and North America

Venture Capital Growth Equity Private Equity Infrastructure Natural Resources Real Estate Private Debt

Global Private Capital Fundraised across Fund Categories and Regions (2010-2023)

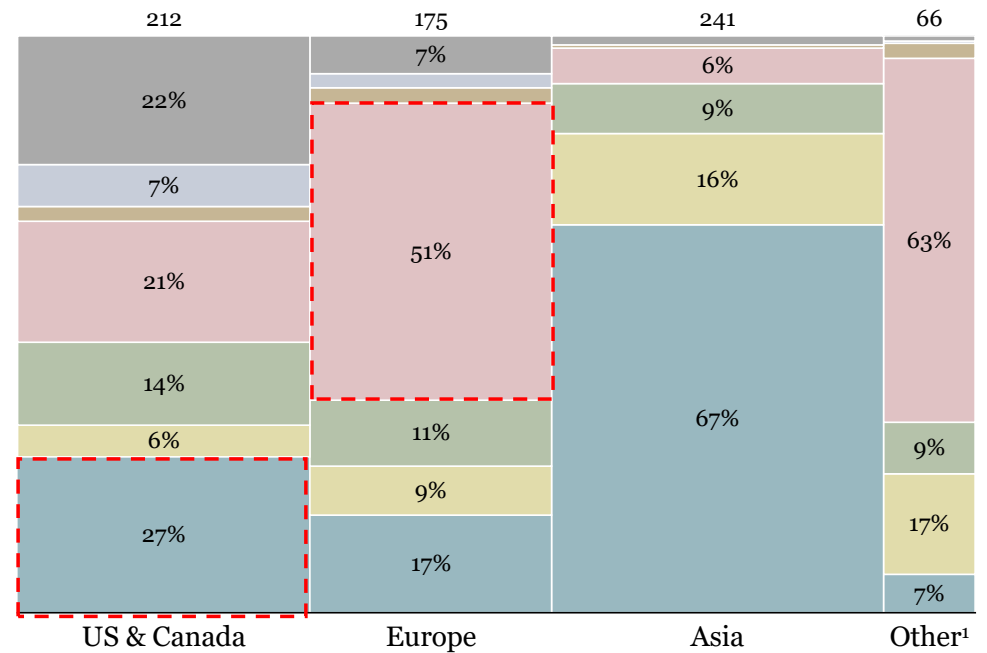
All Industries

\$bn, %



Climate Funds

\$bn, %



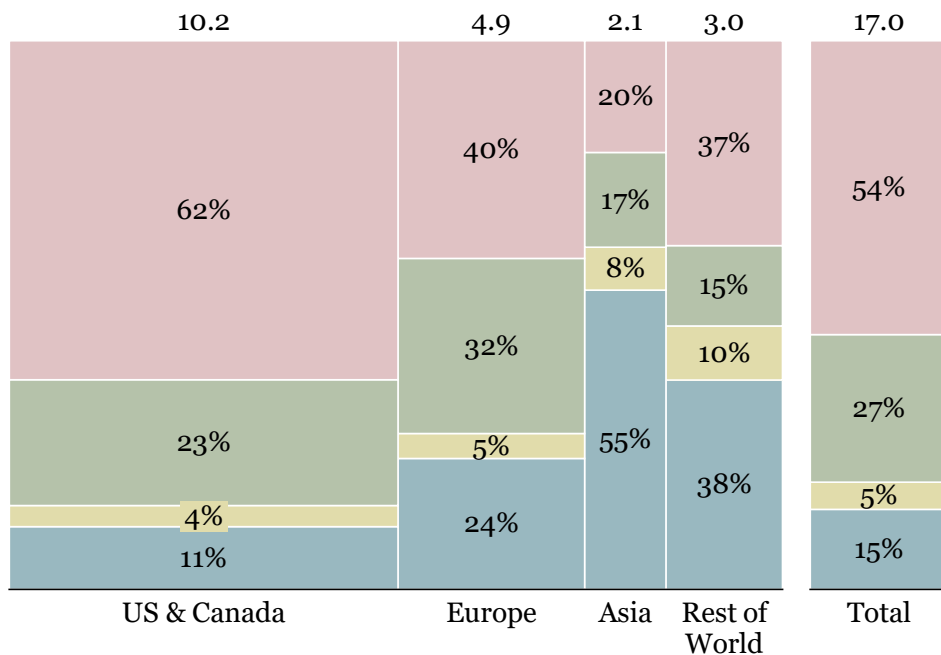
1. Other includes Central America, South America, Middle East, Oceania, and Africa
 Source: Pitchbook Data, Inc.; CREO Analysis

3. Venture Capital dominates climate deal flow capital

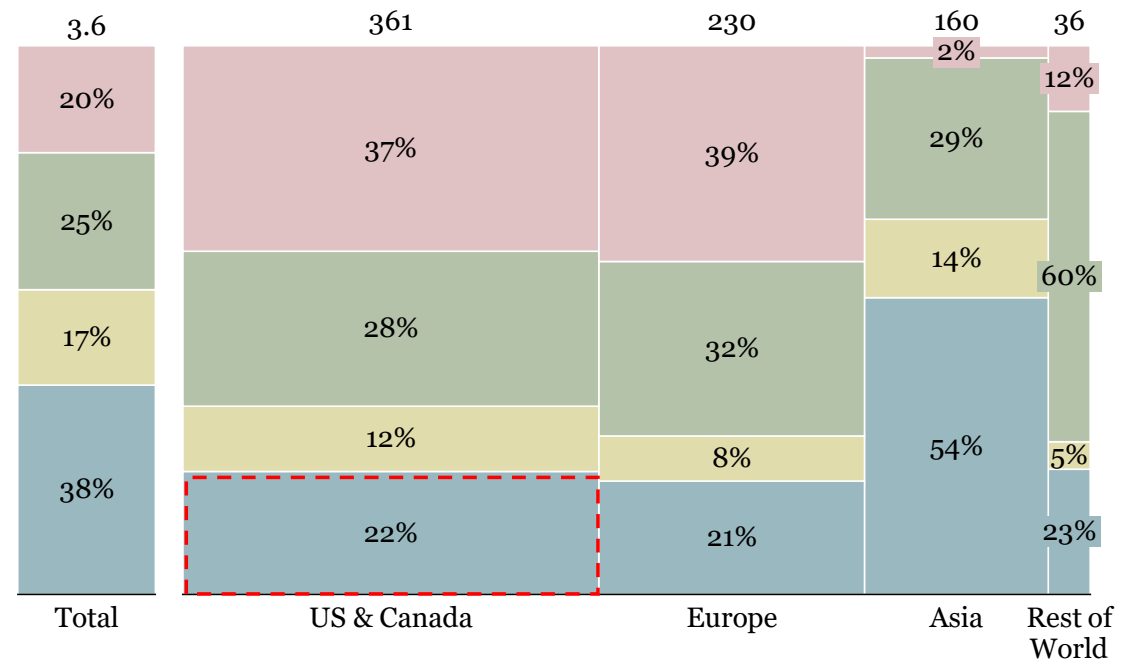
■ Venture Capital
 ■ Growth Equity
 ■ Private Equity
 ■ General Debt

Capital Invested in VC, Growth Equity, PE, and General Debt across Regions by Investment Stage (2018-2023)

All Industries
\$trn



Climate
\$bn

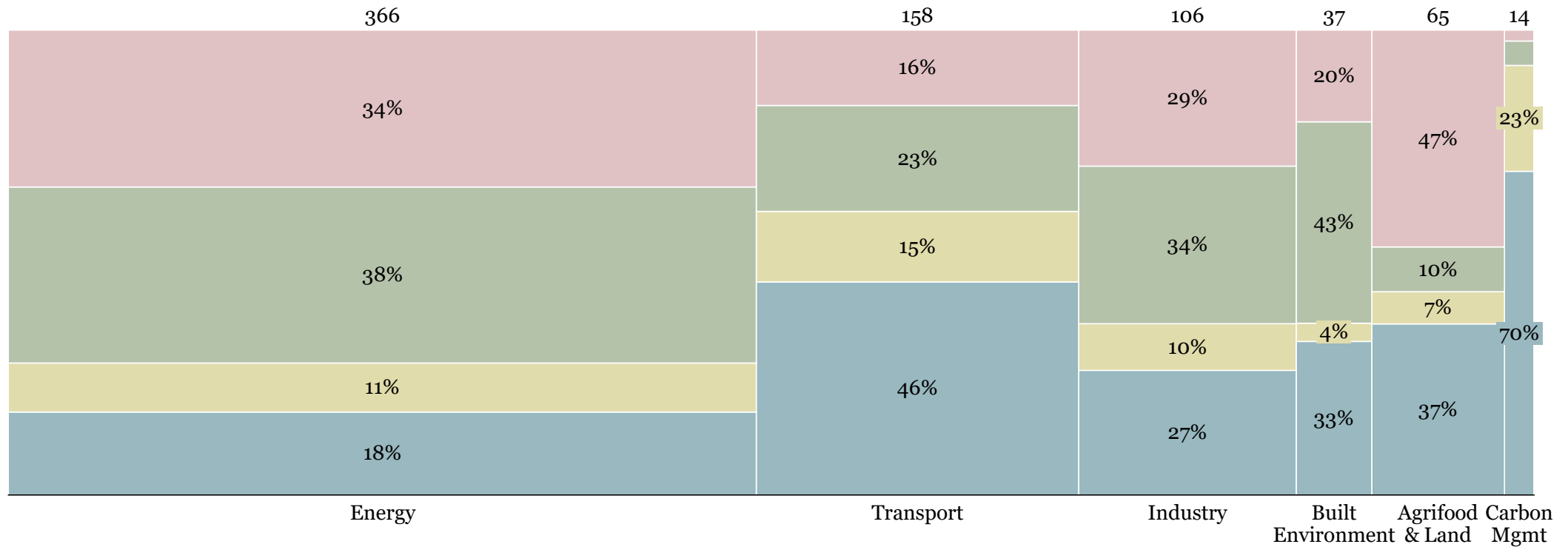


Note: Excludes deals <\$3m, cancelled / failed deals, debt refinancing, debt restructuring & bankruptcy
Source: Pitchbook Data, Inc.; CREO analysis

3. Energy receives proportionally more later stage equity deals and general debt

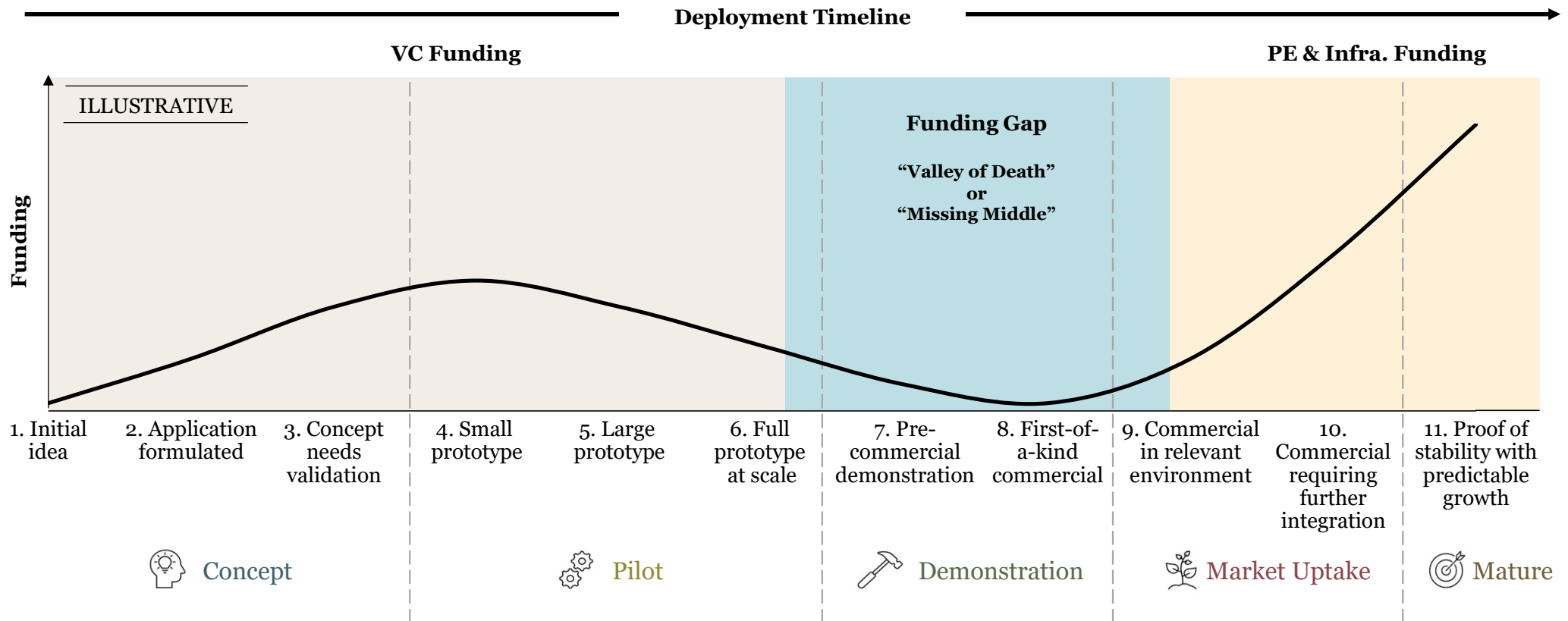
Venture Capital Growth Equity Private Equity General Debt

Global Climate VC, Growth Equity, PE Capital across Sectors across Investment Stage (2018-2023)
\$bn, %



CREO Note: Excludes deals that are <\$3m in size
Source: Pitchbook Data, Inc.; CREO analysis

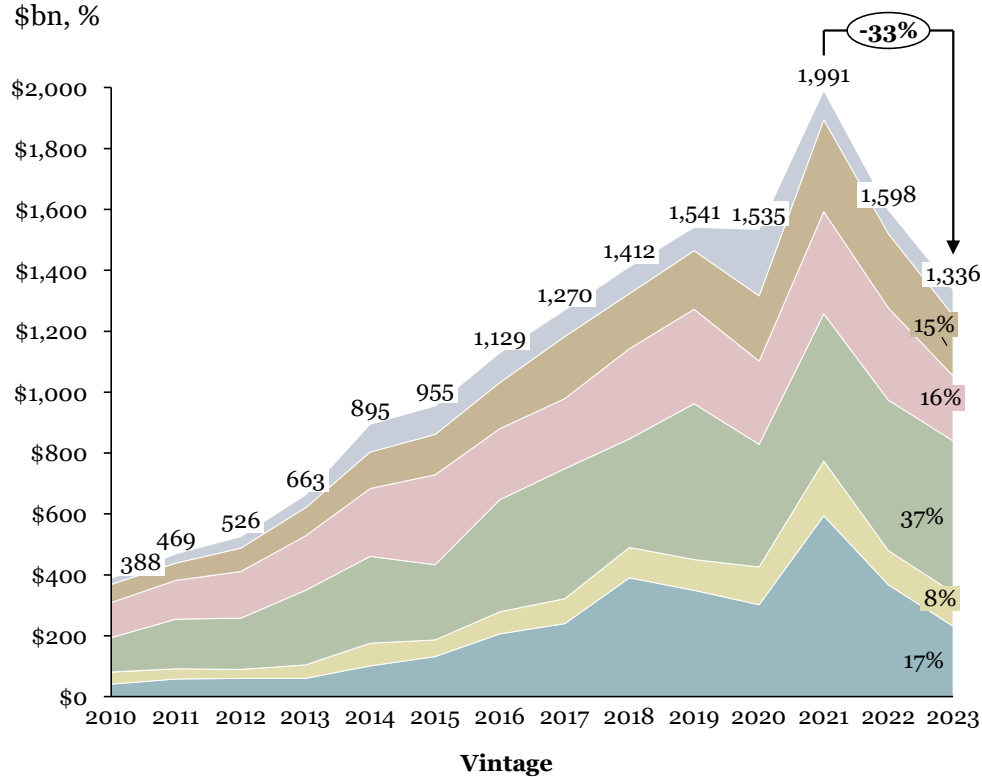
4. The “missing middle” capital gap limits the scaling of emerging solutions



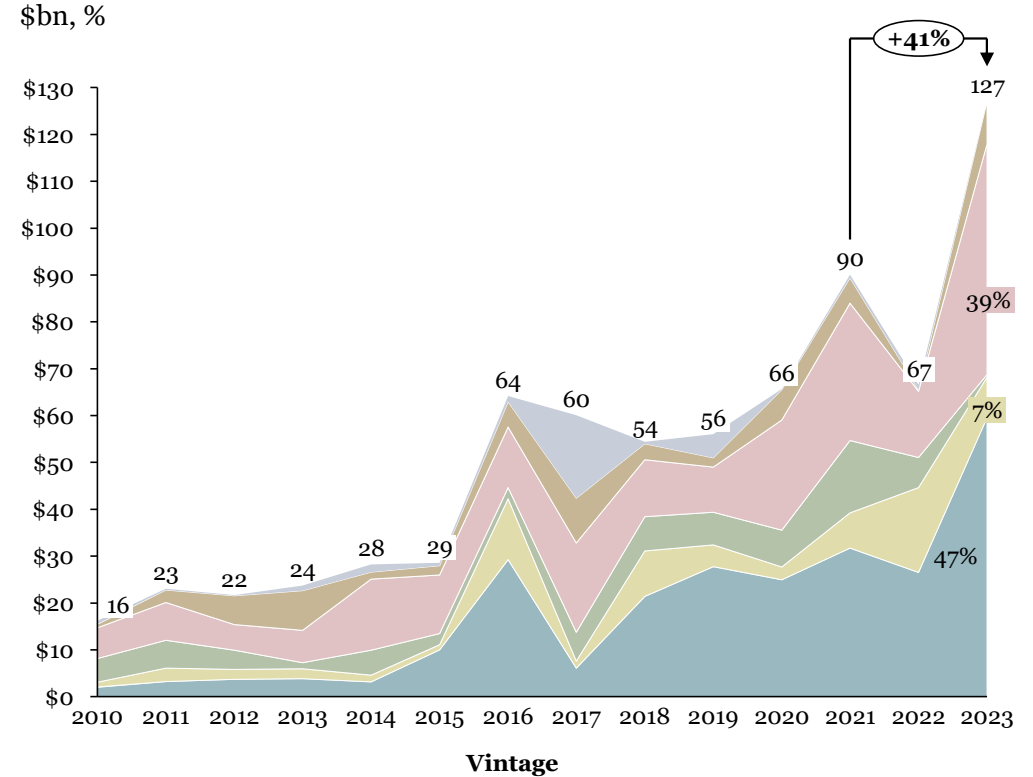
4. VC focused Climate Funds have increased significantly, while PE funding remains limited

X% Absolute Change ■ Venture Capital ■ Growth Equity ■ Private Equity ■ Real Assets ■ Private Debt ■ Other¹

All Industries: Total Capital Raised by Fund Categories



Climate Funds: Total Capital Raised by Fund Categories



CREO 1. Other includes funds of funds, secondaries, co-investments, private finance, and Hedge Funds
 Source: Pitchbook Data, Inc. & CREO Syndicate

4. The 'missing middle' is evident in deals across most climate sectors

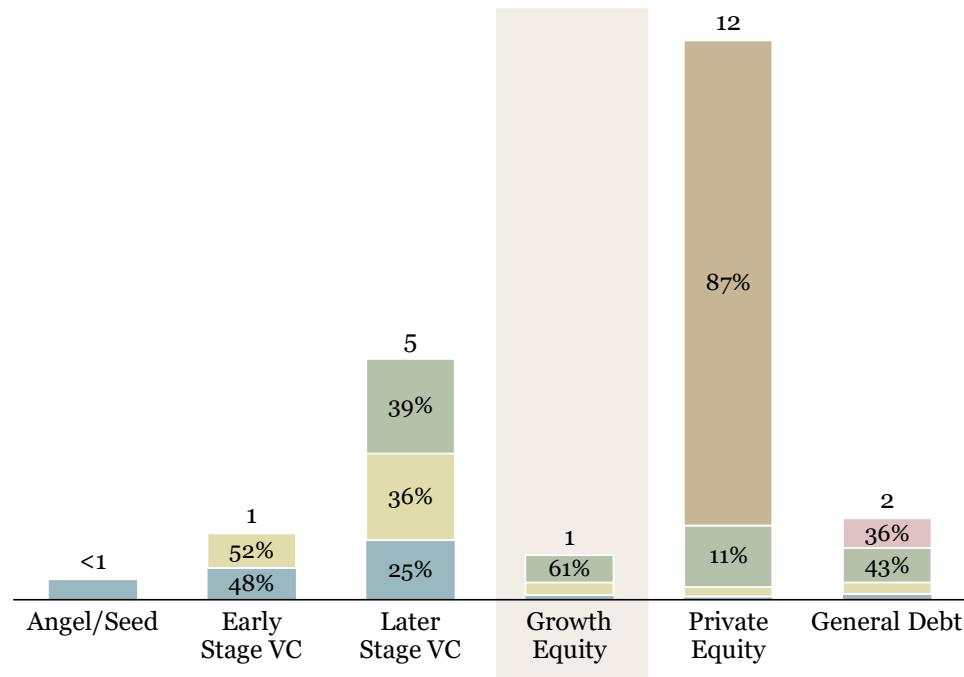
Built Environment Example

\$3-24m \$25-99m \$100-499m \$500-999m \$1bn+

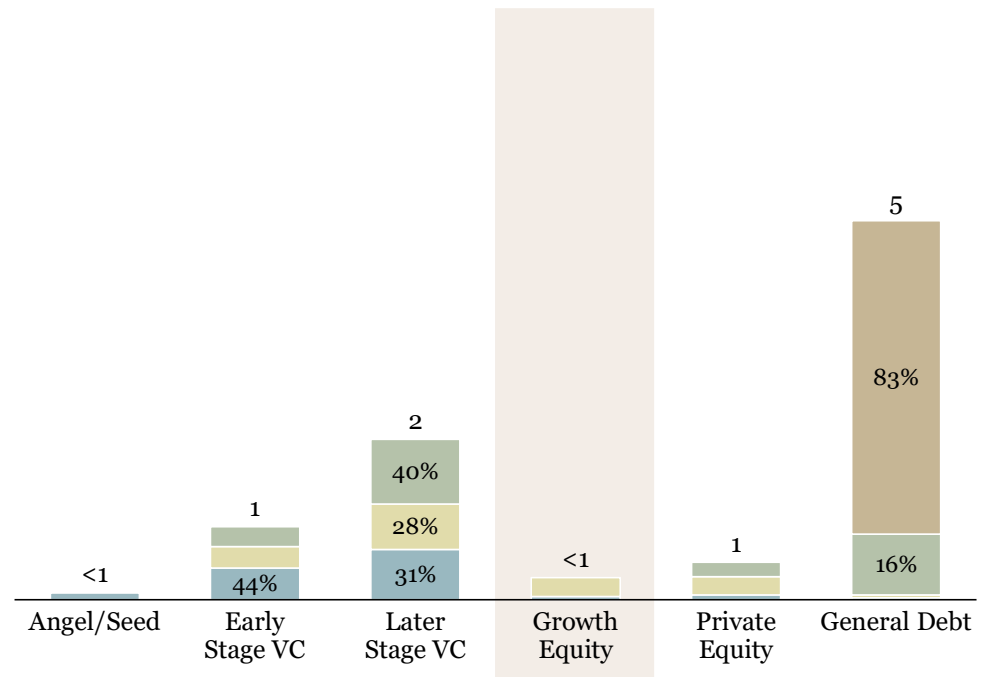
Built Environment Sector | Climate Capital Invested Across Investment Stages by Deal Size (2018 – 2023)

\$bn

United States



Europe



Note: Excludes deals that are <\$3m in size
Source: Pitchbook Data, Inc.; CREO analysis

5. Large asset owners are increasingly entering the climate space and plan to deploy significant capital



NZAOA

The UN Net-Zero Asset Owner Alliance is a member-led initiative of **89 large asset owners** committed to transitioning their **\$9.5trn** investment portfolios to net zero GHG emissions by 2050, with intermediate goals for 2025 and 2030



\$100bn Net Zero Pledge



\$54bn in green assets by 2025
\$10bn transition envelope.



ALTERRA

\$30bn catalytic climate fund
Aim to mobilize **\$250bn** by 2030

Brookfield

\$17bn
BGTF II Climate Fund



\$7.3bn
TPG Rise Climate Fund

Blackstone

\$7.1bn
Green Private Credit Fund III

KKR

\$7bn
Global Climate Fund

BlackRock

\$5bn
Global Infrastructure Fund IV



€1.9bn
Renewable Energy Fund II

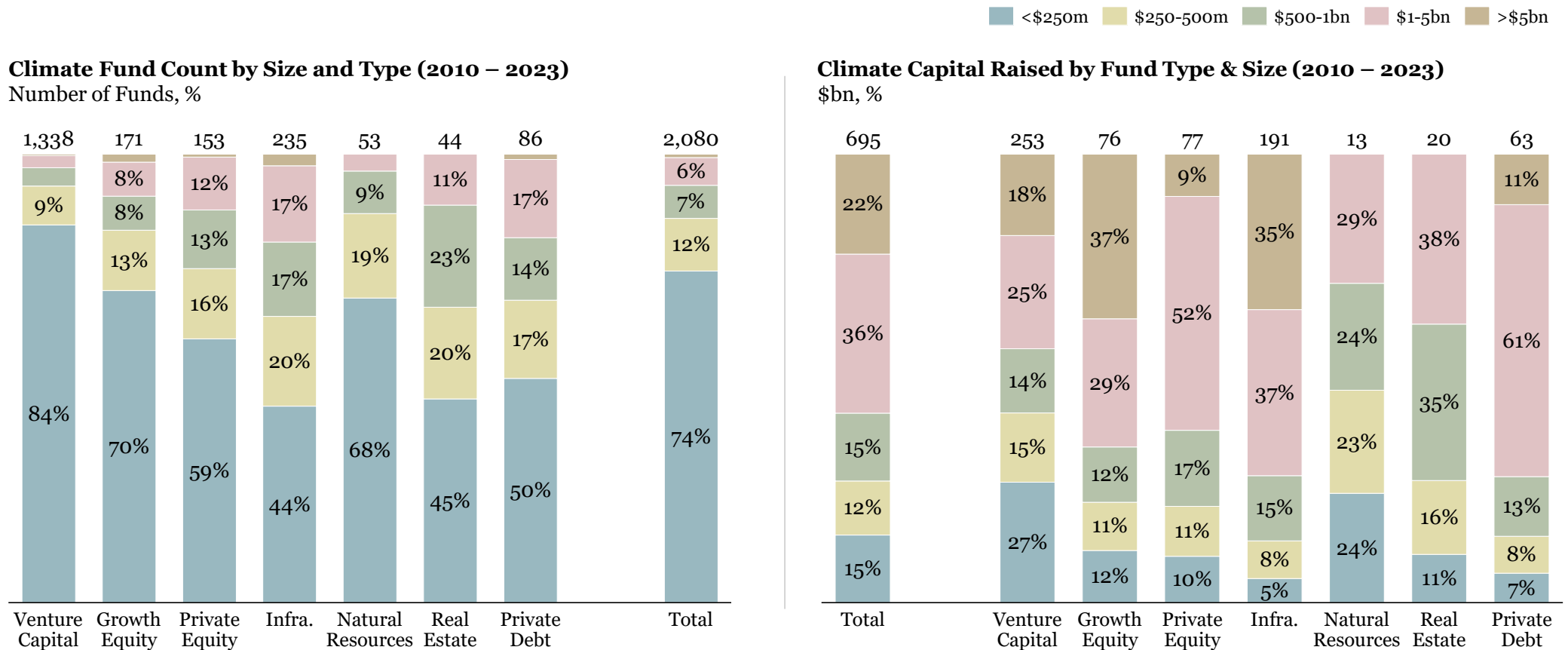


\$1.6bn
Horizon Environment & Climate Solutions Fund

THE CARLYLE GROUP

\$1.6bn
Renewable & Sustainable Energy Fund II

6. Large (>\$1bn) funds dominate the capital raised within the climate sector



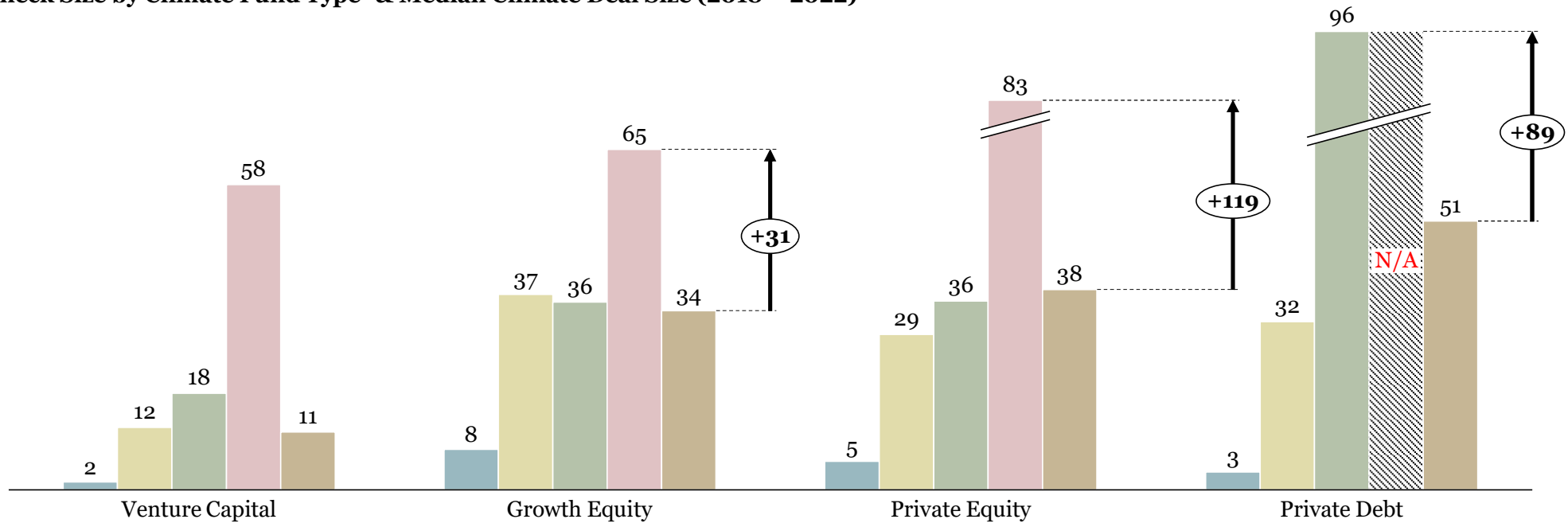
Note: Analysis excludes funds without fund size data
 Source: Pitchbook Data, Inc.; CREO analysis

7. The dominance of large funds may create a capital deployment gap in the VC and Growth Equity sectors

■ <\$250m
 ■ \$250-500m
 ■ \$500-1bn
 ■ >\$1bn
 ■ Median Deal Size¹

Median Check Size by Climate Fund Type² & Median Climate Deal Size (2018 – 2022)

\$m



Number of Funds Included

281

28

25

12



1. Median Deal Size based on Climate 2018-2022 Deals Sizes
 2. Est. Check Sizes calculated for Funds with Vintages from 2018 -2022 by multiplying Called Down % x Fund Size divided by total investments (only for funds with >4 investments)

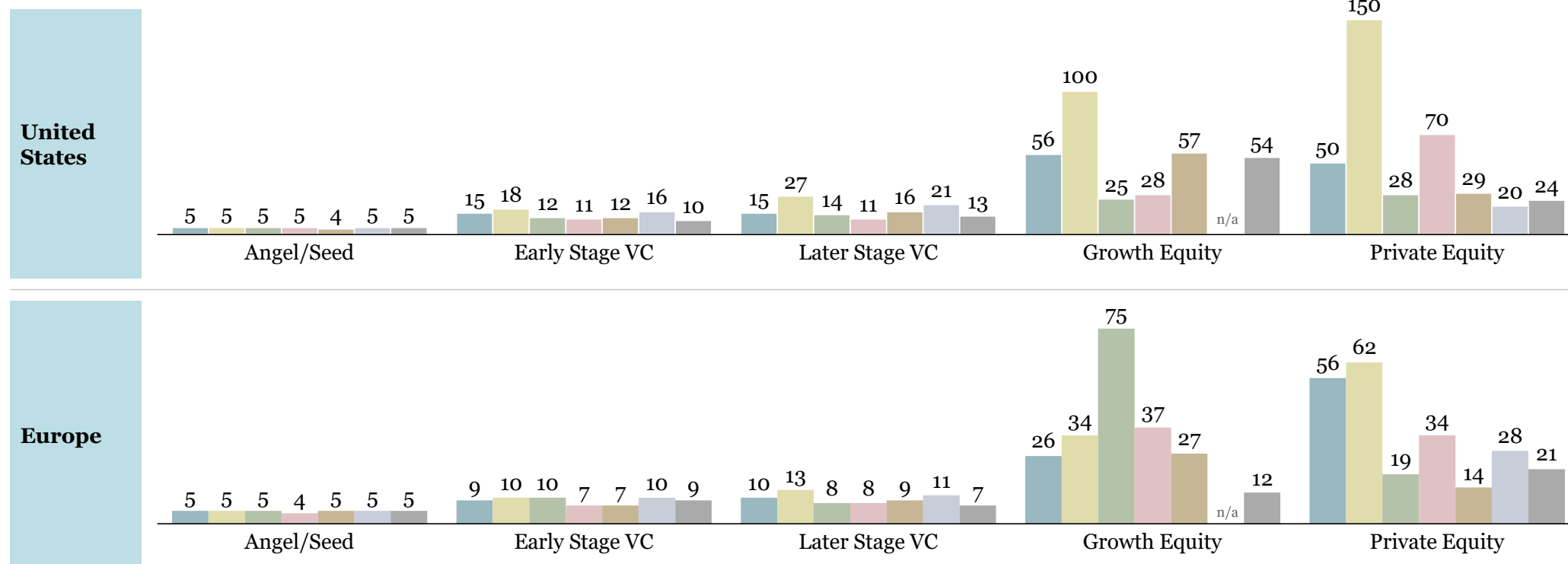
Source: Pitchbook Data, Inc. & CREO Syndicate

7. Sector level analysis highlights the importance of larger investments to scale Energy and Transport solutions

Energy Transport Industry Built Environment Agrifood & Land Carbon Mgmt. Other

Median Deal Size by Sector (2018-2023)

\$m per deal



Note: Excludes deals that are <\$3m in size; Other refers to General Climate Intelligence & Services; Carbon management excluded from growth equity due to small sample size.

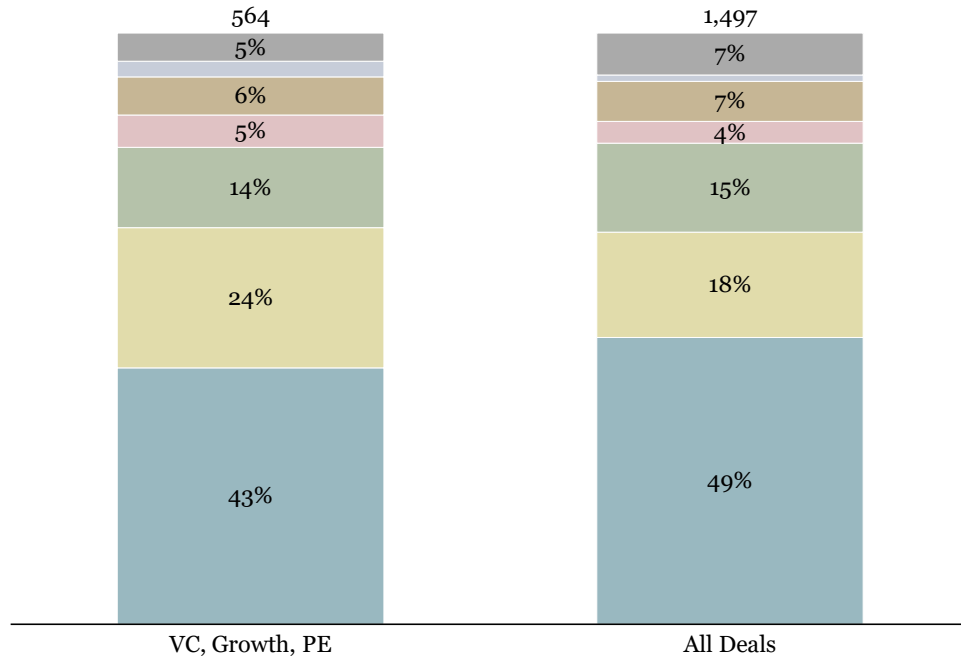
Source: Pitchbook Data, Inc.; CREO analysis

8. Capital is flowing to the largest revenue potential opportunities, not necessarily mitigation potential

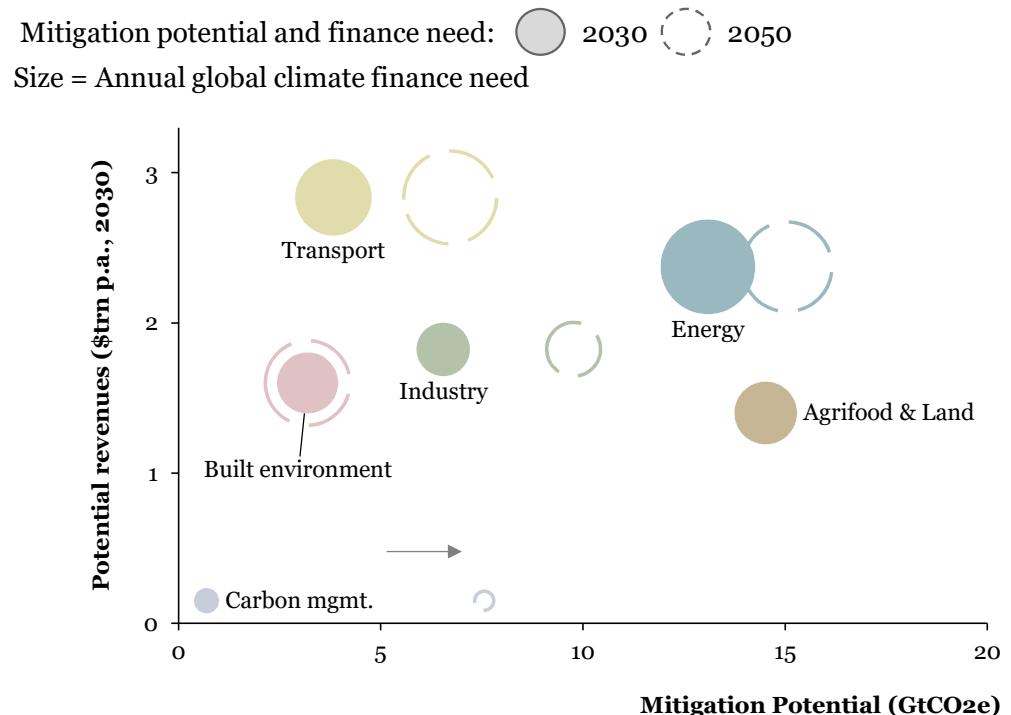
Energy Transport Industry Built Environment Agrifood & Land Carbon Management General Intelligence & Services

Global Climate Sector Deals (2018 – 2023)

\$bn, %



Potential Revenue from Net-zero Offerings (2030) v Mitigation Potential

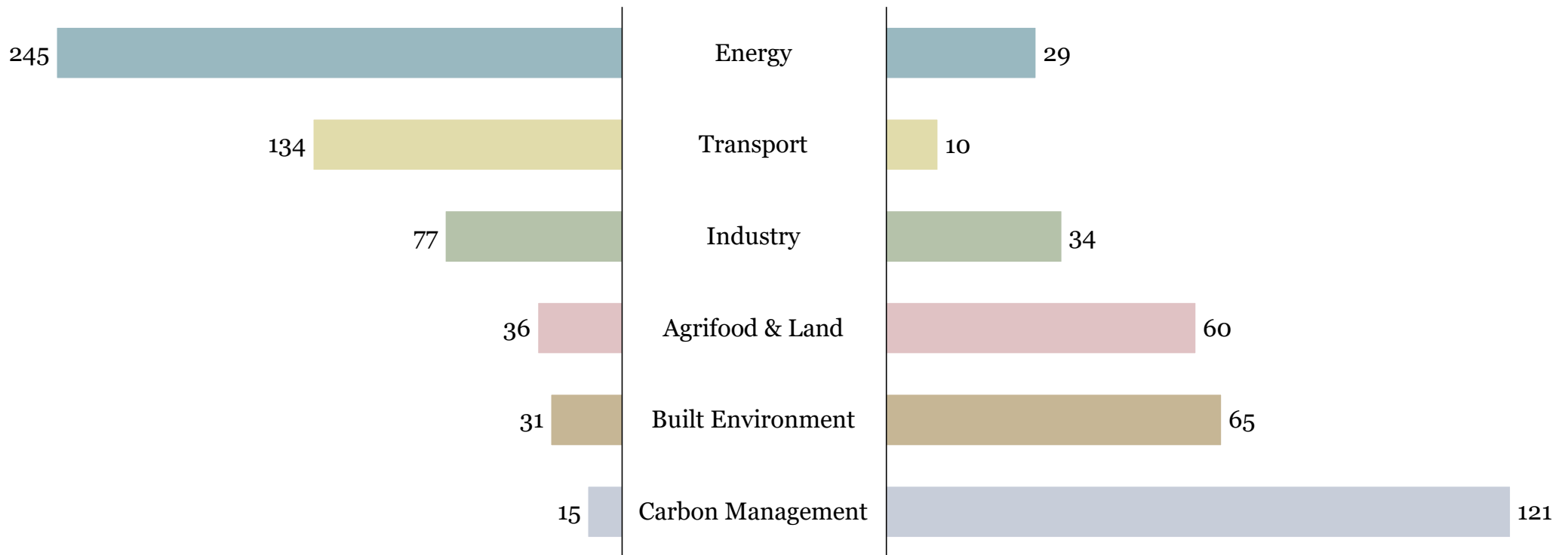


Note: Excludes an estimated additional \$212bn in adaptation finance needed by developing countries up to 2030 (CPI); Excludes Waste & Wastewater;
 Source: CPI (2023) Global Landscape of Climate Finance; CPI (September 2023) How Big is the Net Zero financing Gap?; WRI (2023) State of Climate Action; IPCC (2021) Sixth Assessment Report; BloombergNEF (2023) Energy Transition Investment; McKinsey (2022) Accelerating toward net zero: The green business building opportunity; CREO analysis

8. Capital is flowing to sectors with the lowest technology costs relative to reference costs

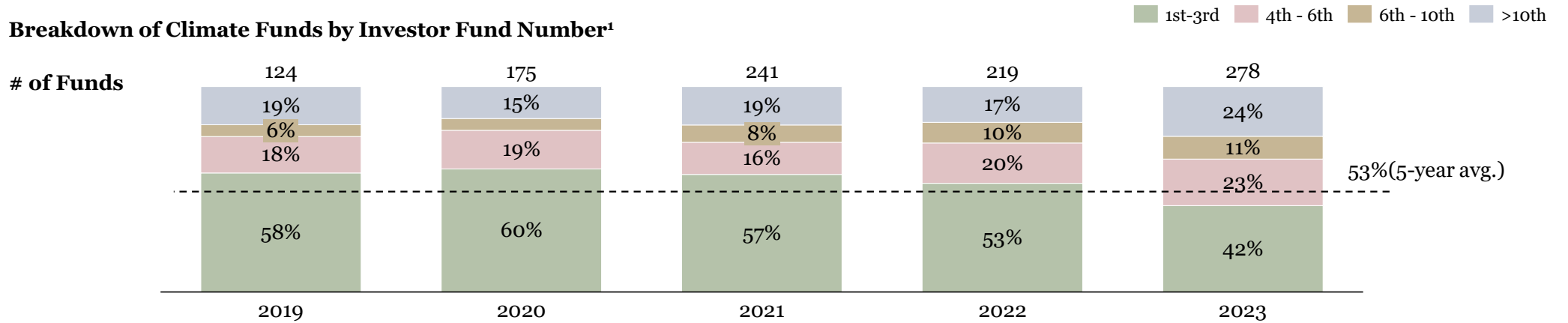
Global VC, Growth Equity, PE Climate Capital Invested (2018-2023)
\$bn

Avg. Potential Cost Relative to Reference Technology (2030)
\$/GtCO₂e

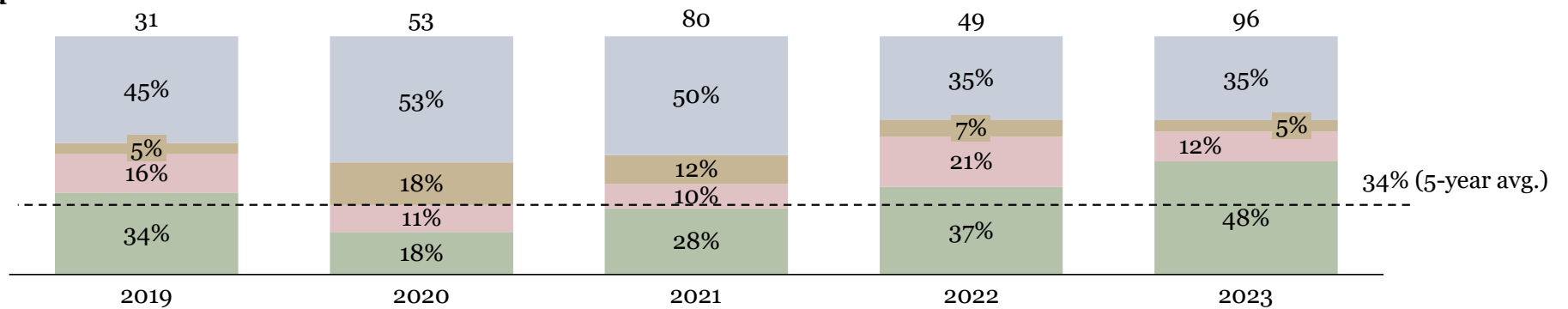


9. Emerging climate fund managers have raised increasing amounts of capital

Breakdown of Climate Funds by Investor Fund Number¹



Capital Raised \$bn



1. Fund Number tracks chronologically the order of a fund by Investor across all funds (not just climate-relevant funds) | Funds I, II, and III are the first 3 funds ever raised by a fund manager and are emerging managers (have launched fewer than four funds) | Fund No. is used to estimate the maturity of the investor fundraising capital

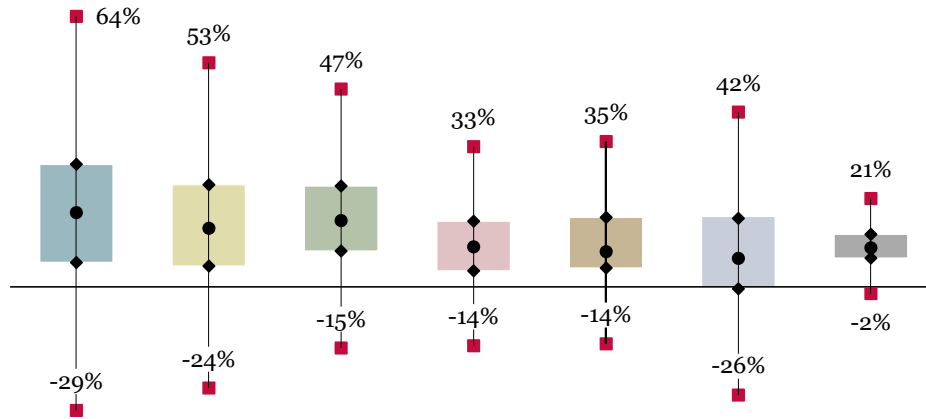
Source: Pitchbook Data, Inc.; CREO analysis

10. Climate fund performance is comparable to the broader market, except for Growth Equity

Performance by Fund Category (2010 – 2023)

Net IRR

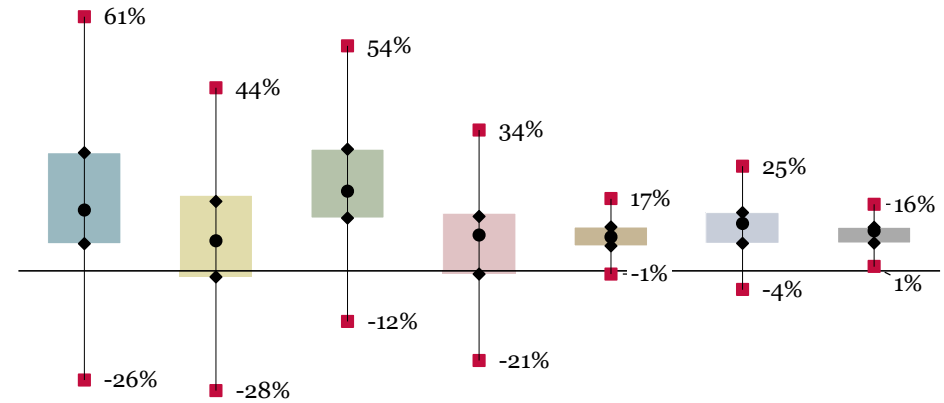
All Industries



	Venture Capital	Growth Equity	Private Equity ²	Infra. ²	Natural Resources ²	Real Estate ²	Private Debt
Quartile Spread (pp.)	23	19	15	12	12	17	6
# of funds	2k	510	2k	370	318	1k	1k

● Median ■ Upper Bound¹ ■ Lower Bound¹ ◆ 25th Percentile ◆ 75th Percentile

Climate Funds



	Venture Capital	Growth Equity	Private Equity	Infra.	Natural Resources	Real Estate	Private Debt
Quartile Spread (pp.)	21	18	16	12	3	7	4
# of funds	56	12	33	33	11	15	24

1. Upper/Lower Whisker is 1.5 x the inter quartile range (IQR), this point is the upper/lower boundary before individual points are considered outliers.

2. PE IRR approximated by Buyout, Infra. IRR approximated by Infra. General, Natural Resources IRR approximated by Natural Resources General, Real Estate IRR approximated by Generalist Real Estate

Source: Pitchbook Data, Inc.; CREO analysis



4

Looking Forward

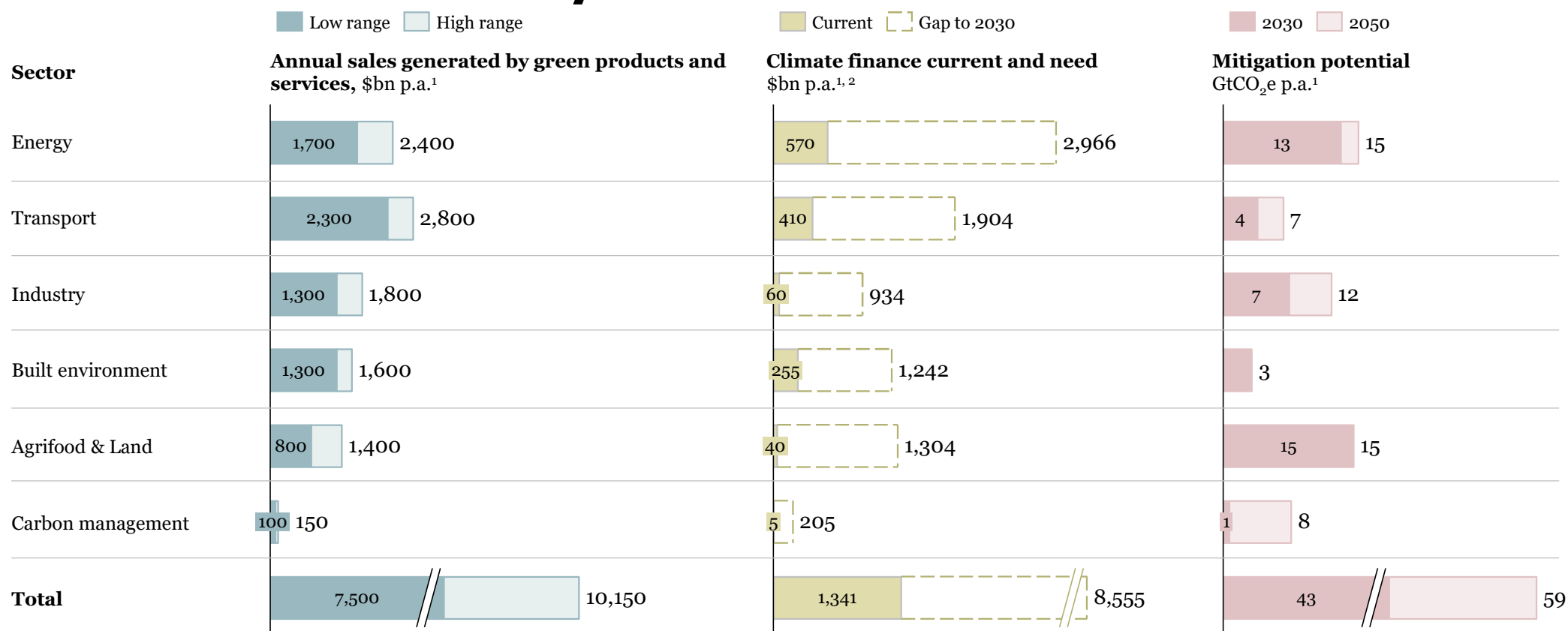
Our analysis highlighted the need to significantly increase capital flows into climate investments but also the potential to redirect existing capital and align it with the climate market's needs

To have any chance of achieving the net zero targets it will be important to:

- a. **Redirect Capital and Innovate Financing Mechanisms:** It is imperative to redirect existing capital toward transformative climate technologies and develop innovative financing mechanisms
- b. **Ensure climate capital flows into appropriate investments:** Enhancing transparency, accountability, and data accuracy in the climate finance sector is crucial
- c. **Encourage the flow of new capital into climate investments:** Regardless of the success in redirecting existing capital to sustainable investments, the world needs to significantly increase the amount of capital invested in the climate sector
- d. **Align the sources of capital with market needs:** Ensuring that capital flows to funds able to effectively invest checks of \$10-40m will go a long way to meeting market needs
- e. **Address the “Missing Middle” in climate finance:** Achieving widespread commercial adoption of critical climate technologies requires accelerating their deployment to decrease costs and enhance viability
- f. **Actively consider investment returns AND mitigation potential:** The financial returns offered in some of the sectors with the greatest mitigation potential appears to have limited the flow of capital to these important opportunities

The potential economic and environmental benefits of closing the climate financing gap are immense. Identified climate solutions could generate up to \$12trn annually in new revenues by 2030 through net zero products and services, and returns from climate fund investments are broadly comparable to those available in other sectors

Sector-based investments in climate could deliver ~\$12trn¹ incremental revenue by 2030



1. Waste & Waste included in industry mitigation potential, excluded from incremental revenue and investment need due to lack of investment need data. Potential to add \$2trn in incremental revenue by 2030;

2. Excludes an estimated additional \$212bn in adaptation finance needed by developing countries up to 2030 (CPI);

Source: CPI (2023) Global Landscape of Climate Finance; CPI (September 2023) How Big is the Net Zero financing Gap?; WRI (2023) State of Climate Action; IPCC (2021) Sixth Assessment Report; Bloomberg NEF (2023) Energy Transition Investment; IRENA (2023) World Energy Transitions Outlook; IEA (2023) World Energy Investment, IEA (2023) Landscape of Climate Finance in Agrifood Systems; Hydrogen Council (2023) Hydrogen Insights; McKinsey (2022) Accelerating toward net zero; CREO Analysis



CREO is a not-for-profit organization with a mission to mobilize and catalyze high-impact capital that drives the necessary transition to a low-carbon, sustainable, and prosperous future for all. CREO has built and currently convenes a membership consisting of the largest community of active family offices and family foundations investing in climate, globally with about 200 members across 30+ countries. We facilitate investment by helping our members build knowledge and confidence via shared insights, research, and programming that focuses on the question of 'how' to invest in climate solutions and the decarbonization transition.



Featherlight is a private investment firm that provides the catalytic capital and proactive operational support that climate-specialist private markets managers most need to effectively scale and commercialize proven climate solutions and grow their businesses. With offices in North America and Europe, Featherlight leverages its team's decades of experience at large pension and sovereign funds, family offices and private investment firms to help great climate investors build great climate investment businesses.