

"混合融资X"

 Blended Finance X

助力气候科技突破融资瓶颈
Unlocking Capital for Climate Technologies

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1 问题：气候科技投资壁垒

当前，全球气候行动正处于关键转折点。根据联合国环境规划署 (UNEP) 分析，全球温室气体排放到2030年需要削减42%，到2035年需要削减57%，才能使全球升温控制在1.5°C的轨道上¹。然而，2024年全球二氧化碳排放量较2023年继续增长2%²。在国际能源署 (IEA) 2050年净零排放中的分析中，2050年净零目标中，35%减排依赖开发中技术，40%依赖未大规模商业化技术³。如绿氢、长时储能、碳移除等关键气候技术虽初具可行性，但缺乏必要的资金和融资结构实现规模化。

基于此背景，盎然气候行动研究院和北京大学国家发展研究院宏观与绿色金融实验室共同探索混合融资创新模式——设计风险分层的结构化证券工具，撬动商业资本参与气候科技发展。结合中国风险投资情况，分析在中国进行气候混合融资实践的挑战与创新模式。

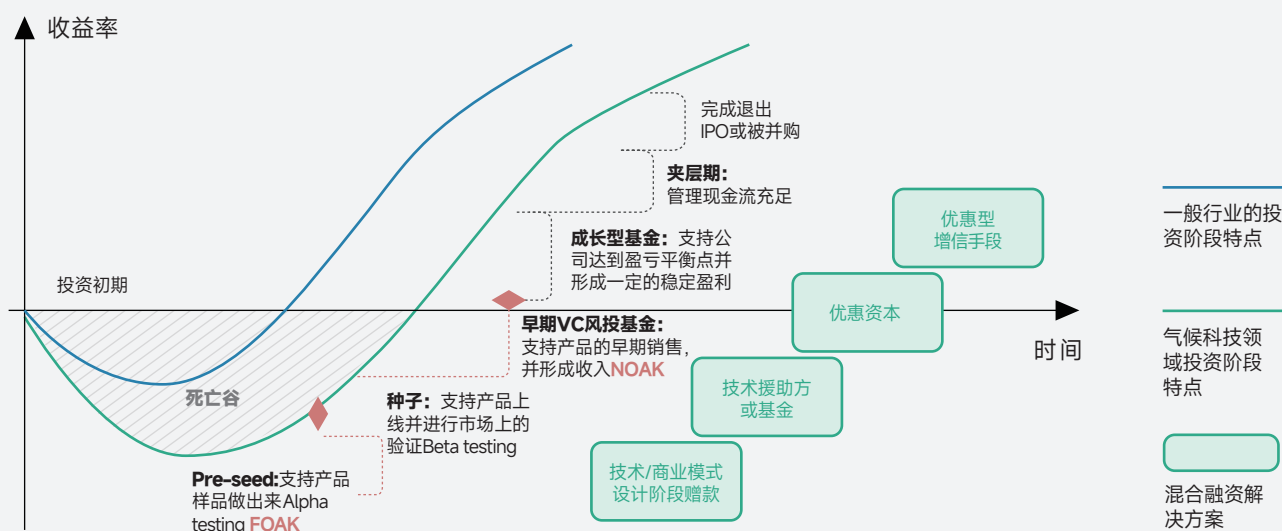
目前，气候科技投资面临减排潜力与投资偏好的错配，比起技术相对成熟的能源、交通等行业，在工业、农业等高排放行业的初创企业所获得的融资相对较少。基于普华永道的分析，在2023-24年间工业领域的初创企业投资额仅占气候科技投资总额8%，而工业占经济总排放量的比例高达34%⁴。

由于气候科技涉及新兴技术和未验证商业模式，金融机构因高技术与市场风险，更倾向投资成熟项目。初创企业则面临信息不对称、资金匮乏、缺乏抵押品等融资障碍，导致贷款审批难度大。

在早期风险投资阶段，前沿技术通常依赖种子基金完成从Alpha测试到Beta测试的过渡。然而，在中国，种子基金因投资周期短（5+5年：18个月至5年的投资期，随后是4-5年的退出期）和科技成果转化难，难以早期介入前沿技术投资；相对而言，硅谷的新兴科技风险投资的周期为8-10年。

短投资周期要求企业快速成长并实现盈利，否则难以通过并购或上市退出。即便早期投资介入，J曲线效应使前期资本投入大、账面价值下滑。

图一 | 气候科技投资J曲线及优惠资本支持在投资阶段中的效用⁵



相比一般行业，气候科技投资的J曲线回报周期更长，由图1可见，气候科技投资的J曲线“死亡谷”凹陷更深，需要到达投资收支平衡的周期更久、需要投资人的更强耐心和更高风险承受度。

总体上，风险资本的缺乏成为了阻碍气候科技大规模推广和实施的重要瓶颈。市场亟需金融创新降低风险，更好的发挥优惠资本的效用，以加速气候技术的商业化，通过金融产品缓解气候投资壁垒。

定义

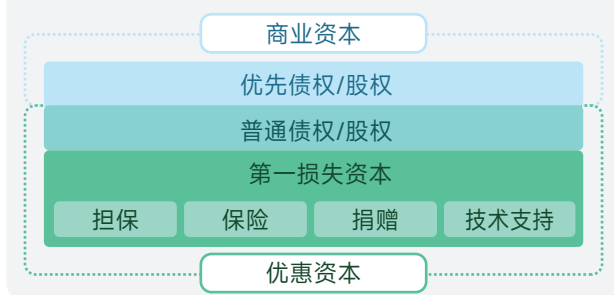
优惠资本：世界银行定义中的优惠资本是由开发银行、多边基金等主要金融机构向发展中国家提供的低于市场利率的融资，用以加速其发展目标的实现。在本研究中优惠资本也包含低于市场利率的公共资金和慈善资金，及对收益要求更低、具有风险承受能力的商业资本。

耐心资本：专注于长期投资的资本形式，不以追求短期收益为首要目标，而更重视长期回报的项目或投资活动，通常不受市场短期波动干扰，是对资本回报有较长期限展望且对风险有较高承受力的资本⁷。

2 解决方案：“混合融资X”

混合融资是目前市场上针对气候融资的主要创新融资产品之一。它是一种结构化方式，旨在让不同目标的机构共同投资并实现各自的目标。混合融资结合了商业资本和来自公共部门和慈善机构等优惠资金，这些优惠资金通常支持社会可持续发展目标。通过设计风险分担机制，优化投资项目的风险收益结构，从而吸引更多商业资本为气候变化缓解与适应项目提供资金。下图为当前混合融资常见模式。

图二 | 混合融资常见模式⁸



然而，目前混合融资面临着优惠资金不足，商业资本撬动率低，且缺乏“可投资的”气候效益项目等问题，尚未发挥出广受期待的影响力。

针对这一现状，盎然气候气候行动研究院与北京大学国家发展研究院宏观与绿色金融实验室共同提出了创新解决方案——“混合融资X”，一种在混合融资核心理念基础上探索模式更新的金融机制。

2.1 核心理念

“混合融资X”的核心理念是通过“证券结构化 X 扩充优惠资本加入”的双重设计，在结合实现优惠资本与商业资本的不同目标的基础上，进一步降低投资风险，解决商业化资本缺少投资意愿的问题，为气候科技初创企业和各类绿色项目提供更为稳定的融资环境。

证券结构化工具（也被称作资产支持融资和结构化信用）通过对金融工具进行设计和重组，以满足特定的投资需求或风险管理目标，从而实现以下成果：

► 风险分层

允许不同风险偏好的投资者选择合意的风险收益特征的资产；

► 分散风险

降低投资组合相关性，平滑整体表现；

► 灵活认购

允许投资者按风险偏好选择份额，降低风险敞口；

► 公开融资

减少对单一渠道的依赖；

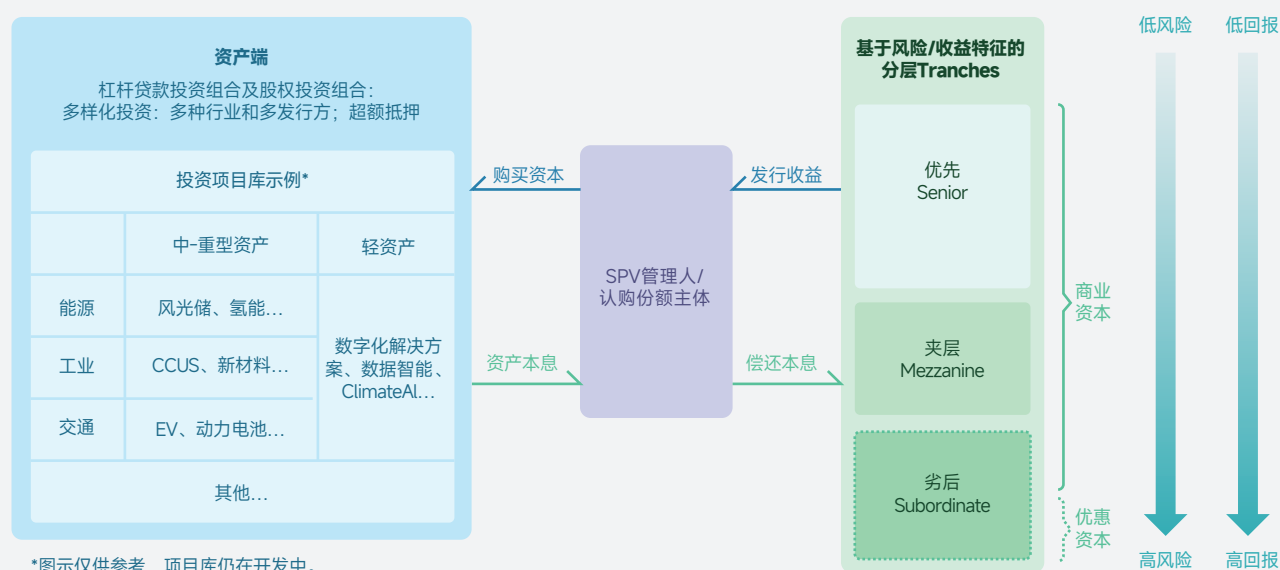
► 便捷退出

支持份额转让，降低退出成本。

在这一机制中，公共和慈善资金的介入尤为必要，这些资金可以发挥优惠资本作用承担初期投资的风险，从而降低商业资本的风险。

2.2 机制设计原理

图三 | “混合融资X”结构化证券机制原理⁹



基于风险/收益特征的分层：

- 在这一机制中，投资者根据自己的风险承受能力和收益预期选择优先、夹层、劣后等各层产品。
- 优先层的投资者面临最低的风险和相应低的回报。同时劣后层投资者面对最高的风险，在优先层和夹层投资者获得支付后会收到剩余的任何现金流，在资产组合表现超出预期的情况下，会获得相应更高的回报；如果资产表现低于预期，劣后层投资者则获得回报概率较小。
- 因此，需要公共和慈善资金来认购劣后层，承担此风险，从而为商业投资者提供保障，降低其风险并吸引更多资金流入社会影响项目。

底层资产风险分散：

- 在底层资产方面，需要通过选取不同类型、属性、行业领域的项目资产，降低投资组合的相关性，平滑整体投资组合的表现，进而降低系统性风险。
- 当然，作为以解决气候问题为出发点的金融机制，在项目选择方面也需要有一定的气候正向标准。

3 期盼：优惠资本与耐心资本发挥更大作用

3.1 优惠资本

目前，国内绿色投资赛道的优惠资本投资模式相对传统，以债权投资为主。投资偏好通常较为保守，倾向于选择风险较小、回报稳定的项目，这在一定程度上限制了对创新和高风险项目的支持。

与之类似的是，近年慈善基金风险偏好相对保守，资金管理思路偏向固定收益，另类资产投资较少。慈善信托的市场很小，关注气候领域的资金非常有限。

在“混合融资X”的结构化证券设计中，优惠资本需要作为缓冲层，认购劣后层资产，在底层资产违约或贬值时优先吸收损失，使优先级投资者获得更稳定的收益，从而提升项目融资吸引力。

3.2 耐心资本

公共资金和慈善资金发挥耐心资本的作用也非常关键，其核心特征是长期投资和高风险承受能力。目前，中国创投市场的主要耐心资本参与者是国有资本，但受短期考核压力影响，面临投资周期与地方政府考核指标不匹配的问题，限制了对高风险、长周期气候科技项目的投资。为增强耐心资本，2024年6月，国务院办公厅发布了《促进创业投资高质量发展的若干政策措施》，其中强调了对政府投资基金管理的优化，提出了改革基金考核和容错免责机制，之后各地政府陆续出台改革措施，包括延长基金存续期、差异化考核、允许合理容忍投资亏损，并建立完善的退出机制¹⁰。

耐心资本对创新、绿色转型和可持续发展至关重要，不仅能够支持企业渡过早期阶段，也为双碳目标提供长期资金保障。只有真正培育耐心资本，才能实现社会效益与经济回报的平衡，推动产业升级与创新发展。



4 预期影响力

4.1 项目尺度

在具体项目的层面上，优惠资本通过承担第一损失，在项目中建立“缓冲区”，降低商业投资者的风险敞口，提升一些“在边际上商业可行的”(marginally bankable)气候项目的可投资性，从而撬动更多商业资本对这些项目的参与。这种撬动效应可以数倍放大优惠资本的影响力，使有限的优惠资金撬动更大规模商业资本投入，增强市场对气候项目的信心，加速具有正向气候效应项目的商业化和规模化，实现更大的影响力。

在通过“混合融资X”撬动更多资金注入的基础上，仍需通过更为有效的投后管理，整合上下游资源，协同创新，使气候技术项目更容易走出“死亡谷”，增强气候领域的整体可投资性。

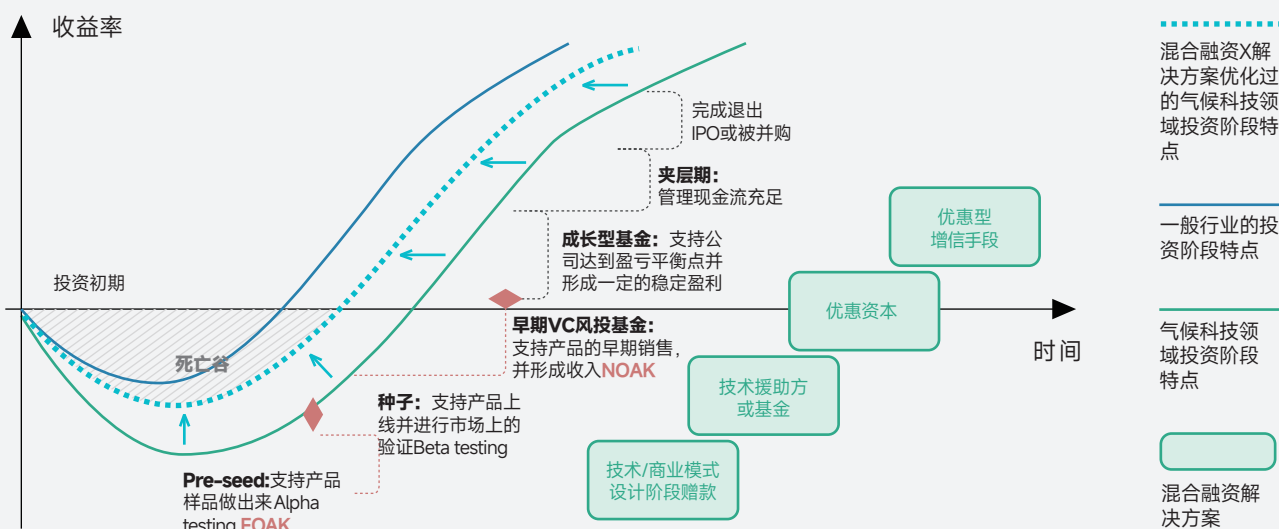
4.2 社会尺度

保证公平的成本分担和资金“再分配”机制是突破社会深度低碳转型资金瓶颈的关键。若能在混合融资道路上有所突破，一方面有望在公共资金之外引入新的优惠资金来源，另一方面可以降低私人资本进入的门槛和顾虑，以更合乎金融逻辑的创新架构与形态，为公共资金、慈善资金与私人资本搭建出互相成就、共创共建的更大空间。

这将为促进低碳转型这一难题的资金池引入更多活水，为以前难以获得传统融资、但对转型具有重要长期价值的各类技术创新、社会创新解决方案匹配到亟需的资源、打开加速成长和规模化的可能性。

此类融资模式可以扩展到其他需要在转型同时考虑公正问题与技术发展的社会领域中，将有助于推动广泛的社会和经济转型，为解决全球可持续发展领域的一些融资难点发挥助力。

图四 | 在“混合融资X”辅助下可投资性提升的气候科技J投资曲线



5 实现建议与下一步

“混合融资X”的构想属于更贴近投资思维的气候金融机制创新，同时也在传统商业资本与慈善资本的差异化思维模式之间打开了协作的窗口。要让此类构想变为现实、发挥出变革性的潜力，需要对气候金融生态的提升：

建议一：金融工具创新实践

设计并应用风险分层结构化证券工具，明确优惠资本（如公共和慈善资金）承担劣后层风险，吸引商业资本进入。鼓励更多对收益要求更低、但也并非纯公益性质的“类优惠资本”出现，在形式、结构方面进行更多的创新探索。

建议二：优化耐心资本考核

延长政府投资基金考核期至10年以上，纳入社会、环境效益等非财务指标，建立容错机制。加强公共和私人资本合作，增强对长期高风险项目的信心。

建议三：多方协同参与

推动监管机构出台混合融资激励政策，鼓励慈善资本通过混合融资工具参与到气候投资领域；强化绿色金融人才激励，吸引更多金融投资专业人才进入绿色领域共建气候金融生态。

此外，在“混合融资X”指引下的具体产品落地，需要进一步开发和完善优质气候投资项目库，保证其中资产组合具有气候影响力的同时能够有效阻断风险传染。



Currently, the global climate action stands at a critical turning point. According to the United Nations Environment Programme (UNEP), global greenhouse gas emissions need a 42% reduction by 2030 and 57% reduction by 2035 in order to stay on track to limit global warming to 1.5°C¹. However, in 2024, global CO2 emissions continued to rise, increasing by 2% over 2023 levels². In the International Energy Agency's (IEA) analysis of the 2050 net-zero scenario, 35% of the emission reductions rely on technologies still under development, and 40% depend on technologies that have not yet been widely commercialized³. Key climate technologies—such as clean hydrogen, long-duration energy storage, and carbon removal—have shown preliminary feasibility, but lack the necessary funding and financial structures for large-scale deployment.

Against this backdrop, Abundant Climate Action Institute and the Macro and Green Finance Lab at the National School of Development, Peking University, are jointly exploring innovative blended finance approaches—specifically, the design of structured securities with layered risk to mobilize commercial capital for climate tech development. The study examines the unique challenges and potential innovations in applying blended finance models to China's venture capital landscape.

1 The Challenge: Barriers in Climate Technology Investment

Currently, climate technology investment faces a mismatch between emissions reduction potential and investor preference. Compared to energy and mobility sectors with higher tech maturity, startups in industrial and agriculture sectors receive significantly less financing. Based on PwC's analysis, startup investment in the industrial sectors in 2023/24 only accounted for 8% of total climate tech investment, while the sectors' emissions accounted for 34% of total economic emissions⁴.

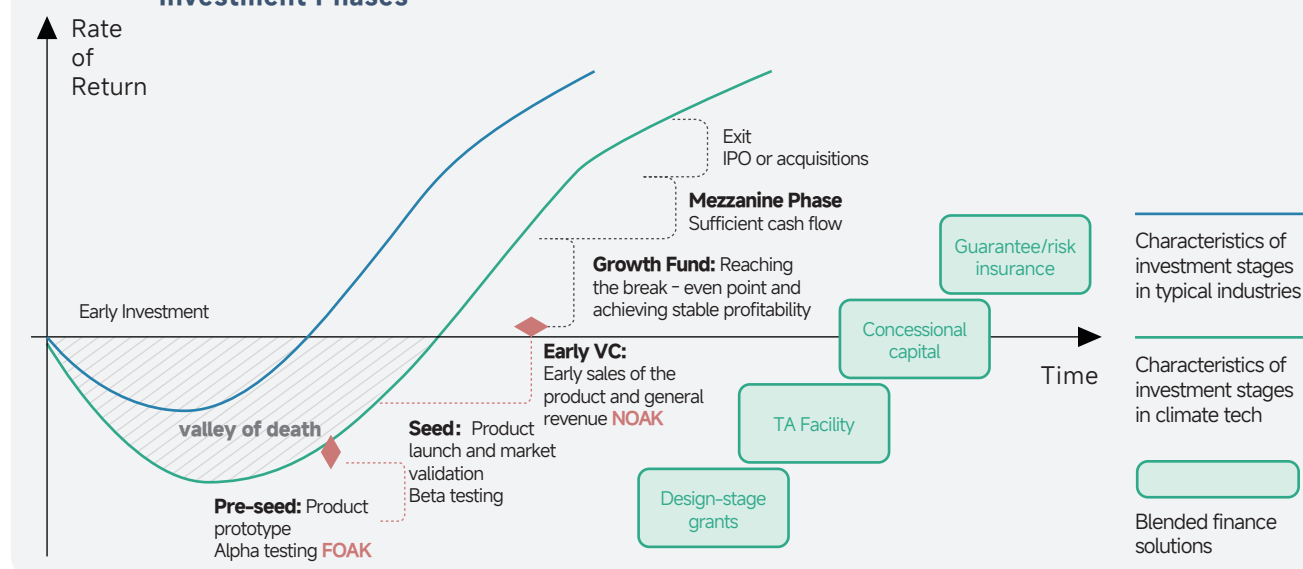
Given the emerging nature of climate technologies and unproven business models, financial institutions—concerned about high technological and market risks—tend to favor mature projects. Startups, in contrast, face multiple financing barriers such as information asymmetry, limited capital, and lack of collateral, making loan approval especially difficult.

At the early-stage venture capital level, frontier technologies typically rely on seed funds to transition from alpha to beta testing. However, in China, seed funds face limitations due to their relatively short investment cycles (5+5 years: 18 months to 5 years for investment, followed by a 4–5 year exit period), as well as the difficulty of turning scientific breakthroughs into marketable products. In contrast, early-stage tech investors in Silicon Valley typically operate on longer cycles of 8–10 years.

Shorter investment cycles require startups to grow quickly and reach profitability, or risk failing to exit through mergers or IPOs. Even with

early-stage investment, the J-curve effect results in significant upfront capital input and a temporary decline in book value.

Figure 1. The Climate Tech Investment J-Curve and the Role of Concessional Capital During the Investment Phases⁵



As shown in Figure 1, climate tech investments experience a deeper “valley of death”, requiring a longer break-even period and greater patience and risk tolerance from investors.

Overall, the lack of risk capital is a major bottleneck preventing the large-scale deployment and adoption of climate technologies. The market urgently needs financial innovation to reduce risk and maximize the impact of concessional capital, accelerating the commercialization of climate technologies and overcoming key barriers through tailored financial instruments.

Definitions

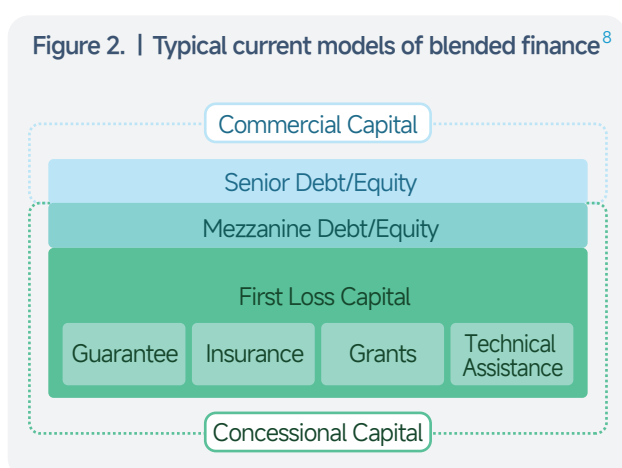
Concessional Capital: According to the World Bank, concessional capital refers to below-market-rate financing provided by major financial institutions (such as development banks and multilateral funds) to developing countries to accelerate the achievement of their development goals⁶. In this study, concessional capital also includes below-market-rate public and philanthropic funding, as well as commercial capital that accepts lower returns and has a higher risk tolerance.

Patient Capital: A form of capital focused on long-term investments, where the primary goal is not short-term financial return, but rather sustained long-term impact and gains. Patient capital is typically less influenced by short-term market fluctuations and demonstrates a higher tolerance for risk and longer return horizons⁷.

2 The Solution: "Blended Finance X"

Blended finance is one of the key innovative financing instruments currently available for addressing climate financing gaps. It is a structured approach designed to enable organizations with different objectives to invest alongside each other while achieving their respective goals. Blended finance combines commercial capital with concessional capital from public institutions and philanthropic organizations, which typically supports broader societal and sustainability objectives. By incorporating risk-sharing mechanisms, it helps optimize the risk-return profile of investment projects, thereby attracting more commercial capital to fund climate mitigation and adaptation efforts.

The diagram below illustrates typical blended finance models currently in use.



However, several challenges persist, such as a shortage of concessional capital, limited leverage rate of commercial capital, and a lack of bankable projects with measurable climate impact. Blended

finance has yet to deliver the widely anticipated impact.

To address these challenges, Abundant Climate Action Institute and the Macro and Green Finance Lab at the National School of Development, Peking University have jointly proposed an innovative solution—"Blended Finance X". This approach builds upon the core principles of blended finance, while introducing a new mechanism aimed at evolving the model.

2.1 Core Concept

The core concept of "Blended Finance X" lies in a dual design that combines **structured securitization** and **expanded concessional capital participation**. Building on the fundamental principle of aligning the different objectives of concessional and commercial capital, it further reduces investment risk and addresses the lack of willingness from commercial capital to invest. This approach seeks to provide a more stable financing environment for climate tech startups and a wide range of green projects.

Structured securitization tools—also referred to as asset-backed financing or structured credit—entail the design and restructuring of financial instruments to meet specific investment objectives or risk management goals. These tools can deliver the following benefits:

► Risk tranching:

Allowing investors with different risk appetites to select assets aligned with their preferred risk-return profile;

► **Risk diversification:**

Reducing portfolio correlation to smooth overall performance;

► **Flexible subscription:**

Enabling investors to choose investment tranches based on risk preferences and reduce exposure;

► **Public fundraising:**

Lessening reliance on a single financing channel;

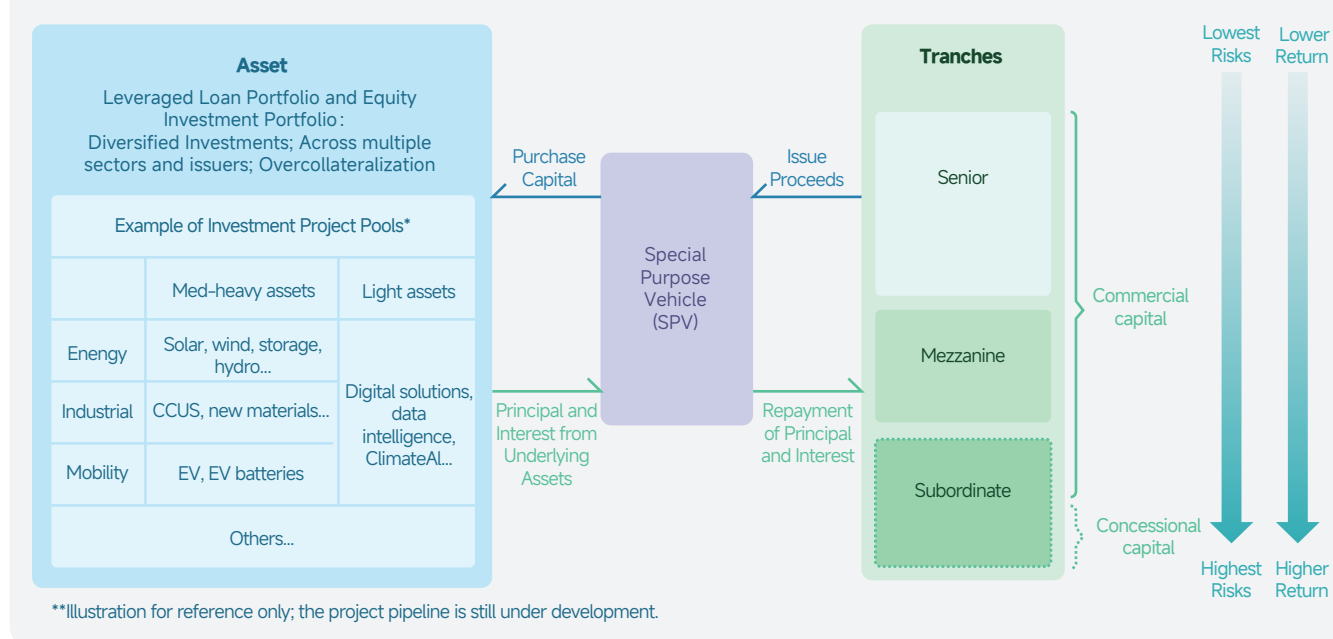
► **Ease of exit:**

Supporting transfer of shares and reducing exit costs.

In this structure, the involvement of public and philanthropic capital is especially critical. These capital can serve as concessional capital by absorbing the early-stage risks of investment, thereby significantly lowering the risks for commercial capital.

2.2 Mechanism Design

Figure 3. “Blended Finance X”: Structured Securities Mechanism



- **Tranches with Different Risk/Return Profiles:**

-
- In this mechanism, investors select products from the senior, mezzanine or subordinate tranche based on their individual risk tolerance and return expectations.
-

Senior tranche investors take on the lowest risk and receive lower returns accordingly. Subordinate tranche investors assume the highest level of risk and receive any residual cash flows after the senior and mezzanine tranches have been paid. If the asset pool

investors may earn higher returns. However, if performance falls short, the probability of returns for subordinate investors significantly decreases.

- ▶ Therefore, public and philanthropic capital is needed to occupy this subordinate tranche, absorbing first losses and providing a risk cushion that protects and reassures commercial investors, thereby encouraging their participation in social impact projects.

Risk Diversification of Underlying Assets:

- ▶ The underlying asset pool should include projects of varying types, attributes, and sectors which would lower the correlation within the portfolio, help smooth overall performance and reduce systemic risks.
- ▶ As a financial mechanism designed for addressing climate challenges, the selection of projects would also adhere to clear climate-positive criteria.

3 Anticipation: Expanding the Role of Concessional Capital and Patient Capital

3.1 Concessional Capital

Currently, concessional capital in green investment sectors in China remains relatively tradi-

tional, primarily consisting of debt investments. Investment preferences tend to be conservative, favoring projects with lower risks and stable returns, leading to limited support for innovative and high-risk initiatives.

Similarly, philanthropic funds in recent years have exhibited a cautious risk appetite, prioritizing fixed-income asset management strategies with minimal allocation to alternative assets. The philanthropic trust market remains underdeveloped, with limited funding directed toward climate-related initiatives.

In the structured design of “Blended Finance X”, concessional capital needs to act as a buffer layer by investing in the subordinated tranche. This structure ensures that losses from defaults or depreciations in underlying assets are absorbed first by concessional capital, thereby stabilizing returns for senior investors and enhancing the project’s overall financing appeal.

3.2 Patient Capital

The role of public and philanthropic capital as patient capital is also critical, with its core characteristics being long-term investment horizons and a high tolerance for risk. In China’s venture capital market, state-owned capital currently dominates this space. However, due to short-term performance evaluation pressures, there is a mismatch between investment cycles and local government assessment criteria, constraining funding for high-risk, long-term climate tech projects.

To boost patient capital, the State Council released the Policies and Measures to Promote High-Quality Development of Venture Capital in

June 2024, which emphasized improvements in the management of government guidance funds. It proposed reforms to performance evaluations and the introduction of fault-tolerant and exemption mechanisms. In response, local governments have begun introducing supporting policies, encouraging extended fund durations, differentiated performance assessments, reasonable tolerance for investment losses, and improved exit mechanisms¹⁰.

Patient capital is vital for innovation, green transitions, and sustainable development. It not only supports early-stage ventures but also secures long-term funding for achieving dual-carbon goals. Cultivating genuine patient capital will balance societal benefits with economic returns, driving industrial upgrading and innovation-driven growth.

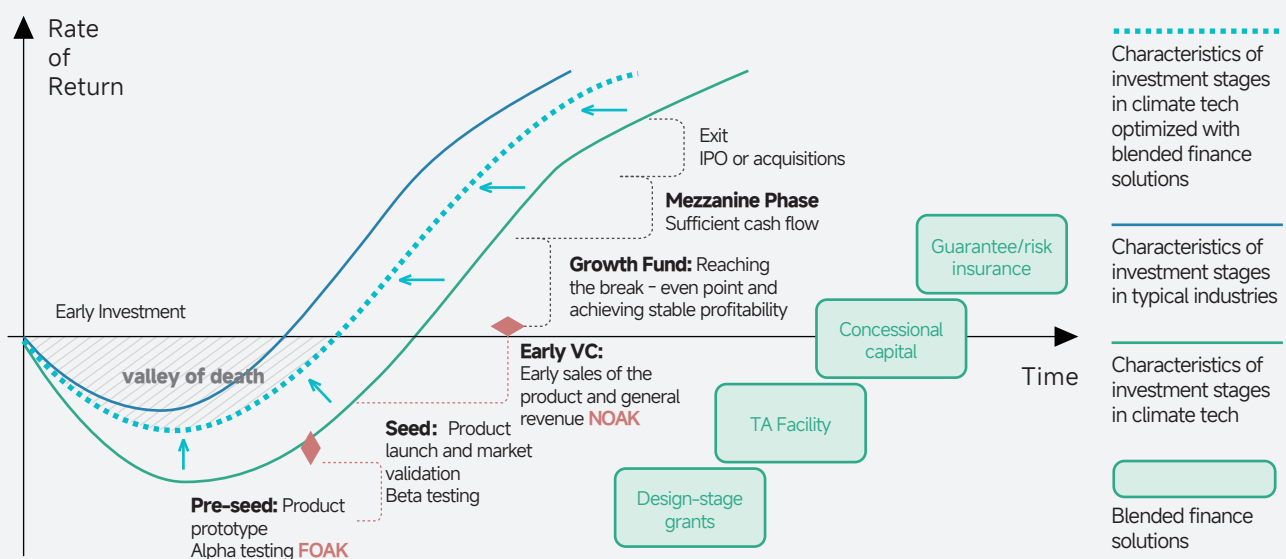
4 Expected Impacts

4.1 Project Level

Concessional capital creates a "buffer zone" in projects by absorbing first losses, thereby reducing risk exposure for commercial investors, improving the bankability of marginally bankable climate projects, and mobilizing greater participation of commercial capital on these projects. This leveraging effect can amplify the impact of concessional capital by multiples, enabling limited concessional funds to unlock larger-scale commercial investments. This strengthens market confidence in climate projects, accelerates the commercialization and scaling of initiatives with positive climate outcomes, resulting in greater overall impact.

On top of mobilizing more capital through "Blended Finance X", more can be done to enhance post-investment management, integrate upstream and downstream resources, and promote collaborative innovation—helping climate tech projects overcome the "valley of death" and improving the overall investability of the climate sector.

Figure 4. The Enhanced Climate Tech Investment J-Curve Under the Support of 'Blended Finance X'



4.2 Societal Level

Ensuring equitable cost-sharing and a mechanism for the redistribution of capital is critical to overcoming financial bottlenecks for a deep, social-wide low-carbon transition. Breakthroughs in blended finance models could introduce new concessional funding sources beyond public funds while lowering barriers and concerns for private capital. By designing innovative financial architectures aligned with market logic, these models create synergies between public funds, philanthropic capital, and private investors, fostering collaboration and shared value creation.

This approach would inject fresh liquidity into the financing pool for low-carbon transitions, directing urgently needed resources to technological and social innovations that struggle to secure traditional funding but hold long-term value for systemic shifts. It unlocks opportunities for accelerated growth and scaling of such innovations.

These financing frameworks can extend to other sectors requiring simultaneous progress on equity and technological advancement during transitions. This would contribute to broader social and economic transformation and help address some of the persistent financing challenges in global sustainable development.

5 Recommendations and Next Steps

The concept of “Blended Finance X” represents a climate finance mechanism innovation that is more aligned with investment logic, while also opening a window for collaboration between the divergent mindsets of traditional commercial capital and philanthropic capital. To bring these kinds of concepts into reality and unlock its transformative potential, the broader climate finance ecosystem must be strengthened:

Recommendation 1:

Financial Tool Innovation Practice

Design and implement risk-tranched structured securitization tools and products, clearly defining concessional capital (such as public and philanthropic funds) as the bearer of subordinate-level risk in order to attract commercial capital participation. Encourage more “quasi-concessional” capital which has lower return expectations but is not purely philanthropic in nature, and explore further innovation on structure and financing models.

Recommendation 2:

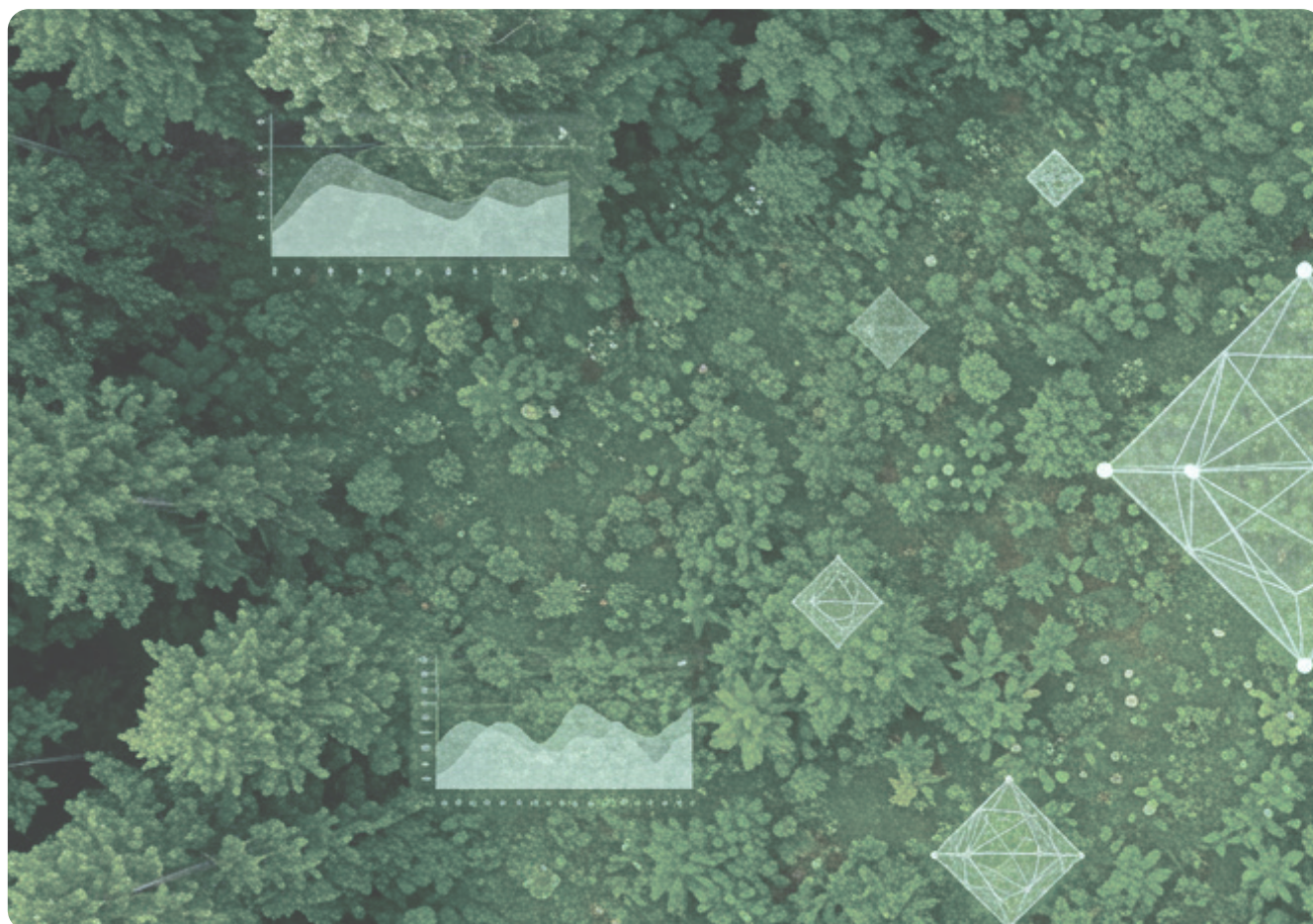
Optimize Patient Capital Evaluation

Extend the performance evaluation period for government-backed investment funds to 10+ years, incorporate non-financial indicators such as social and environmental impact, and establish a fault-tolerance mechanism. Strengthen collaboration between public and private capital to boost confidence in long-term, high-risk projects.

Recommendation 3:**Multi-Stakeholder Collaboration**

Encourage regulatory bodies to issue incentive policies for blended finance and support philanthropic capital in participating in climate investment through blended financial instruments. Strengthen talent development and incentives in green finance to attract more financial investment professionals to jointly build a thriving climate finance ecosystem.

In addition, the successful deployment of products guided by “Blended Finance X” requires further development and refinement of a pipeline of high-quality climate investment projects, ensuring that the asset portfolio not only delivers meaningful climate impact but also effectively prevents risk contagion.



尾声 Closing Remarks

盎然气候行动研究院与北京大学国家发展研究院宏观与绿色金融实验室希望通过“混合融资X”提供一种解决气候投资资金缺口的解法，使气候行动和更广泛的可持续发展项目具备规模化潜力和财务可行性。

盎然气候行动研究院正在积极寻找政府、金融机构、慈善机构与企业等协作者共同探索“混合融资X”的实现可能。与此同时，我们也计划在金融工具支持产业绿色转型、气候科技催化资本等方面进一步开展创新研究与实践。

如有合作兴趣，请访问abundantclimate.com或联系 info@abundantclimate.com。

Abundant Climate Action Institute and the Macro and Green Finance Lab at the National School of Development, Peking University aim to offer a solution to address the climate investment funding gap through the “Blended Finance X” model, enabling climate actions and broader sustainable development initiatives to achieve scalability and financial viability.

Abundant Climate Action Institute is actively seeking collaboration with governments, financial institutions, philanthropic organizations, and businesses to explore how to turn “Blended Finance X” into reality. Meanwhile, we also plan to further advance innovative research and practice in areas such as financial instruments supporting green industrial transition and catalytic capital for climate technologies.

If you are interested in partnering with us, please visit abundantclimate.com or contact us at info@abundantclimate.com.

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