

Position Paper

How to Finance Solar for All?



GLOBAL SOLAR
COUNCIL

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About the Authors

Global Solar Council (GSC)



The Global Solar Council (GSC) is a leading international non-profit organization that represents the collective voice of the solar energy industry worldwide. Established in 2015 during the United Nations Climate Change Conference (COP21) in Paris, the GSC brings together national and regional solar associations, major companies, and key stakeholders across the global solar value chain. The Council is dedicated to accelerating the deployment of solar energy by advocating for supportive policies, fostering international cooperation, and promoting innovation and best practices. Through knowledge-sharing platforms, capacity-building initiatives, and global outreach, the GSC supports the development of robust solar markets, particularly in emerging economies. Its work contributes significantly to advancing the clean energy transition, supporting sustainable development goals, and addressing the urgent challenges of climate change.

Find out more at www.globalsolarcouncil.org.

Jinko Solar



Jinko Solar is one of the world's largest and most forward-looking solar technology companies, recognized for its high-performance photovoltaic products, strong vertical integration, and extensive global presence. Operating in over 160 countries, Jinko delivers reliable and innovative solar solutions that power a wide spectrum of markets, from utility-scale projects to residential and commercial applications. With a strong emphasis on research and development, the company continues to lead advancements in solar efficiency, durability, and intelligent energy systems.

At the core of Jinko Solar's mission is a deep commitment to sustainability and ESG leadership. The company has established zero-carbon factory models within its manufacturing system, integrating clean energy, energy efficiency, and circular economy principles into production processes. These efforts demonstrate Jinko's dedication to reducing its carbon footprint and building a greener, more resilient supply chain for the solar industry.

Beyond manufacturing, Jinko Solar actively contributes to global clean energy dialogue, working with policymakers, investors, and international platforms to promote effective climate policy, unlock green financing, and accelerate renewable energy deployment. By aligning industrial growth with climate action, Jinko Solar supports the global push toward a just, inclusive, and net-zero future. As the chair of the Global Solar Council's Finance Task Force, Jinko plays a leading role in shaping collaborative efforts to address solar financing challenges and advance ESG-aligned investment strategies across the industry.

Find out more at <https://www.jinkosolar.com/en>.

MioTech



MioTech is Asia's leading sustainability technology company, committed to addressing the world's most pressing environmental and social challenges through artificial intelligence.

Combining cutting-edge data infrastructure with deep ESG domain expertise, MioTech empowers financial institutions, corporates, and governments to make informed decisions in green finance, sustainability-linked lending, and climate-aligned investments. Its enterprise platforms enable organizations to collect, analyze, and report ESG performance across supply chains, subsidiaries, and portfolio companies—driving companies' traceable and measurable progress.

As a pioneer in technology-driven sustainable finance, MioTech is shaping the future of green transformation in Asia and beyond. Guided by the mission of "Innovate for a Sustainable Future", MioTech is building a data-powered ecosystem that advances transparency, accountability, and long-term value creation across the sustainability landscape.

Find out more at www.miotech.com/en-US.

Leadership Insights



Rodrigo Sauaia

Chair of Global Solar Council and CEO of Associação Brasileira de Energia Solar Fotovoltaica

"Unlocking finance is fundamental to accelerating solar PV adoption and positioning clean energy as a driver of global prosperity. This position paper highlights how innovative financial mechanisms and accessible capital are key enablers not only of mitigation and adaptation, but also of systemic transformation through sustainable technologies like solar PV and energy storage. As we face the urgency of the climate crisis, mobilizing financial resources at scale is essential to power the energy transition and deliver lasting social and economic impact."



Sonia Dunlop

CEO of Global Solar Council and Vice Chair of Global Renewables Alliance

"Finance is absolutely at the core of getting to 8 terawatts of total solar deployment by the end of this decade. As one of the most capex intensive technologies in the world, with all our costs upfront, we are incredibly sensitive to the cost of finance in all 190 countries around the world. It is no accident that the countries that have the highest solar deployment - China, USA, Western Europe - are the countries that have the lowest cost of capital. This report includes recommendations that will unlock every market around the world, by bringing down the cost of finance for solar projects large and small. On grid and off grid. This is the key to delivering the tripling of renewables, and ultimately, energy access, resilience and a decarbonized electricity system for all."



Dany Qian

Vice President of Jinko Solar

"As Chair of the Global Solar Council Finance Task Force, Jinko Solar brings both industry perspective and practical experience to addressing persistent financing gaps across the solar value chain. Drawing on our role as a global leader in PV manufacturing, with strong ESG performance and zero-carbon factory models, this position paper presents actionable pathways to align capital with sustainability, enhance financial system engagement, and accelerate global solar deployment."



Erin Landy

Climate Policy and Climate Finance Specialist

"This position paper marks a pivotal contribution to the global conversation on scaling solar finance. It presents a clear-eyed view of the structural challenges in the current financial architecture and lays out concrete, actionable recommendations that are both ambitious and pragmatic. The Global Solar Council and its Finance Task Force have done a commendable job in bridging policy, investment, and industry perspectives. I'm pleased to endorse this work and encourage policymakers, financiers, and practitioners to use it as a foundation for collective action."



Zach Malik

KPMG Saudi Arabia, Sustainability Solutions

"This is a timely and strategic contribution that reframes solar finance as a systems challenge, not just a capital gap."

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Executive Summary

“Solar for all” is about ensuring that the world delivers on the COP28 target of tripling renewables and doubling efficiency to remain at 1.5°C. This means global renewable power capacity must roughly increase from 3.8 GW in 2023 to 11 GW by the end of this decade.

IRENA’s 1.5°C scenario solar PV is expected to deliver 5,457 GW of new capacity by 2030 – 49% of the global expansion required (IRENA 2024). This is driven by rising manufacturing capacity, declining costs, and market reforms across major economies. This transformation requires more than power generation – it demands parallel investments in grids, storage and system flexibility.

Scaling solar will depend increasingly on mobilising low cost private capital for both PV and energy storage.

According to the IEA, energy storage capacity must expand sixfold to 1,500 GW by 2030 to support renewables roll out (IEA 2024b). IRENA estimates that annual global investment in renewable power, storage, grids, and flexibility must increase from USD 1.29 trillion in 2023 to USD 4.5 trillion by 2030 (IRENA 2024).

Despite the rapid growth of solar energy investment to almost 700 GW per year, a significant finance gap exists in developing countries. Developing countries suffer from higher perceived and actual risks, driven primarily by low credit ratings for governments and their utilities and a lack of a robust project pipeline, all of which contribute to a lower appetite from investors.

Nonetheless, positive trends are emerging, illustrating the potential of private finance to scale climate solutions

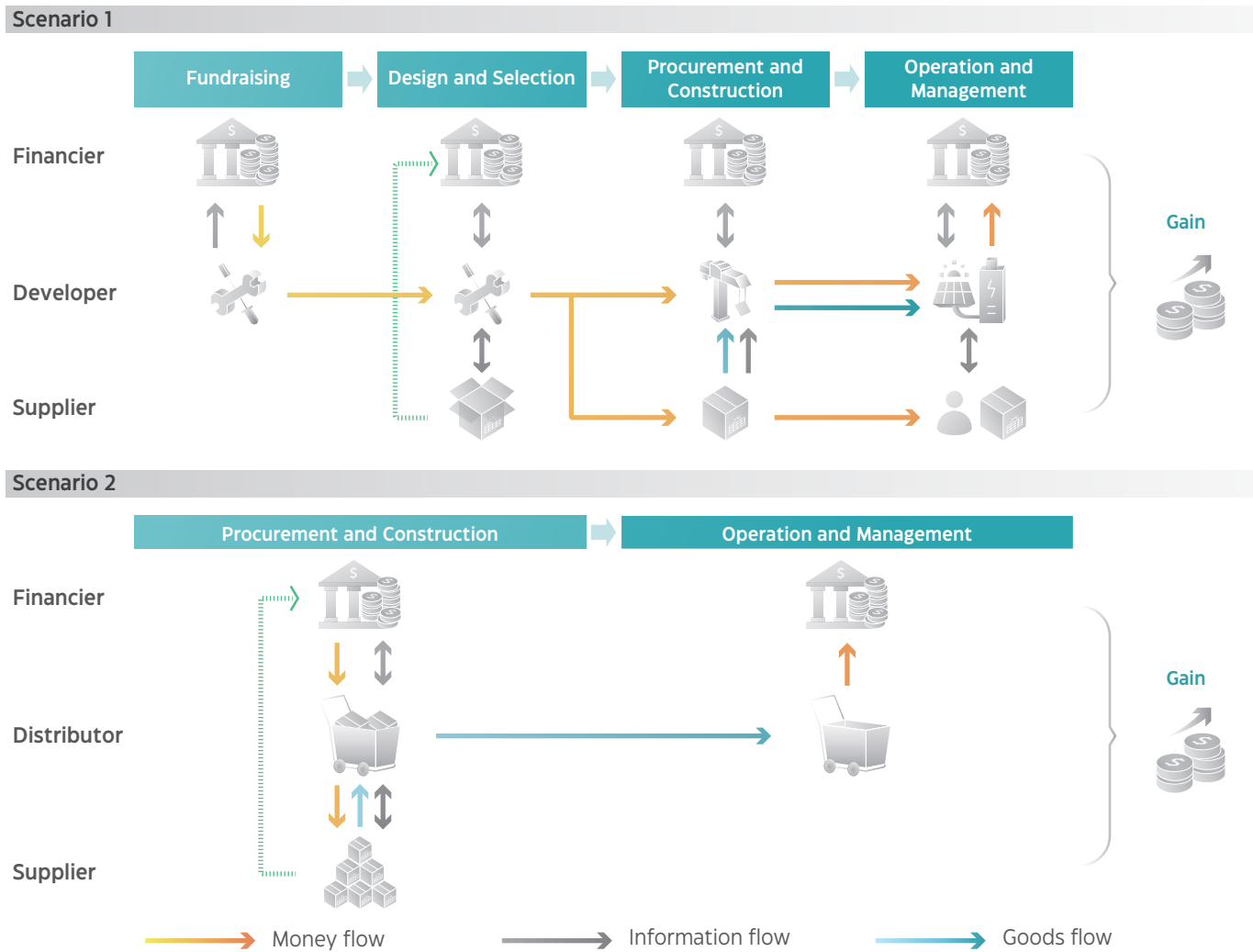
when coupled with deliberate strategy and transparency. Multilateral Development Banks are driving more and more project finance, including South-South cooperation. Their growing presence offers alternative pathways to scale solar deployment in countries underserved by private finance or constrained by shifting geopolitics.

Despite solar PV’s central role in the global energy transition, capital allocation across its value chain remains markedly uneven. While overall investment in solar has grown, it has disproportionately favored downstream project development, leaving other stages—particularly upstream R&D and production, midstream operations, post-project lifecycle support, recycling and capacity building—relatively undercapitalized. These strategic financing gaps should be addressed in a way that supports the holistic maturity of the sector.

A number of actions can be implemented without delay to effectively tackle the abovementioned challenges and scale up solar finance, bridging the current financing gap largely caused by a high cost of capital in EMDEs, constrained public investment, underutilization of long-duration capital pools, imbalanced investment across the supply chain, and fragmented ESG compliance frameworks across financiers.

As a response, private capital mobilisation, more balanced investment across the value chain, enhanced collaboration and dialogue, as well as innovative financing to support emerging uses of solar energy stand as necessary to ensure the deployment of solar and reach the COP28 Dubai UAE consensus goals.

02 How to Finance Solar for All?



Report Highlight: Solar Finance Flow Model

Key recommendations include:

- Public and private investors must collaborate to mobilise low-cost capital for solar projects globally. This involves creating interconnected public-public, public-private, and private-private partnership alongside transparent information channels and risk mitigation strategies to streamline investments flows.
- Address the imbalance in geography by adopting fairer investment standards that account for the high cost of capital in developing countries and emerging markets, ensuring equitable access to solar financing.
- Enhance platforms that promote solar investment, such as the International Solar Alliance’s Global Solar Facility, by strengthening collaboration among banks, financing associations, national and regional solar associations, and manufacturers. Priority should be given to improving continuity, geographic reach, and technical depth of dialogue through regular and structured engagement.

- Use the Solar Stewardship Initiative to facilitate dialogue and deepen due diligence activities within banks, particularly development finance institutions (DFIs) and multilateral development banks (MDBs), where ESG considerations are paramount, ensuring robust ESG integration in investment decisions.
- Develop innovative financing solutions for new use cases of solar energy, including but not limited to, data centers, agri-PV, floating solar and green hydrogen, supporting the diversification and expansion of solar applications.

Scaling solar finance requires structural transformation to deliver solar for all. Achieving "solar for all" means building capital frameworks that address cost barriers, correct investment imbalances, and integrate underfunded value chain segments. Finance must act not just as investment, but as a strategic enabler of durable solar growth across all regions and applications. **Only then can we make sure that we finance solar for all, and that no one is left behind.**

Introduction

Background

The transition to a net-zero future hinges not only on technological advancement but also on the ability to mobilize sustainable finance at scale. Recognizing the pivotal role of finance in accelerating global solar deployment, the Global Solar Council (GSC) established the Finance Task Force as a dedicated platform to bridge the gap between solar industry stakeholders and the financial community.

This Task Force was created in response to the growing demand for tailored financial mechanisms, risk mitigation strategies, and enabling policy environments to unlock investment across diverse solar markets—particularly in emerging and developing economies. It plays an increasing role in current macro investment environment to drive energy transition and to realize Paris Agreement climate target.

Launched as a strategic pillar within the GSC's broader mission, the Finance Task Force chaired by Jinko Solar brings together solar companies, investors, development finance institutions, policymakers, industry associations and technical experts to identify barriers, share best practices, and co-develop solutions that enhance the bankability and scalability of solar projects globally.

The Finance Task Force works in close synergy with GSC's broader work streams, such as "Empowering People with Solar PV Task Force", "Skills Task Force", "Supply Chain Task Force", "Grids Task Force", which focus on strengthening the solar workforce, ensuring resilient and sustainable supply chains, and advancing solar integration into modern grid systems. This cross-functional approach allows GSC to address the multifaceted challenges of the energy transition in a coordinated and practical manner.

By aligning financial solutions with skills development, supply chain security, and grid adaptability, the Council is better positioned to support the creation of a robust and inclusive solar ecosystem capable of delivering on climate, economic, and social development objectives.



Chapter 1

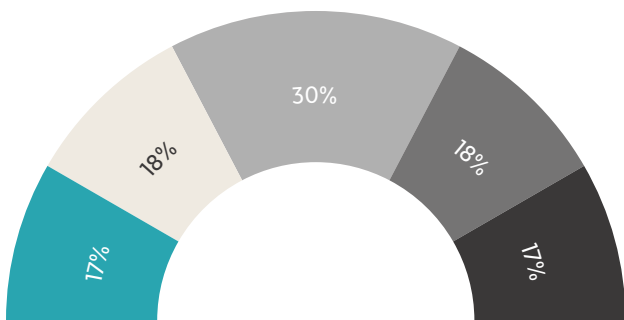
Market Landscape and Core Challenges of Solar Energy Financing

1.1 The Urgency of Climate Action and the Solar Imperative

Progress toward global sustainable development is faltering, with climate-related targets facing escalating headwinds. According to the *United Nations (2024)*¹, only 17% of the Sustainable Development Goals (SDGs) are on track to be achieved by 2030. The combined effects of the COVID-19 pandemic, geopolitical instability, armed conflicts, and

intensifying climate change have widened the implementation gap. Climate action (SDG 13) is among the most lagging, as confirmed by the World Meteorological Organization (WMO), which reported that 2024 marked the first year the global average temperature surpassed the 1.5°C threshold—reaching 1.55°C above pre-industrial levels (*WMO, 2025*)².

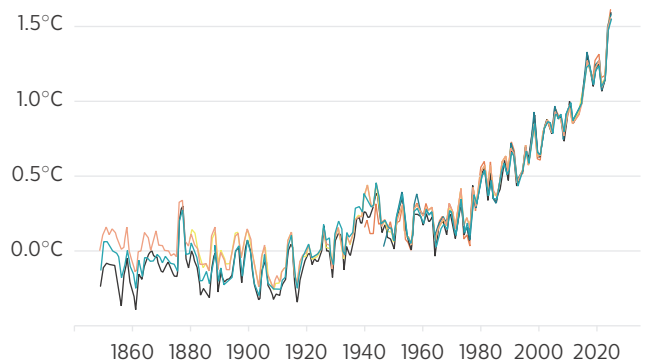
Overall Progress Across Targets
Based on 2015-2024 Global Aggregate Data



- On track or target met
- Marginal progress
- Moderate progress
- Stagnation
- Regression

Source: *United Nations 2024*

Global Mean Temperature 1850-2024
Different from 1850-1900 Average



- HadCRUT5 (1850–2024.11)
- NOAA GlobalTemp v6 (1850–2024.12)
- GISTEMP (1880–2024.12)
- Berkeley Earth (1850–2024.12)
- JRA-3Q (1947–2024.12)
- ERA5 (1940–2024.12)

Source: *WMO 2025*

¹ United Nations (2024). *The Sustainable Development Goals Report 2024 – Advanced Unedited Version*.

² World Meteorological Organization (2025). *WMO Confirms 2024 as the Warmest Year on Record*.

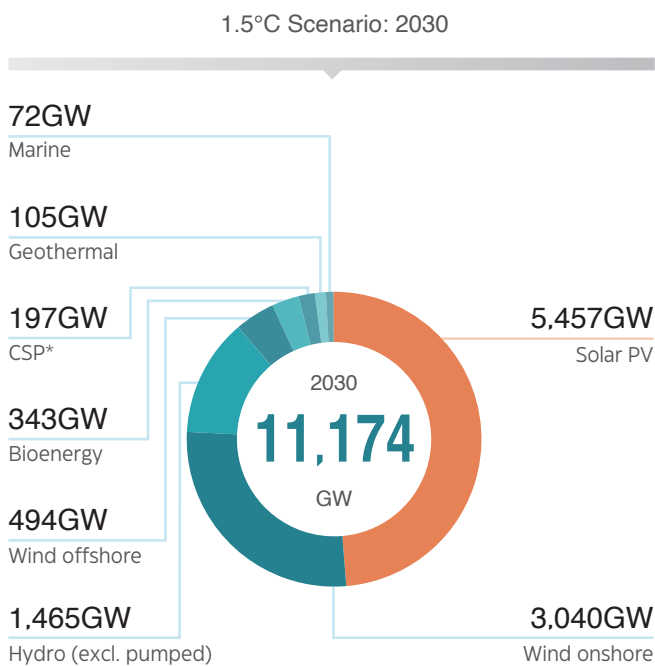
Tripling global renewable capacity by 2030 has become the defining benchmark for a 1.5°C-compatible pathway.

IRENA estimates that to remain on a 1.5°C-compatible trajectory, global renewable power capacity must increase from 3,865 GW in 2023 to 11,174 GW by the end of this decade. This transformation requires more than generation, it demands parallel investments in grids, storage, and system flexibility. At the center of this trajectory is solar PV, which under IRENA's 1.5°C Scenario is expected to deliver 5,457 GW of new capacity by 2030 – 49% of the global expansion required (IRENA 2024)³.

This scale is not aspirational, it is already unfolding.

Between 2017 and 2023, global solar PV cumulative capacity grew nearly fourfold, from 413 GW to 1,612 GW (IEA 2024a)⁴. IRENA reports that in 2024, the capacity had reached 1,865 GW, further consolidating solar's lead among renewable technologies (IRENA, 2025)⁵. This momentum is supported by rising manufacturing capacity, declining unit costs, and supportive policy signals across major economies.

Global Installed Renewable Power Capacity Under the Tripling Goal - 2030 (GW)



*CSP: Concentrated Solar Power

Source: IRENA 2024

Scaling solar will depend increasingly on energy storage and financial reform.

According to the IEA, energy storage capacity must expand sixfold to 1,500 GW by 2030 to support renewable grid integration (IEA 2024b)⁶. Delivering this transformation requires not only technological readiness, but financial reconfiguration. IRENA estimates that annual global investment in renewable power, storage, grids, and flexibility must increase from USD 1.29 trillion in 2023 to USD 4.5 trillion by 2030 (IRENA 2024)⁷. For solar PV, this means channeling capital not only to project deployment, but across the full value chain—from upstream innovation and midstream integration to end-of-life and workforce resilience.

Recent geopolitical shifts have introduced renewed uncertainty into the global climate finance landscape.

In early 2025, the return of the Trump administration signaled a change in regulatory priorities, including a potential rollback of certain clean energy provisions under the Inflation Reduction Act, renewed support for fossil fuel development, and indications of disengagement from the Paris Agreement. At the same time, several major financial institutions have scaled back their public commitments to net-zero alliances. Nonetheless, many of these institutions continue to actively finance renewable and solar energy projects, underscoring the resilience and long-term appeal of the sector despite evolving political narratives.

In parallel, multiple countries have taken protectionist measures to manage the inflow of non-domestic solar cells and panels, especially Asian-manufactured.

These measures have significantly impacted the global solar industry. Investors and financiers are now faced with greater uncertainty and potential cost overruns, making it more challenging to secure funding for new projects. Further, the additional costs and delays are often passed on to consumers, resulting in higher prices for solar energy. This reduces the overall competitiveness of solar energy compared to other energy sources, potentially slowing the adoption of solar technology.

³ IRENA (2024). *World Energy Transitions Outlook 2024: 1.5°C Pathway*.

⁴ IEA (2024a). *Renewable Energy Progress Tracker*.

⁵ IRENA (2025). *Renewable Energy Capacity Statistics 2025*.

⁶ IEA (2024b). *Batteries and Secure Energy Transitions*.

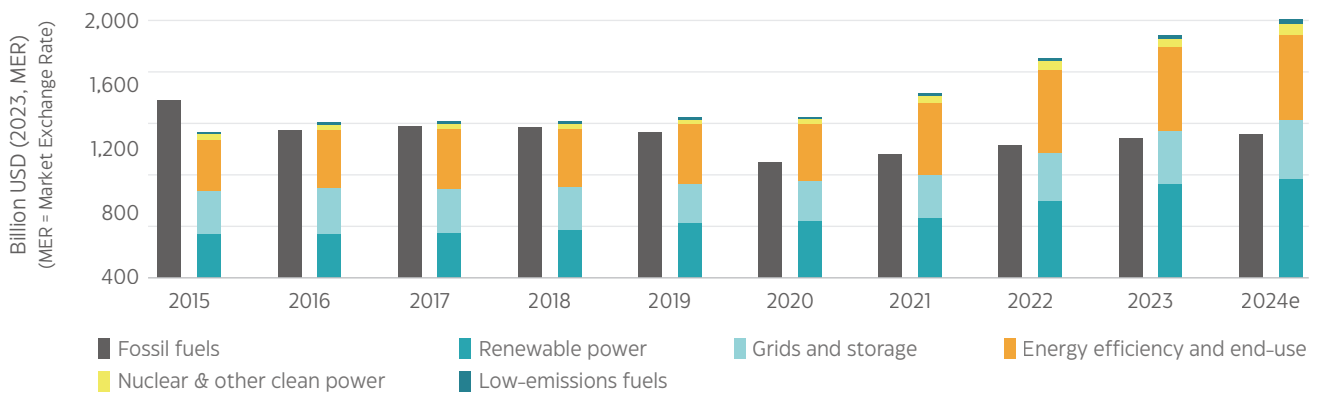
⁷ IRENA (2024). *World Energy Transitions Outlook 2024: 1.5°C Pathway*.

1.2 Global Imperative Growth in Renewable Energy Investment – Solar as the Star Performer

The global energy transition is reshaping investment flows across the energy sector. According to the International Energy Agency (IEA), in 2024, global energy investment reached approximately USD 3,119 billion, with more than USD 2,003 billion directed towards clean energy technologies, including renewable power, grids and storage, energy efficiency and end-use, nuclear and other clean power and low emission fuels—marking a historic shift as capital increasingly flows away from fossil-based assets and toward renewables (IEA 2024c)⁸.

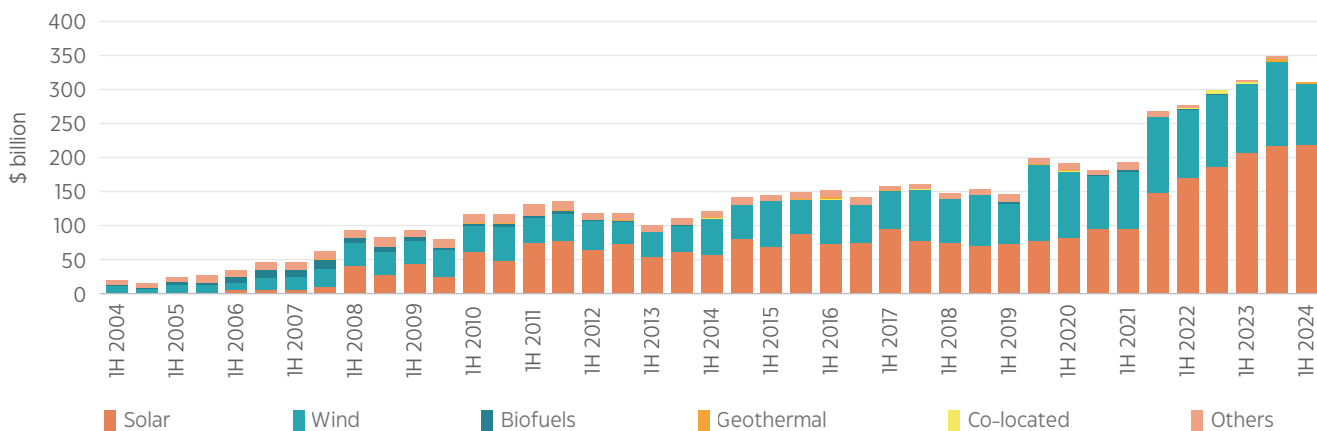
Solar photovoltaic (PV) has taken the lead in this transformation. Recent data from BloombergNEF reveals that since the second half of 2020, solar has overtaken wind to become the dominant recipient of renewable energy investment globally, a position it has held consistently since (BloombergNEF 2024)⁹. In 2024, solar investment continued to grow steadily and was expected to reach USD 500 billion. (IEA 2024c).

Global Investment in Clean Energy and Fossil Fuels, 2015-2024e



Source: IEA 2024c

Global Half-Yearly Investments in Renewable Energy



Source: BloombergNEF 2024

⁸ IEA (2024c). *Global investment in clean energy and fossil fuels, 2015–2024*. IEA Data and Statistics.

⁹ BloombergNEF (2024). *Unlocking Investment to Triple Renewables by 2030*.

1.3 Challenges in Solar Energy Sector Financing

While solar energy has become the fastest-growing pillar of global clean energy deployment, its financing architecture remains structurally misaligned with sectoral needs.

The heavy reliance on private capital, alongside persistent underutilization of public and concessional finance, exacerbates funding gaps and investment volatility. In many emerging markets, high capital costs and perceived risks such as default/payment risks, particularly within smaller off-grid implementations, render projects commercially unviable, despite strong policy interest. Within the solar value chain, investment is disproportionately concentrated in project development, while critical upstream (e.g., manufacturing, R&D) and downstream (e.g., end-of-life recycling) stages remain imbalanced. In parallel, fragmented ESG compliance frameworks across financiers impose duplicative burdens, raising costs and limiting access—particularly for small and mid-sized suppliers. These distortions erode the sector's ability to scale, diversify, and deliver credible climate outcomes.

Uncertain and underdeveloped regulatory frameworks present major barriers to financing renewable energy projects. During development, risks such as retroactive policy changes, unclear permitting processes, and lack of guaranteed grid access or tariffs deter early-stage investment. In the long-term phase, weak contractual structures, unreliable offtakers, and limited legal protections further reduce investor confidence. Without clear national Net Zero strategies and supportive regulations, many markets fail to attract the necessary capital, stalling project delivery and scaling.

1.3.1 Funding Gaps

Despite the rapid growth of solar energy investment, a significant funding gap persists, particularly in developing regions. The global renewable energy funding gap is highly concentrated in emerging markets due to higher risk, and hence, lower appetite from investors (*S&P 2023*)¹⁰. Despite

hosting over 17% of the global population, Africa receives only around 3% of total energy investments worldwide (*IEA 2022*)¹¹. This underinvestment starkly contrasts with the continent's vast solar resource potential and underscores a critical financing imbalance in global clean energy allocation. Similarly, other developing regions such as the Middle East, Latin America, and the Caribbean also account for only a marginal share of global solar investment, reflecting persistent structural barriers in attracting capital for renewable deployment outside advanced economies (*ISA 2023*)¹².

Take off-grid solar (OGS) solutions as an example. Off-grid solar solutions have provided energy access to approximately 560 million people globally, predominantly in Sub-Saharan Africa and South Asia. However, current investment levels are far below the required amount to achieve universal Tier 1 access by 2030. Public funding, while increasing, remains insufficient. The World Bank's 2024 OGS lending was USD 660 million, but more is needed to bridge the funding gap. Private investors are deterred by high risks and long payback periods in the OGS sector, especially in low-income markets with currency volatility and political instability (*The World Bank & ESMAP 2024*)¹³.

Sustained dialogue with multilateral development banks, including the World Bank, ADB, and AfDB etc., will be essential to address the infrastructure financing gap, particularly in developing regions. Given their concessional tools and policy leverage, these institutions remain uniquely positioned to stabilize investment expectations and catalyze broader private participation.

¹⁰ S&P Global (2023). *Renewable Energy Funding in 2023: A Capital Transition Unleashed*.

¹¹ IEA (2022). *A New Energy Pact for Africa*.

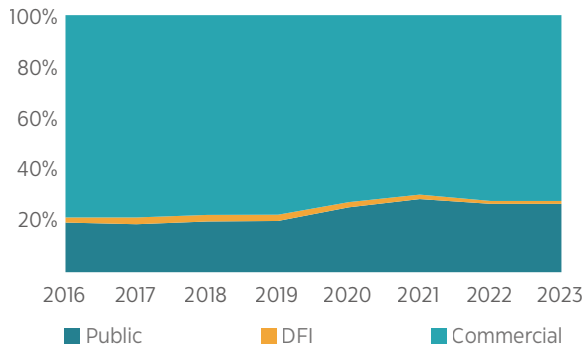
¹² ISA (2023). *World Solar Investment Report 2023*.

¹³ World Bank & ESMAP (2024). *Off-Grid Solar Market Trends Report 2024*.

1.3.2 Capital Allocation Disparities and Emerging Realignments

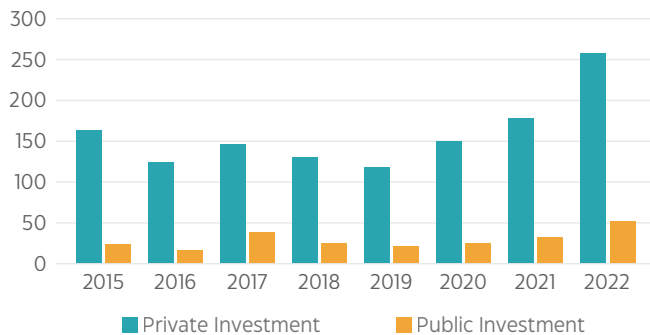
While total investment in clean energy has grown rapidly, the composition of financial sources behind these investments remains heavily weighted towards private and commercial channels. According to the IEA, roughly three-quarters of all global energy investments are financed through these channels—a broad category that includes household savings, corporate retained earnings, and loans from commercial banks. Public finance, including government budgets, sovereign wealth funds (SWFs), and public financial institutions—accounts for only around 25%, while national and international development finance institutions (DFIs) contribute less than 1% (IEA 2024d)¹⁴. This distribution is particularly pronounced in the solar sector, where private capital has consistently outpaced public investment over the past decade (ISA 2023)¹⁵. The trend reflects growing private market confidence in solar as an investable asset class, especially in lower-risk, more financially structured environments.

Changes in Finance Providers Over Time



Source: IEA 2024d

Share of Public and Private Financing in Solar Sector (\$ billion)



Source: ISA 2023

At the same time, this market-driven momentum has yet to translate into truly global trends. In many emerging and developing economies (EMDEs), the cost of capital remains prohibitively high, due to a combination of macroeconomic volatility, currency risk, and policy uncertainty. Under such conditions, commercial finance is often unwilling to engage, especially in early-stage project development or distributed solar models. For instance, South Africa's cost of debt for climate projects is 20.3%, and Vietnam's is 14.0%, compared to Germany's 2.8% and Australia's 5.4%. This high cost of capital directly translates to higher financing costs for solar projects, making them less economically viable. In addition, the required rate of equity return for climate projects is also substantially higher in developing countries. For instance, Nigeria's required rate is 30.8%, Egypt's is 35.1%, and Argentina's is 59.7%, compared to Germany's 8.3% and Australia's 8.5% (Climate Policy Initiative 2023)¹⁶. These high return requirements reflect the perceived risks associated with investing in these regions and further hinder the development of solar projects.

In underserved regions or risk-intensive market segments, public and concessional capitals, such as government budgets and development finance institutions (DFIs), are particularly critical to catalyzing private finance. Yet the deployment of these instruments remains highly constrained. In many emerging and developing economies (EMDEs), elevated cost of capital, currency volatility, and regulatory risk often lead to project cancellations or indefinite delays. Concessional tools—such as risk mitigation instruments, patient capital, and blended finance—are well-suited to address these barriers but remain limited in volume and unevenly applied. In 2023, for example, just 20 out of 574 ADB energy projects were solar-specific, while at the World Bank, only 2 of 332 climate projects focused on solar (ADB 2024; WB 2023)¹⁷.

In parallel, long-duration capital pools—including sovereign wealth funds, pension funds, and endowments—hold substantial potential for climate-aligned infrastructure investment. However, they contributed only 0.4% of global energy transition investment in 2023 (PwC 2024)¹⁸, reflecting persistent barriers to entry and a lack of policy-aligned investment vehicles. Unlocking their full potential will require targeted risk-sharing frameworks and clearer policy incentives tailored to the risk-return profiles of these institutions.

¹⁴ IEA (2024d). *World Energy Investment 2024*.

¹⁵ ISA (2023). *World Solar Investment Report 2023*.

¹⁶ Climate Policy Initiative (2023). *Emerging Markets Cost of Capital for Renewable Energy*.

¹⁷ ADB (2024). *Climate Change Financing Dataset*; World Bank (2023). *FY23 Project-Level CCB Data*.

¹⁸ PwC (2024). *Rethinking the Role of Long-Term Investors in the Energy Transition*.

Private finance plays an indispensable role in scaling solar deployment, but its full potential depends on effective public support.

“

In high-risk or underserved markets, commercial capital alone is often insufficient. The core issue is not the dominance of private finance, but the underutilization of public instruments that could de-risk investment, crowd in private capital, and broaden access.

”

Concerns about the credibility of private sector climate commitments have also emerged. According to BankTrack and other civil society monitors, only 7% of global bank financing to energy companies between 2016 and 2022 was directed toward renewables, with the remaining 93% flowing to fossil fuels (*BankTrack 2023*)¹⁹. Although many banks joined the UN-convened Net-Zero Banking Alliance (NZBA) to align their portfolios with a 1.5°C pathway, policy reversals have followed. In April 2025, the NZBA removed its explicit requirement for member banks to align with the 1.5°C warming limit, replacing it with more flexible language

referencing “well below 2°C”. This shift led major U.S. banks to cite legal risks and domestic political pressures as barriers to coordinated climate finance. (*Reuters 2025*)²⁰. The decision has drawn criticism from advocacy groups such as Reclaim Finance, who argue that it undermines transparency, delays portfolio transition, and weakens accountability mechanisms for private sector climate action (*Reclaim Finance 2025*)²¹.

Nonetheless, positive trends are emerging. Standard Chartered (SC) has committed to mobilizing USD 300 billion in sustainable finance by 2030, (*Standard Chartered 2024a*)²². and as of 2024, SC reported USD 23.3 billion in sustainable finance assets (*Standard Chartered 2024b*)²³. These developments illustrate the potential of private finance to scale climate solutions when coupled with deliberate strategy and transparent progress tracking.

Meanwhile, emerging platforms such as the Belt and Road Initiative (BRI), New Development Bank, and the Asian Infrastructure Investment Bank (AIIB) are becoming increasingly relevant in shaping cross-border solar finance. Their growing presence, especially in South-South financing, offers alternative pathways to scale solar deployment in countries underserved by traditional MDBs or constrained by shifting geopolitics.



¹⁹ BankTrack (2023). *Only 7% of Global Banks' Energy Financing Goes to Renewables*.

²⁰ Reuters (2025, April 22). *ESG Watch: Watered-down Climate Targets by Banks*.

²¹ Reclaim Finance (2025, April 7). *Banks Have a Responsibility to Keep 1.5 Alive*.

²² Standard Chartered Bank (2024a). *Transition Plan 2024*.

²³ Standard Chartered Bank (2024). *Sustainable Finance Impact Report 2024*.

1.3.3 Skewed Capital Allocation in the Solar PV Value Chain

Despite solar PV’s central role in the global energy transition, capital allocation across its value chain remains markedly uneven. While overall investment in solar has grown, it has disproportionately favored downstream project development, leaving other stages—particularly upstream R&D and production, midstream operations, post-project lifecycle support, and capacity building—relatively undercapitalized. A more balanced distribution of finance is necessary to foster long-term sector resilience, innovation, and circularity.

Similarly, energy storage development follows above general structure, with highlighted characteristics due to its different

business model and operating model.

While project development remains the dominant recipient of capital, a sustainable solar ecosystem requires that investment extends more evenly across the full lifecycle of the value chain. This does not imply that all segments should receive equal amounts, but rather that strategic financing gaps—such as those in R&D and production, operations, recycling, and skills—are addressed in a way that supports the holistic maturity of the sector. This approach also reflects the evolving role of innovation and local capability in shaping the next phase of solar deployment.

The solar PV value chain can be broadly divided into five financing stages:



1.3.4 Fragmented ESG Compliance Requirements Hampering Solar Finance

In today's global context of sustainable development, despite solar is already considerably superior in many respects, the importance of Environmental, Social, and Governance (ESG) standards and the transparency and traceability of supply chain are becoming increasingly evident, as they enhance the comprehensiveness of financial decision-making. One of the pressing challenges in mobilizing finance for solar deployment is the lack of unified ESG standards across banks and financial institutions. Developers and suppliers within the solar value chain are frequently subjected to varying ESG due diligence requirements, each tailored to the specific frameworks of individual financiers. This fragmented approach leads to inefficiencies, higher compliance costs, and duplicated efforts, forcing suppliers to navigate a maze of overlapping criteria and audits. For many companies, especially small and mid-sized

actors, the need to cater to multiple, inconsistent ESG expectations represents a significant diversion of resources that could otherwise support innovation, quality, or scale.

Compounding this issue is the limited availability of up-to-date and reliable ESG data across the solar value chain. Due to the layered and often opaque structure of upstream and midstream operations, many financial institutions rely on outdated or generalized ESG information when evaluating solar projects. This lack of accurate, real-time data can lead to misaligned risk assessments, higher capital costs, and missed opportunities to support genuinely sustainable players in the market. Improving data transparency and harmonizing ESG evaluation practices are essential steps to unlocking finance and scaling solar in a credible, efficient, and equitable way.

These four challenge areas are mutually reinforcing: the global funding gap, especially in high-risk markets, is exacerbated by the underutilization of concessional capital and skewed private-sector allocations that favor downstream project finance over upstream innovation and end-of-life solutions. Meanwhile, fragmented ESG requirements increase compliance burdens and investor uncertainty, further narrowing capital flows and deepening the systemic misalignment across the solar value chain.



Chapter 2

Financing Architecture and Commercial Models Shaping the Solar Energy Sector

The solar energy sector is underpinned by a complex financial ecosystem involving multiple stakeholder categories, including public and private capital providers, financial intermediaries, and implementation actors such as EPC firms, O&M providers, manufacturers and suppliers, and distributors. This chapter examines the primary sources of solar energy finance, the financial instruments employed, the pivotal intermediaries facilitating these financial flows, and the commercial architectures that define stakeholder interactions.

2.1 Solar Energy Capital Providers and Investment Actors

The financing of solar energy projects involves a dual-layered ecosystem: those who make investment decisions, and those who provide the capital to realize them. According to the International Energy Agency, **investment** refers to capital expenditures used to build or acquire an asset, while **finance** refers to the origin, form, and provider of those funds. Understanding this distinction clarifies how solar projects are initiated, funded, and scaled across different geographies and market structures.

2.1.1 Sources of Finance - Capital Providers

Capital providers are institutions that supply the financial resources necessary to execute solar energy investments. While they may not initiate projects themselves, they determine the scale, structure, and timing of capital deployment, shaping the financial viability and risk profile of solar ventures. These providers generally fall into public strategic institutions and private market-based actors.

(a) Public Strategic Capital Providers

Sovereign Wealth Funds (SWFs) and Public Pension Funds

These entities manage long-duration public capital and often pursue strategic objectives such as energy security, intergenerational wealth preservation, or sustainability transitions. While theoretically well-positioned to support solar deployment, their actual allocations to solar remain modest.

Multilateral and Development Finance Institutions (MDBs and DFIs)

Institutions such as the World Bank and Asian Development Bank (ADB) provide concessional loans, guarantees, and blended finance instruments to mitigate risks and attract private co-investment. They are particularly important in high-risk or underserved markets, where commercial capital is reluctant to engage.

(b) Private Market-Based Capital Providers

Commercial Financial Institutions

This category includes commercial banks, investment banks, and private credit providers. Their participation, however, tends to concentrate in lower-risk and more financially structured projects.

Private Investors

Comprising large listed or non-listed corporates, private institutional investors such as pension funds, insurance companies, and infrastructure funds, these investors are drawn to the stable, long-term cash flows of solar assets.

2.1.2 Investment Actors - Capital Decision Makers

Investment actors are the entities that make the financial decisions to initiate and execute solar energy projects. While they may use capital from diverse sources, public, private, or blended, the investment commitment itself reflects their risk appetite, strategic priorities, and return expectations. In the solar energy ecosystem, investment actors span both institutional and individual levels, as well as public and private spheres.

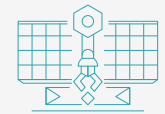
Governments and State-Owned Enterprises (SOEs)

Governments and their operational arms, such as state-owned utilities and energy agencies, are key initiators of solar energy investment, particularly in markets where public infrastructure dominates. These actors often invest directly in solar capacity to achieve national decarbonization targets, enhance energy security, or fulfill public service mandates.



Project Developers

Project developers originate, structure, and coordinate solar energy investments. Developers also act as transaction sponsors, interfacing financiers, suppliers, and offtakes across the project lifecycle.



Private Corporations

Commercial and industrial firms invest in solar energy for operational cost savings, risk hedging, or ESG-driven commitments. These investments may take the form of on-site installations, corporate PPAs, or equity participation in project platforms. Funding is often sourced from internal capital but may also involve leasing arrangements or structured financial instruments.



Households and Small Enterprises

Residential users and SMEs drive the adoption of rooftop solar and off-grid systems, particularly in distributed energy markets. Investment decisions are typically based on energy access, affordability, or resilience concerns, with financing drawn from personal savings, microloans, or third-party ownership models.



2.2 Major Financial Instruments in Solar Energy Finance

Solar investments are structured through a diverse set of financial instruments (*ISA 2023*)²⁴.

2.2.1 Conventional Financing Instruments

Concessional Instruments (Grants and Low-cost Debt Instruments)

Typically employed by governments, multilateral development banks (MDBs), and development finance institutions (DFIs), these instruments support early-stage development, R&D, or projects in geographies with high risk or limited bankability. Concessional debt offers below-market interest rates, extended tenors, or grace periods to improve the commercial viability of solar investments in underserved markets.

Project-level Market-rate Debt

This is the dominant financing structure for utility-scale solar installations, providing capital based on expected cash flows from for instance Power Purchase Agreements (PPAs). Lenders assess project creditworthiness using conventional criteria, requiring strong contractual structures and risk mitigation—especially in less mature markets.



Project-level Equity

Equity financing entails direct ownership in solar projects, typically undertaken by developers, infrastructure funds, or strategic investors. Returns are generated from operational revenues after debt servicing, reflecting both market risk and long-term asset performance.

Balance Sheet Financing (Debt and Equity Portions)

Corporates, utilities, and institutional actors may finance solar assets directly using internal capital or corporate borrowing. These investments are accounted for within the entity's overall capital structure and often reflect strategic, rather than purely financial, objectives—such as decarbonization or energy cost reduction.

2.2.2 New Financing Instruments and Trends

In recent years, a range of innovative financial instruments has emerged to complement traditional solar financing approaches. **Green bonds** have gained traction as a mechanism for directing institutional capital toward environmentally sustainable projects, including utility-scale solar and grid infrastructure. **Sustainability-linked loans** and bonds link financing terms to the achievement of ESG targets, encouraging broader decarbonization commitments across corporate portfolios. **Impact investing** continues to grow, with investors seeking measurable

environmental and social outcomes alongside financial returns—particularly in off-grid and energy access markets. **Crowdfunding and digital finance platforms** are expanding access to capital for smaller-scale projects, supported by technologies such as blockchain and smart contracts. Meanwhile, **blended finance models**, combining public and private capital through concessional tranches or guarantees, are being increasingly applied in high-risk or underserved solar markets to unlock private sector participation (*ISA 2023*)²⁵.

^{24,25} ISA (2023). *World Solar Investment Report 2023*.

2.3 Other Key Players in Solar Energy Finance

Beyond capital providers and investment actors, a range of intermediaries and enabling stakeholders play key roles in the execution and bankability of solar energy projects. These entities shape technical, logistical, and contractual dimensions that underpin investor confidence and project performance, especially in decentralized or multi-stakeholder settings.

These intermediaries, while not always directly providing capital, play a critical role in structuring and executing solar energy projects.



Engineering, Procurement, and Construction (EPC) Firms

Responsible for construction financing, designing, sourcing, and building solar installations. Their ability to manage construction risks and deliver projects on time and within budget directly affects financial outcomes.



Operations and Maintenance (O&M) Providers

These actors ensure that solar assets operate efficiently over their lifecycle, affecting yield reliability and return predictability. Performance guarantees and real-time monitoring capabilities are increasingly central to financing contracts.



Manufacturers and Suppliers

Component quality, delivery timelines, and warranty structures provided by module, inverter, and battery manufacturers critically influence project cost and risk profiles. Suppliers also serve as key channels for technical innovation and cost deflation.



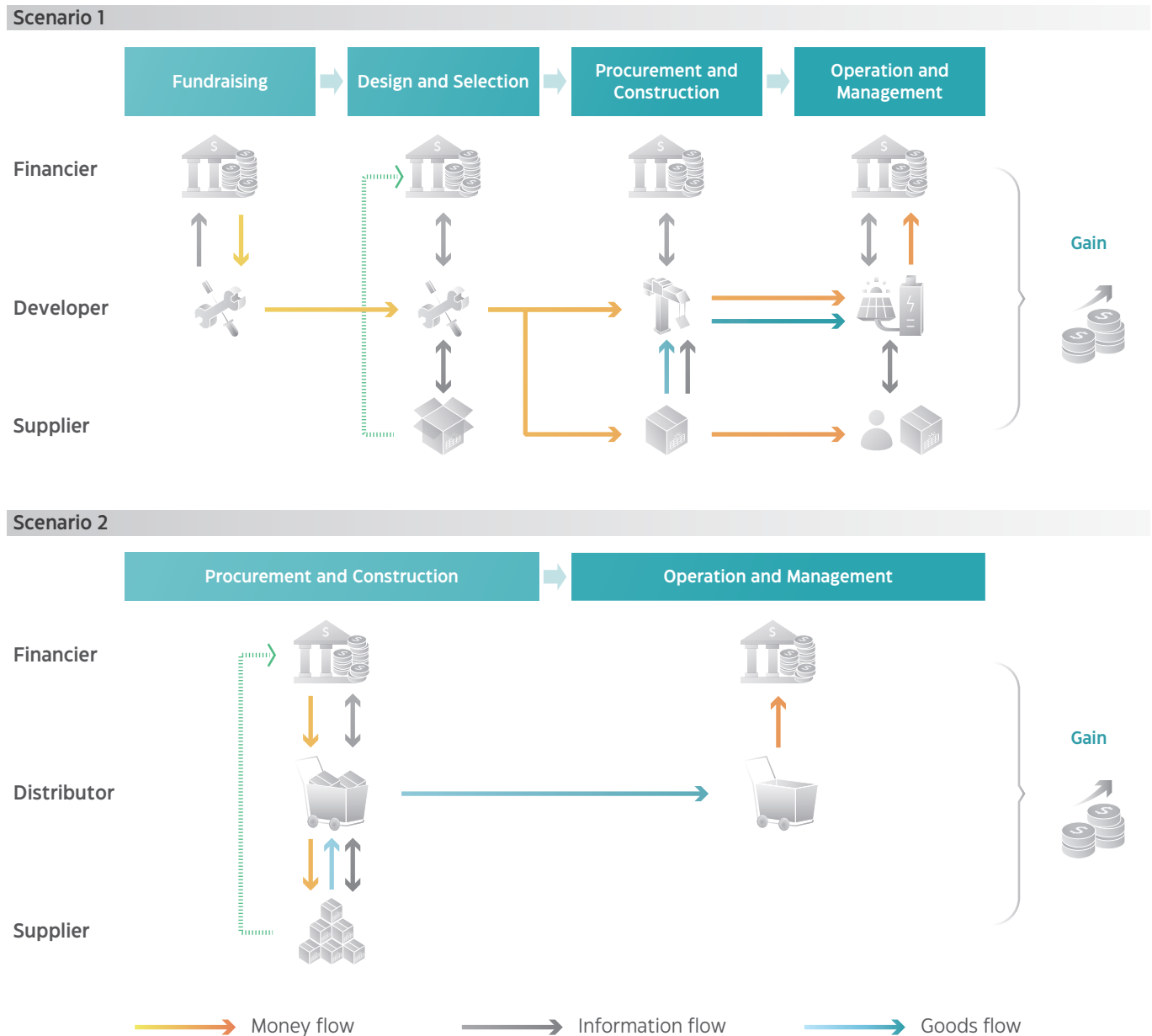
Distributors & Installers

Distributors and installers bridge manufacturers and end-users, managing logistics, local warehousing, and, in many cases, system installation and commissioning. Their role is especially critical in fragmented or off-grid markets, where streamlined last-mile delivery determines project viability.

2.4 Commercial Architecture of the Solar Energy Sector: An Integrated Flow Analysis

The solar energy sector’s commercial architecture revolves around three essential flows—money, information, and products—which circulate among four principal actors: financiers, developers, suppliers, and distributors. These flows unfold across five key project stages: **Fundraising (FR)**, **Design and Selection (D&S)**, **Procurement and Construc-**

tion (P&C), **Operation and Management (O&M)**, and **Gain (GA)**. Together, they define the interconnected dynamics of two complementary modes: a centralized deployment mode (serving utility-scale or grid-connected solar infrastructure) and a distributed deployment mode (serving rooftop, off-grid, or retail-oriented solar systems).



Solar Finance Flow Model

2.4.1 Information Flow

Information exchange precedes all other flows and initiates during the **Fundraising (FR)** stage. Here, developers submit detailed proposals, technical assessments, and business models to financiers, initiating a one-way flow of information critical for project appraisal. No capital is transferred at this stage; instead, this interaction forms the basis of financial evaluation and risk screening.

As projects move into **Design and Selection (D&S)**, information flow becomes bidirectional: developers work with suppliers to determine technical specifications, system configurations, and delivery timelines. Financiers remain in the loop, validating design assumptions against financial covenants or ESG conditions.

During **Procurement and Construction (P&C)**, information becomes time-sensitive and operational: project developers and distributors provide construction updates, delivery confirmations, and milestone completions to both financiers and suppliers. This stream continues into the O&M stage, where operational performance data—such as generation output or equipment faults—is continuously fed back to financiers and suppliers, especially where performance guarantees or covenants apply.

2.4.2 Money Flow

The money flow begins at the very first stage—**Fundraising (FR)**, where capital is deployed by financiers to enable project initiation. In the developer-centric loop, financiers transfer funds to developers upon approval of investment proposals, initiating the capital cycle. This early-stage disbursement supports feasibility studies, pre-development activities, and initial project mobilization.

As the project advances to **Design and Selection (D&S)**, although no new money changes hands, financial accountability continues through milestone-based monitoring and disbursement conditions.

During **Procurement and Construction (P&C)**, a second layer of capital flow is activated. Developers channel funds to suppliers, typically aligned with delivery and construction milestones. In the distributor-centric loop, distributors similarly receive funding from financiers and use it to purchase components from suppliers.

In the **Operation and Management (O&M)** phase, cash flows generated by solar energy production, are used to repay loans, service equity, or fulfill lease-back obligations.

The **Gain (GA)** phase marks the formal realization of value across all actors: financiers recover principal and returns, developers and distributors generate profits, and suppliers may receive performance-linked bonuses or additional service contracts. This closed-loop capital cycle is essential for reinvestment and scalability.

2.4.3 Product Flow

Product flow is activated in the **Procurement and Construction (P&C)** stage, when suppliers dispatch modules, inverters, and balance-of-system components. In the developer-centric loop, goods flow directly to project sites for utility-scale installation. In the distributor-centric loop, components are routed to distributors and then further down to residential, commercial, or industrial clients.

During **Operation and Management (O&M)**, product flow continues in the form of spare parts, performance upgrades, or warranty replacements. While less visible than financial or informational exchanges, the physical movement of goods represents the material realization of project value—and is directly linked to both capital disbursement and operational performance.

2.4.4 Strategic Implications and Integration Opportunities

The model reveals that while developers remain the primary interface between financiers and the broader project ecosystem, suppliers occupy a unique and underappreciated position—functioning as the connective tissue between the developer-centric and distributor-centric loops.

This dual presence underscores the supplier's structural centrality not only in ensuring product delivery but also in synchronizing the commercial logic across upstream financing and downstream deployment.

In both loops, suppliers support the flow of physical goods and critical information—ranging from technical specifications to performance parameters. Yet, despite their pivotal role in determining the project's technical and operational quality, suppliers often remain peripheral to core financial structuring

dialogues. This arrangement, while functional, may constrain visibility into cost dynamics, delivery risk, and technological innovation—factors that financiers ultimately price into project risk models.

There is therefore merit in exploring mechanisms that enable suppliers to interface more directly with financial stakeholders. Such a shift would not disrupt the developer's coordination function but rather complement it by increasing the transparency of material and performance risk within the capital allocation process.

Over time, this could reduce inefficiencies arising from information asymmetries and foster a more responsive and resilient supply-finance alignment.



“ The model reveals that while developers remain the primary interface between financiers and the broader project ecosystem, suppliers occupy a unique and underappreciated position.

”

Chapter 3

Recommendations for Accelerating Solar Energy Investments

3.1 Capital Reinvigoration

Recommendation 1

Public and private investors must collaborate to revitalize capital for solar projects globally. This involves creating interconnected public-public, public-private, and private-private partnerships alongside transparent information channels and risk mitigation strategies to streamline investment flows.

Recommendation 2

Public investors, ranging from development finance institutions and sovereign wealth funds to long-duration capital pools such as pension funds and endowments, should enhance their role in mobilizing cross-border resources for solar projects, particularly in developing and least-developed countries.

Recommendation 3

Commercial banks must optimize their tools and refine their financial products and services to better support solar projects, including improved loan terms, credit facilities, and specialized financing options.

Mobilizing investment at scale is fundamental for accelerating solar energy deployment, both in large grid-connected projects and smaller-scale projects. As outlined in Chapter 2.1, the landscape of capital sources has diversified, yet structural misalignments persist—particularly in emerging markets, where the cost of capital remains elevated, and project pipelines underdeveloped.

Capital deployment must be aligned through more deliberate coordination. Strategic integration across public-public, public-private, and private-private financing channels can

reduce duplication, enhance risk-sharing, and accelerate deal execution. As discussed in Chapter 2.4, the absence of direct interaction between key stakeholders, particularly between suppliers and financiers, contributes to inefficiencies in capital allocation and due diligence. Institutional platforms that promote shared risk frameworks, transparent project data, and fit-for-purpose risk mitigation instruments are essential to improve capital throughput.

Public investors are critical of activating investment in higher-risk contexts. Sovereign wealth funds and public

banks are uniquely positioned to catalyze private investment, especially where market volatility or credit risk deters commercial lenders. Expanding the use of concessional instruments can significantly improve the bankability of early-stage or distributed solar projects, particularly in EMDE regions together with a mature de-risking evaluation practice.

Private lenders must also adapt beyond conventional structures. Commercial banks, as noted in Chapter 2.2, continue to rely heavily on traditional project finance models that are often misaligned with the capital cycle of solar development. To address this, financial institutions must expand their solar finance toolkit: from long-tenor credit lines to hybrid capital structures co-designed with development finance institutions (DFIs). Strengthened ESG-aligned disclosure practices, as discussed in Chapter 1, will also be vital to improving risk transparency and investor confidence across global markets.

capital – is particularly critical in solar financing. While total investment in clean energy has grown rapidly, the capital composition remains heavily skewed toward private and commercial sources. Local and regional private financiers often possess a deep understanding of the technical, commercial, regulatory and environmental-social aspects of rapidly evolving sectors such as solar. Public financiers, in contrast, typically have greater capacity to absorb the country-level risks (currency fluctuations, political risks etc.)

By collaborating, these two capital sources can address their respective limitations: public investors gain confidence in asset quality, while private actors benefit from reduced exposure to systemic risk. This partnership reduces the overall perceived risk profile of solar projects, thereby lowering the cost of capital. In turn, this enhances the affordability of solar energy solutions and improves their competitiveness relative to conventional energy alternatives.

The role of blended finance – combining public and private

Case Study - Deploying Public Capital at Scale in Fragile Solar Markets

Desert to Power G5 Sahel Facility – Catalyzing Public Capital in Fragile Markets

The Desert to Power G5 Sahel Facility, a joint initiative of the Green Climate Fund (GCF) and the African Development Bank (AfDB), exemplifies a **large-scale public-public financing mechanism targeted at unlocking solar potential in fragile and underinvested regions**. Covering Burkina Faso, Chad, Mali, Mauritania, and Niger, the program aims to deliver over 500 MW of new solar capacity and benefit 3.5 million people, with a projected mitigation impact of 14.4 million tCO₂e.

The Facility leverages USD 150 million in concessional capital from the GCF to mobilize USD 816.7 million in co-financing—comprising USD 379.6 million from AfDB and USD 437 million from private investors. Structurally, it integrates three core components: **grid infrastructure investments** to absorb new solar capacity; **concessional finance and partial risk guarantees (PRGs)** to enhance IPP bankability; and **technical assistance** to improve enabling environments and utility governance.

Beyond its financial architecture, the initiative operates in an ecosystem marked by insecurity, institutional fragility, and poor electrification. By offering de-risking mechanisms, regulatory support, and regional integration (including market-wide storage and transmission investment), the Facility demonstrates how **coordinated multilateral, and public capital can be deployed in service of both energy access and long-term resilience**.

Case Study - Localizing Finance to Scale Distributed Solar

Innovative financing structures anchored in local systems are reshaping how solar capital reaches emerging markets.

In Morocco, the Green Economy Financing Facility (GEFF), supported by EBRD and GCF, channels green finance through four local banks to fund SME solar adoption. Using credit lines embedded with green criteria, GEFF simplifies transactions and enables scale across fragmented markets without complex structuring.

In Central and West Africa, the Afrigreen Debt Impact Fund mobilizes €87.5 million from development and commercial financiers to support commercial and industrial (C&I) solar in countries with unreliable grids. By displacing diesel, Afrigreen helps lower energy costs and avoid 58,000 tons of CO₂ annually²⁶.

Both models highlight the role of local financial actors and blended capital in scaling decentralized solar where traditional infrastructure is weak.

Case Study - Commercial Climate Adaptation Finance in Action

Standard Chartered and Jinko Solar – Climate-Adaptation Finance for Resilient Solar Deployment²⁷

In 2025, Standard Chartered structured an **export finance facility** for Jinko Solar to deliver Tiger Neo N-type modules into climate-vulnerable markets including Florida, UAE, and Saudi Arabia. The project responded to a rising risk profile in solar asset performance due to extreme weather events such as hurricanes and sandstorms.

The deal was the bank's **first adaptation-labelled sustainable finance structure in China**, designed in accordance with the “Guide for Adaptation and Resilience Finance.” Beyond standard export terms, the facility embedded resilience-linked technical specifications—with the modules engineered for wind-load tolerance, thermal stability, and rapid-deployment logistics in disaster-prone regions.

The deal demonstrates the potential of adaptation and resilience as an investable asset class in response to growing demand for resilient infrastructure, particularly in the US (Florida), UAE and Saudi Arabia, where extreme wind, storms and sandstorms degrade and disrupt solar technology, leading to economic losses on investments made:

- Tornadoes and tropical storms in the US (Florida), like the more than 46 tornadoes that occurred throughout Florida in 2024 as a result of Hurricane Milton. Across the US, hurricanes including Hurricane Milton and Hurricane Helene (North Carolina) caused over \$500 billion in economic losses.
- Extreme wind, storms and sandstorms in the UAE and Saudi Arabia, including the severe storm that swamped Dubai in 2024 leading to damages thought to be worth hundreds of millions of dollars to homes and businesses.

In 2024, Standard Chartered, KPMG and the United Nations Office for Disaster Risk Reduction launched the Guide for Adaptation and Resilience Finance, with support from more than twenty leading financial institutions and NGOs as a guide for investment in adaptation and resilience. The guide set out a common reference for adaptation and resilience alongside a list of financeable adaptation and resilience themes and activities, forming a classification framework for the market.

²⁶ Société Générale. *Financing solar energy projects in Central and West Africa, 2024.*

²⁷ Standard Chartered (2024, March 19). *Scales Finance for Resilient Infrastructure*.; Standard Chartered CIB [@sccib] (2024, March 20). *First-labelled adaptation finance deal with Jinko Solar*.; Sustainability Magazine (2024, March). *Standard Chartered's Latest Green Deal.*

3.2 Balanced Investment Across the Value Chain

Recommendation 4

Address the imbalance in geography by adopting fairer investment standards that account for the high cost of capital and lower required rates of return in developing countries and emerging markets, ensuring equitable access to solar financing.

Recommendation 5

Achieve a more balanced investment approach across the solar PV value chain through enhanced communication and coordination among stakeholders, ensuring sufficient funding for R&D and production, project development, end-of-life recycling, and training & capacity building.

Recommendation 6

Direct greater attention and investment to solar-plus-storage applications, recognizing their critical role in advancing the solar energy sector and enabling higher levels of renewable energy integration.

Investment patterns in the solar sector remain highly uneven—both geographically and across the value chain. As shown in Chapter 2, funding is heavily concentrated in project development stage, while upstream manufacturing, innovation, storage integration, and end-of-life solutions receive comparatively little attention.

To ensure resilience and long-term sustainability, capital must be more evenly distributed. In developing and least-developed countries, high financing costs—often compounded by currency risk and limited credit enhancement—act as structural barriers. Revisiting risk-return expectations and scaling blended finance solutions is critical to enabling broader market participation.

Within the value chain itself, stakeholder coordination is essential. Chapter 2.4 highlighted that suppliers and downstream service providers often remain peripheral in investment flows, despite their integral role in system performance. A more deliberate approach is needed—one that supports R&D, local manufacturing, storage deployment, and circular economy infrastructure.

Among emerging segments, solar-plus-storage represents a strategic inflection point. Despite increasing policy support, storage remains undercapitalized relative to its potential contribution to grid stability and system flexibility. To fully leverage this synergy, financing models must internalize the long-term system value of storage, not just its upfront cost.

Unlocking solar's full potential as a climate and development solution depends on a more balanced and forward-looking capital allocation strategy across geography and value chain.

Case Study - Solar-plus-Storage

Solar-Plus-Storage Deployment in Island Settings: The Tahiti Model²⁸

In 2023, Jinko Group deployed an **8.6 MW solar PV system integrated with 17.2 MWh of battery storage** in Tahiti, French Polynesia. The project was designed to address both **supply reliability** and **fuel dependency**—two persistent structural issues in non-interconnected island power systems.

The system uses **Tiger Neo N-type PV modules** paired with **SunTera energy storage**, supporting day-night load balancing without reliance on backup fossil generation. Its technical architecture is adapted for coastal deployment, with C5 anti-corrosion certification applied to the ESS container—an important consideration given Tahiti's exposure to salt-laden humidity and long-duration operating cycles.

The financing structure departed from conventional solar procurement. **Rather than treat storage as a secondary addition, the system was delivered as a bundled design-finance-operate package with embedded O&M and performance guarantees.** A long-term offtake arrangement with the local grid operator provided volumetric certainty, enabling the project's revenue model to rest on dispatchable delivery, not variable generation.

By embedding durability, dispatchability, and climate conditions into procurement and financial design, the project created a bankable profile for what would otherwise be a high-risk, small-scale market. It reflects a shift away from viewing storage as a capex add-on, toward viewing it as a revenue enabler for decentralized clean power in remote geographies.



Case Study - Financing Lifecycle Responsibility through Regulatory Integration

EU WEEE Directive – Advancing End-of-Life Solar Recycling through Producer Responsibility

The European Union's WEEE Directive requires solar manufacturers to **finance the collection and recycling of decommissioned modules, embedding end-of-life costs into product economics.** Producers must report volumes, contribute to national take-back schemes, and ensure certified material recovery.

Advance eco-contributions, priced at the point of sale, enable **developers and financiers to incorporate recycling costs into project financial models.** Some manufacturers have gone further, **developing proprietary take-back systems to improve traceability and reduce investor uncertainty.**

This model shows how regulatory design can structurally finance underfunded stages—such as decommissioning—by codifying producer responsibility and aligning investment frameworks with circularity goals.

²⁸ PV Magazine (2023, November 21). *inko ESS Implements PV+ESS Project in Tahiti.*

3.3 Collaboration and Dialogue

Recommendation 7

Enhance platforms that promote solar investment by strengthening collaboration among banks, financing associations, regional solar associations, and manufacturers. Priority should be given to improving continuity, geographic reach, and technical depth of dialogue through regular and structured engagement.

Recommendation 8

Foster partnerships on standard harmonization and mutual recognition by working with financial institutions and international organizations, ensuring consistency and compatibility across solar and solar-plus-storage project standards. In doing so, consider leveraging frameworks such as the EU Taxonomy for Sustainable Activities as a reference point for developing globally aligned, transparent, and science-based classification systems.

Recommendation 9

Enhance ESG integration through dedicated intermediaries and improved disclosure to streamline due diligence and financing. Establish intermediaries—particularly within DFIs and MDBs—to facilitate dialogue with solar stakeholders and strengthen ESG due diligence. At the same time, companies should improve ESG disclosure, especially on risk identification, management, and performance indicators, aligned with global standards. These efforts will support faster, more consistent investment decisions, while enabling companies to detect ESG risks early and take timely mitigation actions to protect project bankability.

As underscored throughout Chapters 1 and 2, institutional coordination forms the backbone of effective solar investment strategies. With solar markets scaling and diversifying, fragmentation in standards, risk assessment, and disclosure practices have emerged as a significant bottleneck.

Currently, investors operate across jurisdictions with divergent technical, legal, and ESG frameworks. This lack of harmonization imposes high compliance costs and slows capital deployment, especially for developers operating in multiple markets. Manufacturers, in particular, face mounting inefficiencies in adapting to different requirements.

Standardization has become less a technical concern and more a financial imperative. The Global Solar Council (GSC), via its International Solar Finance Group, is well-positioned to lead on this front. Building on the model of the EU Taxonomy for Sustainable Activities, a global reference framework for solar investment—co-developed with

institutions such as UNEP FI and EDFI—would accelerate due diligence, reduce costs, and broaden access to capital, particularly for smaller players.

In parallel, stronger disclosure practices are needed. While several financial institutions now report their clean energy portfolios, practices remain inconsistent. Aligning solar investment disclosure with frameworks like the Task Force on Climate-related Financial Disclosures (TCFD) would enhance comparability and accountability across markets.

Finally, institutional forums that support continuous dialogue—across banks, regional solar associations, and technical intermediaries—are essential for building shared risk language and unlocking joint investment opportunities. In this context, platforms like the GSC's International Finance Group should expand their reach by convening annual stakeholder events in key financial centers worldwide.

Case Study - Building a Global Dialogue Platform to Connect Solar and Finance Communities

GSC's International Solar Finance Group (ISFG)

The Global Solar Council (GSC) launched the International Solar Finance Group (ISFG) in 2024 during COP28 to respond to persistent fragmentation in the solar finance ecosystem. The platform brings together multilateral development banks, commercial lenders, regional solar associations, manufacturers, and public agencies to institutionalize dialogue between the financial and solar sectors.

Structured around quarterly roundtables and task-specific working groups, the ISFG fosters continuity in engagement while addressing financing challenges and ESG disclosure gaps. **One key contribution has been translating project-level operational realities into due diligence insights that financial institutions can incorporate into solar risk models.**

Discussions also focus on **integrating ESG indicators into investment pipelines, with outputs aligned with recognized frameworks such as the EU Taxonomy.**

To reduce friction in project finance preparation, ISFG is also piloting tools including a solar finance ecosystem map, developer-investor interface protocols, and ESG-aligned risk metrics. These efforts support more coherent co-investment strategies, especially in emerging markets where overlapping standards remain a barrier.

By deepening coordination between solar and finance stakeholders, the ISFG is helping to **improve transparency, accelerate capital flows, and strengthen the structural foundation for scalable solar investment.**

Case Study - Enabling ESG Standard Harmonization to Unlock Sustainable Solar Finance

Solar Stewardship Initiative (SSI)



The Solar Stewardship Initiative (SSI), in collaboration with industry participants including manufacturers and buyers of solar photovoltaic modules, as well as other stakeholders, is the **first-ever supply chain sustainability assurance scheme dedicated to the needs of the solar PV sector and its customers to foster responsible production, sourcing, and stewardship of materials in the solar value chain.**

Members of the SSI stakeholder Advisory Group and observer organizations vary from MDBs such as IFC, EIB and ADB, IOs such as IRENA and OECD, as well as NGOs. To highlight, **in 2025, the SSI collaborated with the Global Solar Council and the European Investment Bank to develop a shared ESG reporting template aligned with the EU Taxonomy.**

This template bridges the mismatch between project-level ESG practices, and the evaluation needs of institutional capital. The innovation lies not in redefining ESG criteria, but in translating them into bank-interpretable disclosure logic. The template was piloted by solar manufacturers and validated through training sessions with commercial lenders and MDBs. This reduced friction in solar project due diligence, particularly for emerging market deals where ESG data has historically lacked structure and comparability. In parallel, independent ESG pilot audits are carried out across manufacturers' facilities, including Jinko Solar and other solar module suppliers for deeper understanding and recognition of solar value chain resilience.

To summarize, by simplifying how sustainability performance is communicated and verified, the SSI case aims at repositioning ESG from a reputational label to a mutually-aligned financial de-risking lever.

3.4 New Application Scenarios

Recommendation 10

Develop innovative financing solutions for emerging usage scenarios of solar energy, including but not limited to data centers, electrolysis aluminum, and agrivoltaics, supporting the diversification and expansion of solar applications.

The scope of solar energy is rapidly expanding. As technology matures, new applications—ranging from solar-powered data centers to agrivoltaics and solar for industrial processes—are emerging at the frontier of the energy transition.

These scenarios present both opportunity and complexity. Many involve hybrid business models that cut across sectors, complicating traditional project finance logic. As IRENA notes in its 2024 Outlook, future investment strategies must go beyond scale—they must adapt to cross-sectoral innovation and system-level value.

Financing these use cases requires purpose-built solutions. “Innovation windows” within green banks, outcome-linked incentives, and cross-sector aggregation platforms can help

bridge early-stage risk. Public procurement and industrial decarbonization programs also play a role in creating demand certainty.

Beyond climate benefits, these scenarios carry strong development co-benefits. Agrivoltaics, for example, supports food-energy co-optimization, while solar-enabled data infrastructure underpins digital connectivity. Recognizing and financing these broader impacts requires new thinking—not just in technology, but in how finance is structured and deployed.

By extending its reach into new markets and use cases, solar can become a cornerstone of the low-carbon, multipurpose infrastructure of the 21st century.

Case Study - Targeted Support for Early-Stage Solar Innovation

SEFA’s Technical Assistance and Green Mini-Grids Help Desk²⁹

The Sustainable Energy Fund for Africa (SEFA), managed by the African Development Bank, provides concessional finance and technical assistance to unlock private sector investment in renewable energy. Established in 2011, the fund is supported by multiple donors including the governments of Denmark, the United States, and Germany, as well as institutions like the Nordic Development Fund and the Global Energy Alliance for People and Planet.

SEFA’s interventions focus on **early-stage project development and structural market barriers**. Among its core instruments is **technical assistance (TA)**, delivered as grants to both public and private sector actors. These grants are designed to unlock investments by strengthening project design, regulatory readiness, and bankability—particularly in contexts where commercial capital remains reluctant to engage.

A flag initiative is the **Green Mini-Grids Help Desk**, a digital platform providing tools, templates, training, and market insights for developers and policymakers across the continent. **This enhances local project bankability and de-risks investments through standardized approaches.**

By bridging information gaps and offering blended finance instruments, **SEFA empowers developers to scale applications such as agro-solar systems, rural electrification, and coastal microgrids**, where commercial capital is still reluctant to engage.

²⁹ African Development Bank (2024). *Sustainable Energy Fund for Africa (SEFA)*; Green Mini-Grid Help Desk (2024). *SEFA Knowledge Platform*.

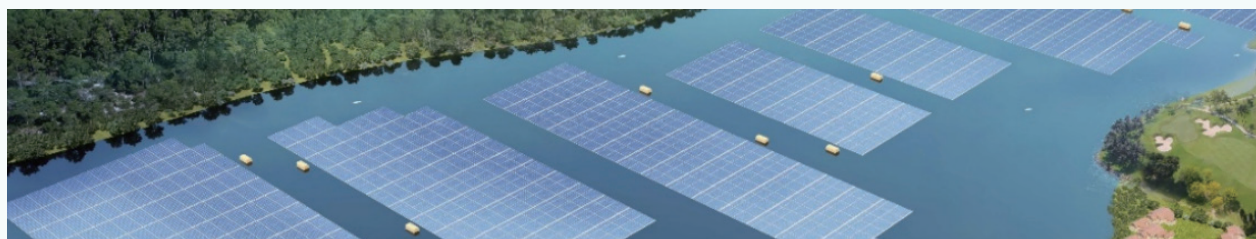
Case Study - Scaling Solar for Water-Energy Nexus and Industrial Offtake

Floating PV and Corporate PPAs in Singapore³⁰

Singapore's **Tengah Reservoir floating solar farm**, with a capacity of **60 MWp**, represents **one of the world's largest inland floating solar deployments**. It offsets **32,000 tons of CO₂ annually** and powers **16,000 households**, integrating renewable electricity into national water infrastructure.

Building on this model, Sembcorp and Meta signed a 25-year agreement for a new **150 MW floating solar farm** on Kranji Reservoir, dedicated to powering Meta's data centers in Singapore. **This project exemplifies how floating PV can unlock land-constrained markets and enable direct industrial decarbonization through solar-powered data infrastructure.**

By combining innovative siting, long-term PPAs, and tech-sector demand aggregation, the project **redefines how solar can support energy-intensive digital and industrial applications.**



Source: PUB Programme, the Ministry of Sustainability and the Environment (MSE) of Singapore

Case Study - Solar Infrastructure as a Resilience-Integrated Digital Asset

Tencent's Solar-Powered Data Centers in Tianjin, China³¹

Tencent deployed a **10.54 MW rooftop solar system** at its Tianjin data center, producing **12 million kWh annually—equivalent to powering 6,000 households**. This system is part of Tencent's broader rollout exceeding 50 MW of installed solar capacity across China.

The project integrates three technical layers: **DC-to-AC power conversion with voltage stabilization, large-scale energy storage for demand smoothing, and backup reliability**. The system supports real-time server loads and stabilizes power during peak demand and pricing fluctuations.

Instead of relying on grid-tied PPAs, **Tencent finances these systems as internal infrastructure upgrades, embedding energy resilience into core digital operations**. This approach aligns renewable generation directly with **mission-critical IT performance**, bypassing external offtake risk and reducing grid dependence in a 24/7 operational environment.



Source: Tencent

³⁰ Data Center Dynamics (2024, March). *Meta Signs 25-year Floating Solar Agreement*.

³¹ Tencent (2023). *How Tencent is Powering Data Centers Sustainably*.

Chapter 4

Key Take-aways

What does it truly mean to finance solar for all?

Solar PV holds the promise of the most universal energy technology—scalable, adaptable, and accessible across geographies regardless of current geopolitical world. Yet despite its modularity, affordability, and global access, the deployment of solar PV remains profoundly uneven. Financing solar for all means more than expanding capacity; it demands deliberate attention to how and where opportunity is created and extended.

Where do today's financing architectures fall short?

Solar finance remains fragmented across capital providers and investment actors, creating breaks in the flow of money, information, and products. Critical contributors such as suppliers often remain peripheral to financing frameworks, limiting transparency and increasing project risks. Investment flows disproportionately favor mature markets and project development stages, while early innovation, end-of-life solutions, and human capacity building remain underfunded. Fragmented ESG requirements further raise transaction costs and restrict access. Addressing these structural gaps is essential to make solar deployment truly scalable, inclusive, and resilient.

Where must solar finance evolve next to meet the needs of all markets?

The next generation of solar finance must be built for flexibility, resilience, and system enablement. Public-private coordination must deepen, with concessional capital unlocking new pipelines. Investment must flow not just to project assets but across the full innovation-to-recycling cycle. ESG frameworks must converge to lower compliance friction. Financing models must adapt to support emerging solar uses—from integrated storage to digital infrastructure—ensuring that solar remains a driver of system-wide transformation.

What future could solar finance help shape?

A future where access to clean energy is determined not by geography or financial risk, but by the strength of systems built to connect capital with opportunity. Solar finance together with energy storage, restructured for resilience and inclusion, can turn today's fragmented pathways into integrated networks that support innovation, expand access, and strengthen climate resilience. In shaping how and where solar grows, finance will shape the kind of energy future that becomes possible.

Who needs to do what?

To realize this future, financiers must integrate ESG costs into credit decisions and support value chain-wide lending. Governments and DFIs need to deploy concessional capital to de-risk underserved segments and harmonize ESG standards. Solar industry actors should enhance data transparency and participate in shaping unified ESG frameworks. Together, these efforts will enable solar finance to evolve into an inclusive, lifecycle-based engine for global climate progress.

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^a Jinko Solar Global Sustainability Development Department

^b International Finance Corporation, European Bank for Reconstruction and Development

^c Standard Chartered, Société Générale

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