Tailwind FUTURES

Identifying Maladaptation Risks in Climate Adaptation & Resilience Solutions

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An Educational Primer for Private Market Investors

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This report is a publication of Tailwind Futures, an investment firm and ecosystem builder focused on accelerating the development and deployment of adaptation and resilience solutions.

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Introduction

Purpose

Climate adaptation and resilience investments are urgently needed, and private capital has a critical role to play in supporting solutions that reduce vulnerability, strengthen resilience, and protect communities and ecosystems.

This toolkit is intended to help investors identify the most effective and impactful solutions and get them to the people and communities who need them most.

Adaptation decisions are made under uncertainty and with resource constraints. This means trade-offs are often inevitable, and there may not be a single, ideal adaptation solution.

Understanding the pros and cons of different solutions and taking a broad lens to acknowledge systemic considerations are key to ensuring the solutions that get deployed withstand the test of time and support equitable outcomes.

Intended Users

This Toolkit is primarily intended for private market investors who deploy capital in adaptation and resilience solutions. This guidance is for investors interested in 1) maximizing the adaptation & resilience benefits of companies they support, and 2) proactively mitigating potential maladaptive impacts before they arise.

While designed with venture capital and private equity investors in mind, the framework may be useful to other market participants looking to evaluate maladaptation risk in commercial climate adaptation solutions - including founders / business leaders, credit and lending institutions, philanthropies, and corporations.

How to Use this Toolkit

The full **Maladaptation Diligence Toolkit includes:**

- **Educational Primer:** The Primer (this deck) introduces key concepts such as Maladaptation outcome types, how context influences maladaptation risks, and how to assess for maladaptation risks in commercial solutions. It serves as the entry point into the Maladaptation Due Diligence Questionnaire.
    - For readers short on time - read the **Executive Summary**.
- **Maladaptation Due Diligence Questionnaire (DDQ):** The DDQ helps private investors uncover potential maladaptation risks and trade-offs in A&R solutions, so they have the information needed to make responsible investment decisions.
    - **DDQ Spreadsheet** and its companion **AI Maladaptation Screener** for investors using LLMs.
    - **2 Case Studies** of how to use the DDQ to assess a company and what mitigation actions look like in action, located within the DDQ spreadsheet.

Find all materials at **www.tailwindfutures.com/maladaptation.**

Disclaimer

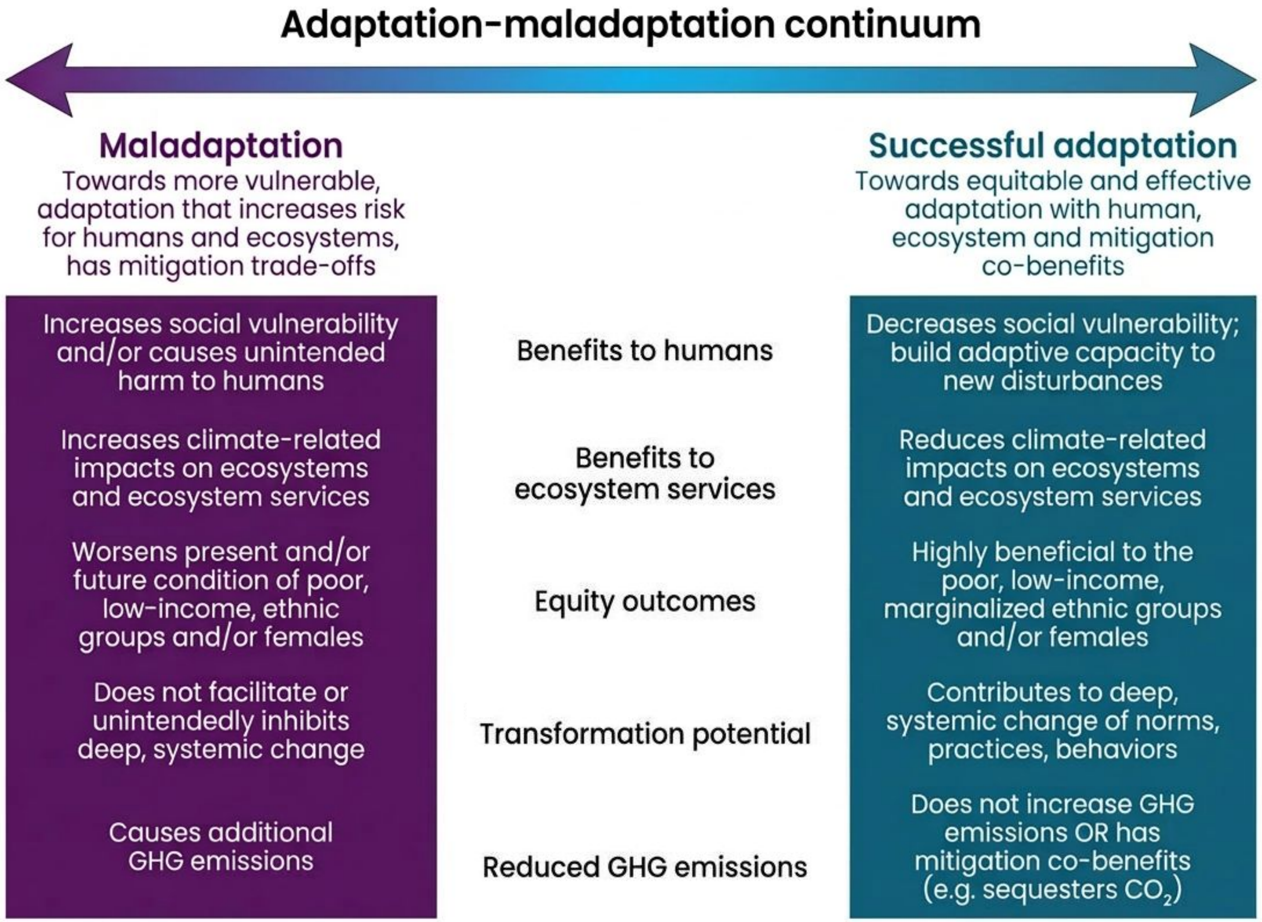
It is important to clarify what this Educational Primer and Diligence Questionnaire can and cannot do. Maladaptation risks cannot be fully "screened out" at the point of entry, and a diligence question-based assessment has inherent limitations. This Toolkit is not a certification or guarantee, nor is it a replacement for stakeholder and community engagement, long-term monitoring, or adaptive project design and governance. It is designed to complement existing environmental and social (E&S) risk and impact management frameworks, which share some overlap with the Toolkit. However, the DDQ also contains unique aspects for private investors in adaptation solutions. Please see the Appendix for a mapping of the DDQ to a shortlist of widely-used frameworks, and review additional sources cited in this document to supplement your approach.

KEY CONCEPTS

What is Maladaptation?

Maladaptation refers to “actions that may lead to increased risk of adverse climate-related outcomes, including via increased greenhouse gas emissions, increased or shifted vulnerability to climate change, more inequitable outcomes, or diminished welfare, now or in the future. Most often, maladaptation is an unintended consequence” (IPCC AR6 2022).

In other words, an intervention that appears adaptive in the short term may unintentionally worsen long-term outcomes, shift risks onto other communities or ecosystems, or reduce future resilience.



The IPCC defines maladaptation as existing along a continuum rather than a binary of being maladaptive or not.

Source: Figure 17.10, IPCC AR6 WG2

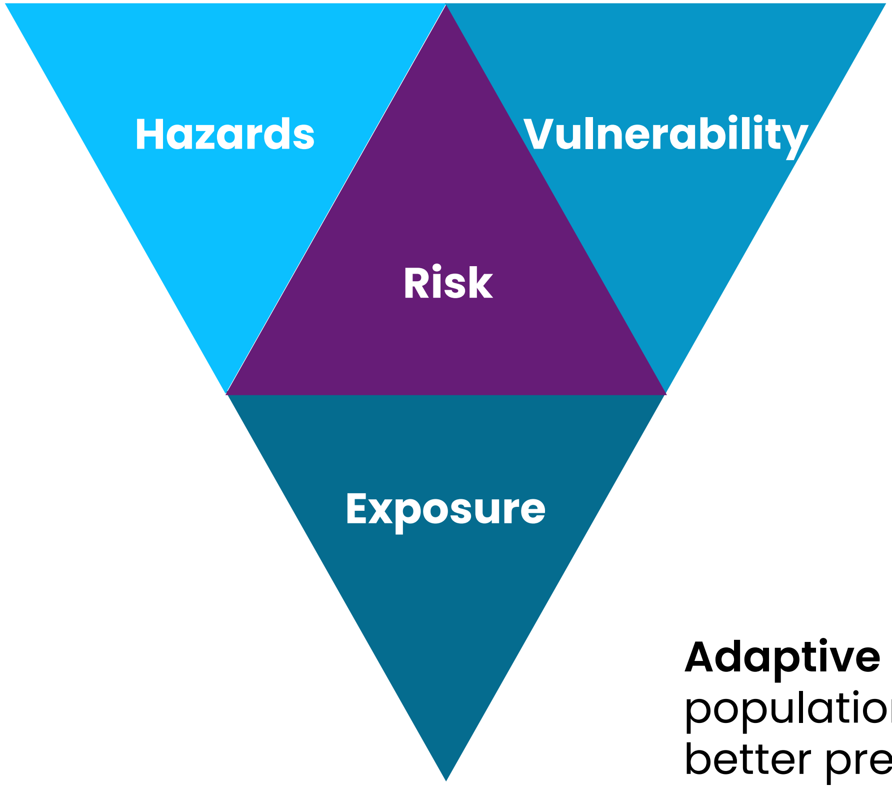
An Example of Maladaptation & Risk Mitigation

This example overviews the maladaptation diligence findings and outcomes for a fictional company. Additional examples can be found in the DDQ (2 detailed case studies) and through the rest of this Primer.

- **The Solution:** An early-stage precision irrigation company deploys AI-optimized drip systems to help almond and pistachio farmers in California's Central Valley maintain yields through worsening drought, in a region where groundwater depletion is accelerating and state water allocations are projected to decline significantly through 2050.
- **Maladaptation Risks Identified:** The DDQ surfaced a serious risk that irrigation infrastructure, combined with the 25-year lifespan of almond and pistachio orchards, was locking farmers into California's most water-intensive crops precisely as water availability is projected to decline most severely. The technology would make it even more difficult to switch to drought-resilient crops later. A further risk was the absence of water availability scenario planning in customer onboarding, meaning farmers were making 25-year capital decisions without forward-looking data.
- **Mitigation Steps & Outcome:** In response to the concerns raised, the founding team partnered with a regional agricultural extension service to develop a crop transition feature integrated into the customer platform, giving farmers access to forward-looking water availability projections and alternative crop economics alongside their irrigation data. The company also incorporated water stress scenario modelling into its customer onboarding process. Together these steps gave both parties greater confidence in the product's long-term resilience impact, with crop transition uptake incorporated as a shared metric going forward.

Climate Risk, Vulnerability, & Adaptive Capacity

Climate Risk is the intersection of hazards, exposure and vulnerability.



Exposure is the presence of people, assets, or ecosystems in harm's way. Ex: coastal cities facing higher *exposure* to floods.

Hazards include extreme heat, floods, wildfires, water scarcity & other chronic or acute changes from climate change.

Vulnerability is a factor of Sensitivity and Adaptive Capacity.

Adaptive Capacity: What makes a population, ecosystem or asset better prepared or able to withstand or recover from climate hazards.

Sensitivity: What makes a population, ecosystem or asset suffer more from a climate hazard (economic hardship, historically disenfranchised communities, fragile ecosystems, etc.).

Understanding Adaptive Capacity

Adaptive capacity is defined by the IPCC as “the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences."
(IPCC Fifth Assessment Report)

Adaptive capacity is determined by “economic assets, natural resources, social networks, power structures, agency, rights, institutions, governance modes, human capital, and available knowledge and technology.”
(Higuera Roa et al., 2025)

Maladaptation can undermine adaptive capacity by harming the resources and systems communities rely on, making it harder for people, ecosystems, and institutions to respond to climate change now or in the future.

Maladaptation can also manifest as **failed adaptation**, where vulnerability outcomes are neutral, and **simulated adaptation**, where actions provide a false sense of security but do not actually reduce vulnerability or build resilience. We treat those as part of a broader continuum of maladaptive outcomes.

Additionally, they both carry an opportunity cost from investing in a solution that did not work effectively.

Sources: IPCC Fifth Assessment Report, Higuera Roa et al. (2025)

Balancing Growth & Impact

Maladaptation matters for private investors because it ties directly to product-market fit and growth potential: if the solution does not improve adaptation & resilience as intended, it will likely not scale successfully. In some instances, screening for maladaptation may help prevent liability risks.

Maladaptation can happen in public and community-led adaptation projects. However, it manifests differently in venture-backed companies and private businesses. The illustrative examples in this Primer demonstrate that **maladaptation risks are not about bad intentions.**

Commercial solutions operate under different pressures, including revenue targets, go-to-market strategy, growth expectations, venture capital structures and intellectual property considerations. These factors shape how and where maladaptive outcomes can emerge as startup operators balance operational and commercial considerations.

Identifying where commercial products and services could inadvertently increase maladaptation risk is a precondition for strengthening the investment case around the A&R solution's efficacy.

Considering maladaptation risks enables companies and their investors to deploy capital with greater confidence, accountability, and impact.

Importantly, **this primer and diligence toolkit are not intended to discourage investments in adaptation and resilience.**

The goal of this toolkit is to give investors and founders the structure to identify those trade-offs, assess whether they're manageable, and make better decisions as a result.

TYPES OF MALADAPTIVE OUTCOMES

Types of Maladaptive Outcomes

This toolkit outlines **four primary types of maladaptive outcomes** and examples of how they manifest.

Inhibits Socioeconomic Progress

- Financial Access & Livelihoods
- Social & Community
- Health, Safety, & Security
- Conditions for Historically Marginalized Groups

Increases Climate-Related Ecosystem / Biodiversity Impacts

- Conservation or Restoration Efforts
- Sustainable Management

Inhibits Systemic Change and/or Adaptive Capacity

- Increases Exposure or Sensitivity to Climate, Social, or Economic Impacts
- Increases Severity of Hazards
- Introduces New Risks to the System
- Prevents or Delays Systemic Changes

Materially Increases GHG Emissions

- Substantially increases demand for energy in a carbon-intensive energy system
- Promotes carbon intensive activities

Sources: IPCC, BII & FMO's Climate Investment Playbook (2024), European Commission, Higuera Roa et al. (2025), Barnett & O'Neill (2010), Schipper (2020), Magnan (2014), Juhola et al. (2016), Chi et al. (2021), Jones et al. (2015)

Inhibits Socioeconomic Progress

Definition

Maladaptation that inhibits socioeconomic progress occurs **when adaptation actions inadvertently worsen social inequities or undermine livelihoods, labor conditions, health, safety, and community well-being** - particularly for historically marginalized groups such as low-income populations, women, minorities, and informal workers.

Examples

Financial Access & Livelihoods

A maritime robotics company retrofits a fishing harbor with automated mooring / loading systems, eliminating informal net-mending and fish-sorting work that women (excluded by cultural norms from boat crews) rely on as primary cash income.

Health, Safety, & Security

A wearable cooling technology for workers in extreme heat conditions tests and designs its solution only on men, leading to ineffective results and dangerous medical conditions in the field for female workers.

Social & Community

Autonomous harvest-assist machines are deployed to protect agricultural workers from heat exposure, but this reduces demand for seasonal fieldwork around which migrant communities structure their travel, credit cycles, and social gatherings.

Conditions for Historically Marginalized Groups

A SaaS wildfire risk assessment platform assigns elevated risk scores to properties in tribal reservations based on historical land-use data that predates tribal land management practices, resulting in insurance exclusions and mortgage restrictions.

Increases Climate-Related Ecosystem / Biodiversity Impacts

Definition

Maladaptation that increases climate-related ecosystem or biodiversity impacts occurs **when adaptation actions degrade ecosystems, reduce biodiversity, or undermine ecological functions that support resilience**. Consistent with IPCC literature, such outcomes arise when interventions intended for climate risk reduction inadvertently damage habitats, weaken conservation or restoration outcomes, or disrupt sustainable ecosystem management, thereby increasing long-term environmental vulnerability.

Examples

Conservation or Restoration

A seed technology company distributes drought-tolerant hybrid varieties to smallholder farming communities in a drought-prone region, achieving short-term yield gains. Widespread adoption displaces the locally-adapted landraces that farmers had selected across generations, thus eroding agrobiodiversity.

Sustainable Management

A desalination company attempting to provide drinkable water to a community experiencing drought discharges the brine from its operations into a habitat for a critical seagrass, threatening the species that underpins the health of local fisheries.

Inhibits Systemic Change and/or Adaptive Capacity (1/2)

Definition

Maladaptation that inhibits systemic change or adaptive capacity occurs **when adaptation actions increase exposure or sensitivity to climate, social, or economic hazards, introduce new risks, intensify the severity of impacts within a system, transfer risks elsewhere, or create path dependency.** Such outcomes arise when responses constrain long-term adaptive capacity, reinforce path dependencies, or limit the ability of institutions, communities, or ecosystems to anticipate, respond to, and transform in the face of climate risks.

Examples

Increased Exposure and/or Sensitivity to Climate, Social, or Economic Impacts

An HVAC efficiency solution is retrofit into urban commercial buildings, reducing indoor heat risk for office workers. However, waste heat expelled at night raises ambient temperatures in surrounding neighborhoods, worsening outdoor heat exposure for residents without AC.

Increased Severity of Hazards

An eco-concrete company lines coastal flood walls and storm drains with its saltwater-resistant material, enabling infrastructure to extend further into intertidal zones than previously viable, increasing the hard-surface area in ways that can accelerate stormwater runoff and raise downstream flood peaks during hurricanes.

Inhibits Systemic Change and/or Adaptive Capacity (2/2)

Juhola et al. (2016, *Environmental Science & Policy*) offers a useful breakdown of maladaptation relevant to systemic change:

- **Rebounding vulnerability:** The maladaptive consequence loops back onto the original actor, often after a lag.
- **Shifting vulnerability:** Vulnerability is transferred elsewhere in the system, creating an illusion of local success.
- **Eroding adaptive capacity:** Maladaptive actions block development options, create pathway dependency, reinforce feedback loops, or relegate problem-solving to future generations.

Examples

Introducing New Risks to the System

A centralized solar–powered technology for cold-chain logistics deploys refrigerated storage for heat-sensitive crops in a region with unreliable grid backup, creating a single point of failure where a multi-day grid outage causes larger aggregate spoilage losses than the distributed informal storage it replaced.

Shifting Vulnerability

An automated smart flood barrier deploys sensor-activated barriers to protect commercial and residential properties in a flood-prone urban area. By diverting peak floodwater away from protected sites, the system moves displaced water flows into adjacent, unprotected neighborhoods. This shifts rather than reduces overall vulnerability to floods.

Creating Pathway Dependency

A precision irrigation solution uses AI-optimized drip systems to help almond farmers stay productive through worsening drought. But the 25-year lifespan of almond trees and high irrigation infrastructure costs lock farmers into this water-intensive crop, making it economically impossible to switch to drought-resilient alternatives even as water availability is predicted to continue to decline.

Materially Increases GHG Emissions

Definition

Maladaptation that materially increases greenhouse gas (GHG) emissions occurs **when adaptation actions result in significant increases in direct or indirect emissions**, thereby undermining long-term climate risk reduction. Such outcomes arise when adaptation responses rely on or unintentionally lock users into carbon-intensive technologies, energy use, or land-use changes that exacerbate climate change and increase future climate hazards.

The qualifier "*materially*" in this definition is critical. According to the IPCC AR6 Synthesis Report (2023), even in the most ambitious climate pathways the scientific consensus is that some level of human-caused GHG emissions will always remain. This is a case where the trade-off must be assessed on a case-by-case basis.

Example

A residential air conditioning company subsidizes installations across heat-exposed low-income communities, but because the national grid is overwhelmingly coal-powered, each additional unit drives material increases in coal combustion to meet demand.

CONTEXTUAL FACTORS

Contextual Factors

In most cases, maladaptation is not intrinsic to a technology but rather depends heavily on context.

Who or what the technology interacts with or depends on is material context that can drive maladaptive impacts. Investors must consider how and under what conditions adaptation solutions interact with the real-world. These include factors such as demographics, geography, time horizons, and other considerations below.

A key characteristic of maladaptive impacts is the fact that they can be delayed, indirect, or occur in a different location from where the solution is deployed. This means that **they can manifest in people, entities, or ecosystems outside of the immediate or intended customer, user base, geography, or time horizon.** The factors that drive and interact with maladaptation can change over time. As a result, maladaptation risks should be monitored continuously, rather than just identified once in a static assessment.

Maladaptation risks can be uncovered by assessing decisions made across key business operations, such as the product design or the project design of pilots and commercial deployments, overlaid with the factors we outline in the following slides. This may include assessing how climate hazards and infrastructure conditions can change over a product's lifetime or whether there are indirect consequences of the solution's deployment for a specific community.

The examples here should be treated as situations where mitigation steps should be considered, not as exclusion criteria. Also refer to the two case studies (in the DDQ spreadsheet) for additional examples of mitigation steps.

Source: Higuera Roa et al. (2025)

Examples of Contextual Factors & Mitigation Measures

Contextual Factors

Geography: Climate solutions engineered for one environment (coastal, urban, arid, downstream zones) can fail or cause harm when deployed in a different physical or ecological context.

Time Horizons: This includes whether interventions prioritize short-term gains over long-term resilience benefits, or how climate hazards and infrastructure conditions could change over time.

Climate Shocks or Erratic Weather Conditions: Extreme weather events or large-scale climate patterns like ENSO can expose mismatches between a solution's design assumptions and the conditions it actually faces on the ground.

Maladaptation Examples

A modular flood barrier engineered for temperate river systems is deployed in a coastal region, where tropical rainfall intensity and tidal backflow cause it to trap, rather than redirect floodwater downstream.

A flood resilience rating platform certifies buildings as low-risk based on current flood maps, leaving certified properties progressively underinsured as sea level rise erodes the accuracy of those maps over time.

A smallholder crop reinsurance product priced on historical ENSO data underestimates loss severity as climate change intensifies El Niño events beyond historical norms, leaving policyholders undercompensated in the high-loss years the product was designed to address.

A parametric drought insurance product indexed to a single rainfall gauge fails to trigger payouts when localized storms register at the gauge, but drought persists across the broader insured area.

Risk Mitigation Measures

Test and configure the product for local hydrological conditions before deploying in new regions; require evidence of this as an investor.

Build automatic reassessment triggers when flood maps update or based on updated flood models; investors should check whether the business model incentivises avoiding reassessment.

Replace static historical baselines with forward-looking climate scenarios and annual repricing triggers; stress-test under intensified El Niño conditions.

Replace single-gauge indices with satellite-derived soil moisture data; commission an independent basis risk assessment before investing.

Examples of Contextual Factors & Mitigation Measures

Contextual Factors

Demographics: Income, race and ethnicity, gender, physical ability, age, language, socio-cultural dynamics, or employment types can all shape adaptive capacity and sensitivity and therefore make certain communities more exposed or vulnerable to climate hazards as a result.

Maladaptation Examples

Race & Ethnicity: A nature-based flood control company implements a large-scale floodplain park along the Tietê River in São Paulo, but its execution requires removing thousands of low-income families from informal settlements, disproportionately displacing Afro-Brazilian communities historically pushed into flood-prone areas and severing the social ties that are themselves a determinant of flood resilience.

Income: A company offering a parametric property insurance solution for wildfire requires those who buy it to use smart phones inaccessible to many of the low-income individuals who would most benefit from the insurance product.

Gender: A flood early-warning platform deploys SMS alerts to registered household heads in Bangladesh, but some women in affected communities are culturally restricted from owning phones, leaving those most likely to be trapped indoors unreached.

Physical Ability / Age: A smart building energy management system responds to heat-triggered grid stress by load-shedding both lifts and cooling to non-priority floors, stranding mobility-impaired residents in units that have simultaneously lost cooling.

Risk Mitigation Measures

Require distributional impact and resettlement assessments before deployment; investors should verify the quality and extent of community engagement.

Develop an alternate claim trigger for non-smartphone users; investors could ask what share of the target market the current interface excludes.

Restructure alert delivery through female community networks or community radio to reach women directly, not only household heads.

Exempt lifts and cooling for mobility-impaired residents from load-shedding protocols; verify compliance with disability access regulations in target markets.

Examples of Contextual Factors & Mitigation Measures

Contextual Factors	Maladaptation Examples	Risk Mitigation Measures
Regulatory & Policy Changes: New laws, reclassification, or withdrawn incentives can make previously compliant solutions suddenly illegal, uninsurable, or commercially unviable. This could penalize early adopters or discourage uptake.	An AI-enabled heat stress wearable shares worker biometric risk scores with employers under a national safety incentive; a subsequent data protection reclassification treats this as sensitive health data, deterring at-risk workers from consenting to monitoring.	Design the data architecture to separate aggregated risk insights from individual biometric records, reducing reclassification exposure; investors should monitor evolving health data regulation in target markets.
Macroeconomic & Geopolitical Forces: Financial volatility, trade disruptions, and geopolitical instability can sever the supply chains, financing structures, or market conditions that adaptation solutions depend on to function.	A modular cold-chain refrigeration company serves climate-vulnerable food systems using single-source components; when trade sanctions make replacements unaffordable, the infrastructure fails during peak heat periods when it was designed to perform.	Diversify component sourcing across at least two supplier regions and hold a strategic spare parts inventory; investors should more deeply assess supply chain concentration in diligence.
Technological Trends or Infrastructure Dependencies: Solutions built on specific tech could become vulnerable when the underlying infrastructure degrades, becomes obsolete, or fails under stress.	A flood early-warning platform routes alerts via cellular networks; during the storm events it was designed to manage, damaged towers render it inoperable in the time of highest need, while analogue backup systems have been decommissioned.	Build offline-capable alert functionality and require backup communication protocols (such as radio or siren integration) before deploying in regions with unreliable cellular infrastructure.

GUIDANCE FOR INVESTORS

Managing Maladaptation Risks

The full process of managing maladaptation risks includes:

1. **Identify & Assess** risks (the DDQ)
2. **Proactively Prevent or Mitigate** risks before they happen (high-level guidance in this Primer)
3. **Manage** negative outcomes if they occur
4. **Monitor** and re-assess conditions (use this Toolkit as needed)

For Step 1 – Identify Risks, we created the Maladaptation Due Diligence Questionnaire (DDQ) to help investors identify and get ahead of maladaptation risks when investing in adaptation & resilience solutions. This is a tool for investors to diagnose what the maladaptation risks or trade-offs are in existing or potential portfolio companies, so they have the information needed to make responsible investment decisions.

The questionnaire can be completed with the accompanying **AI maladaptation screener** which uses your AI assistant of choice to take a first pass at the full DDQ. Please note that using this tool alone is insufficient and not a replacement for human reasoning. **Two case studies** within the DDQ spreadsheet show investors what the full process of diligencing then proactively mitigating maladaptation risks can look like in action.

Find all materials at www.tailwindfutures.com/maladaptation.

Identifying & Assessing Maladaptation Risks

The DDQ is structured around three key steps:

- Screen for different types of **Maladaptation Risk**, using contextual factors
- Assess potential for **Risk Reduction**
- Determine the **Residual Maladaptation Risk**

The DDQ enables a qualitative assessment and scores that can be used to align with the investor's priorities, impact approach, and risk tolerance. The assessment may be used as material in the Investment Memo, shared in IC for discussion, or in other parts of the investment decision and management.
Although designed for investors, the DDQ could also be used by companies interested in understanding where and how maladaptation risks can arise from their business decisions.

Q#	Section		Questions by Maladaptation Type
Section 1: Inhibits Socioeconomic Progress			
Q1	S1	Labor and Working Conditions	How could the product's deployment impact the livelihoods, working conditions, and wages of employees and people living in or adjacent to the project site?
Q2	S1	Social and Community Risks	To what extent has input from pertinent communities shaped the product development or GTM strategy? If or where that input is limited, what product design assumptions or GTM approaches may not hold when deployed?
Q3	S1		In what ways could the product rely on the reallocation or movement of resources, jobs or wages away from those who currently have access to them?
Q4	S1		Could there be relevant social or cultural norms that may impact whether the product can be used or adopted effectively in target geographies? Could using the product potentially conflict with certain socio-cultural expectations (i.e. gender norms and cultural expectations for type of work) that will impact livelihoods, health, or social wellbeing?
Q5	S1	Health, Safety, and Security Risks	What are the potential health, safety, or security risks to workers and community members interacting with the product or service?
Q6	S1	Conditions for Historically Marginalized Groups	How does the company ensure that their procurement, labor model, and supply chain do not engage in exploitation or cause unintended harm to marginalized people or communities?
Q7	S1		Which user demographics has the product been designed and tested to be effective, usable, and accessible for? I.e. if it is a wearable, has it been tested on different genders, ages or body shapes?
Section 2: Increase Climate-Related Ecosystem or Biodiversity Impacts			
Q8	S2	Conservation and Restoration Efforts	What land use, water use, energy needs, waste streams, noise or light pollution are critical to the product's supply chain and/or deployment?
Q9	S2	Sustainable Management	Which ecosystems, habitats, and key species could be negatively affected by the product's supply chain and/or

Find the DDQ at www.tailwindfutures.com/maladaptation.

Identifying & Assessing Maladaptation Risks

Maladaptation risks can be uncovered by considering the company's products, business model, supply chain, and go-to-market strategy, as well as by considering contextual factors (like those included in this Primer) relevant to the markets where the company operates.

Maladaptation Risk Level

Level	Criteria
Low	The solution may generate minor unintended negative effects that are limited in scope and readily addressed through standard product design or operational adjustments.
Medium	The solution carries meaningful maladaptation risks that affect a notable group or system, but can be managed with deliberate mitigation actions that are realistic for the company to implement.
High	The solution poses serious maladaptation risks with significant harm potential across affected groups or systems, requiring substantial and proactive mitigation efforts that may be difficult but are still feasible for the company to undertake.
Red Flag	The solution poses irreversible and/or catastrophic maladaptation risks. Investors and companies should only proceed if they can implement a realistic and comprehensive mitigation plan. We expect investors to use "Red Flags" sparingly.

Assessing Risk Reduction and Net-Residual Risk

Risk Reduction Potential

Level	Criteria
High	The risk mitigation step will be highly effective in lowering maladaptation risk and is also highly possible to implement successfully.
Medium	The risk mitigation option may be somewhat effective in lowering maladaptation risk, and/or also faces considerable challenges for implementation due to capacity, resources, complexity, or founder / investor appetite.
Low	Based on a combination of feasibility and effectiveness, this risk mitigation option offers a Low level of risk reduction.
No Feasible or Effective Mitigation Options	There are no potential mitigation options because they are either not feasible due to severe constraints (including capacity, resources, complexity, or founder / investor appetite), and/or would not be materially effective even if successful.

Net Residual Risk: Managing Trade-Offs

Solutions should be assessed within the broader context of what risk mitigation actions are both feasible and effective, and in light of the harm they seek to prevent. The Net-Residual risk score is intended to capture that balanced perspective.

A clean bill of health is not a prerequisite for investment. Some level of net residual risk is expected and acceptable, and investors should use their judgment to manage trade-offs.

Low Potential for Risk Reduction should fit one of these conditions:

- **High feasibility and low efficacy:** The risk mitigation option would be minimally effective in lowering maladaptation risk, even if it is successfully implemented.
- **Low feasibility and high efficacy:** The risk mitigation option may effectively lower maladaptation risk if successful, but is very challenging to implement due to capacity, resources, complexity, or founder / investor appetite.
- **Both low feasibility and low efficacy**

Ways to Proactively Prevent & Mitigate Risks

Once maladaptation risks are identified, investors and companies can work to mitigate them through actions such as product or business model improvements, operational adjustments, or more deliberate engagement with external stakeholders.

Internally: What can the company do within its own business decisions and company operations, to mitigate or avoid the potential maladaptation risks?

- Consider whether the product should be tested under different conditions, or whether the product design needs to be altered.
- Consider whether the project deployment plan incorporates perspectives from relevant customers and stakeholders.
- Consider tiered pricing, discounts or targeted marketing to reach certain demographics.
- Consistently monitor for the development of maladaptation risks.

Externally: What can be changed or who needs to be worked with, outside of the company's operations?

- Consider whether any of the contextual factors that are driving or exacerbating the maladaptation risk can be changed / worked with.
- Consider whether communication and participation by local and adjacent users, communities, customers, and other stakeholders should be improved.

Risk Mitigation Measures

To determine feasible mitigation actions, investors must think about what steps companies can take to reduce or eliminate risks posed by their products and businesses. Organizations including the IPCC, OECD and UNEP provide guidance on what makes mitigation approaches effective. Below is a combined framework for what types of mitigation measures most often fit across our four most common categories of maladaptation. See "Mitigation Measures: Resources" in the Appendix for more information.

Maladaptation Type	Best-Practice Mitigation Measures
Inhibits Socioeconomic Progress	Stakeholder engagement, equity assessment, inclusive design, tiered pricing, supply-chain due diligence
Increases Climate-Related Ecosystem / Biodiversity Impacts	Life cycle assessments, biodiversity screening, nature-based design methods
Inhibits Systemic Change / Adaptive Capacity	Climate scenario analysis, modular design, adaptive management, lock-in assessment
Materially Increases GHGs	Lifecycle carbon accounting, counterfactual analysis, emissions reduction targets

APPENDIX

Framework	Overlap Between Frameworks & Tailwind Futures Maladaptation DDQ Methodology	Relevant DDQ Questions
IPCC AR6 WGII	Q11 and Q16 findings operationalize IPCC AR6 WGII Ch.17 maladaptation pathways (systemic substitution, scenario resilience) for a company-level investor context. Q19 counterfactual framing aligns with IPCC guidance on evaluating A&R solution net impact.	Q11, Q13, Q16, Q19
EU Taxonomy / DNSH	Q8 (waste streams), Q17–Q19 (GHG lifecycle) findings directly address DNSH technical screening criteria for the climate mitigation, circular economy, and pollution prevention objectives. Completing the recommended CRANE + LCA assessment would support EU Taxonomy alignment for any EU institutional buyers.	Q8, Q9, Q10, Q17, Q18, Q19
IFC Performance Standards	Q1 (supply chain labor) → PS2 due diligence. Q2 (community input) → PS1 ESMS and PS7 engagement. Q5 (health/safety) → PS4. Q6 (supply chain exploitation) → PS2. Q8 (resource/waste) → PS3. Q9–Q10 (ecosystem) → PS6. Mitigation actions across Sections 1 and 2 map directly to PS requirements; DDQ findings provide the input documentation for a post-investment ESMS.	Q1, Q2, Q5, Q6, Q8, Q9, Q10, Q17, Q18
OECD Guidelines (2023)	Q1–Q2 (labor/community) → Ch.IV–V enhanced due diligence. Q6 (supply chain) → Ch.V. Q8–Q10, Q14, Q17–Q19 (environment) → Ch.VI, which explicitly covers technology development and deployment (the strongest single LP-reporting anchor). Q12, Q16 (regulatory/scenario) → Ch.VI climate provisions. OECD Ch.II process due diligence applies across all 19 questions.	Q1, Q2, Q4, Q6, Q8, Q9, Q10, Q12, Q14, Q16, Q17, Q18
UNGPs	Q1, Q2, Q5, Q6, Q7 findings address HRDD Principles 17–18 (identify and assess actual/potential human rights impacts). Q7 (inclusive design) and Q2 (community input) address Principle 18 heightened attention to vulnerable groups. Q11 findings have partial resonance with Principle 13 (addressing impacts the enterprise is involved in, not only caused).	Q1, Q2, Q4, Q5, Q6, Q7, Q11
IRIS+ / ARIC	Q2 and Q7 distributional equity findings complement IRIS+ beneficiary disaggregation metrics and ARIC's equity dimension. Q19 counterfactual framing aligns with ARIC's additionality approach. Using IRIS+ positive impact metrics alongside this DDQ gives the investor a complete picture: IRIS+ defines what success looks like; the DDQ defines what downside risks looks like.	Q2, Q7, Q16, Q19
Operating Principles for Impact Management (OPIM)	This assessment constitutes the Principle 5 negative impact assessment for an investment: assessing, addressing, monitoring, and managing potential negative impacts. Q13 and Q16 Section 3 findings are also relevant to OPIM Principle 7 (responsible exits), where systemic dependencies that persist post-exit are a Principle 7 concern. Principle 6 (monitor progress) maps to the post-investment mitigation tracking.	All questions - Principle 5; Q13, Q16 - Principle 7
DDQ-ONLY (Tailwind Futures Methodology)	Q11 (Systemic Substitution Risk), Q13 (Lock-in / Reduced Adaptation Options), Q15 (Competitive Advantage Scales with Harm Severity), and Q16 (Business Model Resilience under Accelerated Scenarios) have no meaningful equivalent in any of the seven frameworks above. These questions, and particularly Q11, represent the methodology's most distinctive contribution to A&R investor diligence.	Q11, Q13, Q15, Q16

Mitigation Measures: Additional Resources

Across the IPCC, OECD, and UNEP FI, the most frequently cited and effective maladaptation risk mitigation actions are:

Mitigation Measures	Purpose	Tools and Resources
Participatory Stakeholder Engagement and Equity Assessment	Ensure affected stakeholders are involved early on, so that their perspectives can shape product development and inform GTM strategy and deployment decisions.	UNDP's Principles 18-21
Equity and Distributional Impact Assessment	Identify who benefits, who bears costs, and whether vulnerable groups are excluded.	UNEP FI ARIP Framework
Inclusive Product Testing	Ensure effectiveness across user demographics and varied operating conditions.	University of Cambridge Inclusive Design Toolkit
Climate Scenario Analysis	Ensure the product remains beneficial under future climate scenarios.	UNEP FI Climate Pathways Navigator
Continuous Monitoring and Adaptive Management with Flexible Product Design	Set up systems and processes to detect unintended impacts and ensure the solution's design is adaptable as conditions change. This will help preserve future adaptation options and avoid lock-ins in product design.	IPCC AR6 Chapter 17, IFC Performance Standards
Life Cycle Assessments	Identify environmental impacts across sourcing, manufacturing, operation, and disposal to ensure adaptation benefits are not offset by materially increased emissions.	CRANE, openLCA
Biodiversity and Ecosystem Screening	Avoid degradation of ecosystems and ecological resilience by identifying company impact on local conservation efforts.	WWF Biodiversity Risk Filter
Supply-Chain Due Diligence	Prevent hidden labor, environmental, and sourcing risks.	OECD DD Guidance for Responsible Business Conduct

Methodology & Bibliography

Methodology

This project builds upon the considerable work and thoughtful research done by experts across academia, industry, and government, to create an educational tool and assessment framework that is fit-for-purpose for private investors funding adaptation & resilience technologies. It was developed by Tailwind Futures with literature review, discussions with A&R practitioners, and expert judgement and review.

Reach out to info@tailwindfutures.com with questions, suggestions, or opportunities to engage.

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