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*Navigating a Changing World*

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# **The Resilience Dividend of Sustainable Development**

*Reducing Systemic Risk While Accelerating Human Progress*

Why the investments that lift people up are the same investments that stop shocks from spreading

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Research Report · October 2026

## Abstract

Sustainable development and disaster-risk reduction are usually budgeted as rivals. This report argues that they are largely the same investment seen at two moments in time: before a shock, as a reduction in exposure and vulnerability; after it, as faster recovery. It tests that claim against the evidence of 2026, a year in which a war-driven oil and fertiliser shock, the largest supply disruption in the history of the oil market according to the IEA, coincided with a record 23 per cent fall in development aid and a UN finding that only 36 per cent of SDG targets are on track.

The report extends the triple dividend of resilience (avoided losses, induced economic benefits and co-benefits) with a fourth, cascade dampening: the reduction in losses that propagate between systems. It reviews five domains: energy, health and human capital, food-water-nature, social protection and finance, and infrastructure and early warning. In energy, renewables passed coal in 2025 at 33.8 per cent of world electricity, and Pakistan's solar build-out is modelled to have avoided more than \$12 billion of fossil-fuel imports by February 2026. In human capital, immunisation has averted an estimated 154 million deaths, and Bangladesh cut cyclone deaths from about 500,000 in 1970 to 26 in 2020. Against this, developing countries paid almost \$1 trillion in net interest in 2025, international public adaptation finance (\$26 billion) is a twelfth to a fourteenth of modelled need, and social-protection coverage in the 20 most climate-exposed countries is 8.7 per cent.

Reported benefit–cost ratios for resilience-building investments range from about 2:1 to above 50:1; even halved, they stay above break-even. An illustrative Monte Carlo model shows that cutting vulnerability by a quarter and cascade transmission by half reduces mean annual loss by 58 per cent and the 99th-percentile loss by 61 per cent, and cuts the probability of a severe year from 7.9 to 0.9 per cent. The report proposes a five-question Resilience Dividend Test, five investment bundles, a risk register, four scenarios to 2035 and a ten-indicator scorecard with 2026 baselines.

**Keywords:** resilience; sustainable development; systemic risk; polycrisis; cascade dampening; energy security; clean energy; social protection; early warning; adaptation finance; disaster risk reduction; human capital; Hormuz energy shock; SDGs

**JEL classification:** Q54, O13, Q01, Q43, I15, H12; climate and natural disasters; economic development and the environment; sustainable development; energy; health and development; crisis management

**Data and method:** This report synthesises UN, World Bank, IEA, IRENA, Ember, FAO, WMO, UNDRR, UNEP, UNCTAD, OECD, WHO and insurer data (2024–26), published benefit-cost studies and peer-reviewed research. Every quantitative claim is linked inline and listed in Appendix B. Figures are classified as reported, modelled or illustrative in their captions; the Monte Carlo model (Figures 17–18, Appendix A) and the break-even arithmetic are the author's own and carry no empirical claim.

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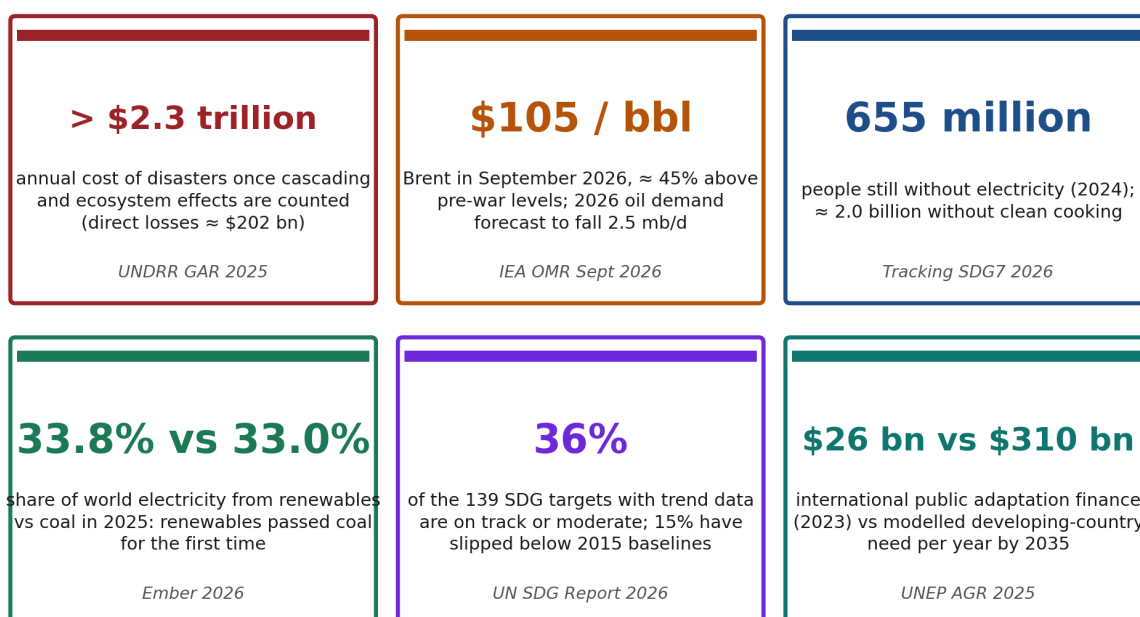
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## Executive Summary

*Sustainable development and risk reduction are usually budgeted as rival claims on scarce public money. This report argues that they are largely the same investment seen at two moments in time: before a shock, as a reduction in exposure and vulnerability; after it, as faster recovery. The 2026 energy shock gives that argument a live test.*

The world is running two experiments at once. The first is a record supply shock. Since the war that began on 28 February 2022, Gulf oil exports have been running at [nearly half their pre-war level](#), Brent crude stood near \$105 a barrel in September, and the IEA has described the disruption as [the largest in the history of the oil market](#). The second is a long, slowing development campaign. The UN's 2026 review finds that only [36 per cent of the 139 SDG targets with trend data are on track or making moderate progress](#), while official development assistance [fell by a record 23 per cent in 2025](#). Each experiment illuminates the other.



**Figure 1.** The report in six numbers.

Sources: [UNDRR](#), [IEA](#), [Tracking SDG7](#), [Ember](#), [UN SDG Report](#), [UNEP](#).

## Key findings

- **The dividend is real, but it is larger than conventional appraisal shows.** Reported benefit–cost ratios for resilience-building investments run from about 4:1 for resilient infrastructure to 20–26:1 for immunisation on a conservative cost-of-illness basis (Figure 16). These ratios mostly capture avoided direct losses, development gains and co-benefits. They largely miss a fourth dividend: the dampening of cascades between systems. In the illustrative model in Section 10, cutting vulnerability by a quarter and cascade transmission by half lowers the mean annual loss index from 100 to about 42 and the 99th-percentile loss from 731 to 288.
- **Clean domestic energy has become a security asset.** Renewables supplied [33.8 per cent of world electricity in 2025, passing coal for the first time](#), and solar alone met three-quarters of

demand growth. Pakistan's solar build-out is modelled to have avoided [more than \\$12 billion of fossil-fuel imports by February 2026](#), before the worst of the shock.

- **Human-capital investments are shock absorbers.** Immunisation has [averted an estimated 154 million deaths since 1974](#); research on 125 countries finds that [education is the strongest social factor associated with lower disaster mortality](#); and Bangladesh cut cyclone deaths from several hundred thousand in 1970 to a few dozen in 2020 through warning, shelters and volunteers (Figure 15).
- **The finance system is pushing against resilience.** Developing countries paid [almost \\$1 trillion in net interest in 2025](#); international public adaptation finance was about [\\$26 billion against a modelled need of \\$310 billion a year](#); and the 20 most climate-exposed countries have [social-protection coverage of only 8.7 per cent](#).
- **The binding constraint is sequencing and money, not knowledge.** The same investments that are cheapest per unit of risk avoided are concentrated where fiscal space is thinnest. A resilience dividend that accrues to those who cannot afford to invest is a dividend foregone.
- **What to do.** The report proposes a no-regret core of five bundles (secure clean power, health and human capital, food–water–nature buffers, shock-responsive protection and finance, and warning plus prevention) governed by a five-question Resilience Dividend Test and tracked on a ten-indicator scorecard with 2026 baselines (Section 13).

## How to read this report

Every quantitative claim is linked in the text to its source, and a full register appears in Appendix B. Figures are classified in their captions as *reported* (a value from a cited source), *modelled* (an estimate from a cited model) or *illustrative* (the author's own stylised calculation). Where sources disagree, the report says so; where a widely quoted number could not be verified, it is omitted. The Monte Carlo model and the break-even arithmetic in Section 10 are the author's own and are labelled as such, as are a few derived values in figures (flagged in their captions).

# 1. Introduction: Progress and Peril

*In a year when oil crossed \$100 a barrel, fertiliser prices spiked and aid budgets contracted, a familiar argument returned: that sustainable development is a fair-weather ambition, to be resumed when the emergency passes. The evidence points the other way. The countries, households and systems that weathered the shock best were those that had already built the buffers development provides.*

## 1.1 The question

Public budgets treat two things as competitors that are, in practice, close to identical. One is *development*: electricity, schooling, health care, clean water, social protection, sound infrastructure. The other is *risk reduction*: early warning, flood defences, reserves, insurance, emergency stocks. A clinic with solar power and a vaccine cold chain is both. A household with a bank account and a cash-transfer entitlement is both. A grid with distributed generation is both. The distinction is one of timing and accounting, not of substance: the same asset is counted as progress in a normal year and as protection in a bad one.

This matters because the two are budgeted by different ministries, financed from different windows and evaluated on different metrics. A development project is judged by what it adds; a risk-reduction project by what it prevents. Neither metric captures the thing that matters most in a polycrisis, which is how much *less* a shock in one system spreads into the others. This report asks whether investing in sustainable development is the most efficient way to lower systemic risk, and what the dividend looks like once that second effect is counted.

## 1.2 Why 2026 is the right year to ask

Three developments make the question urgent. **First, a stress test is under way.** The conflict that began on 28 February has disrupted a chokepoint through which [roughly 15 million barrels of crude and 5 million barrels of products normally pass each day](#). By September the IEA reported that [more than 10 million barrels a day of Gulf output remained shut in](#) and had pushed the expected recovery into 2027. The IMF's July update cut 2026 global growth to [3.0 per cent, with oil averaging \\$89 a barrel and inflation at 4.7 per cent](#). The FAO warned that [urea prices had risen 52 per cent in the United States and 60 per cent in Brazil by mid-April](#), with the biggest effects on food security likely to arrive later as farmers cut inputs.

**Second, the development campaign is losing momentum.** The UN's 2026 review credits real gains (nearly a billion people gained safely managed drinking water since 2015, electricity now reaches 92 per cent of the world, and 134 countries have met the child-mortality target) but concludes that [49 per cent of assessable targets are moving too slowly and 15 per cent have slipped below 2015 baselines](#). The SDSN's independent assessment is harsher: [fewer than one in five targets is on track](#). The financing is moving the wrong way: ODA [fell 23.1 per cent in 2025, the largest annual contraction on record](#), and the OECD projects a further 6.9 per cent fall in 2026, with health aid down by 29 to 46 per cent between 2024 and 2026.

**Third, the cost of unmanaged risk keeps rising.** The UNDRR's 2025 Global Assessment Report puts the full cost of disasters at [more than \\$2.3 trillion a year once cascading and ecosystem effects are included](#), against direct losses of about \$202 billion. Swiss Re counted [\\$220 billion of natural-catastrophe losses in 2025, about half uninsured](#). Global temperature reached [1.43°C above pre-industrial levels in 2025](#).

### 1.3 The argument in brief

The report develops six claims.

- **Claim 1: Resilience is mostly development.** The assets that reduce exposure, vulnerability and the cost of recovery are the assets of development itself. Treating them as separate budgets understates the return on both.
- **Claim 2: There are four dividends, not three.** Avoided losses, development gains and co-benefits are well documented. A fourth, the dampening of cascades between systems, is under-measured because it shows up in the tail of the loss distribution rather than in the average.
- **Claim 3: Energy is the cleanest test case.** Domestic renewable power is cheaper than new fossil generation in most markets, cannot be blockaded, and lowers exposure to the shocks that propagate fastest into food, finance and household budgets.
- **Claim 4: Human capital is the slowest-building and most durable buffer.** Health, schooling and social protection lower vulnerability for decades and make every other investment work.
- **Claim 5: The dividend is unevenly accessible.** The countries with the highest exposure face the heaviest debt service, the thinnest social protection and the sharpest aid cuts. The binding constraint is finance and sequencing.
- **Claim 6: Evidence quality is uneven and must be managed.** Reported benefit–cost ratios depend on modelling choices. A responsible programme uses haircuts, tracks outcomes and publishes failures.

### 1.4 Evidence standard and structure

The report uses published data and peer-reviewed or institutional estimates, linked inline. It does not rely on any figure that could not be traced to a primary or clearly attributed source. The report uses three labels throughout: *reported*, *modelled* and *illustrative*. Section 2 sets out the conceptual framework. Section 3 describes the risk landscape. Section 4 reviews the progress record. Sections 5 to 9 examine five domains: energy; health and human capital; food, water and nature; social protection and finance; and infrastructure, warning and prevention. Section 10 synthesises the evidence on returns and presents an illustrative model of the cascade-dampening dividend. Section 11 sets out failure modes, Section 12 four scenarios to 2035, and Section 13 actions by actor with a roadmap and scorecard. Section 14 concludes.

## 2. A Framework: Systemic Risk and the Four Dividends

*A shock becomes a systemic crisis when it finds a path between systems. Sustainable development lowers the odds that it does, and the cost if it does. Counting that second effect changes the arithmetic of what to fund first.*

### 2.1 Systemic risk and the polycrisis

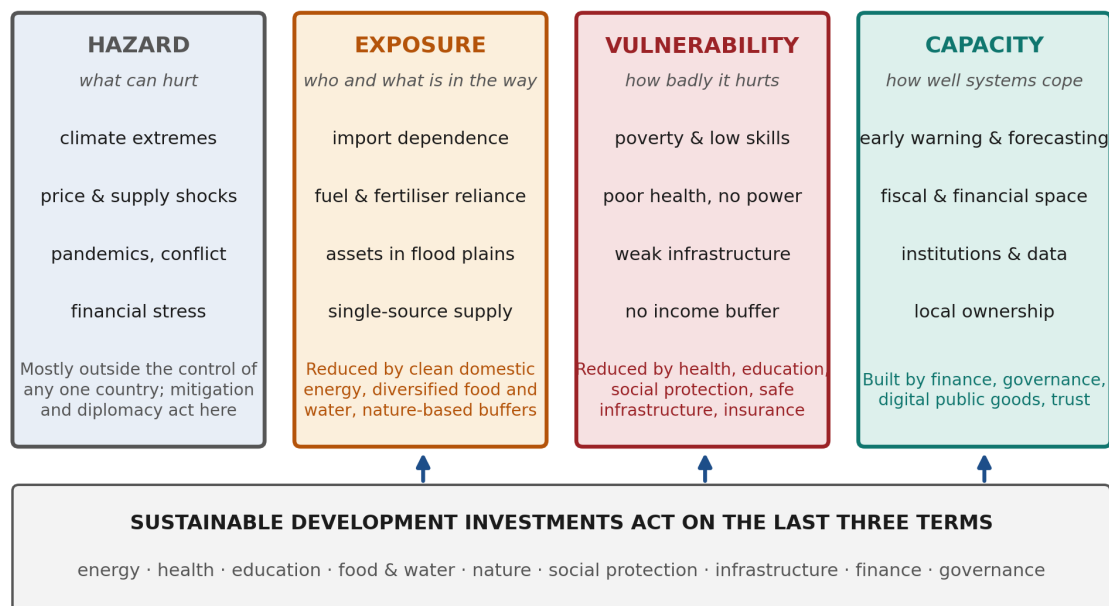
The word *polycrisis* has been used so loosely that it risks meaning nothing. Lawrence, Homer-Dixon, Janzwood, Rockström, Renn and Donges give it a working definition: [the causal entanglement of crises in multiple global systems in ways that significantly degrade humanity's prospects](#). Their companion paper identifies [three linking pathways: common stresses, domino effects and inter-systemic feedbacks](#). The 2026 oil shock illustrates all three. A *common stress* (a blockade) hits energy, shipping, fertiliser and food simultaneously. A *domino* runs from fuel to transport to food prices to household budgets. A *feedback* runs from higher import bills to weaker currencies to costlier debt service to less room to subsidise fuel and food.

The UN University's Interconnected Disaster Risks work adds a warning about thresholds. Its 2023 edition identified [six risk tipping points: accelerating extinctions, groundwater depletion, mountain-glacier melt, space debris, unbearable heat and an uninsurable future](#), each defined as the point where a system can no longer absorb risk and perform its function.

### 2.2 Where development acts

Standard disaster-risk practice decomposes risk into hazard, exposure, vulnerability and capacity. Figure 2 maps development investments onto that decomposition. Most development acts on the last three terms. It rarely changes the hazard, though mitigation does over the long run. It does change who is exposed (through domestic energy and diversified food and water), how badly exposure hurts (through health, schooling, protection and sound infrastructure), and how well systems cope (through forecasting, fiscal space and institutions).

$$\text{RISK} = \text{HAZARD} \times \text{EXPOSURE} \times \text{VULNERABILITY} \div \text{COPING \& ADAPTIVE CAPACITY}$$



**Figure 2.** Sustainable development investments act on three of the four terms of the risk equation. Conceptual.

Source: author's synthesis of the standard hazard–exposure–vulnerability–capacity decomposition.

## 2.3 From the triple to the four dividends

The resilience literature has two durable ideas. Judith Rodin popularised the *resilience dividend* as [the capacity to bounce back from a crisis, learn from it and achieve revitalisation](#). Tanner, Surminski and colleagues, in work for the World Bank's GFDRR and the Overseas Development Institute, framed the [triple dividend of resilience](#): avoided losses, induced economic benefits and wider social and environmental co-benefits.

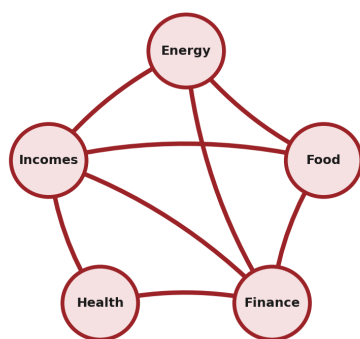
This report adds a fourth. **Cascade dampening** is the reduction in the probability and size of losses that propagate from one system to another. It is not the same as avoided direct loss, because it operates on the correlation between losses rather than on any single loss. It is hard to see in project-level appraisal, which evaluates one asset against one hazard. It is large in the tail, where polycrisis costs are concentrated. Table 1 summarises the four dividends and how they are usually measured.

Table 1. The four dividends of resilience-building development

| Dividend             | What it is                                                     | Typical measure                                                   | Visible in appraisal? |
|----------------------|----------------------------------------------------------------|-------------------------------------------------------------------|-----------------------|
| 1. Avoided losses    | Direct damage and casualties that do not occur                 | Expected annual loss avoided; lives saved                         | Yes, standard         |
| 2. Cascade dampening | Losses that stay in one system rather than spreading to others | Tail loss (99th percentile); recovery time; correlation of losses | Rarely                |
| 3. Development gains | Growth, productivity and income gained in normal years         | Return on investment; jobs; output                                | Partly                |
| 4. Co-benefits       | Health, climate, nature and equity gains                       | Lives, DALYs, tonnes CO <sub>2</sub> , hectares                   | Partly                |

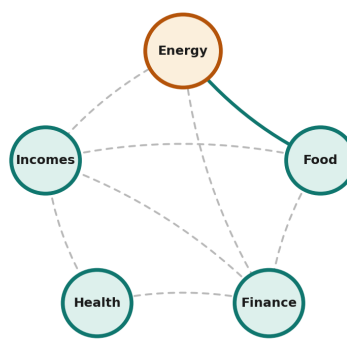
Dividends 1, 3 and 4 follow the [triple-dividend framework](#); dividend 2 is this report's addition.

(a) Exposed and fragile: shock cascades



high exposure × high vulnerability × weak capacity:  
a loss in one system becomes a loss in all

(b) Buffered: shock is absorbed locally



diversified supply, buffers and protected households  
break the links: the initial hit stays local

Conceptual schematic. Arrow weight indicates strength of transmission.

**Figure 3.** A shock cascades in a fragile, exposed system (a) and stays local in a buffered one (b). Conceptual.

Source: author's schematic, drawing on the common-stress, domino and feedback pathways of [Lawrence et al. \(2024\)](#).

## 2.4 The Resilience Dividend Test

To move from principle to prioritisation, the report proposes five questions to put to any programme.

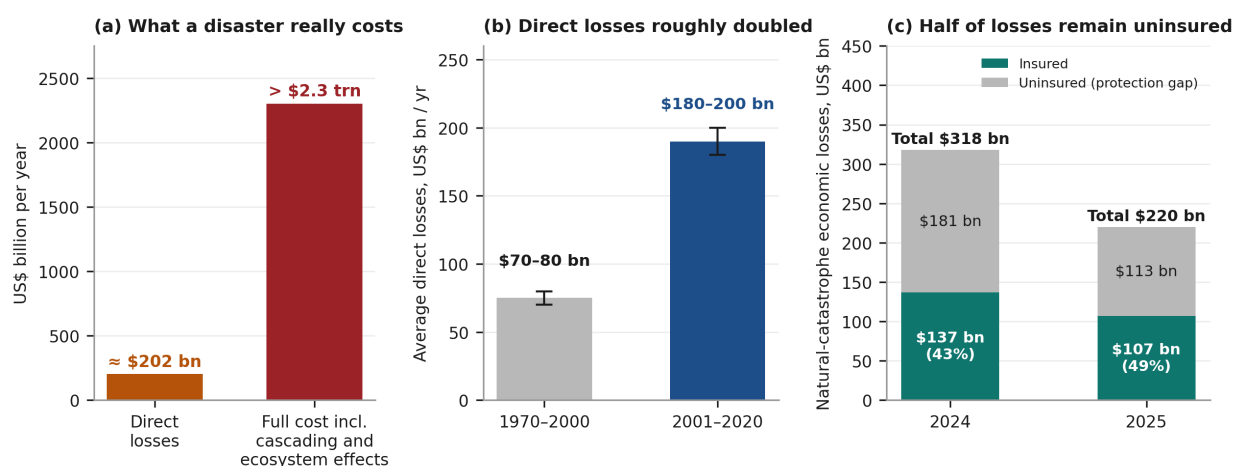
- **Exposure test.** Does it lower exposure to a shock that is likely to recur within the investment's life (fuel price spikes, floods, heat, disease)?
- **Vulnerability test.** Does it reduce vulnerability for the poorest or most exposed group, not only the average?
- **No-regret test.** Does it pay off in a normal year, so that it is worth doing even if the shock does not arrive?
- **Transmission test.** Does it break at least one channel between systems (energy to food, food to finance, health to income)?
- **Durability test.** Does it remain functioning, funded and locally controlled after external support tapers?

### 3. The Risk Landscape: What Development Must Defend Against

*The risks that matter most are interlocking: climate extremes, energy and food shocks, debt stress, conflict and eroding trust. Their costs are larger than direct damage counts suggest, and they fall hardest on the people least able to absorb them.*

#### 3.1 The true cost of disasters

Official loss tallies understate the problem. The UNDRR's *Resilience Pays* puts direct disaster losses at about \$202 billion a year, up from \$70–80 billion a year in 1970–2000 to \$180–200 billion a year in 2001–2020. When cascading and ecosystem costs are added, it estimates the full burden at more than \$2.3 trillion a year. The report also identifies three reinforcing cycles that trap vulnerable countries: rising debt, shrinking insurance access and growing dependence on humanitarian relief. Figure 4 sets out the picture.



**Figure 4.** Disaster losses: (a) direct versus full cost; (b) direct losses by era; (c) insured and uninsured natural-catastrophe losses. Reported.

Sources: [UNDRR GAR 2025](#); Swiss Re Institute [sigma 1/2026](#) and [sigma 1/2025](#). Insured amounts for 2024 derived as total minus uninsured.

Insurance does not close the gap. Swiss Re estimates that 2025 economic losses of \$220 billion were about 49 per cent insured, the highest share on its records, but the 2024 protection gap was \$181 billion, or 57 per cent of losses. Munich Re's tally for 2025 was about \$224 billion overall with \$108 billion insured; it recorded roughly 17,200 deaths, below the ten-year average of 17,800. In Asia-Pacific only about \$9 billion of \$73 billion was insured. The pattern is stark: where the most people live, losses are least insured.

The long record shows both sides of the story. The WMO's atlas counts 11,778 reported disasters from 1970 to 2021, with just over 2 million deaths and \$4.3 trillion in losses, more than 90 per cent of the deaths in developing countries. Deaths have fallen as early warning and disaster management improved; losses have risen as exposure grew. That divergence, falling mortality with rising damage, is the signature of a world that has learned to protect lives but not yet assets or livelihoods.

#### 3.2 How risk is perceived

The World Economic Forum's *Global Risks Report 2026* shows a decision-making class that expects turbulence. Goeconomic confrontation ranked first on the two-year horizon, environmental risks dominated the ten-year view, and half of respondents expected a turbulent or stormy world over two years.

[up 14 percentage points from a year earlier](#). The WEF's own press materials note that adverse outcomes of AI jumped from 30th place over two years to 5th over ten. The combined message is that risks are multiplying faster than the capacity to manage them, and that the sources of risk are as much economic and political as environmental.

### 3.3 Climate and Earth-system stress

The physical hazard is intensifying. The UN reports that [2025 global temperatures reached 1.43°C above pre-industrial levels and greenhouse-gas emissions hit a record high](#). The Global Tipping Points Report 2025 concluded that [warm-water coral reefs, on which nearly a billion people depend, have already passed their thermal tipping point](#). Heat is a growing killer: the Lancet Countdown estimates that [heat-related deaths averaged 546,000 a year in 2012–21, 63 per cent more than in the 1990s](#), though the rate per 100,000 rose by a smaller 23 per cent because the vulnerable population grew.

### 3.4 Economic, financial and political stress

Fiscal and political risks compound the physical ones. UNCTAD reports that [3.7 billion people live in 51 developing countries where interest payments exceed spending on either health or education](#), and the UN's SDG review notes that [violent conflict has forcibly displaced 118 million people](#). The Hormuz shock layers a price shock on top: the IEA expects [2026 oil demand to fall by 2.5 million barrels a day](#) as high prices destroy consumption, an adjustment that is painful in rich economies and punishing in poor ones.

**Table 2. Major systemic stressors and how they transmit (2026 evidence)**

| Stressor                  | Latest evidence                                                                                                    | Main transmission channels                                            |
|---------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Energy supply shock       | Gulf output >10 mb/d shut in; Brent ≈ \$105 ( <a href="#">IEA</a> )                                                | Fuel, freight, fertiliser, food, inflation, currencies                |
| Climate extremes          | Full disaster cost >\$2.3 trn/yr ( <a href="#">UNDRR</a> )                                                         | Assets, crops, health, insurance, public finance                      |
| Debt and fiscal stress    | ≈ \$1 trn net interest in 2025; 51 countries pay more interest than health or education ( <a href="#">UNCTAD</a> ) | Crowding out of health, schooling, adaptation; higher borrowing costs |
| Aid retrenchment          | ODA –23.1% in 2025; further –6.9% projected ( <a href="#">OECD</a> )                                               | Health, humanitarian and early-warning funding gaps                   |
| Conflict and displacement | 118 million forcibly displaced ( <a href="#">UN</a> )                                                              | Lost output, remittances, food insecurity, fragility                  |
| Earth-system thresholds   | Warm-water reefs past tipping point ( <a href="#">GTP 2025</a> )                                                   | Fisheries, coastal protection, tourism, food                          |

*Evidence reported by the cited sources; transmission channels are the author's synthesis.*

## 4. The Progress Record: What Development Has Already Delivered

*The case for treating development as risk reduction rests on what development has demonstrably done. The record is large, uneven and, in the places where it relies on fragile finance or institutions, reversible.*

### 4.1 Gains at scale

Global life expectancy reached [73.3 years in 2024, up from 70.9 years at the pandemic low](#), returning to pre-COVID levels in nearly all countries. Under-five deaths fell to [4.9 million in 2024, a 60 per cent decline in the rate since 1990](#), and 134 countries have met the SDG child-mortality target. The Lancet's 50-year analysis of the Expanded Programme on Immunization estimates that vaccination [averted 154 million deaths, 146 million of them in children under five](#), accounting for 40 per cent of the observed decline in global infant mortality and 52 per cent in Africa.

Infrastructure gains have been equally large. The UN's 2026 review reports that since 2015 [nearly 1 billion people gained safely managed drinking water and 1.2 billion safely managed sanitation](#); electricity now reaches 92 per cent of the world's people, a third of it renewable; internet use rose from 40 to 74 per cent; and social protection covers more than half the global population for the first time. The 2026 Tracking SDG7 report shows the number of people without electricity falling from [1,141 million in 2010 to 655 million in 2024](#).

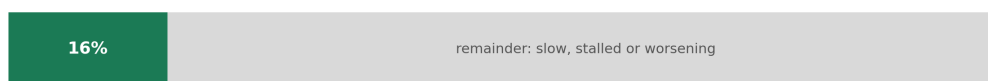
### 4.2 The scorecard is mixed

Against these gains the UN scorecard is sobering. Of 139 targets with trend data, [36 per cent are on track or making moderate progress](#), [49 per cent are moving too slowly](#) and [15 per cent have regressed](#). The SDSN's separate index, which uses a different method, puts the on-track share at [under one in five](#). The two should not be compared as if they measured the same thing, but they agree on direction. Extreme poverty is stuck: Our World in Data counts [about 817 million people below the \\$3-a-day line in 2024](#) and notes that the progress of past decades has stalled. Food insecurity affects 2.3 billion people, more than 150 million children are stunted, and 2.1 billion lack safely managed drinking water.

(a) UN SDG Report 2026: 139 targets with trend data

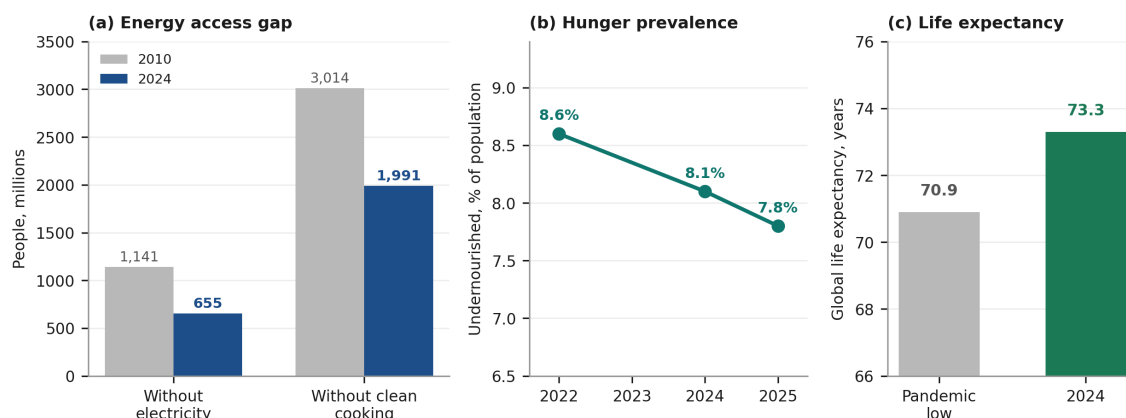


(b) SDSN Sustainable Development Report 2026: share of targets on track (different method)



**Figure 5.** SDG target status, 2026, on two independent methods. Reported.

Sources: [UN SDG Report 2026 key messages](#); [SDSN via IPS](#). Method differences mean the two panels are not directly comparable.



**Figure 6.** Selected progress indicators: (a) energy access gaps, 2010 and 2024; (b) hunger prevalence; (c) life expectancy. Reported.

Sources: [Tracking SDG7 2026](#); [SOFI 2026](#); [UN WPP 2024](#).

### 4.3 Where progress held, and where it reversed

A pattern runs through the record. Progress built on **delivery systems with technology at the core** (vaccination, electrification, mobile connectivity, solar) has been fast and has largely survived shocks. Progress that depends on **institutions, public finance and sustained attention** (learning, nutrition, social protection, governance) has been slower and more reversible. The COVID years show the second pattern. Learning poverty, the share of ten-year-olds unable to read a simple text, [rose from 57 per cent to 70 per cent in low- and middle-income countries](#) and stands at an estimated 89 per cent in sub-Saharan Africa. Hunger peaked in 2022: SOFI 2026 reports that [undernourishment fell from 8.6 per cent in 2022 to 7.8 per cent in 2025, about 645 million people](#), a third consecutive year of decline but still above the target path. Child mortality progress has [slowed by more than 60 per cent since 2015](#), and the UN IGME warns that about 27.3 million children would die before their fifth birthday between 2025 and 2030 if current trends hold.

**Table 3.** Progress that survived a shock, and progress that did not

| Indicator       | Shock                      | What happened                                                        | Reading                                                |
|-----------------|----------------------------|----------------------------------------------------------------------|--------------------------------------------------------|
| Life expectancy | COVID-19                   | Fell to 70.9 years, recovered to 73.3 in 2024 ( <a href="#">UN</a> ) | Resilient: health systems and vaccines rebuilt quickly |
| Hunger          | Pandemic, 2022 price spike | Peaked at 8.6% in 2022; 7.8% by 2025 ( <a href="#">SOFI</a> )        | Recovering, slowly                                     |
| Learning        | School closures            | Learning poverty rose from 57% to 70% ( <a href="#">UNICEF</a> )     | Fragile: no recovery system                            |
| Child mortality | Slowing since 2015         | Decline slowed >60% since 2015 ( <a href="#">WHO</a> )               | Stalling                                               |

Reported values; classification in the last column is the author's.

The implication is that development is not self-protecting. Gains that rest on durable assets and systems that can be maintained locally persist. Gains that rest on programmes funded from one window do not. This is the logic of the Durability Test in Section 2.4: count not only who has a service, but whether it survives the next shock.

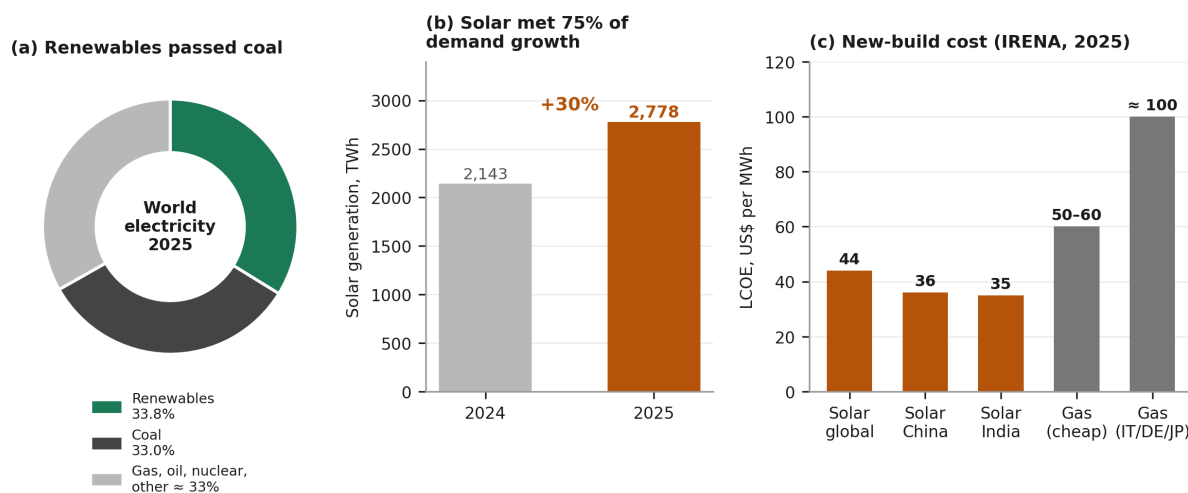
## 5. Energy: The Security Dividend of Clean Power

*Energy is the system through which shocks travel fastest. Fuel prices feed into transport, fertiliser, food, cooking, cold chains, pumping and public budgets. Reducing exposure to imported fuel is the single most leveraged way to break the cascade, and in 2026 the economics of doing so became unusually favourable.*

### 5.1 The supply-side shift

The clean-power transition has passed a threshold. Ember's *Global Electricity Review 2026* reports that renewables supplied 33.8 per cent of world electricity in 2025 against coal's 33.0 per cent, the first time renewables have passed coal. Solar generation rose by a record 636 TWh, or 30 per cent, to 2,778 TWh, and by itself met 75 per cent of the net rise in electricity demand; wind and solar together met about 99 per cent. Fossil generation fell 0.2 per cent, only the fifth annual decline this century. In India, fossil generation fell 3.3 per cent, the first decline this century; in China it fell 0.9 per cent. Battery costs fell 45 per cent in 2025 and deployment grew 46 per cent.

The cost evidence points the same way. IRENA's *Renewable Power Generation Costs in 2025* reports a global weighted-average solar PV cost of \$44 per megawatt-hour, with more than 90 per cent of new utility-scale renewable projects cheaper than the cheapest new fossil alternative. A turbine shortage has pushed new gas costs towards \$100 a megawatt-hour in Italy, Germany and Japan, and about a quarter of new utility-scale solar is now paired with storage, with the best hybrid sites delivering firm power below \$85 a megawatt-hour. IRENA estimates that renewables avoided about \$480 billion of fossil-fuel costs in 2025. Investment follows: the IEA projects 2026 energy investment of \$3.4 trillion, of which \$2.2 trillion is clean energy, almost double the fossil-fuel figure.



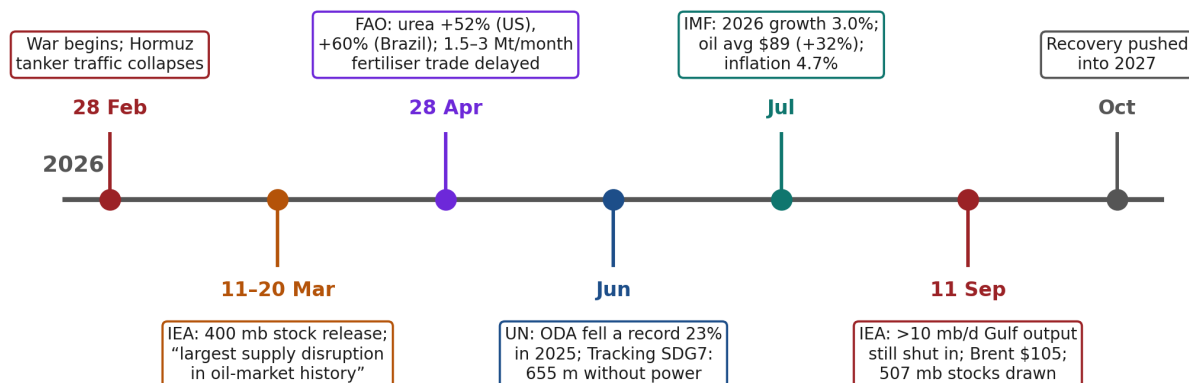
**Figure 7.** The clean-power shift: (a) share of 2025 world electricity (the 'other' slice is the remainder); (b) solar generation; (c) new-build costs. Reported; slice (a) 'other' is derived.

Sources: [Ember GER 2026](#); [IRENA RPGC 2025 \(via pv-tech\)](#).

### 5.2 The 2026 stress test

The Hormuz shock is the largest real-world test of energy exposure in modern times. The IEA calls it the largest supply disruption in the history of the global oil market; member countries released 400 million barrels from emergency stocks on 11 March, the largest release on record. Six months on, the IEA's

September report finds Gulf exports about 13 million barrels a day, [nearly half their pre-war level](#), cumulative stock draws of 507 million barrels since February, and Brent about 45 per cent above its pre-war price. IEA Executive Director Fatih Birol has said that more than 80 energy facilities in the region were damaged and that [recovery could take up to two years](#).



**Figure 8.** The 2026 energy shock: key milestones and indicators. Reported.

Sources: [IEA](#); [FAO](#); [UN](#); [IMF via SteelOrbis](#); [IEA OMR](#).

The transmission into development was rapid. The FAO notes that the strait normally carries about a quarter of seaborne oil trade plus significant LNG and fertiliser volumes, that [tanker traffic fell by more than 90 per cent at the peak](#), that an estimated 1.5 to 3 million tonnes of fertiliser trade a month was delayed, and that Bangladesh sources 53 per cent of its fertiliser from the Gulf. The IMF found energy importers in emerging and developing economies hardest hit; [Pakistan's prime minister said the weekly oil import bill rose from about \\$300 million to about \\$800 million](#). Table 4 maps the channels against the buffers that development investments provide.

**Table 4.** Transmission channels of the 2026 shock and the buffers that cushion them

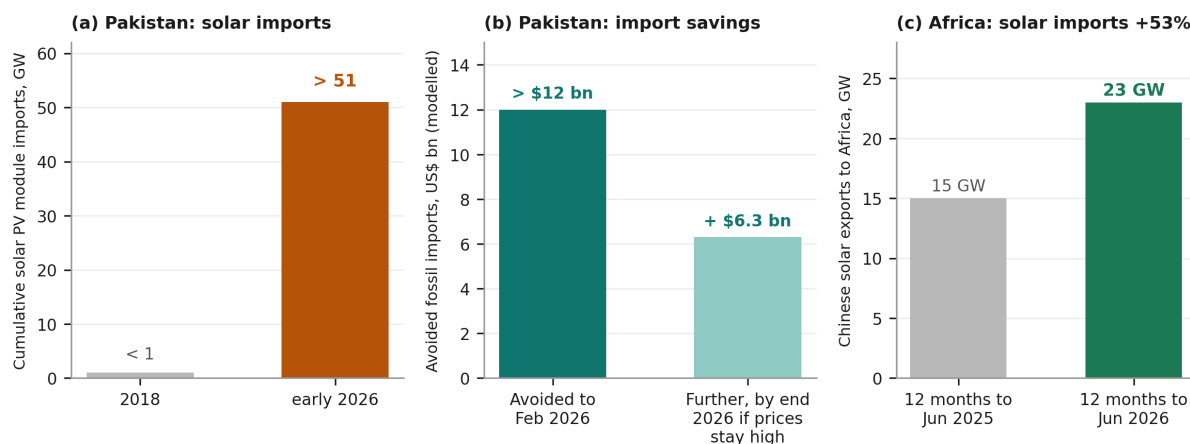
| Channel              | How the shock arrives                               | Development buffer                               | Evidence                                                              |
|----------------------|-----------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------|
| Power and fuel bills | Imported LNG and diesel costs spike                 | Domestic solar, wind, storage, efficient grids   | Pakistan solar modelled savings > \$12 bn ( <a href="#">CREA</a> )    |
| Cooking              | LPG shortfalls and price spikes                     | Electric and other modern cooking                | IEA flags electric cooking to manage LPG gaps ( <a href="#">IEA</a> ) |
| Food                 | Urea and diesel cost; Gulf staple imports           | Fertiliser efficiency, diversified sourcing, R&D | Urea +52% US, +60% Brazil ( <a href="#">FAO</a> )                     |
| Public finance       | Higher import bills, weaker currencies, costly debt | Fiscal buffers, lower import dependence          | IMF: energy importers hardest hit ( <a href="#">ODI</a> )             |
| Household incomes    | Inflation; weaker Gulf remittances                  | Social protection; diversified income            | FAO flags remittance risk ( <a href="#">FAO</a> )                     |

Evidence as reported by the cited sources; mapping of buffers is the author's.

### 5.3 Who was cushioned

The clearest case so far is Pakistan. A March 2026 analysis by the Centre for Research on Energy and Clean Air, Renewables First and the Secure Energy Project found that [solar-module imports rose from under 1 GW in 2018 to over 51 GW by early 2026 and that avoided fossil-fuel imports exceeded \\$12 billion by February, with a further \\$6.3 billion possible by year-end if prices stay elevated](#). The authors stress that these are cumulative imported modules, not installed capacity, and that savings are modelled, with utility-scale and urban solar assumed to displace LNG and rural off-grid solar assumed to displace diesel. Fossil-fuel imports fell about 40 per cent between 2022 and 2024. The authors attribute the surge partly to a zero-rated tax regime on solar imports. The distributional and grid-integration consequences of rapid, largely decentralised adoption are still being worked out, so the lesson is not that unplanned adoption is optimal but that cheap modular technology can spread faster than policy and cushion shocks when it does.

The pattern is spreading. Ember estimates that Chinese solar exports to Africa reached [23 GW in the 12 months to June 2026, up 53 per cent from 15 GW a year earlier](#), with South Africa's share of continental imports falling from 52 per cent in 2023 to 20 per cent. Ember expects about 17 GW to be installed in Africa in 2026, noting that historically only about 73 per cent of exports are installed. The benefit is that the continent's most fuel-exposed economies are building a hedge; the caveat is that imports are not installations and that distribution grids, financing and maintenance determine whether the hedge holds.



**Figure 9.** *Solar as a hedge: Pakistan's imports and modelled import savings; Africa's solar imports. Reported and modelled.*

Sources: [CREA/Renewables First/Secure Energy Project](#); [Ember \(Africa\)](#). Pakistan values are cumulative module imports and modelled savings.

### 5.4 Access is the other half

The shock also exposed the population with no modern energy at all. The Tracking SDG7 report finds [655 million people without electricity in 2024 \(including more than 560 million in sub-Saharan Africa\) and 1,991 million without clean cooking](#), with 644 million still unelectrified in 2030 on current trends. Access is a resilience issue because a household with no power cannot run a pump, a phone charger, a cold chain or a clinic. The WHO, World Bank, IRENA and SEforALL assessment estimates that about [one billion people rely on health facilities with either no electricity or an unreliable supply](#), and that \$4.9 billion is urgently needed to bring facilities in the sub-Saharan countries it studied to a minimal or intermediate level of electrification.

Clean cooking is the cheapest large lever. The IEA estimates that universal access would cost [about \\$8 billion a year to 2030, less than 1 per cent of what governments spent in 2022 keeping energy affordable](#), and would avoid some 2.5 million premature deaths and save households at least 1.5 hours a day. In a supply shock it also reduces exposure to LPG disruption.

## 5.5 Limits and design implications

Three limits keep the energy case honest. **First, manufacturing and jobs are concentrated.** IRENA and the ILO report [16.6 million renewable jobs worldwide in 2024, but Africa accounted for under 3 per cent and the top five countries for more than 85 per cent](#); import-based hedges do not create local employment on their own. **Second, imports are not resilience.** A solar panel is a hedge only if the grid, finance and repair ecosystem keep it working. **Third, the transition is not instantaneous.** As [reported by Net Zero Compare](#), the IEA noted that about three-quarters of 2026 energy investment reflected decisions taken before the conflict began, so build-out lags the shock by years. For this reason the IEA's own shock guidance emphasises immediate demand-side measures, from remote work to carpooling, with [national car oil use down 1 to 6 per cent from speed-limit cuts](#) alone, alongside the structural shift.

The design implication is a two-speed energy-security policy. In the short run, protect the poorest from price spikes through targeted support and demand management. In the medium run, systematically replace imported fuel with domestic generation, storage and electrified end-uses, prioritising loads that matter for resilience: health facilities, water pumping, cold chains, and cooking.

## 6. Health and Human Capital: Resilient Bodies, Resilient Minds

*People are the shock absorbers of last resort. Healthy, educated, protected people recover faster, adapt faster and are less likely to be pushed into poverty by a single event. These are among the longest-lived and best-evidenced resilience assets.*

### 6.1 Health systems and prevention

Prevention is the model case for the resilience dividend. The Lancet analysis of the Expanded Programme on Immunization found that vaccination against 14 pathogens [averted 154 million deaths over 50 years, with measles vaccination contributing 60 per cent of the benefit](#). Sim and colleagues, studying 94 low- and middle-income countries, found that immunisation against ten pathogens returned [\\$26.1 per dollar invested for 2011–20 and \\$19.8 for 2021–30 on a cost-of-illness basis, and about \\$51–52 per dollar when lives are valued by statistical life](#). The same logic applies to pandemic preparedness. The G20 High Level Independent Panel argued in 2021 that [\\$15 billion a year in additional international spending was the minimum needed](#) and that, in Lawrence Summers's words, [spending tens of billions could save tens of trillions](#).

Yet the financing trend is reversing. OECD projections show [health ODA falling by 29 to 46 per cent between 2024 and 2026](#), and the UN IGME warns that progress on child survival has slowed sharply. The resilience argument is that prevention budgets are being cut at exactly the moment that the next shock, whether a pandemic, a heatwave or a food-price spike, is most likely to find the weakest systems.

### 6.2 Air, cooking and heat

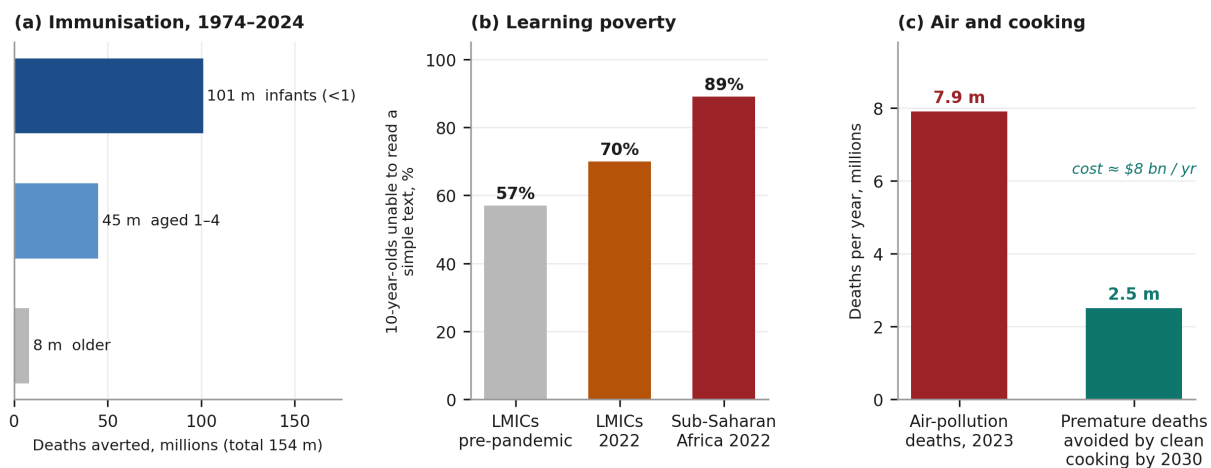
Several of the largest preventable health burdens are environmental. The State of Global Air reports that air pollution caused [about 7.9 million deaths in 2023 and that 2.6 billion people are exposed to smoke from solid cooking fuels](#). Clean cooking (Section 5.4) and clean power address much of this. Heat is the growing hazard: the [546,000 average annual heat deaths in 2012–21](#) are concentrated among older adults and outdoor workers. Powered health facilities, reliable cooling in clinics and schools, and heat-health warning systems are among the lowest-regret adaptations.

### 6.3 Education as a disaster-risk factor

Education is typically budgeted as human-capital investment, not disaster-risk reduction, but the evidence for the latter is strong. Striessnig, Lutz and Patt analysed disaster deaths in 125 countries since 1980 and found that [education was the most significant social and economic factor associated with lower vulnerability, with female education especially important, and that once education was included income lost significance](#). In a rough scenario for sub-Saharan Africa in 2040–50, faster education gains were associated with about 60 per cent fewer disaster deaths than constant enrolment. The authors caution that their results need micro-level confirmation and may reflect selection bias in disaster data, so the number is best read as indicative of direction and order of magnitude.

Education also underpins every other buffer: health literacy, financial inclusion, adoption of new crops and technologies, and the ability to understand and act on a warning. The learning crisis therefore has a resilience cost. With [70 per cent of ten-year-olds in low- and middle-income countries unable to read a](#)

[simple text and 89 per cent in sub-Saharan Africa](#) (figures from the 2022 estimate), the stock of adaptive capacity in the youngest cohorts is low.



**Figure 10.** Human-capital buffers: (a) immunisation deaths averted; (b) learning poverty; (c) air-pollution deaths and clean-cooking benefits. Reported.

Sources: [Shattock et al., Lancet 2024](#); [World Bank/UNICEF learning poverty](#); [State of Global Air 2025](#); [IEA clean cooking](#). Panel (a) 'aged 1-4' and 'older' derived from totals.

## 6.4 Implications

The common thread is that the cheapest, most durable resilience investments in this domain are delivery systems rather than hardware: a vaccination programme, a trained teacher, a powered clinic with a trained nurse. They fail the Durability Test when financed from external windows that can contract by a quarter in a year. The strategic implication is to finance the recurrent costs of health and education from domestic budgets wherever possible, and to use external finance for capital and for shock-contingent top-ups.

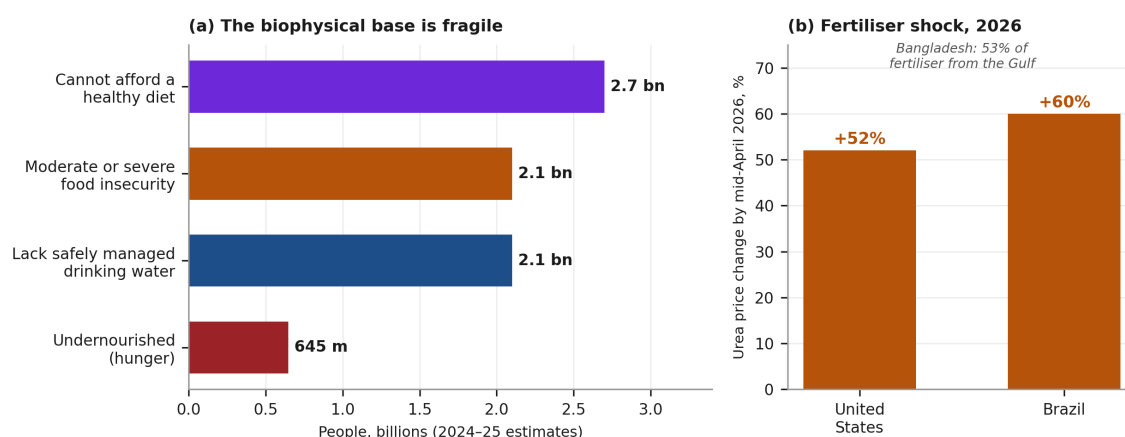
## 7. Food, Water and Nature: Securing the Biophysical Base

*Food, water and ecosystems are the physical substrate of every other system. They are also where energy shocks, climate extremes and economic stress converge, and where investments in efficiency, research and natural infrastructure can pay several dividends at once.*

### 7.1 Food systems under compound stress

The food system entered 2026 in better shape than in 2022 but far from secure. SOFI 2026 estimates that 645 million people (7.8 per cent) were undernourished in 2025, 2.1 billion experienced moderate or severe food insecurity and 2.7 billion could not afford a healthy diet. Hunger is shifting towards Africa, where 309 million people were affected in 2025 and where 56 per cent of the world's hungry could live by 2030. The Hormuz shock threatens that fragile recovery through three channels: fertiliser cost and availability, diesel and freight, and Gulf-linked income and remittances. The FAO reported urea up 52 per cent in the United States and 60 per cent in Brazil by mid-April, an estimated 1.5 to 3 million tonnes a month of fertiliser trade delayed, and Gulf countries importing 70 to 90 per cent of their staple food. Its recommended 90-day responses (diversify trade routes, avoid export restrictions on energy and fertiliser, support farmers, prioritise fertiliser shipments to low-income landlocked countries) are exercises in cascade dampening.

The strategic response is to reduce the food system's exposure to imported inputs. In the author's reading, three levers matter most: raising nutrient-use efficiency so that a given yield needs less imported fertiliser; diversifying sources and building regional buffer stocks; and investing in crop and farming-system research that lowers input needs and heat vulnerability. The evidence on research returns is strong but should be handled with care. A retrospective estimate puts the return on CGIAR investment at roughly 10:1 over five decades; forward-looking models are higher, such as an IFPRI and Copenhagen Consensus central estimate of 33:1 and a University of Chicago market-shaping estimate of more than \$24 per dollar for an advance market commitment on heat-tolerant staples. Such ratios are sensitive to attribution rules: a study of Embrapa's varietal research in Brazil found a ratio of 78:1 if all benefits were credited to one institution but 16:1 under a collaboration-adjusted rule.



**Figure 11.** The food–water base: (a) people affected by food and water insecurity; (b) fertiliser price shock, April 2026. Reported.

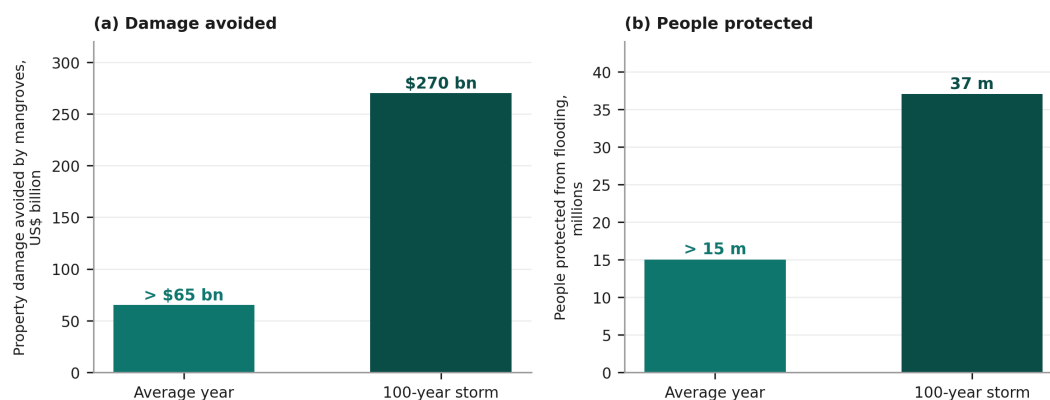
Sources: [SOFI 2026](#); [UN SDG Report 2026](#); [FAO](#).

## 7.2 Water as growth infrastructure

Water is the resource most likely to convert a physical shock into an economic one. The JMP reports that [2.1 billion people lacked safely managed drinking water and 3.4 billion safely managed sanitation in 2024](#), although [961 million people gained safe water access in the decade to 2024](#). The Global Commission on the Economics of Water projects that the water crisis could cut [global GDP by an average of 8 per cent by 2050, and by up to 15 per cent in lower-income countries](#), with nearly three billion people living in areas of scarce or fluctuating supply and more than half of global food production at risk. Long-horizon GDP projections are uncertain, and critics have urged shorter horizons, but the direction is not in dispute. Water systems link health, food, energy and cities, which makes water-security investment a classic transmission-breaker.

## 7.3 Nature as infrastructure

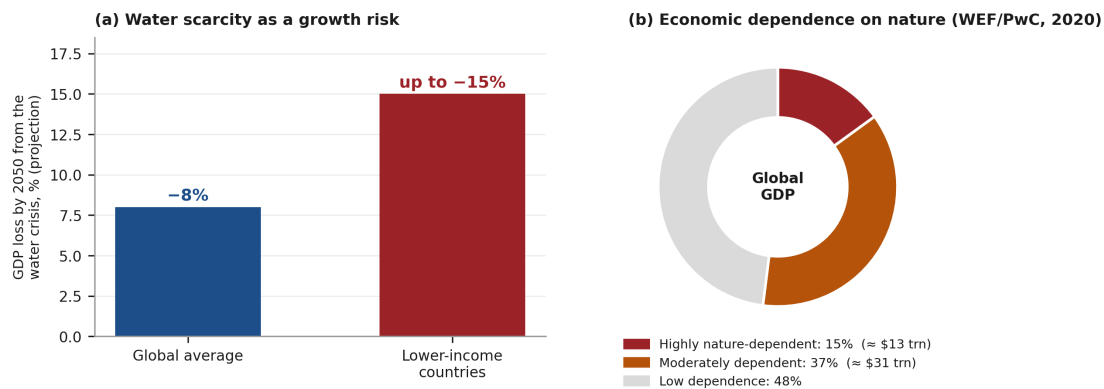
Ecosystems provide protection that is difficult to replace. A study of mangroves across 59 countries found that they [avert more than \\$65 billion of flood damage and protect more than 15 million people in an average year, rising to \\$270 billion and 37 million people in a 100-year storm](#); about 90 per cent of that protection comes from tropical cyclones, and losing mangroves would raise flooded land, people and property damage by 29, 28 and 9 per cent respectively. These are counterfactual estimates of avoided damage, not measured payouts. They nonetheless illustrate why nature-based defences feature in resilience portfolios: they are cheap per unit of protection, self-maintaining and carry co-benefits for fisheries and carbon.



**Figure 12.** Mangroves as flood defence: (a) damage avoided; (b) people protected, in an average year and a 100-year storm. Modelled counterfactual.

Source: [Menéndez et al., Scientific Reports 2020, via the Nature-Based Solutions Initiative.](#)

Economies depend on nature more than national accounts suggest. A WEF and PwC analysis of 163 sectors found that [\\$44 trillion of economic value generation, more than half of world GDP, is moderately or highly dependent on nature](#). The Global Tipping Points Report 2025 shows what happens when a natural system crosses a threshold: warm-water coral reefs, [on which nearly a billion people and a quarter of marine life depend, have passed their thermal tipping point](#). Protecting remaining ecosystem buffers is therefore not only a conservation goal but a cost-avoidance strategy.



**Figure 13.** Water and nature: (a) projected GDP losses from the water crisis; (b) share of world GDP dependent on nature. Reported and modelled.

Sources: [Global Commission on the Economics of Water via Down To Earth](#); [WEF/PwC New Nature Economy](#).

## 7.4 What the evidence implies

Three conclusions follow. First, the three domains share a structure: each has a *flow* that is exposed to shocks (inputs, water, ecosystem services) and a *stock* that can buffer them (nutrient efficiency and research, storage and water systems, intact ecosystems). Investing in the stock lowers exposure to the flow. Second, the returns are real but uneven in quality: counterfactual damage estimates and long-horizon GDP projections are useful for ordering priorities, not for budgeting to the dollar, and the right response is to favour options that pay off under several futures. Third, these investments are slow. Crop research, aquifer management and mangrove restoration take years to mature, so they cannot be improvised once a shock arrives. A food, water and nature strategy that waits for the next price spike will be built too late; one that treats 2026 as the signal can have buffers in place well before the next.

## 8. Social Protection, Finance and Fiscal Resilience

*A shock does most of its lasting damage through household balance sheets and public budgets. Social protection stabilises the first; fiscal and financial resilience protects the second. Both are weakest where exposure is highest.*

### 8.1 Protecting households

Disasters are regressive. The World Bank's *Unbreakable* study estimated that, once the greater vulnerability of poor households is counted, natural disasters impose [a welfare loss equivalent to about \\$520 billion a year in lost consumption across 117 countries](#). The study framed adaptive social safety nets as a core resilience measure alongside dikes and building codes, because a transfer that arrives quickly prevents the asset sales, school withdrawals and borrowing that turn a shock into a poverty trap.

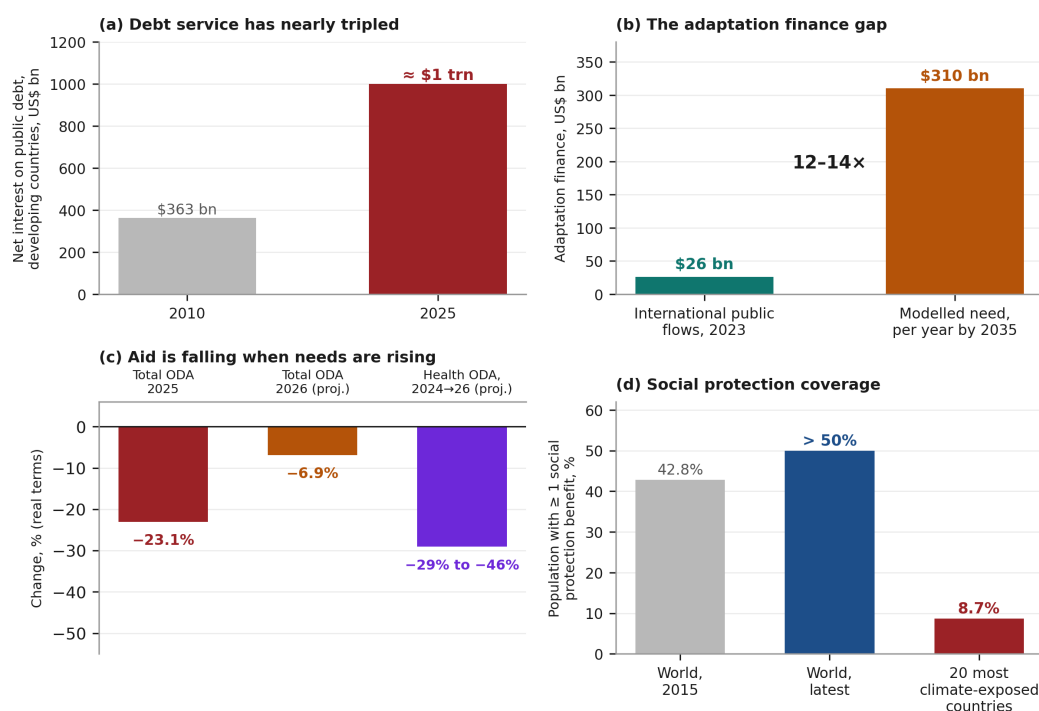
Coverage is improving but remains thin where it matters. The ILO's World Social Protection Report 2024–26 found that [more than half the world's population is covered by at least one social-protection benefit for the first time, up from 42.8 per cent in 2015, but 3.8 billion people remain unprotected and in the 20 countries most exposed to climate risk only 8.7 per cent are covered](#). At the current pace, universal coverage would take until 2073. These figures are reported in secondary summaries of the ILO report and should be checked against the primary text before formal citation.

Acting before a shock is more effective than responding after it. In 2020 the World Food Programme sent [BDT 4,500 \(about \\$53\) by mobile money to roughly 145,000 people along the Jamuna River as early as four days before floodwaters peaked](#); the transfers reached households about 100 days earlier than the 2019 flood response. Evaluations found that recipients were more likely to evacuate (by 12 per cent) and to evacuate livestock (by 17 per cent), better able to avoid costly borrowing, and [36 to 52 per cent less likely to go a day without eating](#) depending on the study. The evidence is from a single flood event and the two estimates differ, but the direction is consistent and the peer-reviewed analysis finds improved welfare during and three months after the flood and reduced asset loss.

### 8.2 The fiscal squeeze

Public finances are the second balance sheet. UNCTAD's *A World of Debt* reports that developing countries paid [almost \\$1 trillion in net interest on public debt in 2025, nearly three times the \\$363 billion of 2010](#); between 2014 and 2024 interest payments rose 102 per cent while revenues rose 39 per cent, and 3.7 billion people live in 51 countries that spend more on interest than on health or education. Academic work finds that climate vulnerability itself raises borrowing costs: Kling and colleagues estimate that [V20 countries paid roughly \\$62 billion in extra interest from 2007 to 2016 because of their vulnerability](#), a premium of about 1.17 percentage points, and that social readiness is associated with lower yields. This is a direct financial return to the resilience investments discussed above.

At the same time the external support that might have offset fiscal stress is contracting. The OECD reports ODA fell [23.1 per cent in 2025 to \\$174.3 billion \(0.26 per cent of donors' income\), with a further 6.9 per cent fall projected for 2026](#). UNEP's *Adaptation Gap Report 2025* puts developing-country adaptation needs at [\\$310 billion a year by 2035 on modelled costs \(\\$365 billion on country plans\) against international public flows of \\$26 billion in 2023](#), a gap of 12 to 14 times. UNDRR's *Resilience Pays* describes the resulting reinforcing cycles of [debt, shrinking insurance access and humanitarian dependence](#).



**Figure 14.** The finance squeeze: (a) developing-country interest burden; (b) adaptation finance gap; (c) aid changes; (d) social-protection coverage. Reported; 2025 interest rounded to ≈ \$1 trillion.

Sources: [UNCTAD via Down To Earth](#); [UNEP AGR 2025](#); [OECD](#); [ILO via OWID](#). Panel (d) 'latest' shown as 50 to indicate 'more than half'.

### 8.3 Matching instruments to the problem

The finance problem is not that resilience is unaffordable, but that its financing is mismatched to its risk. The UN's SDG review puts the annual SDG financing gap at [\\$4 trillion and points to the Sevilla Commitment and financial reform](#) as the route to close it. Table 5 sets out, in the author's synthesis, which instrument fits which problem.

**Table 5. Matching financial instruments to resilience problems**

| Problem                                         | Instrument                                                                                      | Condition for success                                                  |
|-------------------------------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Recurrent social services (health, schooling)   | Domestic revenue; predictable multi-year concessional support                                   | Tax capacity; protection from procyclical aid cuts                     |
| Slow-onset adaptation (water, nature, research) | Grants and concessional loans; results-based finance                                            | Avoids adding to debt service (adaptation finance is much of it loans) |
| Sudden shocks (floods, price spikes)            | Pre-arranged finance: contingent credit, risk pools, shock-responsive cash, debt-service pauses | Triggers agreed in advance; delivery systems tested                    |
| Insurable assets                                | Public-private insurance and risk transfer                                                      | Premium support for the poorest; credible loss data                    |
| Fiscal space                                    | Debt restructuring and swaps linked to resilience outlays                                       | Transparent conditionality; local ownership                            |

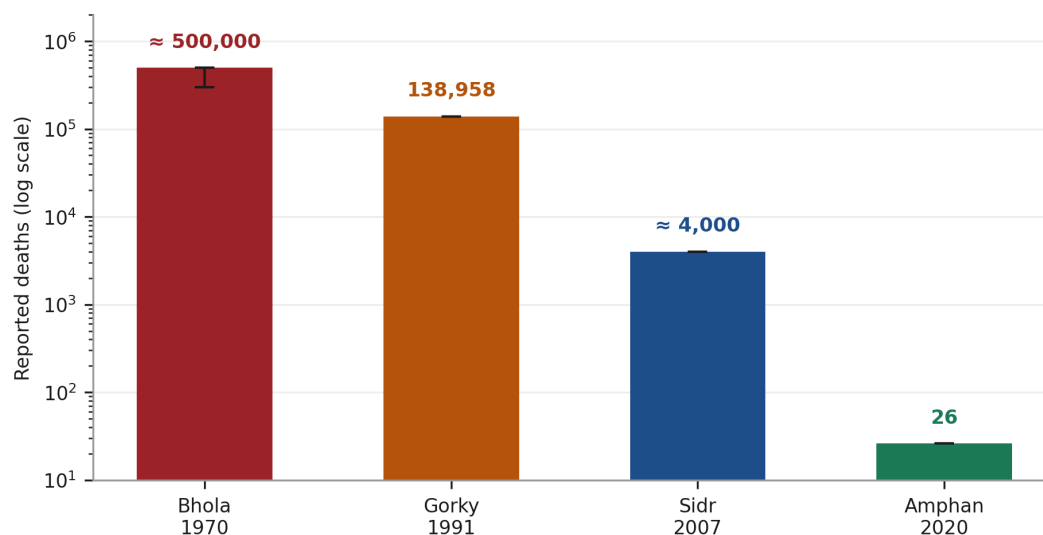
Author's synthesis. The UNEP report notes that private flows could provide around \$50 billion a year if backed by targeted policy ([SEI summary](#)).

## 9. Infrastructure, Early Warning and Prevention

*Some of the best-documented returns in development come from the least glamorous investments: forecasts that arrive in time, infrastructure that keeps working in a storm, and prevention that stops a crisis before it starts.*

### 9.1 Early warning: the case study that works

Bangladesh is the best-documented example of risk reduction by development. The 1970 Bhola cyclone killed about 500,000 people (some estimates are lower); in 1991 cyclone Gorky killed 138,958; Sidr in 2007 killed about 4,000; and Amphan in 2020 killed 26, according to [a Business Standard review of 50 years of cyclone preparedness](#). The review credits improved early warning, trained volunteers, more shelters and stronger institutions: the Cyclone Preparedness Programme now has about 76,000 volunteers, half of them women, and in 1970 the country had only 44 cyclone shelters. Death tolls vary by source, but the order of magnitude is not in doubt. Lower mortality has not meant lower losses: infrastructure, crops and livestock losses from Amphan were barely reduced, which is a reminder that warning protects lives better than livelihoods.



**Figure 15.** Cyclone deaths in Bangladesh fell by roughly four orders of magnitude (log scale). Reported.

Source: [The Business Standard](#). Bhola estimates vary (whisker shows a lower estimate of 300,000); other bars are the reported values.

The Global Commission on Adaptation estimated that [24 hours' warning of an impending hazard can reduce damage by 30 per cent](#), and that spending \$800 million on early-warning systems in developing countries could [avoid \\$3 to \\$16 billion of losses a year](#). The WMO cites the Commission's benefit–cost ratio of 1:9. Those are potential savings, not measured outcomes. The delivery gap is large: the WMO's October 2025 assessment of 62 countries found that [only half have basic capacity to monitor extreme weather and 16 per cent have less than basic capacity](#), while land-based stations now share 60 per cent more observations than in 2019. The Early Warnings for All goal of universal coverage by 2027 is [advancing country by country through national consultative workshops](#), but the funding environment is tight.

## 9.2 Resilient infrastructure

The World Bank and GFDRR's *Lifelines* found that [more resilient power, water, transport and telecoms infrastructure in low- and middle-income countries could generate \\$4.2 trillion in net benefits, about \\$4 for each \\$1 invested](#), partly because outages impose costs on firms and households that dwarf repair bills. Direct natural-hazard damage to power and transport assets alone costs about \$18 billion a year. The report's central insight is that resilience is mostly about *spending better*: building redundancy into networks, by adding connections that serve a community, can be a game-changer.

The same logic favours distributed over centralised design where possible. A system with many small power sources, water points or clinics degrades gracefully. A system with one pipeline, one port or one fuel loses everything when that node fails. This is the infrastructure counterpart of the Transmission Test in Section 2.4.

## 9.3 Prevention beyond hazards

Conflict is the most expensive systemic risk, and the one where development acts most indirectly. The 2018 UN–World Bank study *Pathways for Peace* estimated that [each \\$1 spent on successful prevention saves roughly \\$16 later](#); its lead author argued that even if prevention succeeded only [one time in four it would save about \\$5 billion a year](#). This is a modelled estimate of avoided conflict costs, and the qualifier *successful* matters, but it suggests that the inclusion of governance, inclusion and economic opportunity in a resilience portfolio is not a luxury. With [violent conflict displacing 118 million people](#), the stakes are high.

## 9.4 What the evidence implies

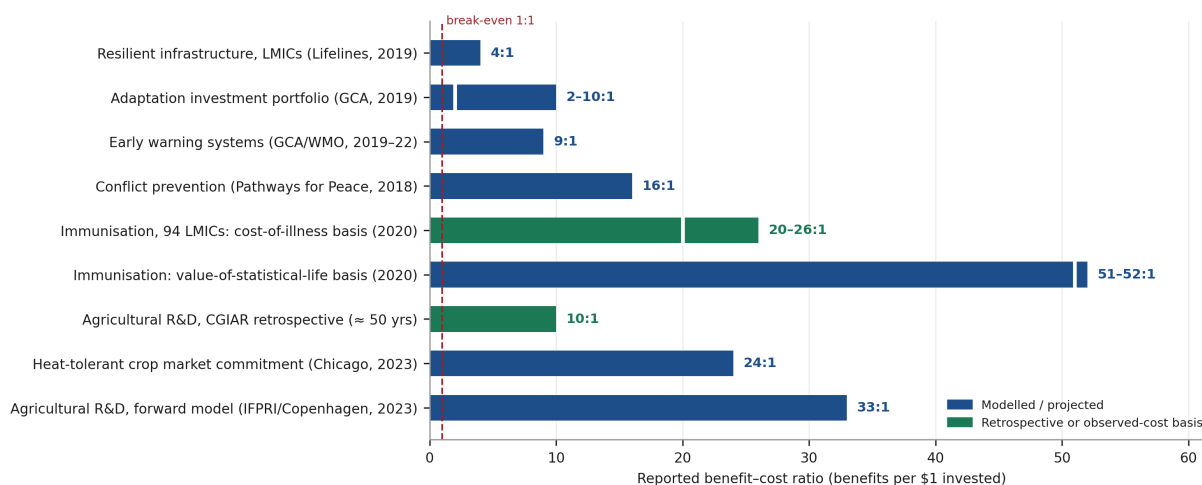
Three lessons emerge. First, warning is only as good as the **last mile**: Bangladesh's success rests on volunteers, shelters and trust, not on forecasting alone. Second, **observation is the weak link**: models are becoming cheap, but the ground truth that anchors them is thin in the places that need it most. Third, **anticipation beats response**: the same dollar delivered before a shock is worth more than after it, which argues for pre-arranged triggers in budgets and programmes.

## 10. Quantifying the Dividend: Returns, Haircuts and Cascades

*The published returns on resilience-building investments are high, and they are mostly estimates of the first, third and fourth dividends. The second, cascade dampening, is the one most likely to be missing from the arithmetic. A simple model shows why it matters.*

### 10.1 What the literature reports

Figure 16 collects the benefit–cost ratios reported in the sources used in this report. They range from about 2:1 at the low end of the Global Commission on Adaptation's portfolio to above 50:1 for immunisation when lives are valued at the statistical value of life. The Commission estimated that \$1.8 trillion invested between 2020 and 2030 in five areas (early warning, resilient infrastructure, dryland agriculture, mangroves and water resources) could yield \$7.1 trillion in net benefits, with ratios from 2:1 to 10:1. *Lifelines* reports about 4:1 for resilient infrastructure. *Pathways for Peace* reports about 16:1 for successful conflict prevention. For immunisation, Sim et al. report 20 to 26 per dollar on a cost-of-illness basis and 51 to 52 on a value-of-statistical-life basis.



**Figure 16.** Reported benefit–cost ratios for resilience-building investments. Whiskers/ticks show the lower bound where a range is reported. Reported and modelled; not additive and not like-for-like.

Sources: [GCA via WEF](#); [Lifelines](#); [WMO](#); [Pathways for Peace](#); [Sim et al. 2020](#); [CGIAR returns](#); [Chicago Market Shaping](#); [IFPRI/Copenhagen Consensus](#).

Table 6. How much weight each reported return can bear

| Estimate                                                  | Reported ratio           | Basis                                                     | Main caveat                                                  |
|-----------------------------------------------------------|--------------------------|-----------------------------------------------------------|--------------------------------------------------------------|
| Resilient infrastructure ( <a href="#">Lifelines</a> )    | ≈ 4:1                    | Modelled, from firm and household surveys of outage costs | LMIC averages; depends on counterfactual outage rates        |
| Adaptation portfolio ( <a href="#">GCA</a> )              | 2:1 to 10:1              | Modelled; five areas, 2020–30                             | Partial portfolio; 2019 vintage                              |
| Early warning ( <a href="#">WMO</a> )                     | ≈ 9:1                    | Potential savings; 24 h warning cuts damage 30%           | A projection, not a measured outcome                         |
| Conflict prevention ( <a href="#">Pathways</a> )          | ≈ 16:1                   | Modelled avoided costs                                    | Applies only to <i>successful</i> prevention                 |
| Immunisation ( <a href="#">Sim et al.</a> )               | 20–26 (COI); 51–52 (VSL) | Modelled, 94 LMICs                                        | VSL basis embeds value judgements                            |
| Agricultural R&D, retrospective ( <a href="#">CGIAR</a> ) | ≈ 10:1                   | Observed output over five decades                         | Attribution rules move ratios several-fold                   |
| Agricultural R&D, forward ( <a href="#">IFPRI</a> )       | ≈ 33:1                   | Projection: NPV benefits \$2.1 trn vs costs \$61 bn at 8% | Model-dependent; decades to accrue                           |
| Heat-tolerant crops ( <a href="#">Chicago</a> )           | > 24:1                   | Advance market commitment, projected                      | An earlier memo gave a far higher figure; the later is cited |

Ratios are as reported and are not comparable across rows. COI = cost of illness; VSL = value of a statistical life.

## 10.2 Haircuts and break-even

Reported ratios are almost certainly optimistic in their details and probably robust in their direction. A prudent planner applies haircuts. If every ratio in Table 6 is cut in half, the lowest end of the GCA range falls to break-even (1:1) and every other figure stays at 2:1 or better. The conclusion that these investments are worth making does not hinge on any single number.

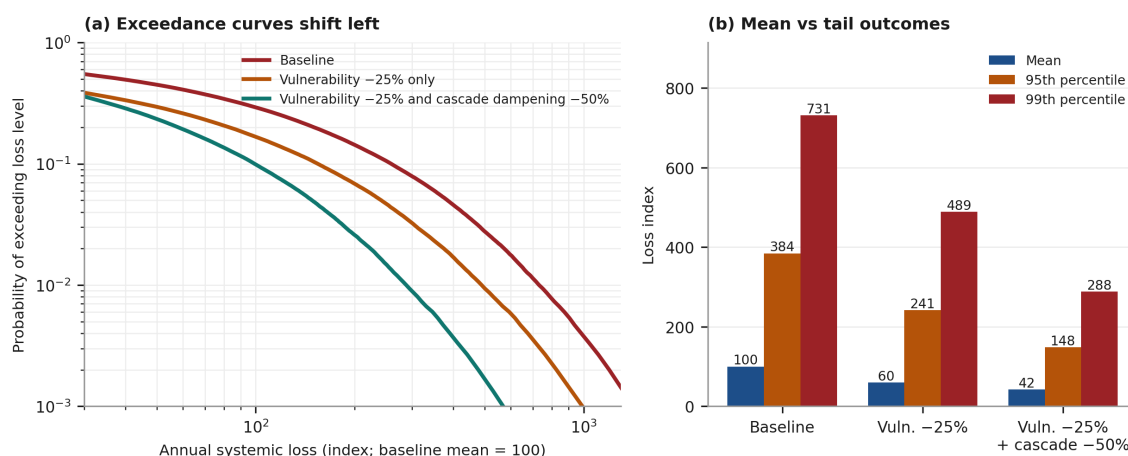
A break-even calculation gives a second perspective. UNEP puts developing-country adaptation needs at about \$310 billion a year by 2035. UNDRR puts the full cost of disasters at above \$2.3 trillion a year, of which direct losses are about \$202 billion. In round numbers, and as illustrative arithmetic rather than a forecast, an adaptation programme at the modelled need would pay for itself if it avoided about 13 to 14 per cent of a disaster burden the size of today's full cost. Against *direct* losses alone the programme could not pay for itself on avoided damage, because \$310 billion exceeds \$202 billion. That is an important honest point: the case for resilience spending rests on counting cascading costs, development gains and co-benefits, not on avoided repair bills alone. It is also the reason cascade dampening deserves explicit attention.

## 10.3 An illustrative model of the second dividend

To show how cascade dampening changes the picture, the report uses a deliberately simple Monte Carlo model (Appendix A). A stylised economy has five coupled systems (energy, food, finance, health and incomes). Each year a common stress and system-specific shocks generate lognormal severities; loss in each system is its severity times its vulnerability; and a system hit beyond its tolerance threshold passes the excess on to the others. Two levers are varied: **vulnerability** (the multiplier on each system's direct loss) and **cascade transmission** (the strength with which excess loss in one system propagates). Results are indexed so that the baseline mean annual loss equals 100. The model is not calibrated to any country and

its absolute numbers have no empirical meaning; its purpose is to show how the shape of the loss distribution responds.

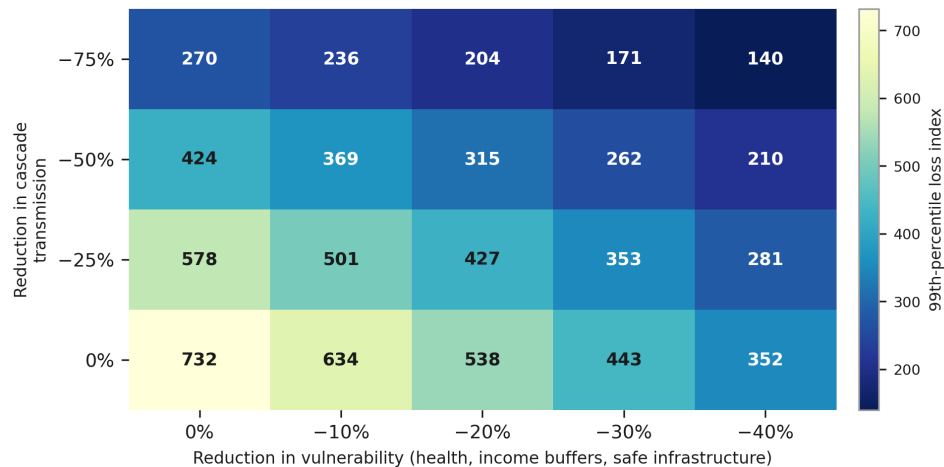
In the baseline, cascades account for about two-thirds of mean loss and more than four-fifths of the 99th-percentile loss. That share is, if anything, conservative: UNDRR's comparison of \$202 billion of direct losses with more than \$2.3 trillion of full cost implies that non-direct costs are about nine-tenths of the total, although that figure includes ecosystem costs as well as system-to-system cascades.



**Figure 17.** Illustrative model: (a) probability of exceeding a given annual systemic loss; (b) mean, 95th- and 99th-percentile losses under three policy cases. Illustrative; baseline mean = 100.

Source: author's Monte Carlo model (200,000 simulated years; parameters in Appendix A). Not calibrated to any economy.

Three results stand out. **First, vulnerability reduction helps, but cascade dampening is what compresses the tail.** Cutting vulnerability by 25 per cent lowers the mean loss index from 100 to about 60 and the 99th-percentile loss from 731 to 489. Adding a 50 per cent reduction in cascade transmission takes the mean to about 42 and the 99th percentile to 288. **Second, the probability of a severe year falls sharply.** The chance that annual loss exceeds 300 index points falls from 7.9 per cent in the baseline to 3.2 per cent with the vulnerability reduction alone and to 0.9 per cent with both measures. **Third, the effects interact.** Figure 18 maps the 99th-percentile loss across a grid of vulnerability and cascade reductions. Moving from the baseline (732) down the vulnerability axis to a 40 per cent reduction gives 352; moving up the cascade axis to a 50 per cent reduction gives 424; doing both gives 210. The two levers are complements, not substitutes.



**Figure 18.** Illustrative model: 99th-percentile systemic loss index across vulnerability and cascade reductions.

*Illustrative; baseline = 732 (the 99th-percentile loss when baseline mean = 100).*

Source: author's Monte Carlo model (120,000 simulated years per cell; Appendix A).

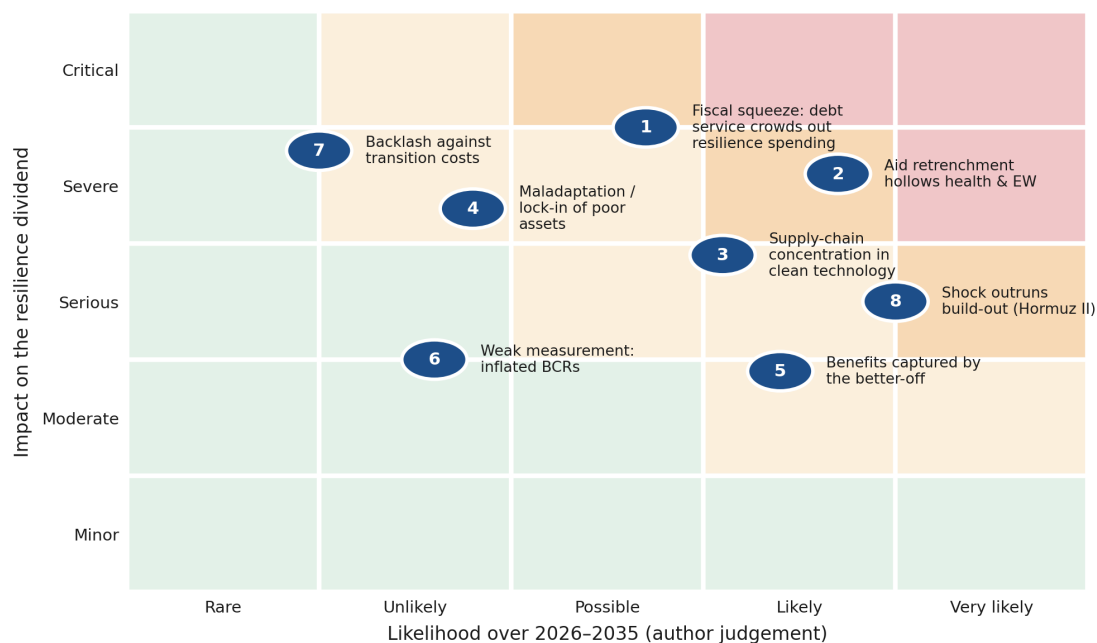
The practical meaning is that appraisal methods that examine each project against its own hazard will understate the value of investments that act on transmission: diversified energy supply, shock-responsive social protection, regional food buffers, pre-arranged finance. Those are the investments that lower the correlation of losses, and they merit a premium in portfolio choice. The model also shows why diversification, redundancy and local control matter beyond their individual returns.

## 11. Failure Modes: What Could Undermine the Dividend

*A resilience dividend is a conditional claim: it accrues if investments are well designed, financed and sustained. The main ways it can fail are fiscal, political, technical and analytical. Naming them is the first step to managing them.*

### 11.1 Eight risks to the dividend

Figure 19 plots eight risks on a likelihood and impact grid, using the author's judgement over 2026–2035; Table 7 pairs each with a mitigation.



**Figure 19.** Risks to the resilience dividend, 2026–2035. Author's qualitative assessment.

Source: author's assessment; no quantitative probabilities are implied.

Table 7. Risks to the resilience dividend and mitigations

| # | Risk                       | How it undermines the dividend                                                                        | Mitigation                                                          |
|---|----------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| 1 | Fiscal squeeze             | Debt service crowds out health, schooling and adaptation ( <a href="#">UNCTAD</a> )                   | Protect resilience outlays in restructurings; concessional finance  |
| 2 | Aid retrenchment           | Health and early-warning funding falls ( <a href="#">OECD</a> )                                       | Shift recurrent costs to domestic budgets; multi-year pledges       |
| 3 | Supply-chain concentration | Clean-technology manufacturing and jobs concentrated in a few countries ( <a href="#">IRENA/ILO</a> ) | Diversify sourcing; local assembly and maintenance                  |
| 4 | Maladaptation and lock-in  | Poorly designed assets raise risk or foreclose better options                                         | Stress-test designs; prefer modular, reversible options             |
| 5 | Elite capture              | Benefits flow to the better-off; coverage stays thin where exposure is high ( <a href="#">ILO</a> )   | Target by exposure; track distribution                              |
| 6 | Weak measurement           | Inflated or non-comparable returns misdirect funds (Table 6)                                          | Apply haircuts; independent evaluation; publish failures            |
| 7 | Backlash                   | Transition costs and visible losers erode support                                                     | Compensation; early visible gains (cooking, power reliability)      |
| 8 | Shock outruns build-out    | A second shock arrives before buffers exist ( <a href="#">IEA</a> )                                   | Two-speed policy: demand measures now, structural build in parallel |

*Author's assessment; cited evidence supports the existence of the pressure, not the ranking.*

## 11.2 The measurement problem

Resilience is easier to claim than to prove. A programme that works leaves no visible event, because the harm it prevents never happens. Several of the headline numbers in this report are modelled counterfactuals, such as mangrove damage avoided, early-warning savings and Pakistan's avoided imports. They are useful for ordering priorities but weak as evidence of delivered impact. Practitioners should therefore demand three things of any programme claiming a resilience dividend: an explicit counterfactual; ex-post tracking of outcomes after a real shock; and a willingness to report when the shock revealed a design failure.

## 11.3 The equity problem

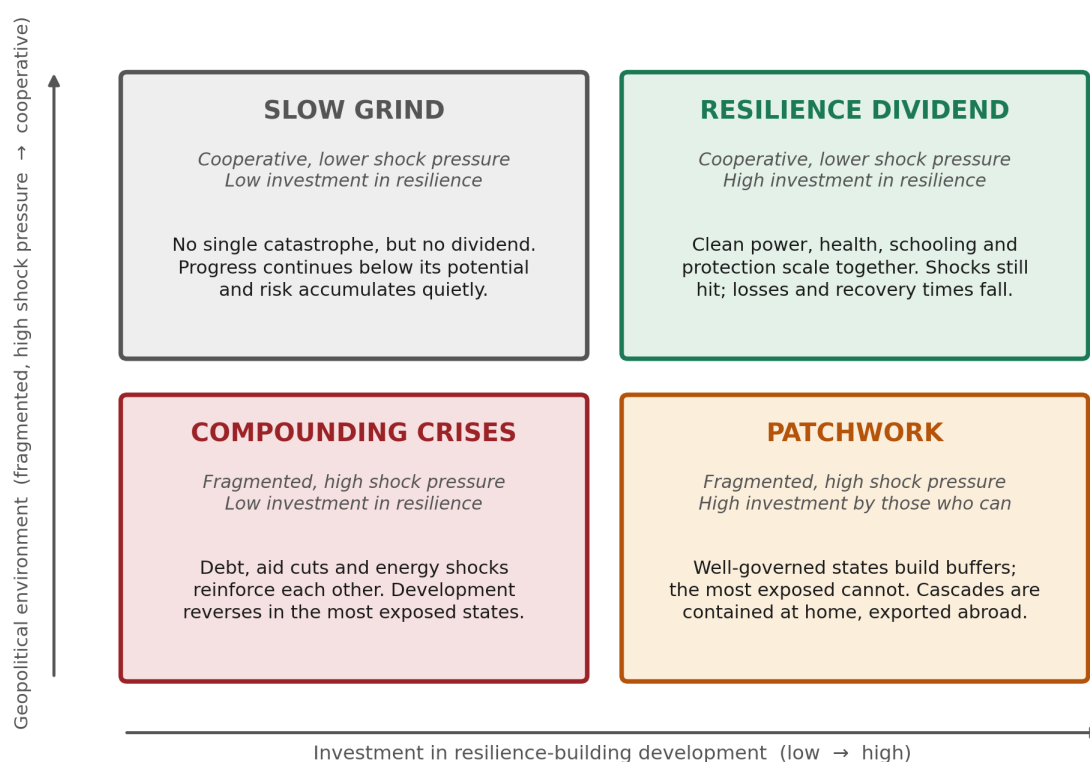
The dividend can be captured by those who need it least. Households that can afford rooftop solar benefit from a fuel shock; those who cannot, face the price spike. The 20 most climate-exposed countries have social-protection coverage of 8.7 per cent. Insurance gaps are widest where exposure is largest. An honest resilience strategy builds distributional tracking into its design and uses exposure, not national averages, as its targeting variable.

## 12. Four Scenarios to 2035

*No one can forecast the next decade, but two uncertainties dominate the resilience question: how much the world invests in resilience-building development, and whether the geopolitical environment is cooperative or fragmented. Crossing them gives four scenarios.*

### 12.1 The scenario frame

Figure 20 arranges four scenarios on two axes. The vertical axis is the geopolitical environment, from fragmented and high shock pressure to cooperative. The horizontal axis is investment in resilience-building development. Table 8 summarises each scenario and lists signposts that would indicate which is unfolding. The scenarios are qualitative; they carry no probabilities and the report makes no forecast.



**Figure 20.** Four scenarios to 2035. Conceptual.

Source: author's scenario framework.

Table 8. Scenario summaries and signposts

| Scenario                   | What happens                                                                                                                         | Signposts to watch                                                                                                                         |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Resilience dividend</b> | Clean power, health, schooling and protection scale together; the 2026 shock becomes a catalyst for structural change                | Hormuz reopens and lessons are institutionalised; ODA stabilises; solar and storage installs track imports; debt relief tied to resilience |
| <b>Patchwork</b>           | Well-governed and richer states build buffers; the most exposed cannot; cascades are exported through migration, prices and conflict | Divergence in insured share and social-protection coverage; fragmented trade; regional blocs                                               |
| <b>Slow grind</b>          | No single catastrophe, but under-investment; progress continues below potential                                                      | SDG share on track stays near one-third; flat adaptation finance                                                                           |
| <b>Compounding crises</b>  | Debt, aid cuts, energy and food shocks reinforce each other; development reverses in fragile states                                  | More countries with interest above health and education spending; repeated supply shocks; rising displacement                              |

*Author's scenarios. Current indicators sit between 'slow grind' and 'compounding crises' on investment and closer to 'compounding crises' on shock pressure, but the 2026 data show early elements of the 'resilience dividend' in energy.*

## 12.2 Reading the signposts

The 2026 evidence shows all four scenarios in embryo. The Pakistani and African solar surge and the clean-energy investment lead point towards the dividend. The 23 per cent aid cut and the \$26 billion adaptation-finance figure point towards patchwork and compounding crises. The 36 per cent SDG on-track share is the signature of a slow grind. The scenario that prevails will depend less on any single event than on whether governments treat the 2026 shock as a one-off to be waited out or as a design brief for the next decade.

## 13. Strategy: Actions, Roadmap and Scorecard

*The strategic task is to invest first where the Resilience Dividend Test is most clearly passed, finance it in ways that do not worsen the fiscal squeeze, and measure whether it works. The report proposes five bundles, an action list by actor, a ten-year roadmap and a scorecard.*

### 13.1 Five bundles

- **Bundle 1: Secure clean power.** Distributed solar, storage and grid reliability; priority loads (health facilities, water pumping, cold chains); electrified and clean cooking. Passes the exposure, no-regret and transmission tests.
- **Bundle 2: Health and human capital.** Primary care and immunisation, powered clinics, learning recovery, girls' education. Passes the vulnerability and durability tests when domestically financed.
- **Bundle 3: Food, water and nature buffers.** Fertiliser-efficiency and crop research, regional buffer stocks, water systems, mangroves and other natural defences. Breaks the energy-to-food channel.
- **Bundle 4: Shock-responsive protection and finance.** Social-protection coverage that scales within days, pre-arranged finance, risk transfer, and debt instruments tied to resilience outlays. Breaks the food-to-finance and finance-to-income channels.
- **Bundle 5: Warning and prevention.** Impact-based forecasting, observation networks, last-mile delivery and anticipatory action; conflict prevention and governance.

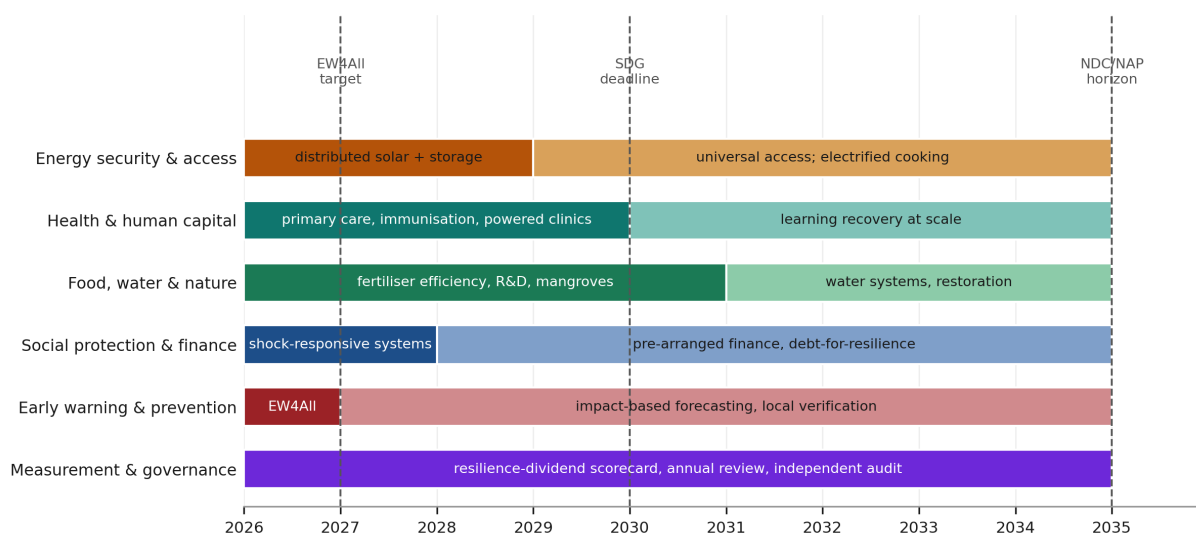
### 13.2 Actions by actor

Table 9. Priority actions by actor

| Actor                                  | Priority actions (next 24 months)                                                                                                                                                                                                                                                             |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| National governments                   | Adopt the Resilience Dividend Test in budget appraisal; protect health, education and protection outlays from fiscal consolidation; legislate triggers for shock-responsive cash; ease import and connection barriers for solar, storage and clean cooking; publish exposure-based targeting. |
| Multilateral development banks and IMF | Offer pre-arranged contingent finance and debt-service pauses; finance recurrent resilience costs through concessional windows; apply cascade-aware appraisal; scale support for powered clinics and early warning.                                                                           |
| Bilateral donors                       | Stabilise ODA, particularly health and early warning; move to multi-year pledges; prioritise grants over loans for adaptation; co-finance observation networks.                                                                                                                               |
| Private sector                         | Finance distributed energy, storage and cold chains; develop insurance products with premium support for the poorest; disclose supply-chain dependence on single-source inputs.                                                                                                               |
| Local governments and communities      | Maintain warning dissemination, shelters and volunteer networks; own and maintain local energy and water assets; verify forecasts locally and feed back.                                                                                                                                      |
| Researchers and statistical agencies   | Measure cascade dampening (tail loss, recovery time); publish ex-post evaluations after real shocks; develop open, disaggregated exposure data.                                                                                                                                               |

*Author's recommendations based on the evidence reviewed.*

### 13.3 Roadmap to 2035



**Figure 21.** Indicative roadmap, 2026–2035. Conceptual.

Source: author's synthesis. Dates marked: EW4All target (2027), SDG deadline (2030), NDC/NAP horizon (2035).

### 13.4 A ten-indicator scorecard

A resilience dividend needs to be measured, not asserted. Table 10 proposes ten indicators with the latest values found in this review and the anchoring targets, where official ones exist. Reporting annually against this baseline would turn the argument of this report into an accountability tool.

**Table 10. The Resilience Dividend Scorecard: 2026 baselines**

| Indicator                                | Latest baseline                                                                        | Direction / anchor                  |
|------------------------------------------|----------------------------------------------------------------------------------------|-------------------------------------|
| People without electricity               | 655 million, 2024 ( <a href="#">Tracking SDG7</a> )                                    | ↓; universal access by 2030 (SDG 7) |
| People without clean cooking             | ≈ 2.0 billion, 2024 (same source)                                                      | ↓; universal access by 2030         |
| Renewable share of electricity           | 33.8%, 2025 ( <a href="#">Ember</a> )                                                  | ↑                                   |
| Undernourishment                         | 645 million (7.8%), 2025 ( <a href="#">SOFI</a> )                                      | ↓; end hunger by 2030 (SDG 2)       |
| Social-protection coverage (≥ 1 benefit) | > 50% world; 8.7% in 20 most climate-exposed ( <a href="#">ILO via OWID</a> )          | ↑; close the exposure gap           |
| Adaptation finance, international public | \$26 bn (2023) vs \$310 bn need ( <a href="#">UNEP</a> )                               | ↑; narrow the 12–14× gap            |
| Debt-service burden                      | 51 countries, 3.7 bn people, interest > health or education ( <a href="#">UNCTAD</a> ) | ↓                                   |
| Learning poverty                         | 70% in LMICs, 2022 ( <a href="#">UNICEF</a> )                                          | ↓                                   |
| Early-warning monitoring capacity        | Half of 62 assessed countries have basic capacity ( <a href="#">WMO</a> )              | ↑; Early Warnings for All by 2027   |
| Insured share of disaster losses         | 49% in 2025; 43% in 2024 (derived) ( <a href="#">Swiss Re</a> )                        | ↑; narrow the protection gap        |

Baselines as reported by the cited sources; the 2024 insured share is derived from Swiss Re's uninsured share.

## 14. Conclusion: Treating Development as Defence

*The 2026 energy shock did not create the case for sustainable development as risk reduction. It made the case visible. Where households, economies and systems had already invested in the buffers that development provides, the shock was a hardship. Where they had not, it was a cascade.*

This report has made six claims and offered evidence for each. Resilience is largely development, and budgeting the two separately understates the return on both. There are four dividends, and the fourth, cascade dampening, is the one most likely to be missing from appraisal. Energy is the cleanest test case: renewables now supply a third of the world's electricity, cost less than new fossil generation in most markets, and cannot be blockaded; countries that built them were insulated at the margin. Human capital, from immunisation to schooling, is the slowest-building and most durable buffer. The dividend is unevenly accessible, because the countries with the highest exposure have the least fiscal room, the thinnest protection and the sharpest aid cuts. And the evidence is imperfect: reported returns are modelled, attribution is contested, and honest haircuts are warranted, but even halved they remain above break-even.

The decision for 2026 is not whether to invest in sustainable development at a time of crisis, but whether to treat it as a design brief for the next shock. That means applying the Resilience Dividend Test to budgets; financing recurrent resilience costs in ways that do not worsen the debt squeeze; building shock-responsive systems that can scale within days; protecting the observation, health and education systems that make everything else work; and measuring cascade dampening explicitly.

### What would change our mind

The argument is falsifiable. It would be weakened if (a) ex-post evaluations after the 2026 shock show that clean-energy and protection investments made no measurable difference to loss or recovery; (b) the haircut-adjusted returns on the main bundles fall below break-even once independent evaluation is applied; or (c) fiscal constraints make the dividend unreachable for the most exposed countries even with concessional finance. The scorecard in Table 10 is intended to provide the data to test each of these.

## Appendix A. Method Notes and Data Classification

### A.1 Classification of evidence

Every figure in the report is classified in its caption. *Reported* values are taken directly from the cited source. *Modelled* values are estimates produced by the cited source's model, such as the Global Commission on Adaptation's net benefits, mangrove damage avoided, and Pakistan's avoided imports. *Illustrative* values are the author's own calculations and carry no empirical claim. *Derived* values are simple arithmetic on reported values (for example, 2024 insured losses as total minus uninsured, and the 'other' slice in Figure 7a as the remainder after renewables and coal). Where a widely quoted number could not be verified against a primary or clearly attributed source, it was omitted. A prominent 2024 estimate of the long-run income effects of climate change was not used because its authors have since [revised it following published critiques](#).

### A.2 The illustrative cascade model

The model simulates 200,000 independent years. In each year, a common stress factor  $Z$  and five system-specific shocks  $e_k$  are drawn from standard normal distributions and combined as  $x_k = \sqrt{\rho} \cdot Z + \sqrt{1-\rho} \cdot e_k$  with  $\rho = 0.35$ . Severity is  $s_k = \exp(0.9 \cdot x_k)$ . Direct loss in system  $k$  is  $d_k = v_k(1-r) \cdot s_k$ , where  $v = (1.0, 0.9, 0.8, 0.7, 0.6)$  are baseline vulnerabilities and  $r$  is the vulnerability reduction. Excess loss in each system is  $\max(0, d_k - \theta)$  with  $\theta = 1.6$ ; cascade loss in system  $k$  is  $c(1-d) \cdot \sum_{j \neq k} \text{excess}_j$  with  $c = 2.0$  and  $d$  the reduction in cascade transmission. Total loss is  $\sum_k (d_k + \text{cascade}_k)$ . Results are rescaled so that the baseline mean equals 100. The random seed is 7 for the main scenarios; the heat map uses 120,000 years per cell. Parameter values were chosen for stylised illustration so that cascades account for about two-thirds of mean loss; they are not calibrated to any dataset. The model has no dynamics, no recovery, no adaptation over time and no cost side. It cannot be used to estimate benefit–cost ratios.

**Table A1. Model parameters**

| Parameter                            | Value                               | Meaning                                                  |
|--------------------------------------|-------------------------------------|----------------------------------------------------------|
| Number of systems (K)                | 5                                   | Energy, food, finance, health, incomes                   |
| Common-stress correlation ( $\rho$ ) | 0.35                                | Share of shock variance common to all systems            |
| Severity scale                       | $\exp(0.9 \cdot x)$                 | Lognormal severity; fat right tail                       |
| Baseline vulnerabilities ( $v$ )     | 1.0, 0.9, 0.8, 0.7, 0.6             | Direct loss per unit severity                            |
| Tolerance threshold ( $\theta$ )     | 1.6                                 | Loss level beyond which a system propagates stress       |
| Cascade coefficient ( $c$ )          | 2.0                                 | Propagated excess loss per unit excess in another system |
| Simulated years                      | 200,000 (120,000 per heat-map cell) | Monte Carlo sample size                                  |

*All values are stylised assumptions chosen by the author.*

## Appendix B. Source Register

*Every source linked in the text, grouped by theme. Hyperlinks were checked in October 2026; a few publishers (notably some news and institutional sites) block automated access but resolve in a browser. Figures reported by secondary outlets are attributed to the underlying institution in the entry.*

### Concepts and framing

1. [Global polycrisis: the causal mechanisms of crisis entanglement](#). Lawrence, Homer-Dixon, Janzwood, Rockström, Renn, Donges; Global Sustainability, 2024.
2. [The Causal Mechanisms of Global Polycrisis \(v1.0\)](#). Cascade Institute, June 2023.
3. [Interconnected Disaster Risks 2023: six risk tipping points](#). UNU-EHS, via PreventionWeb.
4. [Never Waste a Crisis \(review of The Resilience Dividend\)](#). Hudson Institute.
5. [The triple dividend of resilience](#). Tanner, Surminski et al., ODI/GFDRR; LSE CCCEP.
6. [Global Risks Report 2026](#). World Economic Forum, 14 January 2026.

### Disaster losses and risk

7. [GAR 2025 leverages resilience to break the cycle of shocks, losses and debt](#). IISD SDG Knowledge Hub, on UNDRR Global Assessment Report 2025.
8. [sigma 1/2026: natural catastrophes 2025](#). Swiss Re Institute, 2026.
9. [sigma 1/2025: natural catastrophes](#). Swiss Re Institute, 2025.
10. [Insured disaster losses fall to \\$108 billion in 2025: Munich Re](#). Business Insurance, January 2026.
11. [Disaster losses drop in 2025, picture still 'alarming': Munich Re](#). eNCA / AFP, January 2026.
12. [Atlas of mortality and economic losses from weather, climate and water-related hazards 1970-2021](#). World Meteorological Organization.
13. [Global Tipping Points Report 2025](#). National Oceanography Centre, 13 October 2025.
14. [Climate inaction is claiming millions of lives every year \(Lancet Countdown 2025\)](#). WHO, 29 October 2025.
15. [Half of world's GDP moderately or highly dependent on nature \(New Nature Economy\)](#). World Economic Forum / PwC, 2020.
16. [Unbreakable: building the resilience of the poor in the face of natural disasters](#). Hallegatte et al., World Bank, 2017 (via PreventionWeb).
17. [\\$38 trillion in damages each year: world economy already committed to income reduction of 19% due to climate change \(since revised by the authors\)](#). Potsdam Institute for Climate Impact Research.

### Progress record and SDGs

18. [The Sustainable Development Goals Report 2026: key messages](#). United Nations, June 2026.
19. [The world knows what must be done: new SDG report urges end to wars and greater investment in people](#). IPS News, June 2026 (SDSN Sustainable Development Report 2026).
20. [World Population Prospects 2024 press release](#). United Nations, July 2024.
21. [Progress in reducing child deaths slows as 4.9 million children die before age five](#). WHO / UNICEF / World Bank / UN DESA (UN IGME), 18 March 2026.
22. [154 million deaths averted: contribution of vaccination over the past 50 years](#). Swiss TPH / University of Basel, on Shattock et al., The Lancet, 2024.
23. [New international poverty line: \\$3 per day](#). Our World in Data.
24. [70% of 10-year-olds now in learning poverty](#). UNICEF / World Bank.
25. [SOFI 2026: hunger not inevitable, FAO says as global hunger report shows progress](#). Food Security Portal (IFPRI), July 2026.
26. [Progress on household drinking water, sanitation and hygiene 2000-2024 \(JMP\)](#). WHO / UNICEF.

27. [State of Global Air 2025](#). Health Effects Institute / IHME.
28. [Share covered by at least one social protection benefit \(ILO World Social Protection Report 2024-26\)](#). Our World in Data, from ILO.

## Energy and the 2026 shock

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## Appendix C. Glossary and Abbreviations

**Benefit–cost ratio (BCR).** Present value of benefits divided by present value of costs. A ratio of 4:1 means \$4 of benefit per \$1 invested.

**Cascade dampening.** The reduction in losses that propagate from one system to others; the report's proposed fourth dividend of resilience.

**Exposure.** The people, assets and economic activity located where a hazard or supply shock can reach them.

**Haircut.** A proportional reduction applied to a reported benefit estimate to allow for optimism, attribution error or model uncertainty.

**Polycrisis.** The causal entanglement of crises in multiple global systems in ways that significantly degrade humanity's prospects (Lawrence et al., 2024).

**Protection gap.** The share of disaster losses that is not insured.

**Resilience.** The capacity to prepare for disruption, absorb and recover from shocks, and adapt and grow from them.

**Systemic risk.** The risk that a shock in one part of a connected system spreads to cause widespread loss or failure.

**Vulnerability.** How badly a given exposure hurts: the propensity of people, assets or systems to suffer loss when a hazard occurs.

**COI / VSL.** Cost of illness / value of a statistical life: two ways of valuing health benefits.

**EW4All.** Early Warnings for All, the UN initiative to protect everyone on Earth with early warning systems by the end of 2027.

**FAO, IEA, IMF, IRENA, WMO.** Food and Agriculture Organization; International Energy Agency; International Monetary Fund; International Renewable Energy Agency; World Meteorological Organization.

**GAR.** Global Assessment Report on Disaster Risk Reduction (UNDRR).

**LCOE.** Levelised cost of electricity: lifetime cost per unit of electricity generated, in US\$ per megawatt-hour (MWh).

**LMICs.** Low- and middle-income countries.

**mb/d; GW; TWh.** Million barrels per day; gigawatts; terawatt-hours.

**ODA.** Official development assistance.

**SDGs; SOFI; JMP.** Sustainable Development Goals; State of Food Security and Nutrition in the World; WHO/UNICEF Joint Monitoring Programme.

**UNCTAD, UNDRR, UNEP.** UN Trade and Development; UN Office for Disaster Risk Reduction; UN Environment Programme.

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