

H HEURISTICS

Navigating a Changing World

The Diffusion Imperative

Scaling Proven Solutions Across Unequal and Interconnected Societies

Why the central development problem is no longer invention but delivery

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Research Report · October 2026

Abstract

Humanity has invented most of the solutions that its largest problems require. Under-five mortality has fallen by 52 per cent since 2000, solar electricity costs about US\$0.043 per kilowatt-hour, and mobile money and public payment rails now serve hundreds of millions. Yet in 2024 only 22.5 per cent of people in low-income countries used the internet, 49 per cent had electricity, 16 per cent could cook with clean fuels, and DTP3 immunisation coverage stood at 70 per cent, below its 2019 peak. This report argues that the central development problem has shifted from invention to diffusion, and that the shift is urgent.

The report proposes a four-stage account of diffusion, distinguishing reach, uptake, depth and durability, and shows that the world has become better at reach and no better at depth. It identifies a diffusion gradient: solutions that are divisible, affordable, privately purchased and light on infrastructure spread fastest, while those that depend on networks, large capital or a capable state spread slowest. Extending recent trends in a straight line, low-income countries would reach today's high-income electricity access in about 37 years and internet use in about 58, would take over four centuries for clean cooking, and have moved away from parity on immunisation and primary completion since 2019.

Two features of the setting shape every stage. Societies are unequal, so that solutions reach the advantaged first, and interconnected, so that solutions travel through six channels, trade, investment, finance, people, digital networks and policy learning, each of which also transmits dependence and shocks. Five families of barrier explain why proven solutions fail to spread: the price of money, missing complements, limited trust and delivery capacity, the loss of effect when pilots are scaled, and market failure. Five cases, mobile money and public payment rails, vaccine market shaping, distributed solar, Teaching at the Right Level and twice-yearly HIV prevention, show how these barriers have been overcome and where they persist.

The report concludes with seven design rules for scale, three structural risks of interdependence, supplier concentration, a financing squeeze in which official aid fell 23.1 per cent in 2025, and an artificial intelligence divide, and a strategy comprising seven principles, a three-horizon roadmap and a five-measure diffusion dashboard. The imperative is to measure depth and durability as well as reach, to protect the delivery systems that work, to lower the cost of capital, to build shared public rails, to design for the excluded, and to test for scale.

Keywords: technology diffusion; scaling; development; inequality; interdependence; cost of capital; immunisation; digital public infrastructure; energy access; artificial intelligence

JEL classification: O33, O19, O15, I15, I18, F63; technological change and diffusion; international linkages to development; human development; health policy

Data and method: This report synthesises institutional and peer-reviewed research available to October 2026, drawing on World Bank, ITU, WHO, UNICEF, Gavi, IEA, IRENA, OECD, UNCTAD, GSMA, Ember and J-PAL publications. Country-group series are from the World Bank's World Development Indicators (accessed 19 October 2026) and are recalculated where stated. Several 2026 figures are preliminary. Figure 6 is straight-line arithmetic, Figure 7 is an illustrative calculation, and Figures 2 and 12 are stylised illustrations, not estimates.

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Key Findings

The binding constraint on human welfare has shifted from inventing solutions to delivering them. The evidence assembled in this report points to six findings and one conclusion.

- **Solutions exist; delivery lags.** In 2024, 22.5 per cent of people in low-income countries used the internet, 49 per cent had electricity, 16 per cent had access to clean cooking and 70 per cent of infants received three doses of DTP vaccine. The figures for high-income countries are 93, 100, 99.5 and 94 per cent (World Bank, [World Development Indicators](#)).
- **Diffusion follows a gradient.** Solutions that are divisible, affordable, privately purchased and light on infrastructure, such as mobile telephony, have come closest to parity. Solutions that need networks, large capital or a capable state, such as electricity, broadband, clean cooking and routine immunisation, lag by 24 to 84 percentage points.
- **The world has fixed arrival and not depth.** Research by [Comin and Mestieri](#) finds that technology adoption lags have narrowed while differences in intensity of use have widened. The same pattern appears in current data: a usage gap of about 3.1 billion people within mobile coverage ([GSMA](#)).
- **At recent rates, parity is generations away.** Extending 2019-24 trends in a straight line, low-income countries would take about 37 years to reach high-income electricity access, about 58 for internet use and over 400 for clean cooking. For DTP3 immunisation and primary completion they have moved away from parity since 2019 (H Heuristics calculation, Figure 6).
- **Scaling is a discipline, not a repetition.** Effects typically shrink when pilots are scaled. A study of 111 trials found that predictions from the [first ten sites substantially overstated effects in the next 101](#). Design for representative sites, measured fidelity and government ownership recovers much of the lost effect.
- **Interconnection brings access and exposure together.** Solar imports surged to [15 GW in Africa in a year](#), while China holds more than 80 per cent of every major stage of solar manufacturing ([IEA](#)). Official aid fell 23.1 per cent in real terms in 2025 ([OECD](#)), and interest paid by low- and middle-income borrowers reached US\$415 billion in 2024 ([World Bank](#)).

The conclusion

Governments, lenders and funders should treat diffusion as a policy objective in its own right, with targets for reach, uptake, depth, durability and equity. The report proposes seven design rules, a three-horizon roadmap and a five-measure diffusion dashboard in Sections 9 and 11. In brief: protect the delivery systems that work, repair the state-delivered services that are moving the wrong way, lower the cost of capital, build shared public rails, design for the excluded, and test for scale.

1. Introduction: The Delivery Problem

The global under-five mortality rate has roughly halved since 2000, a mobile payments network in one country now settles more than 24 billion transactions a month, and solar electricity is among the cheapest ways ever found to generate power. The solutions exist. What separates a child in a low-income country from the outcomes of a child in a rich one is, increasingly, not whether a proven answer has been invented but whether it has arrived, in working form, at the place where she lives.

For most of the twentieth century development policy was organised around a scarcity of knowledge: the vaccine had not been found, the high-yielding seed had not been bred, the cheap source of power did not exist. That scarcity has been substantially relieved. The [UN Inter-agency Group for Child Mortality Estimation](#) reports that the global under-five mortality rate has fallen by 52 per cent since 2000, and that an estimated 4.8 million children still died before their fifth birthday in 2023, 2.3 million of them in their first month. The [International Renewable Energy Agency](#) puts the global weighted-average cost of new utility-scale solar power at US\$0.043 per kilowatt-hour in 2024 and finds that 91 per cent of newly commissioned renewable capacity delivered electricity more cheaply than the cheapest new fossil alternative. The [World Bank's 2025 Global Findex](#) finds that 79 per cent of adults worldwide now hold a financial account, with mobile money the main driver of recent gains in developing economies.

Yet the same year's data show how unevenly these gains have been distributed. In 2024, according to the World Bank's World Development Indicators, 22.5 per cent of people in low-income countries used the internet, against 93 per cent in high-income countries; 49 per cent had access to electricity, against effectively all; and 16 per cent could cook with clean fuels or technologies, against 99.5 per cent. Three-dose diphtheria-tetanus-pertussis immunisation reached 70 per cent of infants in low-income countries and 94 per cent in high-income ones. Each of these is a technology or service whose effectiveness is not in doubt. The gap is a gap in delivery.

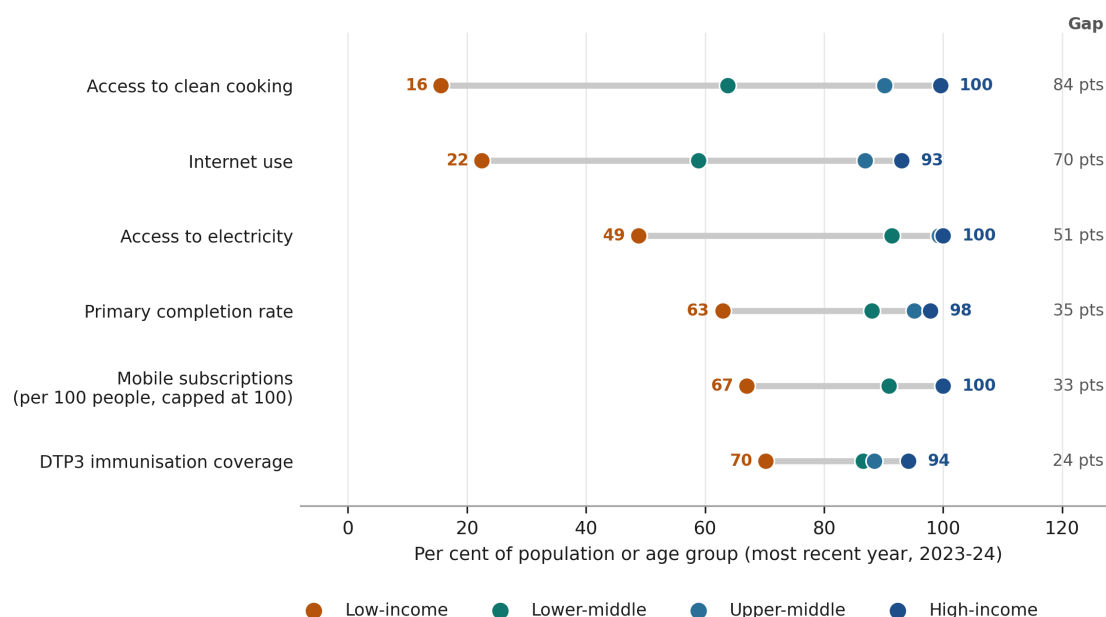


Figure 1. The diffusion gradient: coverage of six proven solutions by country income group, latest year.

Source: World Bank, World Development Indicators (accessed 19 October 2026); H Heuristics calculations. Mobile subscriptions are per 100 people and capped at 100 for display. Income groups follow the current World Bank classification.

Figure 1 is the starting point for this report because of its shape. The gaps are not uniform. Mobile telephony, which needs little from the state and is sold in small, affordable increments, has come closest to parity. Immunisation, which needs a functioning health system but a modest amount of capital, is next. Electricity, internet service and clean cooking, which depend on network infrastructure, large up-front capital or both, lag by 50 to 84 percentage points. The ordering suggests that diffusion is not a single process governed by a single bottleneck. It is a gradient, and where a solution sits on it depends on what it demands of the society it is meant to reach.

1.1 What this report argues

Four claims run through what follows. First, that the central development problem of the 2020s has shifted from *invention* to *diffusion*: from creating solutions to reaching the people who need them, at adequate depth and for long enough to change outcomes. Second, that the societies through which solutions must travel have two features that shape every stage of the journey. They are *unequal*, within and between countries, so that the same solution reaches the well-connected first and the excluded last. And they are *interconnected*, through trade, finance, information and shared shocks, so that diffusion is shaped by distant decisions, concentrated suppliers and transmitted crises. Third, that scaling a proven solution is a design discipline with its own evidence base, not a matter of repeating a pilot at larger size. Fourth, that the present moment makes the discipline urgent. Aid fell by 23 per cent in real terms in 2025, borrowing costs remain close to double their pre-2020 level, and the frontier of new technology, artificial intelligence in particular, is spreading faster in rich countries than in poor ones.

The report calls the resulting priority *the diffusion imperative*. It is an imperative in two senses. It is a moral one, because the cost of non-diffusion is counted in children's lives, in years of schooling and in decades of foregone income. It is also a strategic one, because in an interconnected world a gap in delivery in one

place becomes a vulnerability for all: an unvaccinated population is a reservoir for outbreaks, an unelectrified region is a source of emissions from the fuels used instead, and an excluded workforce is a drag on every market that depends on it.

1.2 Scope, evidence and limits

The report synthesises published research from institutional and peer-reviewed sources available to October 2026, drawing mainly on the World Bank, the International Telecommunication Union, the World Health Organization and UNICEF, Gavi, the International Energy Agency and IRENA, the OECD, UNCTAD and the Abdul Latif Jameel Poverty Action Lab. Quantitative series are taken from World Bank databases and recalculated by H Heuristics where a figure says so. Several 2026 numbers are preliminary and may be revised. The figures labelled “stylised” or “illustrative” are conceptual or arithmetic illustrations, not estimates, and they are described as such in their captions.

Two cautions apply throughout. The first concerns classification. Income groups are reassigned by the World Bank each year, so the low-income group of 2024 is not the same set of countries as that of 2000, and group averages mask very large differences within groups. The second concerns causation. The report documents correlations between design choices and diffusion outcomes and cites randomised and quasi-experimental evidence where it exists, but diffusion is a complex process and few of the claims below are as well identified as a clinical trial. Where the evidence is contested, the text says so.

1.3 How the report is organised

Section 2 sets out a framework: what diffuses, through which stages, and why unequal and interconnected societies change the picture. Section 3 documents what has already spread, and how fast. Section 4 measures the cost of what has not. Section 5 diagnoses why proven solutions fail to travel, and Section 6 examines the channels through which they do. Section 7 asks how inequality acts as both a brake and an accelerant. Section 8 draws on five case studies. Section 9 distils the mechanisms that scale, Section 10 turns to the risks of interdependence, including supplier concentration, the collapse of aid and the artificial intelligence divide, and Section 11 sets out a strategy. Section 12 states the limits of the argument and what would change it. Section 13 concludes.

2. Framework: What Diffuses, How, and to Whom

A solution is proven when it works under controlled conditions. It is diffused when it works under ordinary ones, for ordinary people, without the people who invented it present. The distance between the two is the territory this report maps.

2.1 A working definition of a proven solution

A *proven solution*, as the term is used here, is an intervention, technology, service or institutional design with credible evidence of effectiveness in at least one real-world setting, and with a cost per person reached that is low enough, relative to the benefits, to be worth delivering at scale. The definition is deliberately broad. It covers a vaccine and a cash transfer, a solar panel and a payments network, a teaching method and a seed variety. It excludes interventions whose benefits have been shown only in laboratories or in highly selected pilots, and it excludes those whose cost per outcome is prohibitive at any plausible scale. The definition also excludes the claim that a solution is proven everywhere because it is proven somewhere. Section 5 returns to this point, because it is one of the most common sources of failed scale-up.

2.2 Diffusion as a four-stage process

The classic account of diffusion is Everett Rogers's *Diffusion of Innovations*, which describes how an innovation spreads through a population over time, along an S-shaped curve, as successive groups of adopters, from a small number of innovators to a majority and finally to laggards, decide to take it up. Rogers divides adopters into five categories, with innovators at about 2.5 per cent of the population, early adopters at 13.5 per cent, an early and late majority at 34 per cent each, and laggards at 16 per cent. The account is powerful but it was developed mainly to explain individual adoption decisions in settings where the innovation was available to those who wanted it. In the settings that matter most for development, availability is itself the problem.

This report therefore distinguishes four stages, each with its own measure and its own typical failure.

- **Reach.** The solution is physically and legally available to the person: the clinic stocks the vaccine, the network covers the village, the product is on sale at a price within range. Typical failure: the coverage gap, where infrastructure or supply does not extend to the person at all.
- **Uptake.** The person uses it: the child is brought to the clinic, the subscriber switches the data plan on, the farmer plants the seed. Typical failure: the usage gap, where the solution is available but unused because of cost, trust, skills, language or norms. The [GSMA estimates](#) that about 3.1 billion people live within mobile broadband coverage but do not use mobile internet, against about 300 million outside coverage.
- **Depth.** The use is sufficient to change outcomes: three doses rather than one, a reliable supply of electricity rather than a few hours a week, learning at grade level rather than attendance. Typical failure: arrival without embedding, where a technology is present but too thinly used to raise productivity.
- **Durability.** The use persists when the pilot funding, the donor or the champion leaves. Typical failure: the programme that collapses when the grant ends, the borehole that fails when its first part breaks.

The distinction matters because the four stages are governed by different mechanisms and measured by different statistics. A country can score well on reach and badly on depth, and the policy response differs. It also resolves an apparent paradox in the empirical literature. Comin and Mestieri's study of 25 major technologies across 139 countries, [published in the *American Economic Journal: Macroeconomics*](#), finds that the *lag* with which poorer countries adopt a given technology has narrowed over two centuries, while the *intensity* with which they use it, relative to rich countries, has diverged. In the vocabulary above, the world has become better at reach and no better at depth. [An earlier NBER version](#) estimated an average adoption lag of 42 years, and attributed a large share of the great income divergence between rich and poor countries to differences in lags in the nineteenth century and to differences in intensity of use in the twentieth.

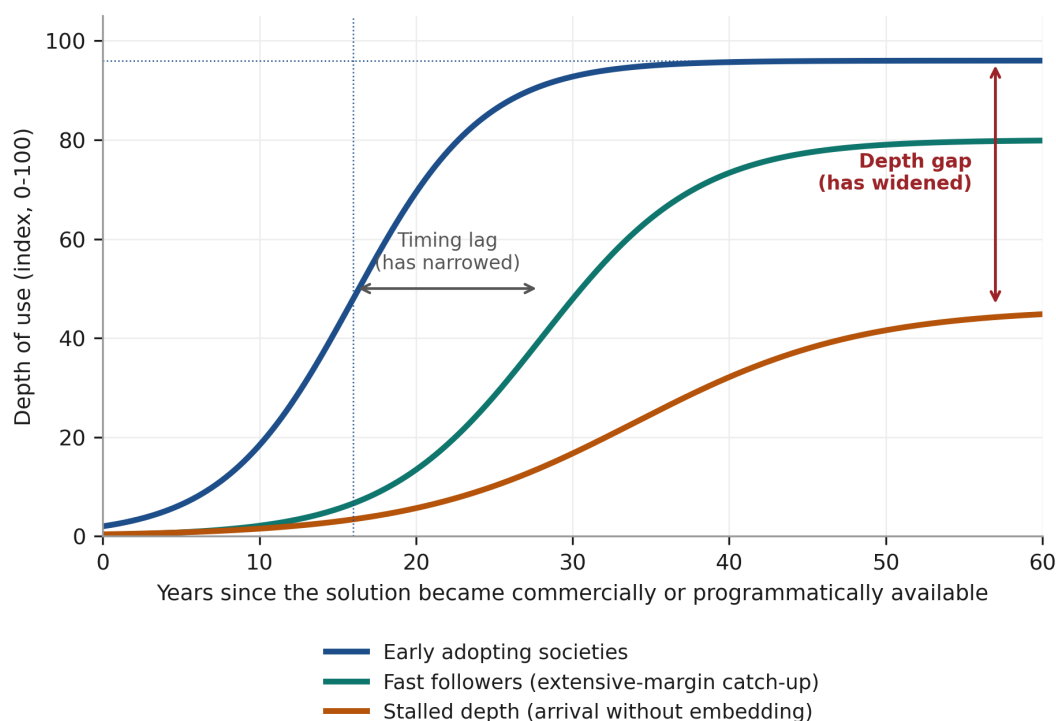


Figure 2. Two kinds of lag: a timing gap that has narrowed, and a depth gap that has not (stylised).

Source: H Heuristics. Stylised illustration of the extensive and intensive margins of technology adoption described in Comin and Mestieri (2018); curves are not estimated from data.

2.3 Unequal societies

The first feature of the setting is inequality, and it acts at three levels. *Between countries*, the differences in income, institutions and infrastructure are large enough that a given solution faces very different costs of delivery. The World Bank's [World Development Report 2024](#) finds that 108 middle-income countries were stuck in what it calls the middle-income trap at the end of 2023, with median income per person never rising above 10 per cent of the United States level since 1970, and that only 34 middle-income economies have reached high-income status since the 1990s. *Within countries*, solutions diffuse first to the urban, the connected, the educated and the male. And *within households and communities*, norms, language and information determine who in a family is allowed to use the new thing. Inequality therefore does more than

determine who is reached last. It shapes the order in which a solution travels, and an order that begins with the already advantaged tends to entrench them.

2.4 Interconnected societies

The second feature is interconnection. Solutions do not diffuse through a vacuum, they travel through six channels examined in Section 6: trade, foreign investment, finance and aid, people and diaspora, digital networks, and policy and peer learning. Each channel is a route by which solutions arrive and a route by which dependence and shocks are transmitted. A country that imports its solar panels from a single dominant supplier has gained access to the cheapest power in history and has accepted a concentration risk. A country that finances its vaccination programme from donor grants has gained scale and has accepted exposure to donor budgets. The interconnected world accelerates diffusion and makes it fragile in the same stroke.

2.5 Properties that predict diffusion speed

Taken together, the stages and the setting generate a testable pattern. Solutions that are modular, cheap relative to income, privately consumed and light on complementary infrastructure should diffuse fastest through unequal, interconnected societies, because they ask little of weak institutions and they can be adopted one household at a time. Solutions that are lumpy, expensive, publicly delivered and dependent on networks should diffuse slowest. Table 1 summarises the pattern and the evidence for it, and Section 3 tests it against the record.

Table 1. Five properties of a solution that predict how fast it diffuses through unequal, interconnected societies

Property	Tends to diffuse fast	Tends to diffuse slowly	Illustration in the data
Divisibility	Can be bought, used or delivered in small units	Needs a large, indivisible investment before any benefit	Mobile subscriptions at 67 per 100 people in low-income countries; grid electricity at 49 per cent access
Price relative to income	Falls to within household budgets	Remains a multiple of monthly income	Clean cooking at 16 per cent access in low-income countries despite decades of programmes
Who pays and delivers	Private purchase by the user	Public delivery by a state with limited capacity	Internet use of 22.5 per cent but DTP3 immunisation of 70 per cent, and falling since 2019
Network dependence	Works on its own	Needs a grid, a road network, a cold chain or a platform	Distributed solar imports surging in Pakistan and Africa (Section 6)
Skills and trust required	Simple, observable, easily trialled	Requires skilled operators or behaviour change	Learning poverty of 70 per cent of ten-year-olds in low- and middle-income countries

Source: H Heuristics synthesis of the diffusion literature and the evidence in Sections 1 and 3.

3. The Record: What Has Already Spread, and How Fast

The case for urgency is not that diffusion fails. It is that diffusion has repeatedly succeeded, at a speed and scale that would have seemed implausible a generation ago, and that its successes teach as much as its failures.

3.1 Faster than before, deeper than before in some places

The adoption of new technology by households has accelerated across the centuries. The [Our World in Data compilation of United States household adoption](#) shows that electrification took decades to reach most households, while smartphones moved from a small base to near-saturation in a fraction of that time. Developing countries have been able to exploit this acceleration. They need not rebuild the history of the technology, and they can adopt the latest version at its lowest price. This is the logic of leapfrogging: countries that never built a comprehensive fixed-line telephone network moved directly to mobile, and countries without a branch-banking network moved directly to mobile payments.

The mobile telephone is the clearest case. In 2024 there were about 67 mobile subscriptions per 100 people in low-income countries and 91 in lower-middle-income countries, against 138 in high-income ones. Those figures count subscriptions rather than unique users, and they overstate the share of people reached, but the gap has narrowed to a factor of about two, which is small compared with gaps in most other sectors.

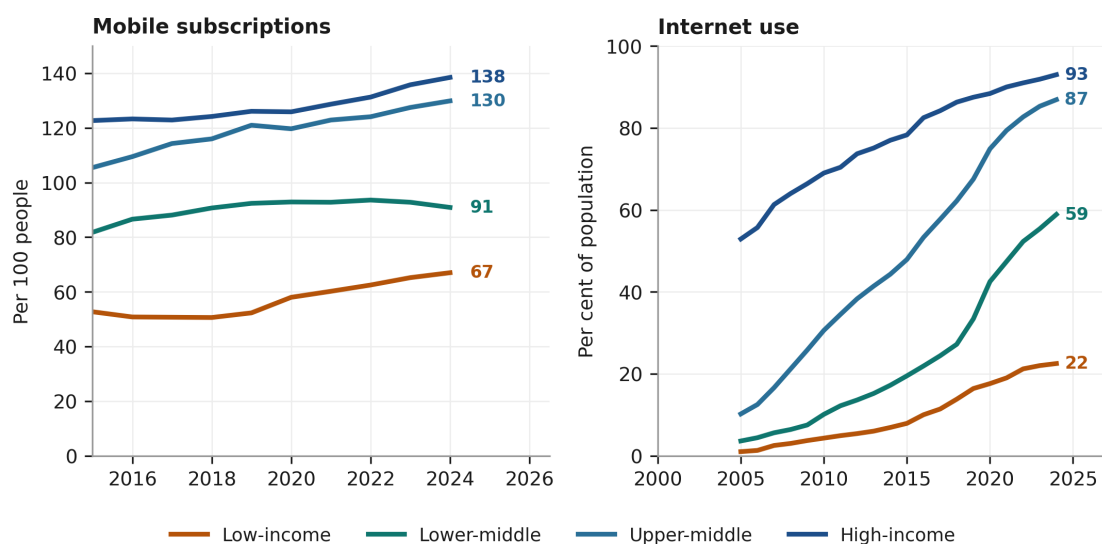


Figure 3. Mobile subscriptions have converged much faster than internet use.

Source: World Bank, World Development Indicators (accessed 19 October 2026). Mobile series shown from 2015 where income-group data are complete. Income groups follow the current World Bank classification.

The second panel of Figure 3 shows a pattern of a different kind. Internet use in lower-middle-income countries rose from about 10 per cent in 2010 to about 59 per cent in 2024, a convergence on the upper-middle group that is one of the faster in the data. In low-income countries it rose from 4.3 per cent to 22.5 per cent. The [ITU's Facts and Figures 2025](#) estimates that about 6 billion people, three-quarters of humanity, used the internet in 2025, and that 96 per cent of the 2.2 billion who did not lived in low- and

middle-income countries. The ITU's own conclusion is that connectivity is advancing steadily but that gaps in quality and affordability persist.

3.2 Health: the largest diffusion success in the record

Health is where diffusion has done most for human welfare. [Oral rehydration therapy](#), a mixture of salt, sugar and clean water, is estimated to have saved around 70 million lives since the late 1970s. It diffused because it was cheap, could be prepared at home, required no equipment and was championed through national programmes and community health workers. Childhood immunisation tells a similar story at larger scale: by 2025 [WHO and UNICEF estimate](#) that 90 per cent of infants globally, nearly 116 million, received at least one dose of a diphtheria-tetanus-pertussis vaccine, and 85 per cent completed three doses.

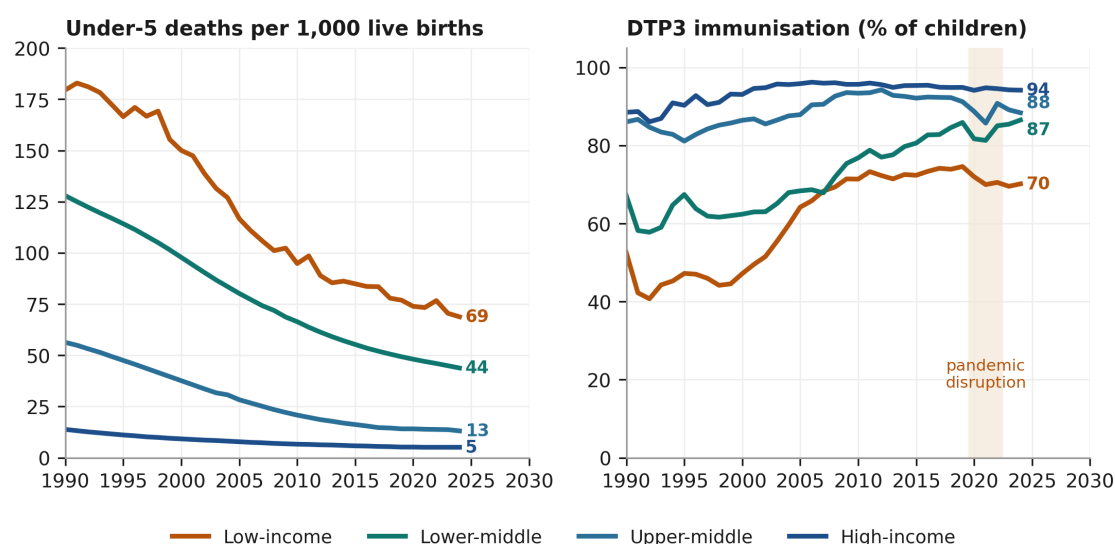


Figure 4. Child mortality has fallen in every income group; immunisation in low-income countries has stalled.

Source: World Bank, World Development Indicators, drawing on UN IGME and WHO/UNICEF estimates (accessed 19 October 2026). Shaded band marks 2020-22.

Figure 4 shows both halves of the record. Under-five mortality in low-income countries has fallen from about 180 deaths per 1,000 live births in 1990 to 69 in 2024. In lower-middle-income countries the decline has been from 128 to 44. These are among the largest improvements in human welfare ever measured. But the right-hand panel shows that in low-income countries, DTP3 coverage rose from a low of about 41 per cent in 1992 to a peak of around 75 per cent in 2019 and has since slipped back to 70 per cent. The 2025 WHO and UNICEF estimates show that 13.5 million infants received no vaccine at all, about 750,000 fewer than a year earlier, while 7.3 million started the schedule and dropped out before receiving a measles dose. Progress, in other words, is neither guaranteed nor monotonic. It depends on a delivery system that can be disrupted.

3.3 Agriculture, finance and energy

The Green Revolution is the canonical agricultural case. [Evenson and Gollin's assessment in Science](#) documented the development and spread of more than 8,000 modern crop varieties in eleven major crops between 1965 and 1998, finding substantial gains in output and falling food prices that benefited consumers,

but gains that were uneven across crops and regions. Later syntheses of the same evidence, such as the IAASTD global assessment, note that in sub-Saharan Africa modern varieties were often released but not adopted in the first decades, because they were poorly matched to local conditions and the supporting inputs and institutions were weak. The lesson, which recurs throughout this report, is that a technology is not the same as a diffusion process.

Mobile money shows a faster version. [Suri and Jack's study of Kenya's M-Pesa](#), published in *Science*, estimated that expanded access lifted about 194,000 households, roughly 2 per cent of the total, above the poverty line, with larger effects for female-headed households, an estimate that has been debated but remains among the most cited in the field. The [2025 Global Findex](#) shows that by 2024 40 per cent of adults in sub-Saharan Africa held a mobile money account, up from 27 per cent in 2021, and 37 per cent in Latin America and the Caribbean, up from 22 per cent.

In energy, the diffusion of solar power is the most visible recent case, and Section 6 and Section 8 treat it in detail. Its distinguishing feature is that the technology is modular, so that a household, a shop or a village can adopt it without waiting for the state to build a network. The same pattern, in which modular technologies outrun network ones, appears in every sector. It is a major reason to design for the gradient described in Section 1.

3.4 What the record teaches

Four regularities emerge from this record. Solutions that are divisible and privately purchased spread fastest. Solutions that need the state to deliver spread more slowly and are more exposed to shocks. Success is contingent on fit: the Green Revolution varieties that transformed Asia were not simply transplanted to Africa. And the speed of diffusion is partly a policy outcome. Oral rehydration therapy, immunisation and mobile money did not spread on their own. They spread because someone did the work of making them cheap, trusted, available and routine.

4. The Cost of Standing Still: Measuring the Delivery Gap

A solution that has not diffused has a price, and the price is paid by people. Counting it requires looking at what is still undelivered, how fast it is being delivered, and what is lost while we wait.

4.1 How many people remain unreached

The number of people not yet reached by proven solutions is measured in billions, not millions. The [2025 Tracking SDG7 report](#) estimates that 666 million people still lacked electricity in 2023, 85 per cent of them in sub-Saharan Africa, and that 2.1 billion lacked access to clean cooking, with progress slower than in the 2010s. The ITU counts 2.2 billion people offline. The World Bank's [State of Social Protection Report 2025](#) finds that 1.6 billion people in low- and middle-income countries were not covered by any form of social protection in 2022 and that roughly three in four people in low-income countries have no coverage. The Global Findex puts the number of adults without a financial account at 1.3 billion.

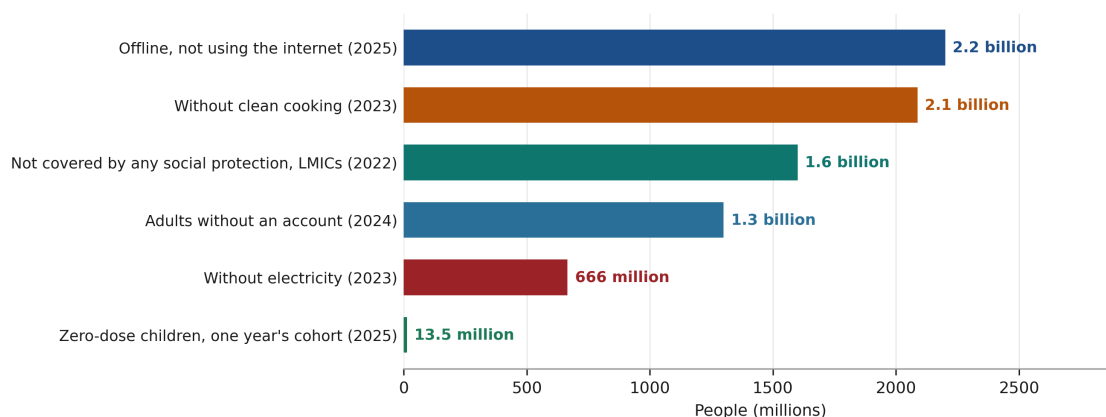


Figure 5. People not yet reached by six proven solutions.

Sources: Tracking SDG7 2025 (electricity, clean cooking, 2023); ITU Facts and Figures 2025 (offline, 2025); World Bank State of Social Protection 2025 (not covered, LMICs, 2022); Global Findex 2025 (adults without an account, 2024); WHO/UNICEF 2025 (zero-dose children in one year's cohort). Counts overlap and units differ: children and adults are not additive.

The categories overlap, since the same household is often without electricity, clean cooking and a bank account, and they are not additive. But the overlap is itself informative. Exclusion from one solution is a strong predictor of exclusion from others, and those excluded are disproportionately rural, female, poor and living in fragile states.

4.2 The price in lives, learning and income

The human cost shows first in survival. Under-five deaths of 4.8 million a year are concentrated where basic health services and nutrition are weakest, and many are caused by conditions, pneumonia, diarrhoea, malaria and neonatal complications, for which cheap and proven interventions exist. The IGME warns that, without renewed effort, an estimated 30 million children could die before their fifth birthday by 2030.

The cost shows next in learning. The World Bank's [learning poverty estimates](#) found that 70 per cent of ten-year-olds in low- and middle-income countries could not read and understand a simple text in 2022, up from a pre-pandemic baseline of 57 per cent in the same report, and that the share was 89 per cent in sub-

Saharan Africa. Primary completion in low-income countries stands at about 63 per cent, and has not improved since 2019. A child who cannot read at ten has little chance of benefiting from any of the solutions that depend on literacy, from labelled medicines to mobile banking to online learning.

The cost shows in income. The GSMA estimates that closing the mobile internet usage gap could add about US\$3.5 trillion to global GDP in the eight years to 2030, a figure that should be read as an indication of order of magnitude rather than a forecast. More robustly, Comin and Mestieri's finding that differences in the depth of technology use account for a large share of the twentieth-century income divergence implies that failures of depth are failures of growth.

4.3 How long would catch-up take?

A useful way to judge the urgency is to ask how long low-income countries would take to reach today's high-income level if they kept improving at the pace they have achieved recently. Figure 6 does this for six indicators by extending each country-group trend since 2019 in a straight line. It is arithmetic, not a forecast. Actual trends will bend, in either direction, and the low-income group's composition changes over time. But it serves to show the scale of the problem at current rates of delivery.

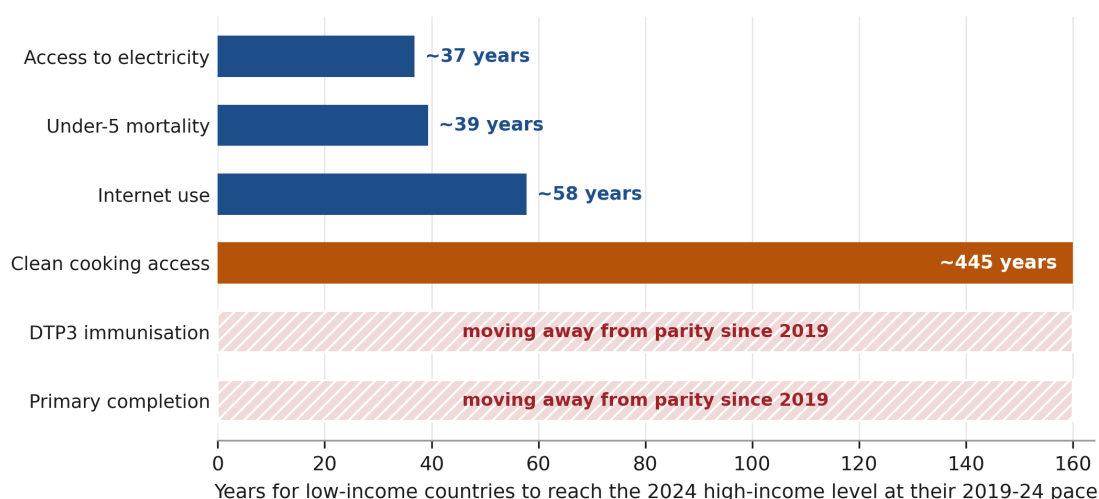


Figure 6. Years for low-income countries to reach the 2024 high-income level, at their 2019-24 pace of change.

Source: World Bank, World Development Indicators; H Heuristics calculations. Straight-line extrapolation of 2019 to latest-year change in low-income country averages to the 2024 high-income value. Primary completion uses 2023 as latest year. Illustrative arithmetic, not a forecast.

The result is sobering. At the recent pace, electricity access would converge in about 37 years and internet use in about 58. Under-five mortality would reach the high-income level in about 39 years on a linear path, although mortality declines are proportional rather than linear and the estimate is crude. Clean cooking access, which has risen by under 0.2 percentage points a year in low-income countries, would take over four centuries. And for DTP3 immunisation and primary completion, the indicators that depend most on the capacity of the state, low-income countries have moved *away* from parity since 2019. The finding does not say that the trends are fixed. It says that the existing pace of diffusion is not sufficient and that, for the most state-dependent solutions, the current direction is wrong.

The next section turns from the size of the gap to its causes.

5. Why Proven Solutions Fail to Spread

Proven solutions stall for a small number of recurring reasons. Naming them precisely matters, because the remedy for a financing barrier is not the remedy for a trust barrier, and programmes that treat every stall as a funding shortfall repeatedly fail.

The sections that follow set out five families of barrier. They are not mutually exclusive, and the hardest cases involve several at once. Table 2 at the end of the section pairs each with a diagnostic question and a response that has worked.

5.1 The price of money

The first barrier is the cost of capital. Almost every solution in this report involves paying an up-front cost to receive a stream of benefits: a solar array, a cold chain, a classroom, a grid extension. The annual cost of owning an asset is dominated by the rate at which its financing is priced, and that rate differs enormously across countries. The [World Bank's International Debt Report 2025](#) records that borrowing costs for developing countries have hovered at about 10 per cent, roughly double their level before 2020, that interest payments reached a record US\$415 billion in 2024, and that low- and middle-income countries sent US\$741 billion more to creditors than they received in new financing across 2022 to 2024, the largest negative transfer in at least fifty years.

The arithmetic of capital cost is simple and unforgiving. Figure 7 shows the annual capital charge on a 25-year asset costing US\$1,000 at four interest rates. At 4 per cent the charge is US\$64 a year. At 16 per cent it is US\$164, a multiple of 2.6, for exactly the same equipment performing exactly the same function. Because many diffusion solutions are capital-intensive and cheap to run, high interest rates raise their lifetime cost disproportionately. This is why [IRENA's global-average cost](#) for solar understates the price faced in a high-rate economy, and why the diffusion of the most capital-intensive solutions, grids, storage and large-scale water and sanitation, is slower than the headline cost declines would suggest.

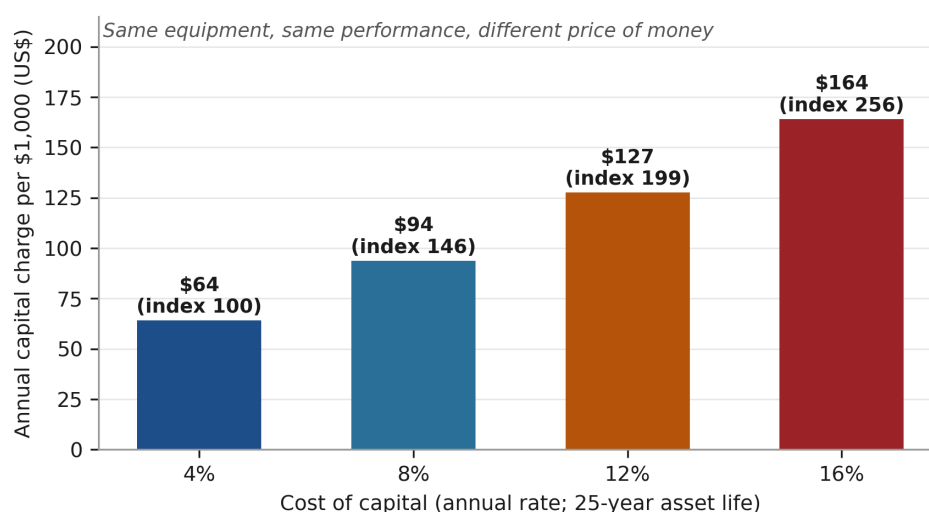


Figure 7. The same asset costs 2.6 times as much a year to own at a 16 per cent cost of capital as at 4 per cent.

Source: H Heuristics calculation. Capital recovery factor for a 25-year asset life; no operating costs, taxes or inflation. Illustrative arithmetic.

5.2 Complementary infrastructure and absorptive capacity

The second barrier is the absence of the things a solution depends on. A vaccine needs a cold chain, trained vaccinators and a record of who has been vaccinated. An electric cooker needs reliable electricity. An online learning platform needs devices, bandwidth, literate teachers and content in the local language. When these complements are missing, the solution reaches the person on paper and not in practice. The International Telecommunication Union's finding that the 6 billion people now online leave 2.2 billion offline, while the GSMA finds a usage gap of 3.1 billion within coverage, reflects exactly this: infrastructure alone does not produce use.

The related idea of *absorptive capacity* describes the ability of an organisation or a country to recognise, adapt and apply external knowledge. In health, it is the capacity of a district system to introduce a new vaccine into its schedule, train and supply its staff and track its coverage. In agriculture, it is the extension service that tells farmers which variety suits which soil. Where absorptive capacity is thin, introduction of a new solution can fail not because the solution is unsuitable but because the receiving system cannot absorb a change. The World Bank's *World Development Report 2024* argues for this reason that countries at lower-middle-income levels must add *infusion*, the adoption of foreign technology and its spread through the economy, to investment, and that upper-middle-income countries must then add *innovation*. The prescription implies that diffusion capacity is itself a policy target, something to be built deliberately.

5.3 Trust, norms and the state's delivery capacity

The third barrier is behavioural and institutional. People adopt what they trust, and trust is earned locally. Immunisation depends on confidence in the health worker and in the information she gives. Mobile money in Kenya spread in part because of the agent network that made it visible and reliable. The WHO and UNICEF data show that conflict and hesitancy are among the reasons that childhood immunisation is only inching forward, and that fragile and conflict-affected settings have much lower coverage than the global average: the Gavi analysis of 2024 data found DTP3 coverage in such settings stuck at 61 per cent while it rose in other Gavi-supported countries.

Delivery capacity is the institutional counterpart of trust. Solutions that require the state to deliver at scale are exposed to the state's weaknesses, which show up in the data of Section 4: the indicators for which low-income countries are moving away from parity, immunisation and primary completion, are state-delivered services. Solutions that a household can buy for itself face a different constraint, which is price rather than capacity, and have fared better. It follows that policy for state-delivered solutions must focus on delivery capacity, workforce, supply chains and information systems, rather than on technology.

5.4 The scaling problem: why good ideas lose voltage

The fourth barrier is intellectual rather than material, and it is the one most often missed. Programmes that work well in a pilot frequently work less well when scaled. John List, who has studied the problem across settings from preschools to ride-sharing, calls it the *voltage effect*, and he and co-authors have argued in an [NBER working paper](#) that it can arise even when all parties act rationally, because the information available to those who run a pilot differs from that available to those who must replicate it. The pilot's apparent effect may reflect the quality of the people running it, the enthusiasm of the sites that volunteered, or conditions that do not generalise.

The empirical evidence is concrete. Hunt Allcott's study of a home energy-report programme, published in the *Quarterly Journal of Economics*, examined 111 randomised trials covering 8.6 million households. Predictions based on the first ten sites substantially overstated the effect in the next 101, because the utilities that adopted the programme early were more environmentally minded, had more responsive customers, and initially targeted heavier users. The lesson is not that pilots are useless. It is that the sites that volunteer for early evaluation are not typical, and that an effect measured at those sites should be treated as an upper bound for the effect at scale.

Voltage drops arise for a handful of reasons that can be anticipated: selection (early sites are the willing and able), fidelity (the programme is delivered less faithfully at scale), staffing (the original team cannot be replicated), spillovers and general-equilibrium effects (a policy that works for a few changes the market when applied to all), and incentives (those who deliver at scale respond to different incentives than those who ran the pilot). Section 9 returns to these when it sets out the design rules for scale. The practical consequence for this section is that a solution proven in one place, especially one proven by an intensive trial, should not be treated as proven everywhere.

5.5 Markets that are too small, too poor or too risky

The fifth barrier is that for some solutions no private seller can profitably serve the people who need them. A vaccine for a disease that mainly affects low-income countries, a medicine for a market with limited ability to pay, or an agricultural variety for farmers too poor to buy new seed each year may all be proven and still not produced or distributed at scale. Where the producer retains patent rights, the access question becomes one of licensing. The case of lenacapavir, examined in Section 8, shows both sides: a biomedical breakthrough that can be made for around US\$40 a year per person under negotiated generic licences, and a licensing map that excludes at least 26 middle-income countries, according to Médecins Sans Frontières as reported in the press.

Fragility compounds all of these barriers. Conflict destroys the infrastructure and institutions on which diffusion depends, deters investors, displaces workforces and diverts budgets. A solution that is cheap and modular in a stable setting can be impossible to deliver in a conflict zone, and the countries with the largest delivery gaps are disproportionately those in which fragility is highest.

Table 2. Five families of barrier, how to diagnose them, and responses that have worked

Barrier	How it shows up	Diagnostic question	A response that has worked
Price of money	Capital-intensive solutions diffuse slower than their headline cost suggests	What is the cost of capital for the buyer, and how does it compare with a high-income benchmark?	Guarantees, local-currency lending, pay-as-you-go and lease models that convert capital cost into a small recurring payment
Missing complements	Reach without use; supply without demand	What does this solution need in order to work that the setting does not yet have?	Bundle the solution with the complement, or sequence it behind the complement
Trust and capacity	Coverage stalls or falls when systems are disrupted	Who delivers, with what workforce, and what happens when they leave?	Government-owned delivery, community health and agent networks, routine information systems
Voltage drop	Results at scale are well below pilot results	Were the pilot sites, staff and conditions typical of where we want to scale?	Test in representative sites, measure fidelity, adapt locally and keep learning
Market failure and fragility	No seller serves the population in need; conflict blocks delivery	Does the buyer lack purchasing power, or the seller lack incentive, or the state lack control?	Advance market commitments, pooled procurement, licensing for access, humanitarian delivery channels

Source: H Heuristics synthesis. Examples are developed in Sections 6 to 9.

6. The Interconnected World: Channels Through Which Solutions Travel

No country diffuses a technology alone. Solutions arrive through trade, investment, finance, people, networks and ideas, and each of those channels brings access and exposure in the same package.

Figure 8 summarises the six channels examined in this section. They connect a frontier, defined as the set of firms, laboratories and institutions that produce proven solutions, to an adopting society whose households, public systems and producers must absorb them. The channels vary in speed and in the kind of dependence they create, and policy has different levers in each.

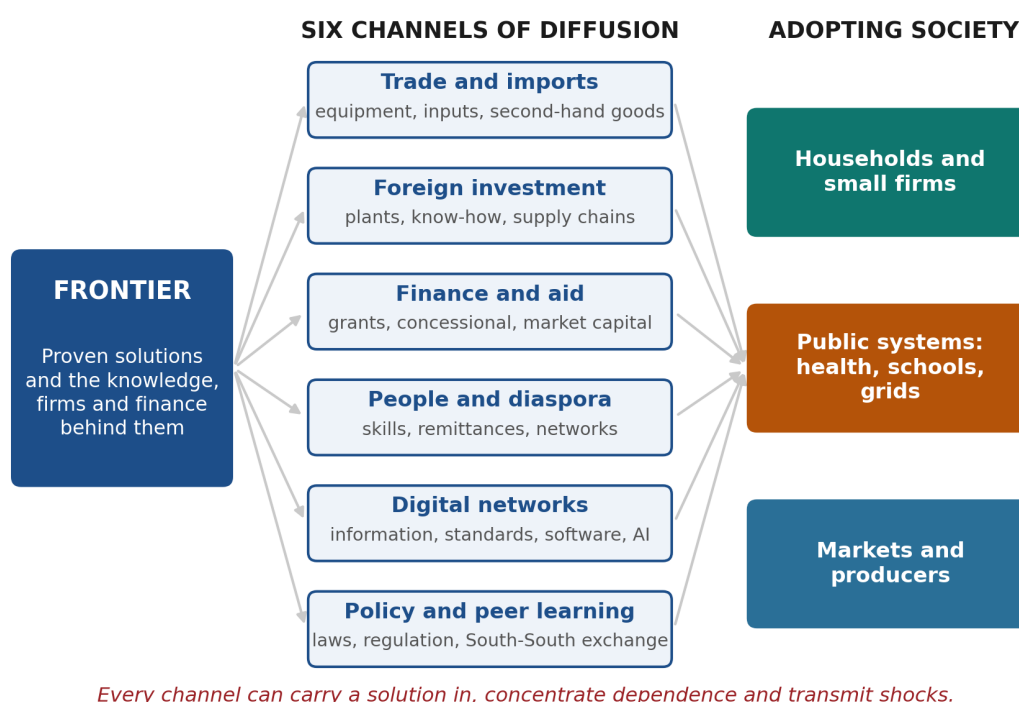


Figure 8. Six channels connect the frontier to adopting societies, and each can create dependence.

Source: H Heuristics. Conceptual schematic.

6.1 Trade and imports

Trade is the fastest channel for physical technology. The recent history of solar panels illustrates how fast it can be. Ember's analysis of Chinese customs data found that [African imports of solar panels reached a record 15 gigawatts in the twelve months to June 2025](#), up 60 per cent on the previous twelve months, with 20 countries setting new records and Nigeria overtaking Egypt as the second-largest importer. Pakistan's imports from China rose from 3.3 gigawatts in 2022 to 19 gigawatts in 2023 and 17 gigawatts in 2024. Ember cautions that these are estimates derived from the value of customs exports, and that they do not show how much equipment was actually installed. The numbers nonetheless show a technology moving across borders at a speed that no aid programme could match.

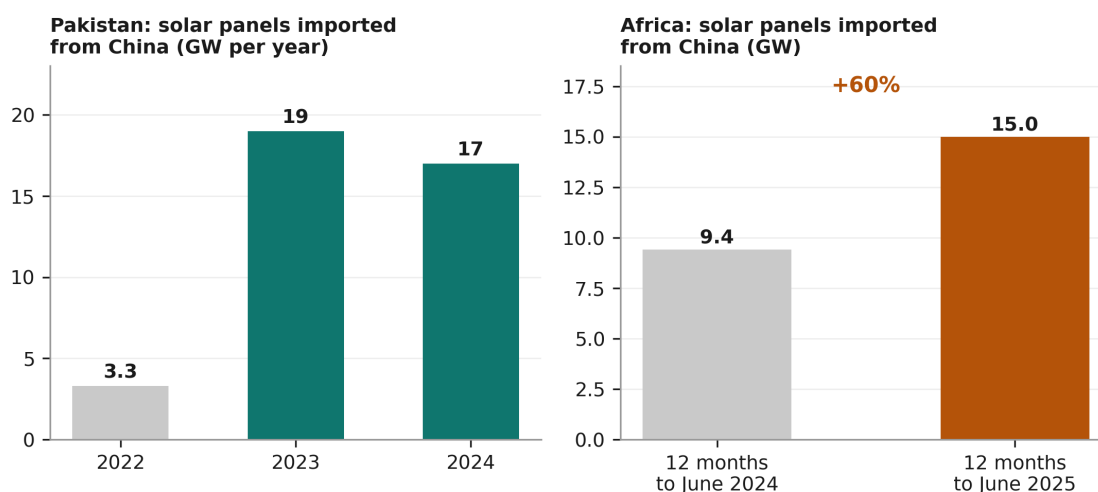


Figure 9. Imports of Chinese solar panels surged in Pakistan and across Africa.

Source: Ember, analysis of Chinese customs data (estimates based on export value); figures rounded. Pakistan: calendar years. Africa: twelve months to June.

The surge also exposes the second edge of the channel. The IEA found in 2022 that [China's share of every major manufacturing stage of solar panels exceeded 80 per cent](#), from polysilicon to modules, and that Xinjiang alone accounted for about 40 per cent of global polysilicon. It described that concentration as a considerable vulnerability for any supply chain. A country that adopts the cheapest solar equipment has gained an extraordinary benefit and has, at the same time, tied its power future to a small number of suppliers. Trade also carries second-hand goods, from vehicles to electronics to medical equipment, which can extend reach at low cost but may bring maintenance and waste burdens.

6.2 Foreign investment and production networks

Foreign direct investment brings not only equipment but the know-how and the supply relationships that surround it. It is the main channel by which a technology is embedded in local production. Its limits are that it follows markets and profitability rather than need, and that the terms of investment determine how much of the knowledge stays. Countries that have used foreign investment to deepen local capability have typically combined it with requirements or incentives for local sourcing, training and technology transfer, and have built supplier firms alongside the anchor investor. Section 9 returns to the staged logic of building local production behind demand.

6.3 Finance and aid

Official finance has historically been the channel for solutions that markets would not deliver: vaccines, public health systems, basic education and rural infrastructure. It is now in retreat. [The OECD's preliminary 2025 data](#) show that official development assistance from DAC members fell by 23.1 per cent in real terms in 2025, to US\$174.3 billion or 0.26 per cent of gross national income, from US\$215.1 billion or 0.34 per cent in 2024. It was the largest annual fall on record, driven largely by a 56.9 per cent reduction in aid from the United States, while humanitarian assistance fell by 35.8 per cent. Section 10 treats the implications. For the present, the point is that the channel that has been most important for diffusing health and education solutions is the one under most strain.

6.4 People and diaspora

People are the slowest channel and in some ways the most durable. Migrants carry skills, remittances and market knowledge. Returnees bring practices, and diaspora networks connect investors and entrepreneurs to opportunities. Remittances are a major source of household finance in many developing countries and often fund the purchase of solutions such as solar systems, phones and schooling. Students trained abroad often return as the technical staff who adapt imported solutions. The channel can also run backwards: the emigration of health workers and engineers from the countries that most need them is a recurring constraint on delivery capacity.

6.5 Digital networks

Digital networks are the fastest channel for knowledge and the one with the lowest marginal cost. They allow a clinical guideline, a teaching method or an open-source design to spread worldwide at close to zero cost. They also underlie the new generation of public platforms. The [Unified Payments Interface in India](#) marked its tenth year in 2026 having grown nearly 13,000-fold in transaction volume, with 703 banks on the platform against 44 in its first year, and it is now live in several other countries. The channel has its own concentration risks: the major platforms, cloud providers and AI developers are located in a few countries, and the [UNCTAD Technology and Innovation Report 2025](#) found that frontier technologies were projected to grow sixfold by 2033 to US\$16.4 trillion while knowledge generation remained concentrated in China and the United States and 100 companies accounted for over 40 per cent of business research and development spending worldwide.

6.6 Policy and peer learning

The sixth channel is the diffusion of policy itself: the spread of laws, regulations and programme designs from one government to another. Conditional cash transfers moved from a few Latin American countries to dozens of others. Teaching at the Right Level, developed in India, has been adopted by governments in Africa. Regulatory approaches to mobile money, pioneered in Kenya, have been studied and adapted by regulators elsewhere. South-South learning has a particular advantage, which is that the adopting government faces circumstances similar to those of the originator and can see a proven design in operation. Peer networks, regional organisations and development banks all accelerate this channel. The caution of the voltage effect applies fully: a design that works in one jurisdiction must be adapted, not copied.

6.7 Interconnection as risk

The six channels are also channels of transmission for shocks. Commodity price shocks, interest-rate rises, pandemics and conflicts are all transmitted through trade, finance, people and networks. The 2021 rollout of COVID-19 vaccines showed the dependence of access on the position of a country in the network: [Airfinity's analysis](#) found that G20 countries had received about 15 times as many doses per capita as sub-Saharan African countries, reflecting supply that was concentrated in a few producers and secured first by the countries with the largest purchasing power. The experience is a reminder that an interconnected world distributes access according to market and political power unless institutions are built to do otherwise.

7. Unequal Societies: Inequality as Brake and Accelerant

Diffusion is never neutral between groups. A solution reaches those with money, connections and information first, and unless the design works against this the gap between early and late adopters becomes a permanent gap in outcomes.

7.1 Who is reached first

The order in which groups adopt a solution is a function of cost, information and access. Wealthier households can pay the entry price, urban residents live closer to the infrastructure, educated people understand the product, and men face fewer social restrictions on using it. The result is a diffusion curve that is not one curve but many, each for a different group, with the leading group saturating while the trailing group has barely begun. This is why national averages mislead. A country in which 50 per cent of people use a service may have 90 per cent usage among the top quintile and 10 per cent among the bottom.

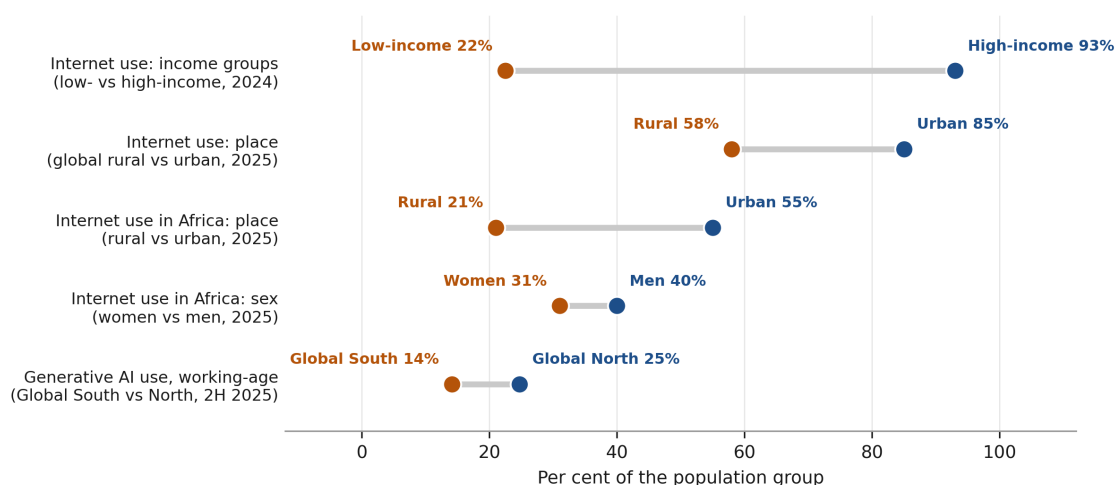


Figure 10. Gaps between and within countries: the same solution, different shares of different groups.

Sources: World Bank WDI (income groups, 2024); ITU Facts and Figures 2025 as reported (place and sex, 2025); Microsoft AI Economy Institute, Global AI Adoption 2025 (2H 2025). Gaps are not directly comparable across rows because definitions differ.

Figure 10 shows five such gaps. Between low- and high-income countries, internet use differs by 70 percentage points. Within the world, the ITU reports that about 85 per cent of urban residents use the internet against 58 per cent of rural residents. In Africa the gap is wider still, 55 per cent against 21 per cent, and women are less likely to be online than men, 31 per cent against 40 per cent. The pattern is repeated for the newest technology. [Microsoft's AI Diffusion Report](#) found that 24.7 per cent of the working-age population of the Global North was using generative AI tools in the second half of 2025, against 14.1 per cent in the Global South, and that the gap widened from 9.8 to 10.6 percentage points over the half-year because adoption in the North grew nearly twice as fast. Countries where low-resource languages predominate, such as Malawi and Laos, showed lower adoption even after adjusting for income and connectivity.

7.2 The inequality trap in diffusion

Three dynamics make unequal diffusion self-reinforcing. The first is *capture*: the early adopters, being better resourced, capture the early benefits, whether cheaper electricity, better credit terms or first access to a scarce service, and use them to consolidate their position. The second is *standard-setting*: products, interfaces and languages are designed for the first users, and become the default that later users must accommodate, as the language effect in AI adoption shows. The third is *infrastructure follow-the-money*: networks are extended first to the places where revenue is highest, which are already the best served. Together, these dynamics mean that the time lag between early and late adopters is not just a delay in benefit but a transfer of advantage.

The Comin and Mestieri result has a distributional counterpart. If the intensity of use of technology differs sharply between rich and poor societies, then differences within societies are likely to be large as well, and the aggregate indicators that countries report may conceal the depth gaps that matter most for welfare.

7.3 Inequality as an accelerant

Inequality is not only a brake. Where a solution answers an acute need that others do not face, the excluded can adopt it faster than the included. Pakistan's households facing unreliable and expensive grid power adopted solar at a remarkable pace, with imports of 17 to 19 gigawatts a year. Rural populations beyond the reach of bank branches adopted mobile money because the alternative was no financial service at all. In Suri and Jack's Kenyan study the gains from mobile money were larger for female-headed households, who had the greatest barriers to conventional finance. The general lesson is that diffusion can be fastest where the gap between the solution and the alternative is largest, provided that the solution is within reach on price and skill. A policy of designing for the excluded is therefore not only a matter of fairness. It can be a route to faster, deeper diffusion.

7.4 Designing for the last mile first

Design rules follow. First, price for the poorest adopter, not the average one, using divisible payments, subsidy where the benefit is public, and credit that does not depend on formal collateral. Second, build in language, literacy and gender from the start, since retrofitting is costly and often fails. Third, measure outcomes by group, not just by national average, so that the gaps are visible to those who can close them. Fourth, make the public rails, identity, payments and connectivity, available to all on non-discriminatory terms, so that the market for solutions built on top of them can reach those who are currently excluded. The rest of this report treats these as design requirements, not as optional extras.

8. Five Cases: What Diffused, and Why

Five cases illustrate the framework: mobile money and public payment rails, vaccines and market shaping, distributed solar, a teaching method, and a new HIV prevention drug that is still in the middle of its journey. None is a template. Each shows a different combination of the properties and barriers set out above.

8.1 Mobile money and public payment rails

Kenya's M-Pesa began as a simple product, sending money by mobile phone, delivered through a network of local agents who turned cash into digital value and back. Its properties fit the gradient: it was divisible, privately paid for, light on infrastructure beyond mobile coverage, and easy to trial. The evidence of its effect is strong, though contested at the margin. Suri and Jack's estimate of 194,000 households lifted out of poverty and of 185,000 women moving into business or retail occupations is the most cited, and its causal interpretation has been debated. By 2024, the Global Findex shows, mobile money accounts were held by 40 per cent of adults in sub-Saharan Africa and 37 per cent in Latin America and the Caribbean.

India's UPI shows a second model, in which the state provides the rail and private firms provide the services. It processed 24.51 billion transactions in August 2026, the highest monthly volume yet, and has extended to 703 banks. Growth has slowed, with transaction volume up 22 per cent year on year in the 2026 data against 34 per cent a year earlier, while value has plateaued, which is the pattern one expects as a system matures. The contrast between the two models is instructive. M-Pesa was a private product that diffused through a private agent network and then attracted regulation. UPI was a public protocol that diffused because the state required interoperability and made the rail free to use. Both succeeded because they were cheap, simple and available to those without access to alternatives.

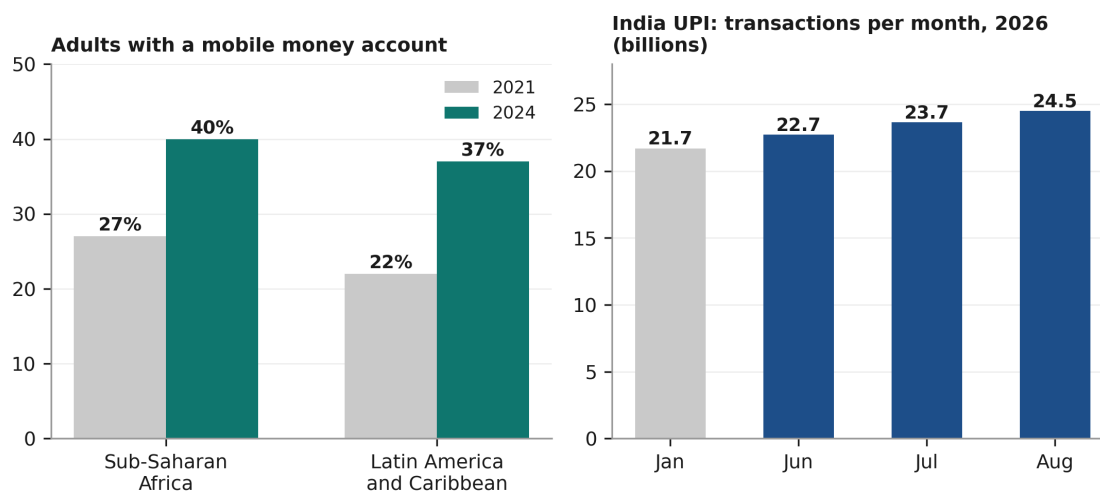


Figure 11. Mobile money accounts have spread widely, and India's public payment rail continues to grow.

Sources: World Bank Global Findex 2025 (mobile money accounts, share of adults); NPCI data as reported by YourStory and Startuptalky (UPI monthly transactions, 2026; selected months shown).

8.2 Vaccines and the economics of market shaping

Vaccines show how a market can be created for a product that the market would not otherwise supply at scale. The [pneumococcal Advance Market Commitment](#), launched in 2009 with US\$1.5 billion from six donors, guaranteed a price to manufacturers who developed and supplied pneumococcal vaccines suitable for low-income countries. The independent evaluation commissioned by Gavi found that 49 million children had been fully immunised with three doses between 2009 and 2014 and estimated that the vaccines averted between 230,000 and 290,000 child deaths through 2015, with more than 3 million projected by 2030. These are model-based estimates, and Gavi's management response notes that other factors, including its wider financing and WHO recommendations, also contributed to the outcome.

The same architecture has since been applied to newer vaccines. WHO reports that, as of February 2026, [25 African countries offer malaria vaccines](#) in childhood immunisation programmes, 5 nationally and 19 in parts of the country, targeting more than 10 million children a year, with Cameroon the first to introduce one nationally in January 2024. Gavi reports a [record 73 million children immunised with its support in 2025](#), and pledges of more than US\$9 billion toward a target of US\$11.9 billion for its 2026 to 2030 period, which is intended to reach 500 million children. The fragility of the model is also clear. The funding gap and the aid cuts discussed in Section 10 are direct threats to the model's continuation, and the 2024 WUENIC data show that coverage in fragile and conflict-affected countries is stuck at 61 per cent.

The next step in the vaccine story is about location. The [African Vaccine Manufacturing Accelerator](#), launched by Gavi in 2024, aims to make up to US\$1.2 billion available over ten years to reward African manufacturers who reach regulatory milestones and supply priority vaccines, in support of the African Union's target of producing 60 per cent of the vaccines the continent needs by 2040. It shifts the diffusion question from how to get vaccines to Africa to how to make them in Africa, and thereby from import dependence toward domestic capacity. It has also been criticised for providing incentives that may favour established international manufacturers over smaller African ones.

8.3 Distributed solar

Solar power in Pakistan and across Africa is a case of a modular technology diffusing largely through private purchase. The drivers are visible in the previous sections: a cost that, on IRENA's series, has fallen by roughly nine-tenths since 2010, unreliable or expensive grid power that made the alternative attractive, and a supply chain that delivered panels in standard units to local retailers. The barriers are also visible. The adoption is concentrated among households and firms that can afford the up-front outlay or have access to pay-as-you-go finance, the grid and the state utility face a loss of paying customers that raises costs for those who remain, and the supply chain is concentrated in one country. Section 6 explained the supply risk. The distribution effect deserves attention: where wealthier households leave the grid, the burden of paying for the network can fall on those who cannot. The policy response is not to discourage solar but to reform tariffs and finance the grid so that early adopters' gain does not become late adopters' loss.

8.4 Teaching at the Right Level

The learning crisis is a delivery problem par excellence: schools are present, children attend and teachers are employed, but a very large share of children do not learn to read. [Teaching at the Right Level](#), developed by the Indian NGO Pratham, groups children by what they can do rather than by their grade and teaches the basics of reading and arithmetic in focused sessions. J-PAL reports that six randomised evaluations in seven

Indian states found test-score gains of between 0.07 and 0.70 standard deviations, that the approach has reached more than 80 million children in India and Africa, and that governments in Zambia and Nigeria have adopted and adapted it. The elements that made it scale are the ones the framework predicts: a simple, low-cost method; evidence from several settings, not one; an approach designed to work within the public school system rather than beside it; and government ownership of delivery. It also illustrates the discipline of scale: the effect sizes vary widely across settings, a reminder that evidence from one place bounds, but does not determine, outcomes in another.

8.5 A live test: twice-yearly HIV prevention

The newest case is not yet complete, which is why it is useful. Lenacapavir, a twice-yearly injection that prevents HIV infection, entered use in Africa in December 2025, when [South Africa, Eswatini and Zambia began administering it](#) under supply that Gilead provides at no profit to programmes supported by the Global Fund and PEPFAR. Indian generic manufacturers are due to supply it from 2027 at [about US\\$40 per person per year](#) across 120 low- and middle-income countries, under arrangements negotiated with Unitaaid and the Gates Foundation. The contrast with a United States list price of around US\$28,000 a year is stark.

Whether it becomes another diffusion success will turn on the barriers already described. Licensing excludes at least 26 middle-income countries, according to MSF. The programmes funded to date aim at about two million people by 2028, against a much larger population at risk, and recent reporting has questioned [who will gain access](#) in practice. A drug that must be injected twice a year depends on a health system that can find people, retain them and deliver on schedule. The lenacapavir case tests whether the machinery of price, licensing, delivery and financing built over the last two decades can be applied quickly enough to a new product. The evidence will accrue over the next several years.

Table 3. Five cases compared

Case	What spread	Scale reached	Main mechanism	Binding constraint now
Mobile money and UPI	Digital payments and savings	40% of adults with mobile money in SSA (2024); 24.5bn UPI transactions in Aug 2026	Private agent networks (Kenya); public interoperable rail (India)	Quality of use; the 1.3 billion adults still without an account
Vaccines	Pneumococcal, malaria and routine immunisation	73 million children immunised with Gavi support in 2025; 25 African countries offering malaria vaccine	Advance market commitments; pooled procurement; donor financing	Aid cuts; coverage of 61% in fragile settings; local manufacturing
Distributed solar	Modular panels and systems	15 GW into Africa in 12 months to June 2025; 17 GW into Pakistan in 2024	Private purchase; falling prices; unreliable grids	Cost of capital; supplier concentration; grid finance
Teaching at the Right Level	A method for foundational learning	Over 80 million children in India and Africa	Government-owned delivery; repeated randomised evidence	Fidelity at scale; teacher capacity
Lenacapavir	Twice-yearly HIV prevention	First public rollouts from December 2025; generics due 2027	Negotiated licences; Global Fund and PEPFAR purchasing	Licensing exclusions; delivery and retention; financing

Source: H Heuristics synthesis of the sources cited in Section 8.

9. Mechanisms That Scale: Seven Design Rules

The cases in Section 8 differ in sector, geography and era, but the mechanisms behind them recur. Seven design rules summarise what the evidence suggests about turning a proven solution into a diffused one.

The rules are organised around the barriers of Section 5 and the framework of Section 2. They are not a sequence, and most successful diffusion efforts use several at once. Table 4 at the end of the section links each rule to the barrier it addresses, an example and a measure.

Rule 1. Design for the last mile first

The solutions that spread furthest were designed for people at the bottom of the income range and the edge of the network, not retrofitted for them. Oral rehydration salts were made so that a mother with no equipment could mix them at home. Mobile money worked on the most basic handsets and through any shop that could act as an agent. Solar products succeeded when they could be bought in small units. The practical test is whether a person in the poorest quintile, in the least connected district, can obtain and use the solution without the help of an intermediary who does not exist. Where the answer is no, the design must change before the delivery plan does.

Rule 2. Shape the market before asking it to deliver

Where no seller serves the population in need, governments and funders can create the market. The pneumococcal advance market commitment guaranteed a price to suppliers and brought a vaccine to scale in low-income countries years sooner than the unaided market would have. Pooled procurement aggregates demand across countries, lowering prices and reducing risk for suppliers. Pay-as-you-go models turn a large up-front cost into a small recurring payment. The principle is that the instrument should fit the failure: a guarantee for a missing buyer, aggregation for fragmented demand, financing for a missing credit market. Funding a pilot does none of these things.

Rule 3. Build public rails and let private actors build on them

Shared digital infrastructure, in identity, payments and data exchange, reduces the cost of every solution that depends on it. India's UPI shows how a public protocol allowed hundreds of banks and thousands of firms to build services that no single actor could have provided. The rail must be open, interoperable and available on non-discriminatory terms, and it must be governed so that it cannot be captured by a single provider. The same logic applies to physical rails: cold chains, grids and roads that serve many solutions at once give a higher return than those built for one.

Rule 4. Make the government the owner

Programmes that are run alongside the state tend to end when the programme ends. Programmes that are run by the state, with external partners providing technical support, are the ones that last. Teaching at the Right Level scaled when it was adopted by state education departments and governments in Zambia and Nigeria. Routine immunisation is, in the end, a government service. Ownership means more than a letter of support. It means that the programme sits in the government's budget, uses its staff and systems, reports

through its information systems and survives a change of minister. Donors and implementers can accelerate this by structuring their support so that responsibility passes to government on a defined timeline.

Rule 5. Lower the cost of capital

Because the price of money drives the cost of the most capital-intensive solutions, instruments that lower it have outsized value. Guarantees and first-loss capital that cover the risks private lenders will not bear, local-currency lending that removes exchange-rate risk, and concessional blending that reduces the average cost of finance all work in this direction, as do debt instruments that pause payments when a disaster strikes. The aim is not to subsidise a solution indefinitely. It is to bring the financing cost of a proven solution closer to that of the same solution in a richer country, so that its price reflects its performance and not the credit rating of the buyer.

Rule 6. Test for scale, not for the pilot

The evidence in Section 5 means that evaluation design should be oriented toward the question of scale from the beginning. Pilots should be run in sites that resemble the target population, not only in willing ones. The pilot team should record what they do in enough detail to be replicated by people who are not the pilot team. Cost per unit of outcome should be measured at each stage and compared with the next best use of the money. Fidelity, the degree to which the programme is delivered as designed, should be monitored in routine operation and not assumed. And the programme should be built to adapt: the best-performing scaled programmes keep learning while they grow, adjusting to local conditions without drifting from the core mechanism.

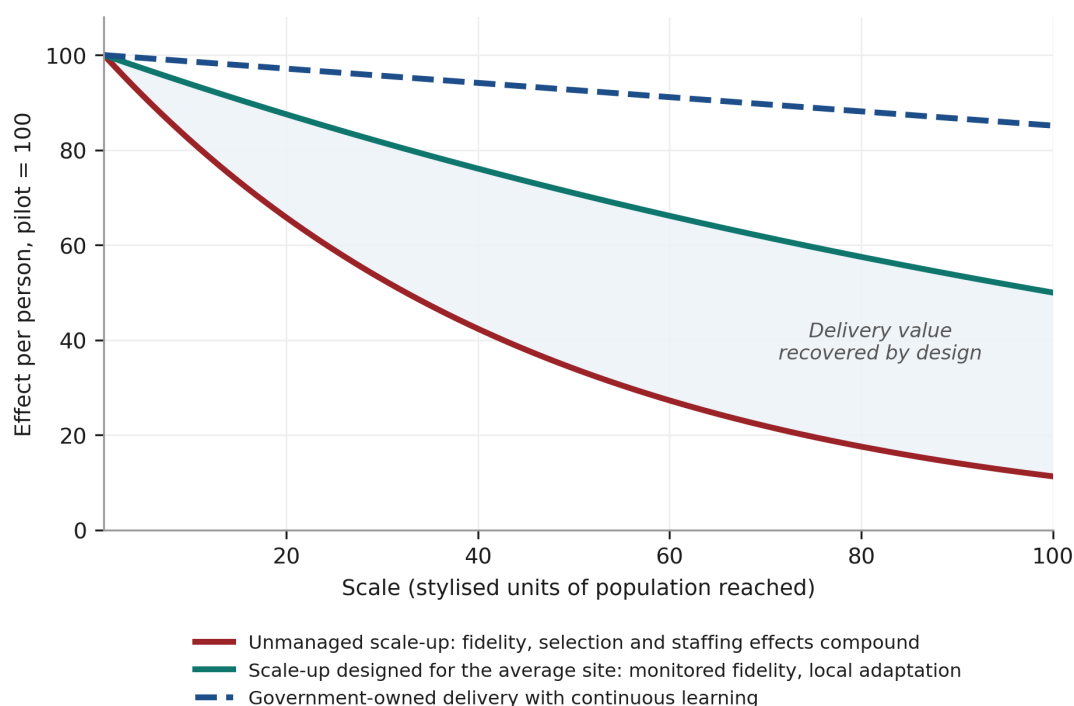


Figure 12. Effects typically shrink as programmes scale; design choices determine how much (stylised).

Source: H Heuristics. Stylised illustration of the voltage effect described by List and co-authors and of the site selection bias documented by Allcott (2015); curves are not estimated from data.

Rule 7. Build local capacity in stages

Dependence on imports for critical solutions is acceptable when supply is diverse and reliable, and dangerous when it is not. The more durable answer is to build local capability in stages behind demand: begin with distribution, installation and maintenance, where local jobs are created quickly; move to assembly and finishing as volumes justify it; and invest in upstream manufacturing only where scale, skills and inputs allow competitive production. The African Vaccine Manufacturing Accelerator is an example of this approach in a high-barrier sector: it pays for output and regulatory milestones rather than building capacity speculatively. Regional pooling, of regulators, procurement and manufacturing, can create the scale that a single small country lacks.

Table 4. Seven design rules, the barriers they address and how to measure them

Design rule	Barrier addressed	Example from the record	Illustrative measure
1. Design for the last mile first	Price; trust; missing complements	Oral rehydration salts; mobile money agents	Uptake among the poorest quintile and rural women
2. Shape the market	Market failure; fragmented demand	Pneumococcal AMC; pooled procurement; pay-as-you-go	Price per unit; number of suppliers; doses delivered
3. Build public rails	Missing complements; cost of every later solution	India's UPI	Cost per transaction or record; share of population on the rail
4. Make government the owner	Durability; delivery capacity	Teaching at the Right Level in Zambia and Nigeria	Share of programme funded and run in the government budget
5. Lower the cost of capital	Price of money	Guarantees; local-currency lending; contingent debt clauses	Cost of capital for a standard solution, relative to a high-income benchmark
6. Test for scale	Voltage drop	Replication across sites in Allcott's 111 trials	Effect in representative sites; fidelity; cost per outcome
7. Build local capacity in stages	Dependence; delivery capacity	African Vaccine Manufacturing Accelerator	Local share of supply; supplier diversity

Source: H Heuristics synthesis of Sections 5 to 8.

10. Governing Interdependence: Concentration, Finance and the AI Divide

The channels that carry solutions are exposed to three structural risks: concentration of supply, a squeeze on the finance that pays for delivery, and a new technology, artificial intelligence, whose diffusion so far is faster where diffusion is already easy.

10.1 Concentration of supply

Concentration is the characteristic risk of an efficient global supply chain. Section 6 documented the concentration of solar manufacturing: the IEA found shares above 80 per cent in China at every major stage in 2022. A comparable concentration characterises vaccine production, pharmaceutical ingredients, critical minerals and, in digital technology, advanced chips, cloud services and the models that run on them. Concentration has brought down prices. It also means that a single policy decision, a trade dispute or a disaster can interrupt supply to many countries at once. The appropriate response is not self-sufficiency, which is rarely affordable, but diversification: multiple suppliers, regional production hubs, strategic stocks of critical items, and open standards that allow substitution.

10.2 The financing squeeze

The finance that pays for delivery is under pressure from two directions at once. Aid is falling. Debt service is rising. Figure 13 sets two flows beside one another. The OECD's preliminary data show that DAC official development assistance fell from US\$215.1 billion in 2024 to US\$174.3 billion in 2025, a decline of 23.1 per cent in real terms. Over the same period, the World Bank's International Debt Report records US\$415 billion of interest paid by low- and middle-income country borrowers in 2024. The two flows are not netted, because they run to and from different parties, but the comparison indicates the scale on which the problem should be understood: for the borrowers as a group, the cost of servicing past debt exceeds the entire flow of official aid.

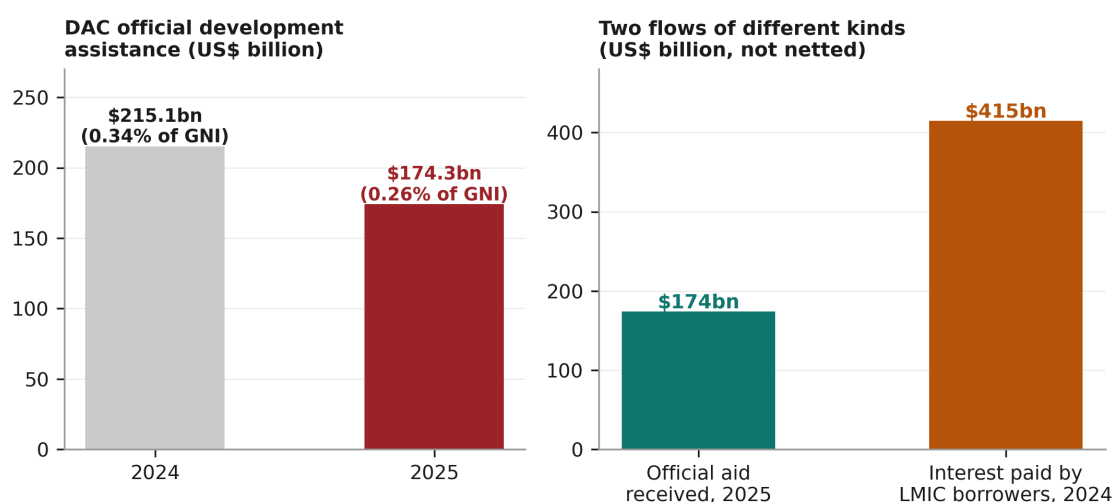


Figure 13. Aid is falling while the interest bill on past borrowing is large.

Sources: OECD preliminary ODA data for 2025 (April 2026); World Bank, International Debt Report 2025. The two flows involve different parties and are not netted; comparison is for scale.

The macroeconomic setting adds to the pressure. The [*World Bank's June 2026 Global Economic Prospects*](#) forecasts global growth of 2.5 per cent in 2026, down from 2.9 per cent in 2025, and growth in emerging market and developing economies of 3.6 per cent, with forecasts cut for two-thirds of economies since January. It warns that by 2028 developing economies other than China and India will have gone nearly a decade without narrowing the per-capita income gap with advanced economies. The financing squeeze falls hardest on the state-delivered solutions that Section 4 identified as moving away from parity, and the programmes that were funded by donors are the most exposed.

10.3 Fragmentation, licensing and standards

Fragmentation of trade and investment into blocs raises the cost of diffusion by restricting the flow of technology and by raising barriers to the movement of equipment and know-how. Licensing arrangements, as the lenacapavir case shows, can determine which countries get access to a new medicine and on what terms, and their reach can be narrower than the group of countries that need the product. Standards matter too. Open, interoperable standards in payments, health records and communications lower the cost of building on shared platforms. Proprietary or incompatible standards raise the cost of switching and the risk of dependence. An interconnected world that fragments into incompatible technology stacks is one in which late adopters will face higher costs and fewer choices.

10.4 The artificial intelligence divide

Artificial intelligence is the diffusion challenge of the present, because it is spreading rapidly and unevenly. Microsoft's data show a 10.6 percentage-point gap between the Global North and the Global South in the share of the working-age population using generative AI tools, widening because adoption in the North is growing nearly twice as fast. UNCTAD finds that access to AI infrastructure and expertise is concentrated in a handful of countries, that only six of 89 national AI strategies came from least developed countries, and that infrastructure, data and skills are the three pillars of an inclusive approach.

The AI case combines every barrier in Section 5. It requires infrastructure, such as reliable electricity and connectivity, that low-income countries lack. It depends on skills and on language coverage that favour a few major languages. Its costs are structured so that the countries with the cheapest capital can build the most capacity. And it is controlled by a small number of firms. It also offers a possible route to faster diffusion of other solutions: tools that translate, tutor, triage patients and advise farmers, delivered through the handsets that are already widespread, could reduce the cost of delivery in precisely the sectors where Section 4 shows the greatest gaps. Whether AI narrows or widens the diffusion gap depends on whether the lessons of the earlier cases, design for the last mile, shared rails, local language and capability, and government ownership, are applied while its diffusion is still young.

10.5 Principles for governing interdependence

- **Diversify without autarky.** Maintain multiple suppliers and regional production capacity for critical solutions, rather than aiming for national self-sufficiency.
- **Pre-arrange for shocks.** Build contingent financing, strategic reserves and surge capacity into delivery systems before the shock arrives.
- **Keep standards open.** Favour interoperable standards and public rails that lower switching costs and allow later entrants to participate.

- **Pool what is too small to build alone.** Regional regulators, procurement and manufacturing hubs give small countries scale.
- **Make access terms transparent.** Licensing and pricing terms should be published and, where public funds finance development, tied to access conditions.

11. A Strategy for the Diffusion Imperative

A strategy for diffusion has to work under the conditions the report has described: unequal societies, interconnected channels, a squeeze on finance and a rising number of solutions waiting to be delivered. It should be organised around outcomes, sequenced by horizon and measured so that failures are noticed.

11.1 Seven principles

- **Measure depth and durability, not only reach.** The record shows that arrival is no guarantee of use, and that use is no guarantee of persistence. Set targets for each of the four stages, and publish them by group.
- **Protect what already works.** Where a delivery system is functioning, as with routine immunisation or an agent network, shield it from the budget cuts that are most likely to hit it first.
- **Fix the state-delivered services that are moving the wrong way.** Immunisation and primary completion in low-income countries are the clearest cases. They need workforce, supply chains and information systems, not new technologies.
- **Treat the cost of capital as a first-order policy variable.** Use guarantees, local-currency lending and contingent clauses so that the price of finance reflects the performance of the solution.
- **Build the shared rails.** Invest in identity, payments, data exchange and connectivity on open terms so that each new solution is cheaper to deliver than the last.
- **Design for the excluded and measure by group.** The poorest, the rural, women and speakers of minority languages should be the design case, and outcomes reported separately for them.
- **Test for scale and keep learning.** Evaluate in representative sites, monitor fidelity and cost per outcome, and adapt as the programme grows.

11.2 Three horizons

The principles can be sequenced. In the first two years, the priority is to protect and measure: to ring-fence the delivery systems that are most exposed to funding cuts, to establish a diffusion dashboard, and to put in place the contingent financing and market-shaping instruments that can be assembled quickly. In the following three years, the priority is to build the rails and the capacity: shared digital infrastructure, lower-cost finance, a trained delivery workforce and regional pooling. Over five to ten years, the priority is to embed and diversify: to close the depth gaps in energy, clean cooking and connectivity, to diversify supply, to move core services from donor to domestic financing, and to retire programmes that no longer earn their cost.

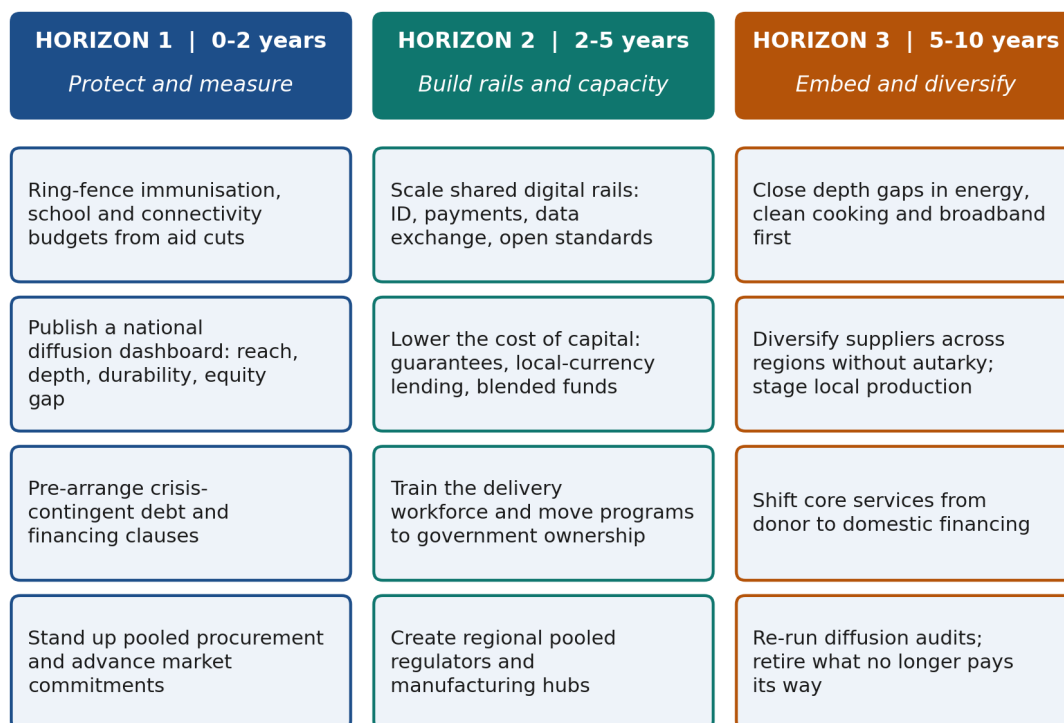


Figure 14. *A three-horizon roadmap for the diffusion imperative.*

Source: H Heuristics.

11.3 A diffusion dashboard

Strategies that are not measured drift. Table 5 proposes a compact dashboard that a government, a multilateral institution or a funder could adopt. It follows the four stages of Section 2 and adds an equity measure. The indicators are illustrative: each country will have its own priorities, and the specification should be matched to available data. The principle is that every solution in the portfolio should be tracked on reach, uptake, depth, durability and equity, and that the groups furthest behind should be reported separately.

Table 5. A diffusion dashboard: five measures and illustrative indicators

Measure	Question it answers	Illustrative indicator (source)	Typical warning sign
Reach	Is the solution available to the person?	Share of population within coverage or catchment (ITU, WHO)	Coverage gap persists where infrastructure has not been extended
Uptake	Do people use it?	Internet use; DTP1 coverage; share of adults with an account (WDI, WHO/UNICEF, Findex)	Usage gap: coverage with no use
Depth	Is use sufficient to change outcomes?	DTP3 and measles coverage; hours of reliable power; learning at grade level (WHO/UNICEF, SDG7, learning assessments)	Drop-out between first and last dose; arrival without embedding
Durability	Does it persist without outside support?	Share of programme financed in the domestic budget; years of continuous operation	Programme collapses when the donor or champion leaves
Equity	Who is left behind?	Gap between richest and poorest quintile, rural and urban, women and men	National average rises while the bottom group is flat

Source: H Heuristics. Indicators are illustrative examples; sources in brackets indicate where comparable data exist today.

11.4 Who does what

National governments own delivery and the public rails, set the regulatory and tariff framework, and publish outcomes by group. *Multilateral development banks* provide concessional finance, guarantees and technical help, and can lower the cost of capital at scale. *Donors* should sustain the market-shaping and procurement instruments that have a record of success, structure their support so that responsibility passes to governments, and avoid abrupt withdrawals that strand systems. *Private firms* supply the products and services, and can extend reach where business models allow. *Civil society and research organisations* test and adapt solutions, hold delivery to account, and generate the evidence that tells everyone else what scales. No single actor can do all of this, and the most effective arrangements, such as Gavi's, combine several.

12. Limits and What Would Change the Argument

A report that argues for measurement should be measured against its own standards. Five limits apply, and four developments would change the conclusions.

12.1 Limits

- **Aggregates hide variation.** Income-group averages combine very different countries, and income-group membership changes over time. The gradient in Figure 1 is a feature of the aggregates and should be tested country by country.
- **Causation is uncertain.** The properties listed in Table 1 are associated with faster diffusion, but few of the associations are as well identified as a randomised trial. The cases in Section 8 are selected to illustrate, not to prove.
- **Several data are preliminary or estimated.** Ember's import figures are derived from customs values, the 2026 UPI and aid figures are early releases, and learning poverty data predate the latest updates.
- **Extrapolation is arithmetic.** Figure 6 extends recent trends in a straight line and should not be read as a forecast.
- **Diffusion is not always the binding constraint.** In settings of severe conflict, weak governance or collapse, delivery of any solution may be impossible, and political settlement must come first.

12.2 What would change the argument

The argument would weaken if the recent stagnation in immunisation and primary completion proved transitory, and low-income countries returned to the faster trend of the previous decade. It would weaken if evidence showed that the cost of capital was not a binding constraint on the diffusion of capital-intensive solutions, for example if cheaper equipment alone brought adoption in high-rate settings. It would be modified if AI-enabled delivery tools were to reduce the cost of state-delivered services so sharply that the gradient flattened. And it would be strengthened, and the urgency heightened, if aid cuts proved to be larger and more lasting than the current 2025 estimates suggest, or if supply concentration were to produce a major disruption.

13. Conclusion: From Invention to Delivery

The twentieth century solved a large part of the invention problem. The twenty-first will be judged by whether it solves the delivery problem.

This report has argued that the central challenge in development is no longer to find what works but to ensure that it reaches, in working form, the people who need it. The evidence is consistent. Child mortality has fallen by half, mobile phones are nearly universal, and solar power is among the cheapest ways to generate electricity. Yet in low-income countries, in 2024, fewer than a quarter of people used the internet, fewer than half had electricity, fewer than one in six could cook with clean fuels, and the two indicators that depend most on the state, immunisation and primary completion, were moving away from the levels of richer countries. At recent rates of progress, parity would take decades for some indicators and centuries for others.

The framework of the report explains the pattern. Solutions diffuse fastest when they are divisible, affordable, privately purchased and light on infrastructure. They diffuse slowest when they need networks, large capital and the state. Unequal societies deliver to the advantaged first, and interconnected ones deliver through channels that bring both access and dependence. The barriers, the price of money, missing complements, limited trust and delivery capacity, the loss of effect at scale, and market failure, are specific enough to be diagnosed, and the design rules that respond to them are specific enough to be applied.

The urgency comes from the moment. Aid is falling, debt service is heavy, and a new technology is spreading faster where diffusion is already easiest. The strategy proposed here asks for four things: that governments, lenders and funders measure depth and durability as well as reach; that they protect and strengthen the delivery systems that work; that they invest in the rails, the finance and the capacity that make each later solution cheaper to deliver; and that they design for the excluded and report on them separately. None of these is new, and each is within reach. The diffusion imperative is the case for doing them now.

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