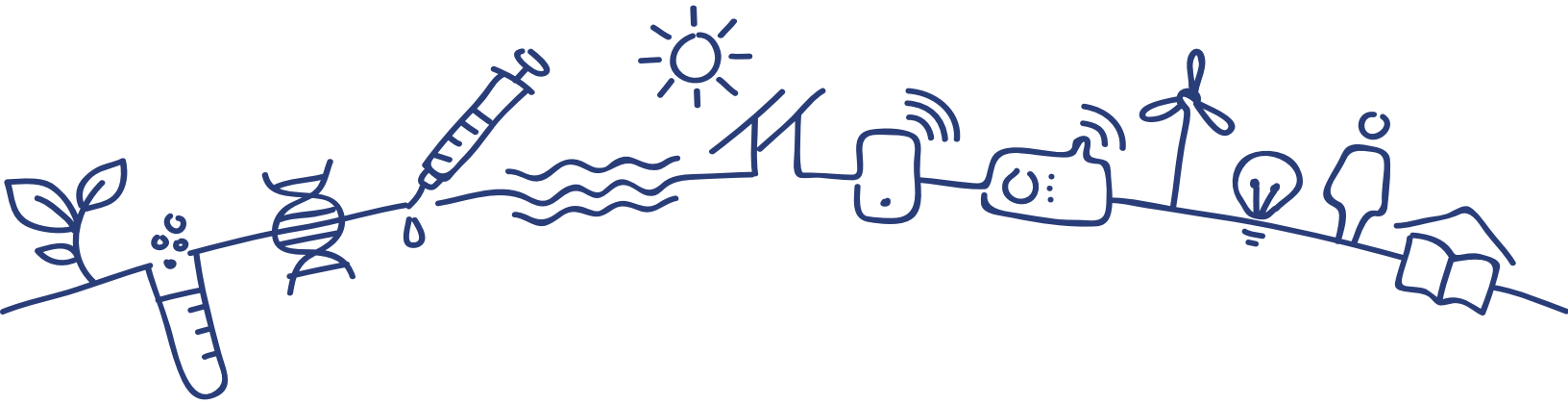
50 BREAKTHROUGHS

Critical scientific and technological advances needed for sustainable global development



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CONCLUSION

What it will take to realize the breakthroughs

Making these breakthroughs come to life will require fundamentally new approaches and business models for funding, technology development, and deployment. The technology-for-development space is currently dominated by NGOs, academic institutions and small-scale social entrepreneurs, predominantly operating on philanthropic grants, with a small but growing amount of 'impact investments'. Most of these recipients are based in—or originate from—the US or Europe. For technology to truly contribute to sustainable global development, we believe this model needs to change in three closely related ways.

Different funding modalities: Funding that creates financial viability rather than simply subsidizing unsustainable products and business models

The breakthroughs identified in this study will require considerable funding—likely hundreds of millions of dollars, if not well over $1 billion. However, more than merely increasing the amount of funding, we believe it is important to change how the funds are deployed.

Currently, most of the funding in the technology-for-development space comes from philanthropic grants. We believe this model does not lead to products which entirely meet the demands of the intended beneficiaries, but rather only to financially unsustainable, small-scale efforts with limited or no accountability beyond the duration of the grant.

In its simplest interpretation, financial sustainability means that products eventually pay for themselves without the need for ongoing subsidies. Presumably, this is because the intended users find them valuable enough to pay for them. However, some population segments will be able to pay enough for some products to make them profitable, while other segments will be too poor to do so. A nuanced analysis is required to segment the market and understand the price elasticity of each income segment. Products that meet the economic constraints of the users require considerable technical and operational prowess. We strongly believe that it is critical to make products inexpensive enough to be affordable to some—even if not all—of the relevant market segments, rather than make them too expensive, and as a result dependent on subsidies for market uptake.

This implies that the traditional model of grant funding needs to evolve much more than it has in recent years, with a much greater emphasis on investments. As illustrated in the matrix [1] below, some technologies will have attractive commercial prospects in both industrialized and developing markets, and hence should be thought of as purely commercial investments, while some will have an attractive market in developing countries only, and hence will require investments at rates-of-return that may be less than those in industrialized markets. Some technologies can be financially sustainable in the long run, but need grants for R&D and initial product development, and a few technologies are not appropriate for generating profits or even revenues. Per our analysis, only 3 of the breakthroughs identified in this study are appropriate for purely philanthropic funding, 23 will likely require grants for R&D and initial product development, and the rest are appropriate for some type of investment.

[1] This matrix has been reproduced here from the List of the 50 Breakthroughs that appears earlier in the report.

Funding mechanisms for the breakthroughs

Commercial potential	0	3	6	8	10	>>10
Non-commercial		**6.** Biometric ID systems	**46.** Distributed sensors for environmental toxins	**40.** DNA-based rape kit		
Emerging markets potential, with initial grant support	**34.** High-nutrient animal fodder	**11.** Short-course TB treatment **18.** Clinic-in-a-box **37.** New seed varieties tolerant to drought and heat	**15.** Complete cure for malaria **19.** Oxygen concentrator **20.** Automated multiplex immunoassays **21.** Point-of-care nucleic acid diagnostics **25.** Nutrient-dense infant weaning foods **28.** Precision agriculture systems for irrigation and fertilizer	**1.** Energy efficient desalination **12.** Microbicides for HIV/HPV **16.** Long-lasting chemical mosquito repellent **17.** Non-chemical spatial mosquito repellent/attractant **33.** Alternative to liquid nitrogen for preserving animal semen **43.** Sustainable aquaculture systems **35.** Portable toolkit for extension workers and veterinarians	**3-4.** Vaccines for HIV, TB, Malaria **9.** New fertilizer production systems **22.** Fully integrated diagnostic panels **24.** Thermo-stabilizing mechanism for vaccines **31.** Herbicides for weeds
Attractive for emerging markets	**7.** Affordable smartphones **10.** Utility-in-a-box for solar mini-grids **48.** New generation of low-cost, energy efficient appliances	**23.** Off-grid vaccine refrigerator **26.** Off-grid refrigerator for households and farmers **30.** Solar powered irrigation pumps **32.** Low cost tilling machine **41.** Wireless broadband technologies **51.** Low cost family transport	**42.** IoT for low income populations **45.** Retrofit filter for vehicle exhaust **44.** Affordable homes resilient to extreme climate events	**27.** Low cost refrigerated vehicle **29.** Low cost shallow water drilling system **50.** Mini-grid management solutions	**8.** New generation of homes for the poor **47.** Low cost PV mini-grid installation	
Attractive for industrialized markets		**5.** Smart electronic textbooks **14.** PrEP antiretrovirals for HIV prevention **38.** Wearable cameras **39.** Low cost aerial vehicles for imagery		**13.** Long-lasting antiretroviral for HIV **36.** Spatial on-farm pest repellent **49.** New bulk storage technologies	**24.** Thermo-stabilizing mechanism for vaccines	

Likely time to market (years), as proxy for funding required

Innovative approaches to R&D, in the absence of enough institutions dedicated to scientific research for advancing global development

Bringing these breakthroughs to life will require a considerable amount of advanced R&D, in several fields including pharmaceuticals, biomedical sciences, crop and soil sciences, food sciences, electrical engineering, mechanical engineering and software development.

Within the technology-for-development space today, dedicated R&D capabilities exist only for crop, soil and food sciences through the Consortium of International Agricultural Research Centers (CGIAR). Beyond this, the little R&D that is conducted, is undertaken by institutions that are not necessarily aligned with the objectives of global poverty alleviation. For example, most of the research for vaccines and other drugs is conducted by pharmaceutical companies in industrialized countries. These organizations are required by their corporate mandate to focus on profit-maximization rather than creating solutions for low income populations. The other source of R&D is universities (also mostly in industrialized countries), where the direct incentives of faculty and students are aligned with academic objectives like professorial tenure and grades. We believe this problem is exacerbated by excessive reliance on grants that do not incorporate mechanisms for accountability beyond the duration of the funding.

The long-term solution is concerted investment in regional and local R&D capabilities in developing countries, through government-run labs, appropriately structured academic research centers, and industrial partnerships. In the meantime, a number of creative structures and funding mechanisms will be required to extract more value from the institutions currently capable of conducting the necessary R&D, including:

- Greater utilization of private sector research in industrialized countries, potentially even subsidizing their R&D through philanthropic or public funds, or by contracting out the research. This is particularly true in biotech, where virtually all the major technological breakthroughs—pharmaceuticals, diagnostics, etc.—have been developed by companies in the US or Europe. It will be important to put in place appropriate measures to ensure that the public interest is protected, and that profit motives do not supersede public good.
- Leverage existing repositories of research and intellectual property in industrialized countries, including unused corporate IP and government-funded labs conducting advanced research. Only a small fraction of patents filed in countries like the US are ever commercialized. While most of these are likely of no use in the global development context, it is possible that some of them hold the key to some of the breakthroughs listed in our study. However, because they may not have commercial value in the industrialized markets, such patents remain 'shelved'.
- More accountable and creative structures for funding universities and other research institutions. As mentioned above, the main challenge with the way universities and academic research institutions are currently used in the technology-for-development context is the misalignment of incentives, and the lack of accountability to outcomes that can come with grant funding. Mechanisms like contracts (which can be terminated for non-delivery), combined with a shift in the nature of academic incentives (e.g., less emphasis on theoretical publications, and a greater emphasis on measurable development outcomes), can unlock a very valuable source of practical R&D.

To create sustainable businesses for deploying the technologies, work closely with the private sector—not just from India and China, but also emerging economies across Africa

In recent years, the economies of several countries in sub-Saharan Africa have demonstrated sustained, strong growth. This growth has been accompanied by greater demand for all manner of goods and services, which companies from India, China and South Africa have been making aggressive investments to meet. A salient feature of this economic growth has been the emergence of successful local companies—led by local corporate leaders—which are achieving true 'double-bottom-line' results

through efficient and sustainable business models. Countries like Kenya, Nigeria, Ghana and Rwanda are all becoming home to successful African companies which are aiming to expand their services to a larger number of consumers in their countries. While not always competitive against established multinationals, these companies are better positioned to provide effective solutions in their home markets, than are international NGOs. Even for products and services which do not lend themselves to purely profit-seeking models, such companies are well positioned to engage in public-private partnerships with their governments. Funders and technologists, alike, should make a much greater effort to find and partner with such companies.

As countries in the developing world have emerged into regional and global powers, there has been an increasing demand for accountability and pragmatism from the social sector. Unfortunately, the social sector—including the technology-for-development sector—has not kept up with these changes, and outdated philosophies and business models still persist as a legacy of the 'aid' mentality. We believe that achieving these technological breakthroughs and translating them to tangible impact will require a fundamental shift in the current incrementalist 'appropriate technologies' model, towards more ambitious and results-based approaches.

Next steps on the 50 Breakthroughs

This study aims to begin a robust and honest conversation about where and how technologies can make a real and sustainable difference to the lives of the billions living in poverty. To that end, our hope is to work with a broad range of organizations and individuals in the ecosystem, and create an ongoing 'State of the Breakthroughs' forum—a combination of online and physical discussions and events. We hope that such a forum will draw attention to innovative, impactful ideas that emerge, and that those ideas get funding as well as the right partnerships to take them to fruition.

We look forward to the conversation.

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