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# Global Public Goods That Matter for Development: A Path for US Leadership

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For more than six decades after the end of World War II, the United States took the leading role in the free world in establishing and managing the institutions and rules that make up today's global architecture of international cooperation and multilateral collective action—most notably the World Trade Organization, the World Bank and International Monetary Fund, and the United Nations and its various agencies. These are complemented today by hundreds of other official and independent global and regional networks, mixed coalitions, and clubs of business, professional, and nongovernmental organizations that together constitute a global institutional system.[2] The global economic and political "system" the United States has championed has provided the open trading environment and the security umbrella for global growth that has delivered millions from poverty in the last 30 years.

Today, the resilience of this global system is being tested by the growing number and intensity of cross-border risks—risks that pose a common threat to Americans and the world's poorest people. These risks include nonstate terrorism, climate change, pandemic diseases, cybercrime, microbial resistance to antibiotics, and more. The development challenge—of reducing poverty and inequality and raising living standards everywhere lies increasingly in managing these global risks and in broadening access to the new knowledge and opportunities that also transcend borders, from vaccines to renewable energy sources and Internet-based information technologies. Some of the risks, such as Ebola and terrorism, are rooted in the fragility of the world's poorest countries. Others, including tropical deforestation and increasing greenhouse gases in emerging markets, are worsened because carbon and other pollutants are underpriced given the damage they cause, and due to the lack of agreed global rules and appropriate financial and technological transfers from richer to poorer countries. The same can be said of unexploited opportunities at the global level.

## POLICY RECOMMENDATIONS

- Increase domestic investment in research and development (R&D) for renewable energy, agriculture, and health.
- Track and publish federal spending on development-relevant global public goods.
- Establish a target share of foreign assistance spending to be directed toward development-related global public goods.
- Use US leadership role in the World Bank to champion creation of a global public goods lending window.

In short, today as perhaps never before, there is a commanding logic to increasing the provision of what can be called development-relevant global public goods (DR-GPGs) and to strengthening the institutions of collective global action for doing so and doing so more effectively.[3] The traditional country-focused model of development assistance can no longer address the global challenges that arise from our ever more interconnected world. Moreover, as a large number of developing countries increase their capacity for domestic financing of public services, the United States will need to refocus its foreign assistance program toward those global priority areas that supplement rather than supplant countries' domestic resources.

The United States has been at the forefront of providing several DR-GPGs, including peace and security via its contributions to international peacekeeping, the monitoring of international sea trade routes, its engagement in forums such as the Financial Action Task Force to stem flows of funding to terrorist organizations, and more.[4] Yet it has not fully capitalized on its comparative advantage in research and development at home that matters especially for the world's poor, or on its opportunities for globally transformative investments abroad in such areas as clean power and disease surveillance.

Global public goods are institutions, mechanisms, and outcomes that provide quasi-universal benefits to more than one group of countries, extending to both current and future generations. They are nonrival and nonexcludable: one country's enjoyment of the good does not affect (or reduce) its enjoyment by others, and once the good becomes available, no country can be excluded from sharing its benefits. We define development-relevant global public goods (and "bads") as those global threats (climate change, disease pandemics) and opportunities (cheaper solar energy technologies, new vaccines), of particular relevance for the world's poor and vulnerable concentrated in developing countries, for which the benefits of investments by or in one single country (the United States, for example) cannot be fully captured by that country; some of the benefits will be available to other countries.

What role should the United States take in shaping an agenda to create and share DR-GPGs? We propose two areas in which the United States has a strong comparative advantage and where its leadership is in our view indispensable.[5]

1. **Invest in research and development at home. Increase US domestic investment in the research, development, and deployment of DR-GPGs** from our rough estimate of $14.6 billion per year to $20 billion by 2020, especially in agriculture and renewable energy in light of a climate-challenged world.

2. **Make investments abroad go further. Ensure that US foreign assistance locks in long-term, global benefits by supporting the creation and access to DR-GPGs in the developing world in two ways:**

   a) Define a target for increasing the share of total US foreign assistance that finances DR-GPGs (e.g., to 20 percent from our current estimate of less than 10 percent); financing could go to DR-GPG-generating US bilateral aid programs—for example, to support reducing deforestation in Indonesia, or to multilateral programs such as the Clean Technology Fund, managed by the multilateral development banks, that subsidize the incremental cost of clean energy. (See Table 1.)

   b) Take leadership in enabling the World Bank and the major regional development banks (the multilateral development banks) to increase their own engagement in the financing and management of DR-GPGs—an activity for which the multilateral development banks now have no clear mandate and only limited resources.

**Table 1 Examples of avenues for US DR-GPG investment**

| | DR-GPG generation via investment in one country | Non-country-specific DR-GPG investment |
|---|---|---|
| Via direct US (bilateral) financing of programs | US agreement with Indonesia to finance the preservation of its tropical forests | US contributions to CGIAR that go toward agricultural research and development |
| Via multilateral agencies/programs | US contributions to the Clean Technology Fund that go toward developing a solar energy plant in Morocco | US contributions to the World Health Organization that go toward global infectious disease surveillance |

**Table 2 Estimated domestic spending on DR-GPG R&D: Health, renewable energy, and agriculture areas (2013)**

| Category of contribution | Associated DR-GPG spending (in $ millions) |
|---|---|
| Health (select NIH and CDC spending[6]) | 10,629 |
| Renewable energy (select DOE spending[7]) | 2,019 |
| Agriculture (select USDA spending on ARS,[8] NIFA[9]) | 2,120 |
| Total | 14,622 |

## Investing at Home: US R&D in DR-GPGs

Solutions to many global challenges begin at home. In addition to proven leadership and unparalleled influence in the global economic and political arena, the United States has another overlooked asset for accelerating global progress in health, agriculture, energy, and other global public goods: impressive public and private research and development (R&D) systems that have transformed the development landscape. Domestic public investment in particular drives innovation that enables more effective provision of DR-GPGs.

Consider health. US resources and research and technical capacity committed to health are unparalleled. Total US public spending on medical research and development equals that of all other nations combined. Over many decades, a good proportion of this spending has gone toward the prevention and control of diseases most prevalent in developing countries. Scientists at the publicly funded National Institutes of Health (NIH) helped develop antiretroviral drugs to treat HIV/AIDS and to prevent mother-to-child transmission during birth, saving lives at home and across the developing world. The NIH's Vaccine Research Center is at the forefront of developing new vaccines for some of the most dangerous diseases, such as swine flu and Ebola. The Centers for Disease Control and Prevention (CDC) leads efforts to monitor, isolate, and treat infectious diseases, protecting the health of Americans as well as people around the globe.

These impressive advances have been financed by a relatively modest share of public health R&D funds. We estimate that the NIH spends about $10 billion, or around 30 percent of its annual budget, on health problems that are prevalent in developing countries, including vaccine development for AIDS, tuberculosis, and malaria. The CDC budgeted $483 million for "global health" (6 percent of its total budget) in 2014. These are only rough estimates, however, as neither the United States nor any other advanced economy or international organization has defined and published data on its contributions to DR-GPGs. (See Table 2.)

While the United States remains the largest funder of health R&D globally, with a strong track record on development-relevant health discoveries, funding for health has stagnated overall (NIH funding reached its peak in 2003, at $35 billion). There is now bipartisan support in the House of Representatives for increasing NIH funding; some of this funding is likely to benefit, at least indirectly, disease control and management in developing countries.[10]

## Investing at Home: R&D in Renewable Energy and Agriculture

The greatest future opportunities for the United States to champion healthier and more prosperous societies (abroad and in the United States) lie in renewable energy generation and more sustainable and productive agriculture. Both types of investments promote resilience to future economic shocks and adaptation to a changing resource landscape and to other global and national challenges as a result of climate change. US investment in the development of new technologies to mitigate the negative consequences of climate change benefits all of us, but it is vital for the citizens of the poorest nations who, with little or no personal savings and weak or nonexistent social safety nets and government emergency assistance programs to fall back on, are the most vulnerable to the coming shocks. Given its expansive R&D infrastructure, the United States has a comparative advantage in revolutionizing these sectors.

Take the recent advances in energy exploration and agricultural innovation. Massive hydraulic fracturing (fracking)—the technology behind the current "shale gas revolution"—had its origins in a Department of Energy–led gas exploration project.[11] Patents for new drilling technologies and advanced drill parts were developed by government engineers and supported by public funds. With a similar commitment to renewable energy sources, the global energy landscape could be transformed. Early US public R&D investments in renewable energy, such as the creation of the Department of Energy's Wind Program in 1975, have played an integral part in kick-starting innovation in wind technologies and making the United States a world leader in wind energy patents.[12]

At the same time, progress in renewable energy and fuels in both Europe and China has outpaced that of the United States in the last five years. China is currently the global leader in total renewable energy generation capacity, while the top five countries in terms of renewable energy generation per capita are all European nations.[13] In 2013, almost 22 percent of global electricity came from renewable energy sources. In the United States, the share of renewables in electricity generation has been growing but was below the global average in 2014, with just over 14 percent. The share of funds committed to energy efficiency and renewable energy R&D within the Department of Energy remains under 10 percent (around 7.4 percent in 2014). The share of energy in total public R&D spending is at a historical low, at $2.4 billion out of the $61 billion federal nondefense R&D budget in 2014, of which commitments to renewables represent an even smaller fraction. In comparison, federal spending on energy R&D was close to $9 billion in 1980.[14]

Domestic public investments in agriculture go back more than 150 years, to when the first land-grant universities were established by Congress with an express mandate to educate citizens about agriculture (as well as "military tactics" and "mechanic arts"). Federal funds were used in 1887 to establish agricultural experiment stations at land-grant colleges to investigate crop variations, soil properties, and other matters crucial to food production. Since then, public funding has been instrumental in the exponential growth of US agricultural productivity. A recent study of agricultural productivity between 1949 and 2002 in the 48 contiguous US states found that each state-specific agricultural research investment dollar generated national benefits averaging $32.[15] If we took into account the benefits to agricultural productivity in the rest of the world through spillovers from new technology and know-how, the returns on domestic investment would be even greater.

Despite these sizable returns to agricultural R&D and its ever-growing importance for poverty reduction, public investment is in decline. Real growth in public agricultural R&D spending has slowed considerably in the last decade, from over 3.5 percent in the 1950s and 1960s to 0.99 percent in the decades after 1990.[16] The share of funding going toward maintaining and improving farm productivity—the most important area for feeding a growing global population—declined from 66 percent to 57 percent over the last 30 years. US Department of Agriculture estimates suggest that even small commitments could secure the growth needed in agricultural output—that raising public funding for R&D by 3.73 percent annually until 2050 could result in a 73 percent increase in US production, in line with anticipated global needs.[17]

In addition to increasing the availability of financial resources for development-relevant R&D, the United States can also improve its innovation capacity by ensuring that it is an attractive place for researchers to live and work.[18] Immigration policies should foster international research collaborations, through making both more long-term visas and more opportunities for short-term visits available to highly qualified individuals abroad.[19]

## Investing Abroad: Assistance to Global Programs and to Developing Countries for Investments in DR-GPGs

In an ever more prosperous and interconnected world, traditional bilateral foreign aid's role as the primary US development policy tool is diminishing. Foreign direct investment, remittances, and governments' own revenues in developing countries now provide the bulk of development resources. At the same time, security and health threats from fragile and failed states that create large negative spillovers for the United States are on the rise. Diminished availability and access to resources fundamental to sustaining human life, such as water, land, and forests, in one part of the world have wide-ranging implications for America through their effect on migration, trade, and violent conflict. For instance, global food production will need to increase by at least 70 percent to meet the needs of a global population projected to reach 9 billion by 2050. Crops will need to produce higher yields while also being more resilient in what is likely to be a rapidly changing environment as a result of climate change.[20] These

**Table 3 Estimated US contributions to DR-GPG transfers (2013)**

| Item | Total expenditure (in $ millions) | Estimated DR-GPG share [21] | Contributions to DR-GPGs (in $ millions) |
|---|---|---|---|
| Contributions to international organizations | | | |
| UN regular budget | 568.0 | 40% | 227.2 |
| Food and Agriculture Organization of the United Nations | 113.6 | 35% | 39.8 |
| International Atomic Energy Agency | 106.9 | 100% | 106.9 |
| World Health Organization | 109.9 | 55% | 60.4 |
| World Meteorological Organization | 15.2 | 100% | 15.2 |
| Organisation for the Prohibition of Chemical Weapons | 20.1 | 100% | 20.1 |
| International Renewable Energy Agency | 3.6 | 100% | 3.6 |
| International Tropical Timber Organization | 0.3 | 100% | 0.3 |
| Contributions for international peacekeeping activities | | | |
| International peacekeeping activities | 1,913.8 | 100% | 1,913.8 |
| Bilateral economic assistance | | | |
| Global health programs | 8,065.9 | 5%[22] | 365.0 |
| Feed the Future | 1,000.0 | 15%[23] | 150.0 |
| Multilateral assistance | | | |
| Global Environment Facility | 124.8 | 53%[24] | 66.1 |
| Clean Technology Fund | 175.3 | 100% | 175.3 |
| Strategic Climate Fund | 47.4 | 100% | 47.4 |
| Total | 12,264.8 | | 3,191.1 |

Source:

shifting global dynamics warrant a new look at the allocation of foreign assistance.

Compared to aid to developing countries for country-specific programs, development-relevant spending directed to international institutions and to countries that are producing DR-GPGs is small. We estimate that in 2013 about $3.2 billion of the State Department's budget—which includes contributions to international organizations as well as USAID (US Agency for International Development) and State Department–led development assistance—went toward providing global public goods (Table 3). This is equivalent to about 10 percent of US spending of just over $30 billion on official development assistance in the same year (and represents only about 6.5 percent of the State Department's total budget).

Yet, the United States has an important role to play in enabling low-emission development in poor countries and in safeguarding natural resources of global importance. Reducing tropical deforestation is an ideal starting point for US investment: it has cross-cutting benefits for global health and food security as well as renewable energy generation and complements domestic US investment in renewable energy R&D. The United States could negotiate its own performance-based agreements with developing countries, in which actual transfers would be based on verified reductions in rates of deforestation.[25] The recently launched Green Climate Fund offers further opportunities for the United States to invest in DR-GPGs: funds go toward supporting developing-country projects in energy efficiency, testing and implementation of renewable energy technologies, and many other climate-relevant operations.

The United States must also do more, both in terms of direct commitments and through its influence at multilateral institutions, to address the nutritional needs of future generations. At the World Bank, an institution that in principle could take leadership in financing the dissemination of DR-GPGs,[26] limited grant funding for such organizations and programs as CGIAR and the Global Development Network (which supports creation of research capacity in developing countries) is declining. CGIAR—which faces a 6 percent decrease in funds from the bank in 2015[27]—has been at the forefront of agriculture R&D to improve crops and agricultural technologies in developing countries today and to meet the needs of future generations. Its 15 global research centers released 44 new rice varieties in 2013 alone, including new flood-, drought-, and salt-tolerant varieties, each adapted to the specific conditions faced by farmers in different developing countries.[28] R&D spillovers from US (and multilateral) investments in these international research centers benefit both US and developing country producers. For example, wheat varieties developed by the CGIAR-affiliated International Maize and Wheat Improvement Center were identified as the "ancestors" in about one-fifth of total US wheat acreage by the early 1990s.[29] Despite the proven successes, the financial stability of CGIAR and development-relevant agricultural R&D is not guaranteed. Additional World Bank support to DR-GPGs comes through such donor-financed trust funds as the Climate Investment Facilities. However, this support is ad hoc to the extent that it depends on individual donor initiatives and is not "owned" by the World Bank's borrowing countries. In effect the bank operates through these trust funds as an agent, and its operations are vulnerable to shifts in donor preferences.[30] Faltering US leadership at multinationals, also evidenced by US resistance to a large World Bank recapitalization in 2010, has contributed to the bank's limited ability and willingness to address global issues.

Overall funding for DR-GPGs from the multilateral banks and the many UN agencies that work on development programs is relatively small. A large share of funding from the World Health Organization for health and from the Food and Agriculture Organization for agriculture programs supports country programs with local or national impact; the same is true for the Global Fund to Fight AIDS, Tuberculosis and Malaria ($3.9 billion in 2013) and for the Global Partnership for Education ($742 million in 2014). These are important programs, of course, but they are not in the category of global public goods, as virtually all the benefits of those programs are captured by the countries that receive them.

## The Data Problem: Counting What Counts

The challenge of global public goods provision is exacerbated by a lack of reporting by individual countries and international organizations. Neither the United States nor any of the major institutions with a global mission, such as the World Bank or the United Nations, report on the funds or programs they dedicate to global public goods. Nations spearheading the effort for global prosperity have not agreed on any standard definition of global public goods, nor do they report systematically on their own spending (according to their own definition) on global public goods.

As a global advocate for transparency and accountability in government and a member of the International Aid Transparency Initiative, the United States should be at the forefront of making domestic as well as foreign public goods spending visible and trackable. The definition and measurement of international transfers for DR-GPGs will also allow the United States to report transfers for DR-GPGS under either traditional overseas development assistance (ODA), which counts foreign assistance to low-income countries, or as "total official support for sustainable development" (TODS), which is a category that can reflect transfers for DR-GPGs that go to middle-income countries not eligible for ODA, including Peru, Brazil, Indonesia, South Africa, and others. The US definition and reporting on DR-GPGs could rely on existing efforts to develop a new measure of donor funding for global functions. A new indicator for health global public goods recently published in *The Lancet* combines globally relevant ODA with donor spending on development-relevant health R&D.[31] Such a measure would allow the United States to highlight its contributions to DR-GPGs via its domestic investments while enabling better priority setting for global assistance.

## Policy Recommendations

The next US president, working closely with Congress, has an opportunity and a responsibility to revitalize the nation's leadership in the creation and provision of global public goods that are critical to global development. We have four specific recommendations to increase the impact of US public spending both via investments at home and via those abroad.

### 1 Increase domestic public investment in R&D for renewable energy, agriculture, and health.

The Unites States has unmatched capacity for scientific research and innovation through its outstanding private and public R&D systems. Renewable energy sources make a logical priority investment given the projected negative consequences of climate change for growth, production, and livelihoods. A recent report by the American Energy Innovation Council, endorsed by US industry leaders such as Bill Gates, Jeff Immelt, and Ursula Burns, suggests that $16 billion a year should be invested in clean energy innovation.[32] The additional funding would easily be absorbed by the R&D community and would enable US scientists and research centers to develop affordable alternative energy sources for households and industries in both the developed and developing world[33] Even relatively small increases in fuel taxes to reflect the negative externalities (congestion, emissions, health costs of local pollution) associated with fuel use would provide the majority of the funding needed.[34]

In light of the need for rapid advances in agricultural productivity, scaling up R&D in agriculture at home and abroad is one of the highest-return investments the United States could make in sustainable development for the future. The returns to development-relevant agricultural research are particularly impressive: CGIAR estimates that every dollar invested in the CGIAR Fund results in about nine dollars in increased productivity in developing countries. Overall, an $8 billion increase in global spending in agricultural R&D is predicted to reduce the prevalence of hunger by 63 percent by 2050.[35]

While the bipartisan support for increased funding for the NIH is a welcome development, it is important to ensure that, beyond 2018, funding keeps pace with historical growth rates, which averaged 2.9 percent between 1977 and 2010.[36] A large share of additional funding should be directed toward pandemics and global health threats that originate in the poorest nations, where health systems are often too fragile to contain spillovers to other countries.

### 2 Develop standards for measuring national spending on DR-GPGs and publish information on US funds dedicated to them annually.

We propose that the president charge the Office of Management and Budget with defining and developing standards for measuring domestic public investment in DR-GPGs. All US government agencies should monitor and publish the size and share of funds they spend on DR-GPGs, both in terms of funds invested domestically, such as those going toward development-relevant R&D, and funds invested abroad via multilaterals, international organizations, and country-specific global projects, such as those aimed at reducing deforestation. This will both highlight US leadership in providing global public goods through public investment at home and show how US foreign assistance and other spending abroad benefit the global community—including those living in the United States. Development of reporting protocols and standards should take place in coordination with the measures and reporting standards of the OECD (Organisation for Economic Co-operation and Development).[37]

### 3 Shift from ad hoc to more strategic and leveraged allocation of US foreign assistance: provide a modest increase in the proportion of total assistance that goes toward global public goods, with a target of 20 percent over eight years. Focus contributions to DR-GPGs on agriculture, forests, and renewable energies in light of the growing challenges arising from climate change.

Given the diminishing importance of traditional bilateral aid among development resources and the growing number of global threats to US and worldwide prosperity, we propose that over the first four years of the presidential term, the next president support the (re)allocation of a substantial amount of US foreign assistance toward DR-GPGs.

Public investment by the United States can also be leveraged to crowd in private-sector investment and skills through targeted incentives. Publicly guaranteed markets for vaccines in poor countries through advance market commitments,[38] for example, can encourage private entities to develop marketable products to address low-income country needs. The Overseas Private Investment Corporation can also help leverage private investments for clean energy in developing and middle-income countries, which would serve traditional developmental objectives such as reducing energy poverty while encouraging the provision of DR-GPGs.[39]

### 4 Champion the idea of a DR-GPG window at the World Bank to better leverage limited resources over the long term.

The next president should use US leverage and influence among World Bank shareholders to provide the bank with a mandate for the support of DR-GPGs, along with some grant financing to support that mandate. As part of this mandate, the next president should champion the creation of a new global public goods window (Global Window) at the World Bank to support investments and programs such as basic agricultural and health research in developing countries; to mainstream subsidies to cover the incremental costs of low-carbon transport, power, and urban housing projects; to perform research and provide policy guidance on making a market for climate-related financing; and to fund the licensing of proprietary technologies for poor countries, among other functions. The United States should use its leadership and influence within the World Bank to give it an explicit global public goods mandate, along with the necessary grant funding, to provide strategic and collective action in response to global demands.[40]

## Additional Reading

Nancy Birdsall. *The World Bank and Global Climate Change: Forever a Big Fish in a Small Pond?* CGD Policy Paper 007. Washington, DC: Center for Global Development, 2012. www.cgdev.org/content/publications/detail/1426335.

Nancy Birdsall and Anna Diofasi. "Global Public Goods for Development: How Much and What For." CGD Note, May 18, 2015. www.cgdev.org/publication/global-public-goods-development-how-much-and-what.

Nancy Birdsall and Alexis Sowa. *The United States: From Multilateral Champion to Handicapped Donor...and Back Again?* CGD Policy Paper 030. Washington DC: Center for Global Development, 2013. www.cgdev.org/publication/united-states-multilateral-champion-handicapped-donor-and-back-again.

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Philip G. Pardey and Julian M. Alston. 2010. *U.S. Agricultural Research in a Global Food Security Setting*. Washington: Center for Strategic and International Studies. http://csis.org/files/publication/100111_Pardey_USAgriRes_Web.pdf.

## Notes

[1] We are grateful to Shanta Devarajan, Alan Gelb, and Ben Leo for their insight and comments on this brief.

[2] On global networks and mixed coalitions of official and civil organizations, see William Savedoff, "Global Government, Mixed Coalitions, and the Future of International Cooperation," and Nancy Birdsall, "Global Markets, Global Citizens, and Global Governance in the Twenty-First Century," in *Towards a Better Global Economy*, ed. Franklin Allen, Jere R. Behrman, Nancy Birdsall, Shahrokh Fardoust, Dani Rodrik, Andrew Steer, and Arvind Subramanian (Oxford, UK: Oxford University Press, 2014). The Birdsall chapter is also available at www.cgdev.org/publication/global-markets-global-citizens-and-global-governance-21st-century-working-paper-329-0.

[3] As far as we know, the term "DR-GPGs" was first used by us in Nancy Birdsall and Anna Diofasi, "Global Public Goods for Development: How Much and What For," CGD Note, May 18, 2015, www.cgdev.org/publication/global-public-goods-development-how-much-and-what.

[4] This engagement in global security is also reflected in the US score on the security component of CGD's Commitment to Development Index, where the United States ranks higher than the OECD average and where it also scores considerably higher than its overall score across all components. See www.cgdev.org/initiative/commitment-development-index/index.

[5] It is often remarked that the United States is the "indispensable" nation to global security. Birdsall and Sowa (2013) argue that it has been indispensable to the creation of a development-friendly system of global governance based on international institutions and rules, and that its faltering leadership and the growing skepticism about its growth model, especially since the global financial crisis starting in 2008, puts the overall system at risk (Nancy Birdsall and Alexis Sowa, "The United States: From Multilateral Champion to Handicapped Donor ... and Back Again?" CGD Policy Paper 29, Washington, Center for Global Development [2013]). On the latter, see also Nancy Birdsall and Francis Fukuyama, "The Post-Washington Consensus: Development after the Crisis," *Foreign Affairs* 90, no. 2 (2011): 8.

[6] Includes NIH spending on research related to global warming / climate change; hepatitis A, B, and C; HIV/AIDS (80 percent of total); immunization (70 percent of total); infectious diseases (70 percent of total); malaria; malaria vaccine; tuberculosis; tuberculosis vaccine; vaccine-related research (including AIDS); vector-borne diseases; and the West Nile virus. CDC spending counted here is that on "global programs." For the breakdown of the NIH's budget by spending category, see http://report.nih.gov/categorical_spending.aspx.

[7] The US Department of Energy's Energy Efficiency and Renewable Energy Program and ARPA-E.

[8] The US Department of Agriculture's Agricultural Research Service: all spending on research programs counted.

[9] National Institute of Food and Agriculture: research and education activities, extension activities, and integrated activities.

[10] The potential returns on health R&D are considerable. Devoting an additional $100 million directly to HIV vaccine R&D has been estimated to generate returns of 600 percent. See Dean T. Jamison, Prabhat Jha, Ramanan Laxminarayan, and Toby Ord, *Infectious Disease, Injury, and Reproductive Health*, 2012 Global Copenhagen Consensus Challenger Paper, www.copenhagenconsensus.com/sites/default/files/infectiousdisease.pdf.

[11] Michael Shellenberger, Ted Nordhaus, Alex Trembath, and Jesse Jenkins, *Where the Shale Gas Revolution Came From* (Oakland, CA: Breakthrough Institute, 2012), http://thebreakthrough.org/images/main_image/Where_the_Shale_Gas_Revolution_Came_From2.pdf.

[12] A Department of Energy evaluation of its wind energy R&D program found that a quarter of the 695 wind energy patent families assigned to leading innovators in wind energy were linked to earlier DOE-supported wind energy patents. See Thomas M. Pelsoci, *Retrospective Benefit-Cost Evaluation of U.S. DOE Wind Energy R&D Program* (Washington: US Department of Energy, 2010), http://energy.gov/sites/prod/files/2015/05/f22/wind_bc_report10-14-10.pdf.

[13] REN21, *Renewables 2014: Global Status Report* (Paris: REN21, 2014), www.ren21.net/Portals/0/documents/Resources/GSR/2014/GSR2014_KeyFindings_low%20res.pdf.

[14] For more detailed graphs and tables on historical US energy spending, see the American Association for the Advancement of Science, "Historical Trends in R&D," R&D Budget and Policy Program website, www.aaas.org/page/historical-trends-federal-rd.

[15] J.M. Alston, M.A. Andersen, J.S. James, and G.P. Pardey, *Persistence Pays: U.S. Agricultural Productivity Growth and the Benefits from Public R&D Spending* (New York: Springer, 2010).

[16] P.G. Pardey and J.M. Alston, *U.S. Agricultural Research in a Global Food Security Setting* (Washington: Center for Strategic and International Studies, 2010).

[17] See Paul Heisey, Sun Ling Wang, and Keith Fuglie, *Public Agricultural Research Spending and Future U.S. Agricultural Productivity Growth: Scenarios for 2010–2050* (Washington: US Department of Agriculture, 2011), www.ers.usda.gov/media/118663/eb17.pdf. Of course, private US agrifirms could and do also finance R&D. However, the proprietary nature of most privately developed innovations could limit their affordability to people in developing countries. There is also the risk that increases in US productivity could make agriculture in the poorest countries less competitive in some crops. Still, in the long run, more knowledge of productivity-increasing farming techniques and crop varieties will generate benefits for developing countries, whether in the form of lower food prices or higher productivity in their own agriculture.

[18] Committee for Economic Development, *America's Basic Research: Prosperity through Discovery* (Washington: Committee for Economic Development, 1998), https://www.ced.org/pdf/Americas-Basic-Research.pdf.

[19] For further recommendations on US immigration policy, see Michael Clemens and Nabil Hashmi, "Modernizing US Migration Policy for Domestic and Development Gains," Chapter B in *The White House and the World: Practical Proposals on Global Development for the Next US President* (Washington: Center for Global Development, 2015).

[20] William Cline, *Global Warming and Agriculture: Impact Estimates by Country* (Washington: Center for Global Development, 2007).

[21] These shares are our best estimates given the limited information available on spending by international organizations. For a detailed discussion on which programs are counted, see Nancy Birdsall and Anna Diofasi, "Global Public Goods for Development: How Much and What For," CGD Note, May 18, 2015,

www.cgdev.org/publication/global-public-goods-development-how-much-and-what.

[22] Funds going toward combatting infectious diseases are considered to be DR-GPG transfers.

[23] Funds going toward agricultural R&D are considered to be DR-GPG transfers.

[24] Funds going toward the climate change, international waters, and chemicals focal areas are considered to be DR-GPG transfers. Data on fund allocation is based on the Global Environment Facility's 2014 cohort.

[25] These could be modeled on agreements Norway has made with Brazil, Indonesia, Guyana, and other forested countries. See, for example, Jonah Busch and Nancy Birdsall's assessment of the Guyana-Norway agreement: "Assessing Performance-Based Payments for Forest Conservation: Six Successes, Four Worries, and Six Possibilities to Explore of the Guyana-Norway Agreement," CGD Note, April 7, 2014, www.cgdev.org/publication/assessing-performance-based-payments-forest-conservation-six-successes-four-worries-and. For more details, see the White House and the World brief "Protecting Tropical Forests, Global Prosperity, and Climatic Stability" by Frances Seymour. "Shifting the Foreign Aid Paradigm—Paying for Outcomes" by William Savedoff, Rita Perakis, and Beth Schwanke provides a number of implementation strategies for a diverse range of projects. Both are available at www.cgdev.org/whitehousedev.

[26] Nancy Birdsall, *The World Bank and Global Climate Change: Forever a Big Fish in a Small Pond?* CGD Policy Paper (Washington: Center for Global Development, 2012), www.cgdev.org/content/publications/detail/1426335.

[27] See FY15 World Bank Budget, http://goo.gl/L66faE. The Development Grants Facility has been financed from the annual administrative budget of the World Bank, which is in turn financed by the bank's net income.

[28] Overall, the benefits of CGIAR research are estimated at $10.8 billion a year for rice, $2.5 billion for wheat, and $0.8 billion for maize in Asia alone.

[29] P.G. Pardey and J.M. Beddow, *Agricultural Innovation: The United States in a Changing Global Reality* (Chicago: Chicago Council on Global Affairs, 2013), www.thechicagocouncil.org/sites/default/files/Agricultural_Innovation_Final%281%29.pdf.

[30] Nancy Birdsall, *The World Bank and Global Climate Change: Forever a Big Fish in a Small Pond?* CGD Policy Paper (Washington: Center for Global Development, 2012), www.cgdev.org/content/publications/detail/1426335. See also Nancy Birdsall and Devesh Kapur, *The Hardest Job in the World: Five Crucial Tasks for the New President of the World Bank* (Washington: Center for Global Development, 2005), www.cgdev.org/content/publications/detail/2868, for an earlier recommendation that the World Bank concentrate more on global public goods.

[31] Marco Schäfferhoff, Sara Fewer, Jessica Kraus, Emil Richter, Lawrence H. Summers, Jesper Sundewall, Gavin Yamey, and Dan T. Jamison, "How Much Donor Financing for Health Is Channeled to Global versus Country-Specific Aid Functions?" *The Lancet* online ahead of print, July 12, 2015, www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(15)61161-8.pdf.

[32] For the full report, see American Energy Innovation Council, *A Business Plan for America's Energy Future,* (Washington: American Energy Innovation Council, 2010), www.americanenergyinnovation.org/wp-content/uploads/2012/04/AEIC_The_Business_Plan_2010.pdf.

[33] Developed country adoption of clean energy sources implies lowering the global risks associated with continued high levels of fossil fuel use and its impact on global climate. For developing countries, there is a difficult trade-off in the short term between the energy poverty of the poor and increasing fossil fuel consumption. Nevertheless, all countries and people will benefit from a technological breakthrough in renewable energy. See Todd Moss, Roger Pielke Jr., and Morgan Bazilian, *Balancing Energy Access and Environmental Goals in Development Finance: The Case of the OPIC Carbon Cap,* CGD Policy Paper 038 (Washington: Center for Global Development, 2014), www.cgdev.org/sites/default/files/balancing-energy-access-case-opic-carbon-cap_0.pdf.

[34] At a yearly US gasoline consumption of 137 billion gallons, a 10-cents-per-gallon increase would provide an additional $13.7 billion in government revenue. For an analysis on the corrective taxes needed to eliminate negative externalities from fossil fuels and the associated gains, see David Coady, Ian Parry, Louis Sears, and Baoping Shang, *How Large Are Global Energy Subsidies?* IMF Working Paper (Washington: International Monetary Fund, 2015), www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf.

[35] The Copenhagen Consensus Expert Panel report estimates that the internal rate of return to increased investments in agricultural R&D is 61 percent with a benefit-cost ratio of 16.1. For more details, see John Hoddinott, Mark Rosegrant, and Maximo Torero, *Investment to Reduce Hunger and Malnutrition*, 2012 Global Copenhagen Consensus Challenge Paper, www.copenhagenconsensus.com/sites/default/files/hungerandmalnutrition.pdf.

[36] Kwame Boadi, *Erosion of Funding for the National Institutes of Health Threatens U.S. Leadership in Biomedical Research* (Washington: Center for American Progress, 2014), https://www.americanprogress.org/issues/economy/report/2014/03/25/86369/erosion-of-funding-for-the-national-institutes-of-health-threatens-u-s-leadership-in-biomedical-research/.

[37] For more details, see OECD, "Measuring Total Official Support for Sustainable Development," July 2015, www.oecd.org/dac/financing-sustainable-development/Addis%20flyer%20-%20TOSSD.pdf.

[38] An advance market commitment is a legally binding agreement for an amount of funds to subsidize the purchase, at a given price, of an as yet unavailable vaccine against a specific disease causing high morbidity and mortality in developing countries. For more details, see Owen Barder, *Making Markets for Vaccines—Ideas to Action*, CGD Policy Brief (Washington: Center for Global Development, 2005), www.cgdev.org/sites/default/files/2792_file_Making_Markets_Brief.pdf.

[39] Todd Moss and Benjamin Leo, "Let There Be Light: Washington's Ambitious Plan to Help Africa Generate Electricity," *Foreign Affairs*, September 2, 2014.

[40] See also Nancy Birdsall and Devesh Kapur, *The Hardest Job in the World: Five Crucial Tasks for the New President of the World Bank* (Washington: Center for Global Development, 2005), www.cgdev.org/content/publications/detail/2868.

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