

# The Science of Sustainability

EXPLORING A UNIFIED PATH FOR  
DEVELOPMENT AND CONSERVATION



While the U.S. city of Louisville, Kentucky isn't known globally for the environmental work happening there, that might very well change—the city has become home to a first-of-its-kind collaboration between environmentalists, city leaders and public health professionals. The Green Heart Project, funded in part by the United States National Institutes of Health, will plant trees in neighborhoods throughout the city and monitor how they affect residents' health. It's a boundary-pushing medical trial—a controlled study of nature as a medical intervention.

Green Heart is just one project in one city, but it represents a new way of thinking about the role of conservation in solving human problems. It is part of an emerging model for cross-sector collaboration that aims to create a world ready for the sustainability challenges ahead.

Is this world possible? Here, we present a new science-based view that says “yes”—but it will require new forms of collaboration across traditionally disconnected sectors, and on a near unprecedented scale.



## A False Choice

Many assume that economic interests and environmental interests are in conflict. But new research makes the case that this perception of development vs. conservation is not just unnecessary but actively counterproductive to both ends. Achieving a sustainable future will be dependent on our ability to secure both thriving human communities and abundant and healthy natural ecosystems.

The Nature Conservancy partnered with the University of Minnesota and 11 other organizations to ask whether it is possible to achieve a future where the needs of both people and nature are advanced. Can we actually meet people's needs for food, water and energy while doing more to protect nature?

**“The perception of development vs. conservation is not just unnecessary, but actively counterproductive to both ends.”**

To answer this question, we compared what the world will look like in 2050 if economic and human development progress in a “business-as-usual” fashion and what it would look like if instead we join forces to implement a “sustainable” path with a series of fair-minded and technologically viable solutions to the challenges that lie ahead.

In both options, we used leading projections of population growth and gross domestic product to estimate how demand for food, energy and water will evolve between 2010 and 2050. Under business-as-usual, we played out existing expectations and trends in how those changes will impact land use, water use, air quality, climate, protected habitat areas and ocean fisheries. In the more sustainable scenario, we proposed changes to how and where food and energy are produced, asking if these adjustments could result in better outcomes for the same elements of human well-being and nature. Our full findings are described in a peer-reviewed paper—“An Attainable Global Vision for Conservation and Human Well-Being”—published in *Frontiers in Ecology and the Environment*.

These scenarios let us ask, can we do better? Can we design a future that meets people's needs without further degrading nature in the process?

Our answer is “yes,” but it comes with several big “ifs.” There is a path to get there, but matters are urgent—if we want to accomplish these goals by mid-century, we'll have to dramatically ramp up our efforts now. The next decade is critical.



Furthermore, changing course in the next ten years will require global collaboration on a scale not seen perhaps since World War II. The widely held impression that economic and environmental goals are mutually exclusive has contributed to a lack of connection among key societal constituencies best equipped to solve interconnected problems—namely, the public health, development, financial and conservation communities. This has to change.

The good news is that protecting nature and providing water, food and energy to a growing world do not have to be either-or propositions. Our view, instead, calls for smart energy, water, air, health and ecosystem initiatives that balance the needs of economic growth and resource conservation equally. Rather than a zero-sum game, these elements are balanced sides of an equation, revealing the path to a future where people and nature thrive together.

***“The impression that economic and environmental goals are mutually exclusive has contributed to a lack of connection among some of the sectors best equipped to solve such interconnected problems.”***



## TESTIMONIALS

DR. SANIA NISHTAR, SI, FRCP, PhD  
*Co-Chair, Independent High-Level Commission on  
Non-Communicable Diseases, World Health Organization*



“We must choose to prioritise long-term sustainability over short-term gratification, and calculate the true cost borne by societies in the future instead of just the price of actions and policies today. The global community has a responsibility to facilitate this transformation, and it starts by recognizing the environment as a key determinant of human health.”

DOMINIC WAUGHRAY  
*Head of the Centre for Global Public Goods, Member of  
the Executive Committee, World Economic Forum*



“We have the knowledge, power and technology to fast-track solutions to the enormous environmental challenges we face. We just need to act much quicker, together and smarter. This analysis offers a wide lens on global systems and shows what’s possible by energizing communities, partnerships and innovative alliances while helping people harness Fourth Industrial Revolution technologies to drive impact.”

ACHIM STEINER  
*Administrator  
United Nations Development Programme*



“Nature-based solutions for climate are one of the most cost-effective approaches we have for achieving our climate goals. They also provide multiple co-benefits for achieving the Sustainable Development Goals. Investing in nature is not only the smart thing to do, it is the right thing to do.”

DR. GARY L. GOTTLIEB, MD, MBA  
*Chief Executive Officer, Partners in Health*



“As we have seen in the fight for health equity, working towards a sustainable world requires a multisectoral approach in which people, their surrounding environment, and the economy flourishes because all sectors have come together in partnership towards a common purpose.”

SIR ANDREW HAINES  
MBBS, MD, FRCP, FRCGP, FRCGP, FMedSci  
*Professor, Environmental Change and Public Health  
London School of Hygiene & Tropical Medicine*



“This landmark report shows how, with bold and ambitious policies which integrate the achievement of conservation and development goals, it is possible for humanity to flourish at much lower levels of environmental impact than hazardous ‘business-as-usual’ approaches.”

DR. CINDY HUANG, PhD, MPA  
*Co-Director of Migration, Displacement, and  
Humanitarian Policy, Center for Global Development*



“We are facing unprecedented global challenges, from climate change to refugee crises to pandemic threats. The linkages between such challenges have yet to be fully explored and appreciated. This new study puts into stark relief why we must look for solutions across sectors and silos.”

DR. GEORGINA MACE, PhD  
*Professor and Head of the Centre for Biodiversity and  
Environment Research, University College London*



“Our growing understanding of the intricate links between nature and the well-being of people shows that there are many options that do not lead to trade-offs between the economy and the environment. The problem is that almost all institutions and decision-making bodies treat the economy, health and the natural environment in separate silos. This governance challenge is critical to address soon.”

DR. HAROLD MOONEY, PhD  
*Senior Fellow Emeritus,  
Stanford Woods Institute for the Environment*



“This important, path-breaking study indicates that—even with projected population and GDP growth—it’s indeed possible to maintain global conservation targets. As it reports, this would require unprecedented policy shifts and collaborations across traditionally disconnected sectors. But it explicitly and holistically shows us what the future could look like. There is promise for what we want to see, but we have to commit to change.”

DR. TERRY CHAPIN, PhD  
*Professor Emeritus, University of Alaska Fairbanks,  
Center for Humans & Nature*



“This paper moves beyond clashing worldviews, which argue that the needs of people must be sacrificed for nature or that nature must be sacrificed for people. Instead, it takes critical goals of each and asks whether they are compatible. Can they be met? Coarse-scale modeling has its limitations, but these findings show a future in which people and nature thrive is indeed plausible and worth working towards.”

# Two Paths to 2050

This vision is not a wholesale departure from what others have offered. A number of prominent scientists and organizations have put forward important and thoughtful views for a sustainable future; but often such plans consider the needs of people and nature in isolation from one another, use analyses confined to limited sectors or geographies, or assume that some hard tradeoffs must be made, such as slowing global population growth, taking a reduction in GDP growth or shifting diets off of meat. Our new research considers global economic development and conservation needs together, more holistically, in order to find a sustainable path forward.

What could a different future look like? We've used as our standard the United Nations' Sustainable Development Goals (SDGs), a set of 17 measures for "a world where all people are fed, healthy, employed, educated, empowered and thriving, but not at the expense of other life on Earth." Our analysis directly aligns with ten of those goals. Using the SDGs as our guideposts, we imagine a world in 2050 that looks very different than the one today—and drastically different from the one we will face if we continue in business-as-usual fashion.

## UN SUSTAINABLE DEVELOPMENT GOALS (SDGs) ADDRESSED DIRECTLY IN OUR ANALYSIS



The UN SDGs envision a world where all people are fed, healthy, employed, educated, empowered and thriving, and where all other life persists.

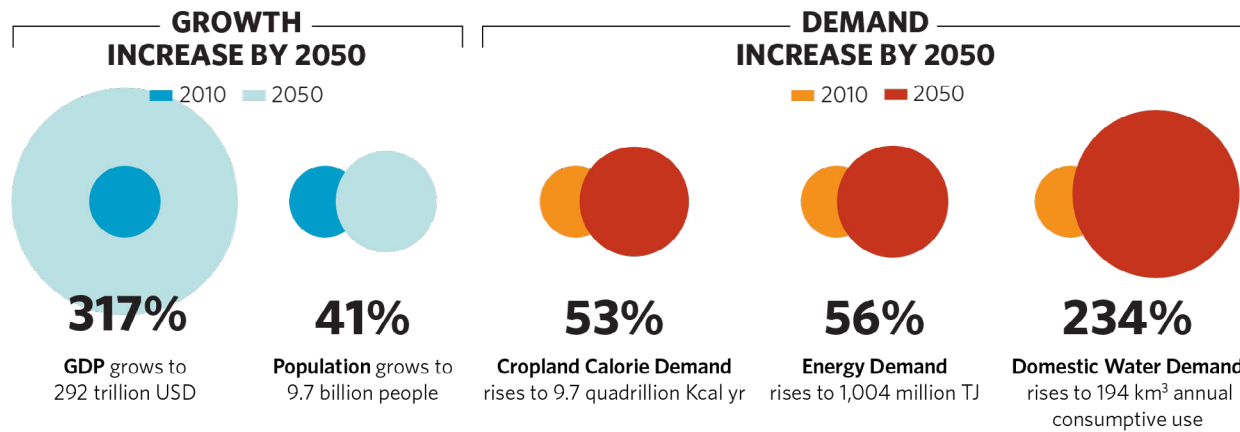


<sup>1</sup> We recognize there are many interconnections among the SDGs. Represented here is the subset included in the modeling exercise.



To create our assessment of business-as-usual versus a more sustainable path, we looked at 14 measurements including temperature change, carbon dioxide levels, air pollution, water consumption, food and energy footprints, and protected areas.

## Projected Growth in Population and Resource Demands by 2050



Over the next 30 years, we know we'll face rapid population growth and greater pressures on our natural resources. The statistics are sobering—with 9.7 billion people on the planet by 2050, we can expect a 54 percent increase in global food demand and 56 percent increase in energy demand. While meeting these growing demands and achieving sustainability is possible, it is helpful to scrutinize where the status quo will get us.

The World Health Organization, World Economic Forum and other leading global development organizations now say that air pollution and water scarcity—environmental challenges—are among the biggest dangers to human health and prosperity. And our business-as-usual analysis makes clear what many already fear: that human development based on the same practices we use today will not prepare us for a world with nearly 10 billion people.

To put it simply, if we stay on today's current path, we risk being trapped in an intensifying cycle of scarcity—our growth opportunities severely capped and our natural landscapes severely degraded. Under this business-as-usual scenario, we can expect global temperature to increase 3.2°C; worsened air pollution affecting 4.9 billion more people; overfishing of 84 percent of fish stocks; and greater water stress affecting 2.75 billion people. Habitat loss continues, leaving less than 50 percent of native grasslands and several types of forests intact.

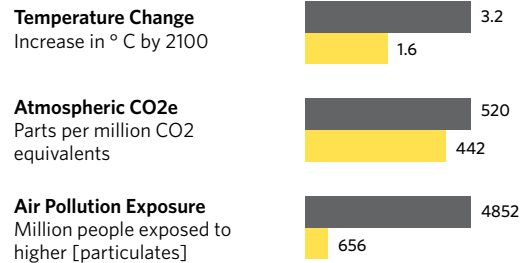
## Our Findings: Two Paths to 2050

If we stay on today's business-as-usual path, we risk an intensifying cycle of scarcity. But with some changes to how we meet our food, water and energy demands, we can find a much more sustainable pathway to mid-century.

■ Business As Usual ■ Sustainable Path

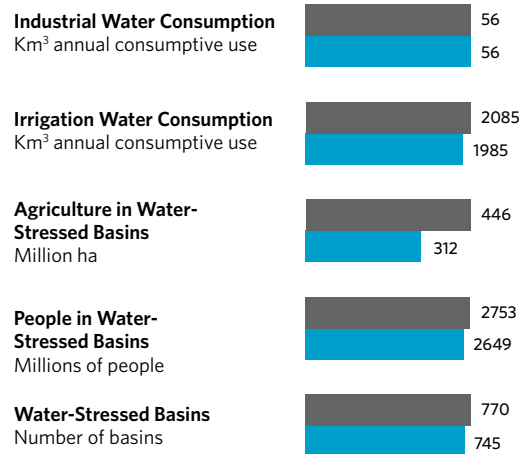
### AIR & CLIMATE

By shifting energy production away from fossil fuels, we constrain CO2 emissions, limit global temperature increases and reduce air pollution.



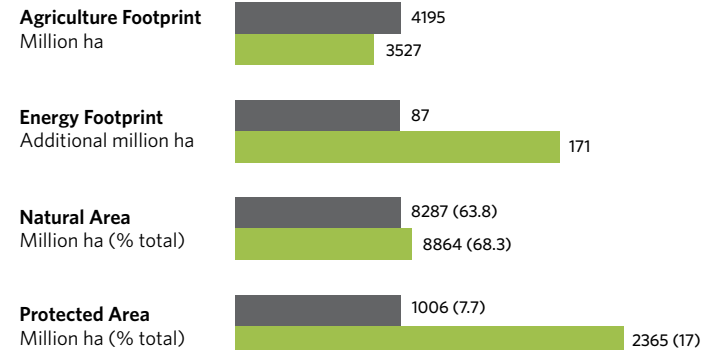
### WATER SECURITY

By changing food and energy production and shifting where crops are grown, we can reduce the number of water-stressed basins.



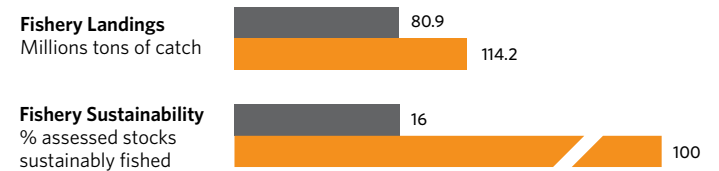
### LAND FOOTPRINT

Improving placement of crops and energy installations allows us to preserve more natural and protected areas.



### FISHERIES SUSTAINABILITY

Managing all fisheries sustainably will result in increased catch yields over 2010 yields.







However, if we make changes in where and how we meet food, water and energy demands for the same growing global population and wealth, the picture can look markedly different by mid-century. This “sustainability” path includes global temperature increase limited to 1.6°C—meeting Paris Climate Accord goals—zero overfishing with greater fisheries yields, a 90 percent drop in exposure to dangerous air pollution, and fewer water-stressed people, rivers and agricultural fields. These goals can be met while natural habitats extend both inside and outside protected areas. All signatory countries to the Aichi Targets meet habitat protection goals, and more than 50 percent of all ecoregions’ extents remain unconverted, except temperate grasslands (of which over 50 percent are already converted today).

## What’s Possible

Achieving this sustainable future for people and nature is possible with existing and expected technology and consumption, but only with major shifts in production patterns. Making these shifts will require overcoming substantial economic, social and political challenges. In short, it is not likely that the biophysical limits of the planet will determine our future, but rather our willingness to think and act differently by putting economic development and the environment on equal footing as central parts of the same equation.

## CLIMATE, ENERGY AND AIR QUALITY

Perhaps the most pressing need for change is in energy use. In order to both meet increased energy demand and keep the climate within safe boundaries, we'll need to alter the way we produce energy, curtailing emissions of carbon and other harmful chemicals.

Under a business-as-usual scenario, fossil fuels will still claim a 76 percent share of total energy in 2050. A more sustainable approach would reduce that share to 13 percent by 2050. While this is a sharp change, it is necessary to stanch the flow of harmful greenhouse gases into the atmosphere.

The reduction in carbon-based energy could be offset by increasing the share of energy from renewable sources to 54 percent and increasing nuclear energy to one third of total energy output—delivering a total of almost 85 percent of the world's energy demand from non-fossil-fuel sources.

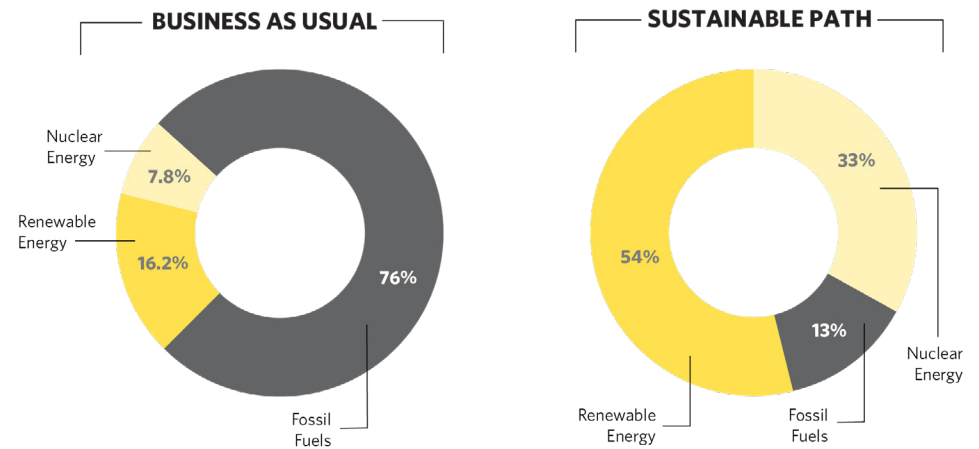
Additionally, we will only achieve the full extent of reduced climate impacts if we draw down existing carbon from the atmosphere. This can be done through greater investment in carbon capture and storage efforts, including natural climate solutions—land management strategies such as avoiding forest loss, reforestation, investments in soil health and coastal ecosystem restoration.

The net benefit of these energy redistribution efforts is twofold. First, they lower the rate at which greenhouse gases are flowing into the air—taking atmospheric carbon projections down to 442 parts per million, compared to business-as-usual estimates that put the level closer to 520 ppm.

Second, these energy source shifts would create a marked decline in particulate air pollution. Our models show that the higher fossil fuel use in the business-as-usual scenario is likely to expose half the people on the planet to poorer air quality by 2050. Under the sustainable scenario, that figure drops to just 7 percent of the world's inhabitants, thanks to lower particulate emissions from renewable and nuclear energy sources.

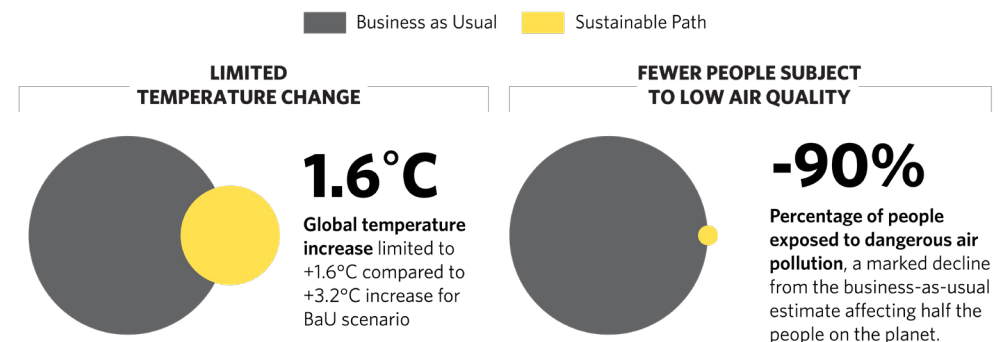
## A Changing Energy Portfolio

In order to both meet increased energy demand and keep the climate in safe boundaries, we'll need to alter our energy makeup to curtail emissions of carbon and other harmful chemicals.



## Mitigating Climate Change and Air Pollution

The net benefit of energy redistribution from fossil fuels to renewable and nuclear energy is twofold. First, it lowers the rate at which greenhouse gases are flowing into the air, taking carbon projections down to 442 parts per million, compared to business-as-usual estimates that put that level closer to 520 ppm. Second, it would create a marked decline in air pollution and the amount of people subject to unhealthy air.







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## FOOD, HABITAT, AND CITY GROWTH

Meeting the sustainable targets we propose requires a second front on land to shift how we use available real estate and where we choose to conduct necessary activities. Overall, the changes we include in our more sustainable view allow the world to meet global food, water and energy demands with no additional conversion of natural habitat for those needs—an outcome that is not possible under business as usual.

While transitioning away from fossil fuels is essential to meet climate goals, new renewable energy infrastructure siting will present land-use challenges. Renewable energy production takes up space, and if not sited well it can cause its own negative impacts on nature and its services to people. In our more sustainable path, we address this challenge by preferencing the use of already converted land for renewables development, lessening the impact of new wind and solar on natural habitat. We also exclude expansion of biofuels, as they are known to require extensive land area to

produce, causing conflicts with natural habitat and food security.

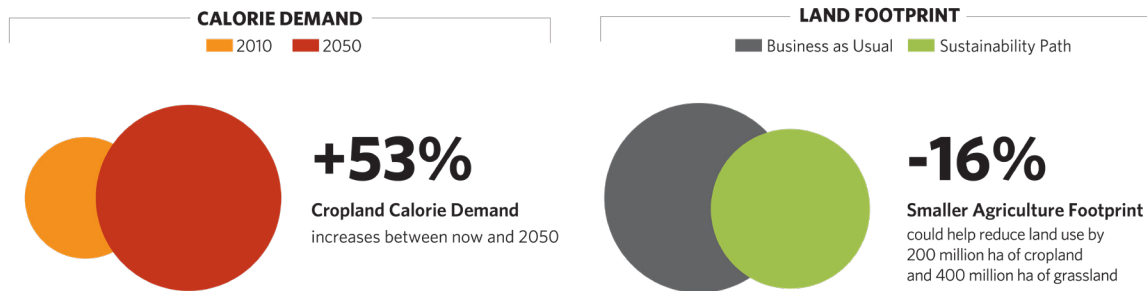
Perhaps most encouraging, we show that it is possible to meet future food demands on less agricultural land than is used today. Notably, our scenario keeps the mix of crops in each growing region the same, so as not to disrupt farmers’ cultures, technologies, capacity or existing crop knowledge. Instead, we propose moving which crops are grown where within growing regions, putting more “thirsty” crops in areas with more water, and matching the nutrient needs of various crops to the soils available.

Unlike some projections used by others, for this scenario we left diet expectations alone, matching meat consumption with business-as-usual expectations. If we were able to reduce meat consumption, especially by middle- and high-income countries where nutritional needs are met, reducing future agricultural land, water and pollution footprints would be even easier.



## More Food, Smaller Footprint

Shifting agriculture to areas of high yield and low water stress will help us meet sustainable targets as well as meeting the demand of feeding almost ten billion people. We can achieve these goals with relatively modest reductions in cropland and pastureland. This scenario would be largely compatible with emerging views that advocate for protecting half the world's land system.



Meanwhile, on the land protection front, our analysis is guided by the Convention on Biological Diversity, the leading global platform most countries have signed. Each signatory country has agreed to protect up to 17 percent of each habitat type within its borders. While many countries will fall short of this goal under business as usual, it can be achieved in our more sustainable option.

We acknowledge 17 percent is an imperfect number, and many believe more natural habitat is needed to allow the world's biodiversity to thrive. Looking beyond protected areas, we see additional differences in the possible futures we face. Our more sustainable option retains 577 million hectares more natural habitat than business as usual, much of it outside of protected areas. Conservation has long focused on representation—it is not only important to conserve large areas, but to represent different kinds of habitat. Under business as usual, we will lose more than half of several major habitat types by mid-century, including temperate broadleaf and mixed forests, Mediterranean forest, and temperate grassland. Flooded and tropical grasslands approach this level of loss as well.

But with the proposed shifts in food, water and energy use, we can do better for nearly all habitats in our more sustainable scenario. The one exception is temperate grasslands, a biome that has already lost more than 50 percent of its global extent today. In all, the more sustainable scenario shows a future that would be largely compatible with emerging views that suggest protecting half of the world's land system.

*“By making changes in food, water and energy use, we can better protect nearly all habitat types.”*





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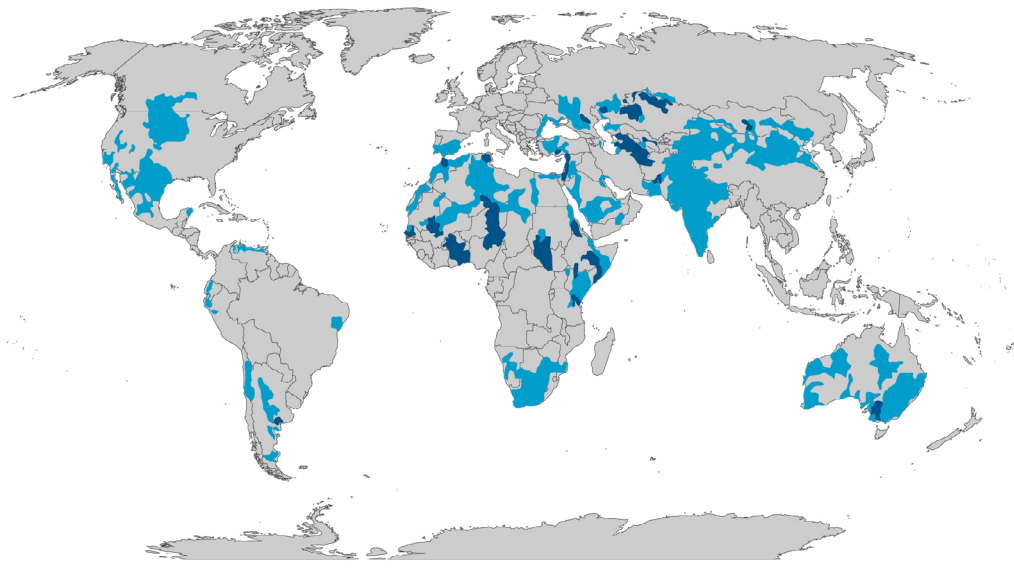
## DRINKING WATER, RIVER BASINS, AND FISHERIES

Water presents a complex set of challenges. Like land, it is both a resource and a habitat. Fresh water resources are dwindling while ocean ecosystems are overburdened by unregulated fishing and pollution. Business-as-usual projections estimate that 2.75 billion people will experience water scarcity by 2050 and 770 water basins will experience water stress. Africa and Central Asia in particular would see fewer water stressed basins in the sustainable scenario.

Changes in energy sources and food production (see above sections) would lead to significant water savings by reducing use of water as a coolant in energy production and by moving crops to areas where they need less irrigation. Thanks to these changes, our more sustainable option for the future would relieve 104 million people and biodiversity in 25 major river basins from likely water stress.

### Fewer Water-Stressed Basins

Water basins where agricultural areas and people face water stress (>40% annual precipitation being consumed)



- Watersheds water stressed under both Business as Usual and Sustainability scenarios
- Watersheds water stressed only under Business as Usual scenario



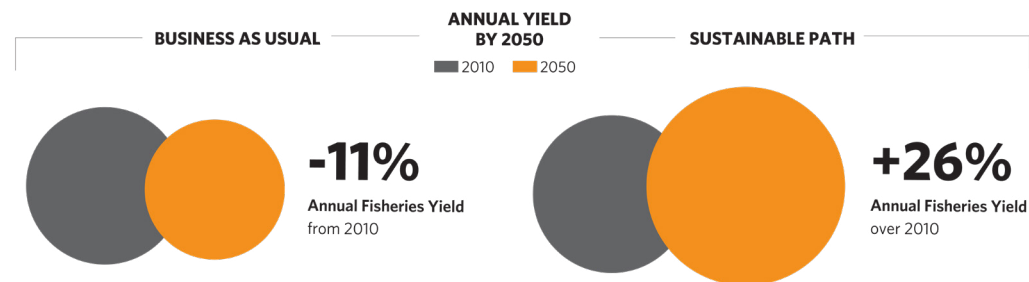
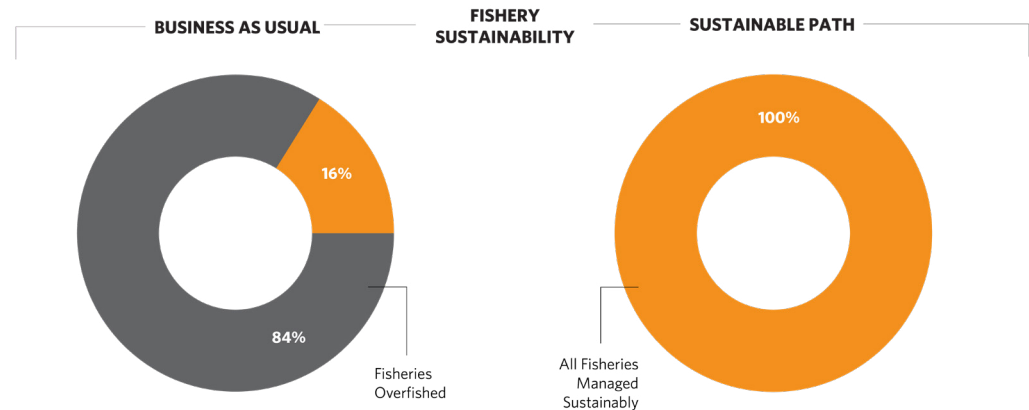


## Zero Overfishing, Greater Catch Yields

We believe that a two-part strategy of sustainable management for all wild fish stocks—which could actually increase fisheries yields to 26 percent above today's thresholds—while continuing to develop aquaculture along current growth projections can provide much-needed protein and nutrients to the world and ensure the biodiversity necessary for healthy ocean ecosystems.

Meanwhile, in the seas, we find an inspiring possibility for fisheries. Continuing business-as-usual fisheries management adds further stress to the oceans and the global food system as more stocks decline, further diminishing the food we rely on from the seas. But more sustainable fisheries management is possible, and our projections using a leading fisheries model shows that adopting sustainable management in all fisheries by mid-century would actually increase yield by over a quarter more than we saw in 2010.

And, while we know that aquaculture is a certain element of the future of fish and food, many questions remain about precisely how this industry will grow, and how it can be shaped to be a low-impact part of the global food system. Given these unknowns, we kept aquaculture growth the same in both our views of the future.





## The Way Forward

This analysis does not represent a panacea for the growing need for economic development across the planet or for the environmental challenges that are ahead. But it does provide an optimistic viewpoint and an integrated picture that can serve as a starting point for discussion.

Our goal is to apply new questions—and ultimately new solutions—to our known problems. We present one of many possible paths to a different future, and we welcome like-minded partners and productive critics to share their perspectives with us. We encourage people from across society to join the conversation, to fill gaps where they exist, and to bring other important considerations to our attention. Most of all, we call on the development (e.g. energy, agriculture, infrastructure), health, and financial communities—among others—to work with us to find new ways of taking action together.

Ultimately, by illustrating a viable pathway to sustainability that serves both the needs of economic and environmental interests—goals that many have long assumed were mutually exclusive—we hope to inspire the global community to engage in the difficult but necessary social, economic and political dialogue that can make a sustainable future a reality.

Protecting nature and providing water, food and energy to the world can no longer be either-or propositions. Nature and human development are both central factors in the same equation. We have at our disposal the cross-sector expertise necessary to make informed decisions for the good of life on our planet, so let's use it wisely. Our science affirms there is a way.

Join us as we chart a new path to 2050 by helping people and nature thrive—together.



## Opportunities to Engage

Designing strategies to address global challenges for people and nature requires integration of diverse bodies of evidence that are now largely segregated. As actors across the health, development and environment sectors pivot to act collectively, they face challenges in finding and interpreting evidence on sector interrelationships, and thus in developing effective evidence-based responses.

Learn more about these emerging coalitions that offer opportunities to engage and connect with shared resources.

**WICKED  
ECON** FEST



**BRIDGE** COLLABORATIVE

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See our full findings, "An Attainable Global Vision for Conservation and Human Well-Being," published in *Frontiers in Ecology and the Environment*.

The Nature Conservancy is a global conservation organization dedicated to conserving the lands and waters on which all life depends. Guided by science, we create innovative, on-the-ground solutions to our world's toughest challenges so that nature and people can thrive together. We are tackling climate change, conserving lands, waters and oceans at an unprecedented scale, providing food and water sustainably and helping make cities more sustainable. Working in 72 countries, we use a collaborative approach that engages local communities, governments, the private sector, and other partners.

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