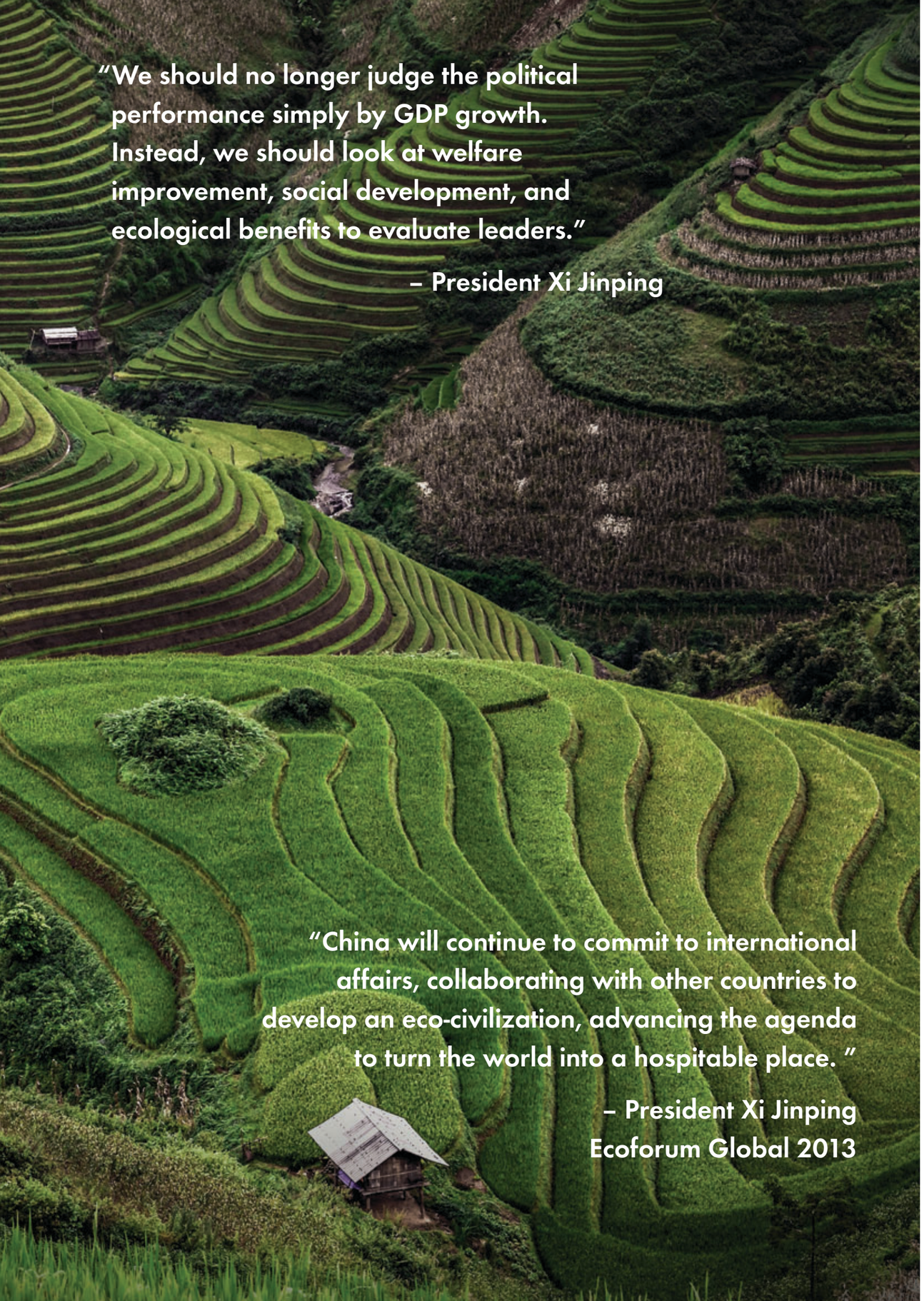
THE Guizhou FOOTPRINT REPORT

METRICS FOR AN ECOLOGICAL CIVILIZATION

Global Footprint Network®
Advancing the Science of Sustainability

Prepared in collaboration with
Guizhou Institute of Environmental Science Research and Design



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EXECUTIVE SUMMARY

China's resource security is becoming more uncertain because of climate change, price volatility, the emergence of new energy technologies and eventual resource constraints. The future of fossil fuel is clouded, and reducing its use might significantly increase the demand on other resources, which are limited as well.

China's significant dependence on fossil fuel and biological resources for key industries and for developing and powering its cities – including gasoline for transportation and coal for electricity, food, water and fibers – is a major vulnerability. It is a challenge that China has the knowledge and economic power to overcome.

A focus on long-lasting assets is critical. Because of the long lifespan of built infrastructure, ensuring new infrastructure investments are suited for a more resource-constrained future is imperative. Assessment tools can help identify options that increase resource security while also being economically and politically desirable.

An economy in harmony with nature is the only path to future resilience, as population growth and the rise of standards of living around the world continue intensifying human demand on natural resources. Such an economy will become any country's most valuable asset. **It is the foundation of an Ecological Civilization.**

1

WHY IS ECOLOGICAL CIVILIZATION ESSENTIAL?

As a global economic power, China is admirably undertaking a transformation to become an ecological civilization, a human civilization living in harmony with nature. Guizhou Province is at a crossroads that exemplifies the challenge of constructing an ecological civilization. Characterized by its mountainous ecosystems and rich biodiversity, Guizhou aims to embody President Xi Jinping's vision of an ecological civilization while improving the well-being of its diverse people. Through an innovative collaboration with Switzerland, Guizhou seeks to emulate Swiss successes in developing a resource-efficient, tourist-friendly, and prosperous economy.

CHINA: AN EXTRAORDINARY COUNTRY FACING EXTRAORDINARY CHALLENGES

China is an exceptional country. Its commitment to driving dynamic change has enabled it to shape its accelerated growth. Unlike many nations who aim for short-term gains, China's planning strategies have focused on long-term wealth creation as the surest way to generate future income. For instance, China has shown an astonishing ability to drive rapid change. Since the end of the 1970s when China initiated Economic Reform, the economy has grown at unprecedented rates exceeding 8% annually, and hundreds of millions of people have improved their standards of living.

Overall, the country's support for science and education, central planning approach, and forward-looking ethos has kept it ahead of any other nation in the region with regard to wealth, economic development, stability, and global influence. Yet, resource risks are on the rise as a result of an uncertain fossil fuel future. With significant internal dependence on fossil fuel for running key industries and powering cities, compounded with growing global demands, China faces the challenge of adjusting to these new circumstances in order to build an efficient and resilient economy.

CONSTRAINTS RULE ON A FINITE PLANET

Every day, the planet must support more and more people. At the same time, their expectations for comfort and better lives are rising. Both trends lead to a growing global demand for resources and services from nature, including food, carbon sequestration, fiber (for clothing and paper), and wood (for furniture).

Human demand on our planet's resources, however, already exceeds what Earth can renew by over 60%. We can continue depleting natural capital as long as the stocks last. But that is a path that undermines our current and future economic possibilities.

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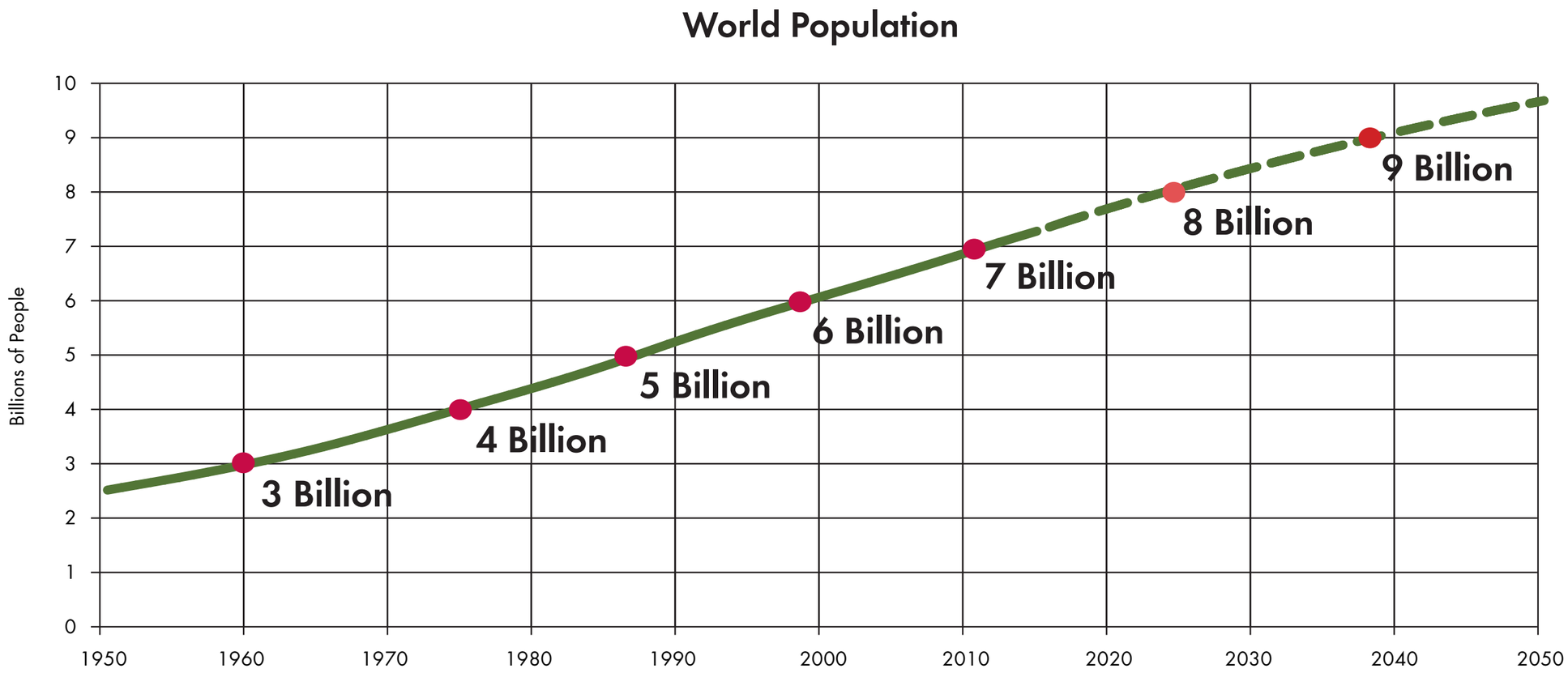
UN CLIMATE CHANGE CONFERENCE

As part of the 2015 Paris climate agreement, 195 countries and the European Union pledged to collectively limit global warming to a maximum of 2 degrees Celsius and to drive efforts to limit the temperature increase even further to 1.5 degrees above pre-industrial levels. Achieving this goal would require reducing global net carbon emissions to zero before 2050.



As the future of the fossil fuel economy is increasingly uncertain, the world's population is still on the rise, and so are people's material expectations.

BIOCAPACITY: OUR ULTIMATE RESOURCE

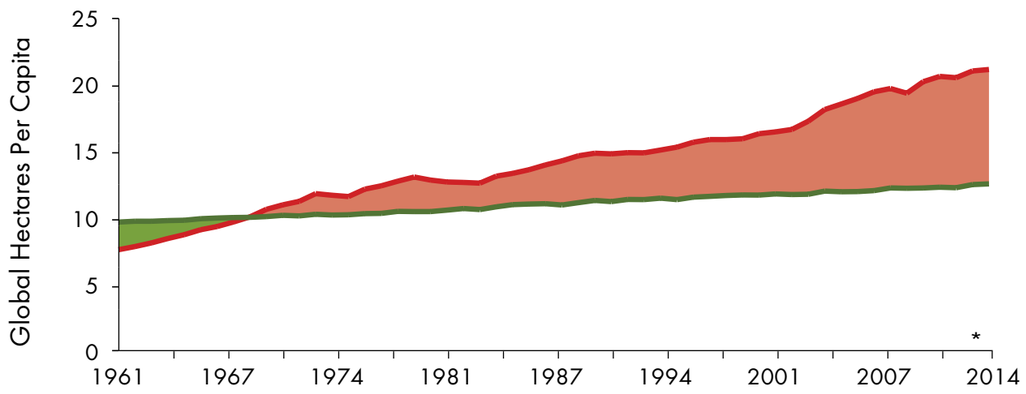
The **Ecological Footprint** is the biologically productive area needed to provide the ecological resources and services a population uses, including areas for fruits and vegetables, fish, wood, fibers, and absorption of carbon dioxide. Humanity's Ecological Footprint has been growing substantially (178%) since 1961.

Biocapacity is the productive area that can renew and provide resources. The planet's biocapacity is now about 30 percent higher than in 1961, largely due to agricultural practices. This expansion, however, may not last, given climate change, water scarcity, energy availability, topsoil erosion, and biodiversity loss. As we phase out fossil fuel – as anticipated in most imaginable scenarios – biocapacity will not only have to feed us. It also will have to help us replace fossil fuel, together with wind and solar power, high-tech energy like nuclear, and possibly fusion in the distant future. Therefore, mapping an economy's material dependence on biocapacity is the most effective approach to exposing long-term challenges and opportunities.

Compared to most countries, China's demand for ecological resources has expanded especially rapidly as a result of China's impressive economic growth, boosting the spending power of the average consumer. At the same time, China also has become one of the world's largest exporters, liquidating its ecological assets to the world's growing population in exchange for economic growth, which has led to widespread environmental degradation in China and beyond.

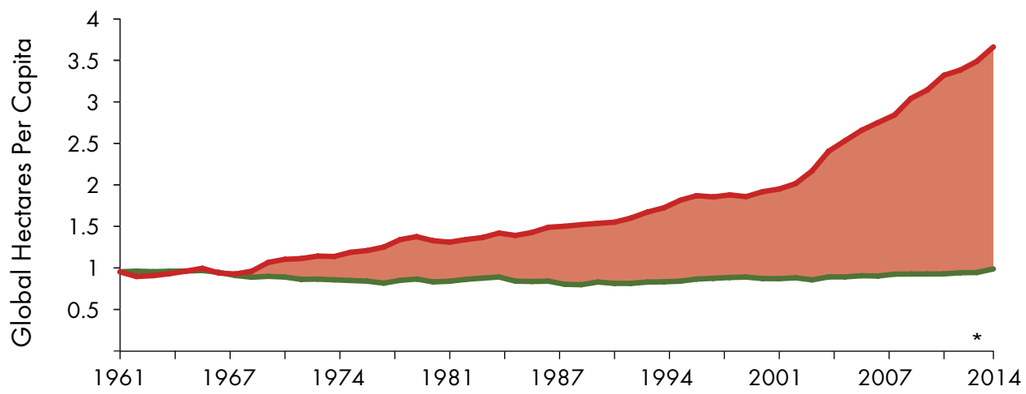
When a nation uses more resources than its ecosystems can regenerate, it is running an "ecological deficit." Nations can run ecological deficits by overusing their own resources, net importing resources, and using the global commons, for instance by emitting CO_2 into the atmosphere.

World Ecological Footprint and Biocapacity



World Ecological Footprint and Biocapacity
*data years 2013-2014 are nowcasted

China Ecological Footprint and Biocapacity



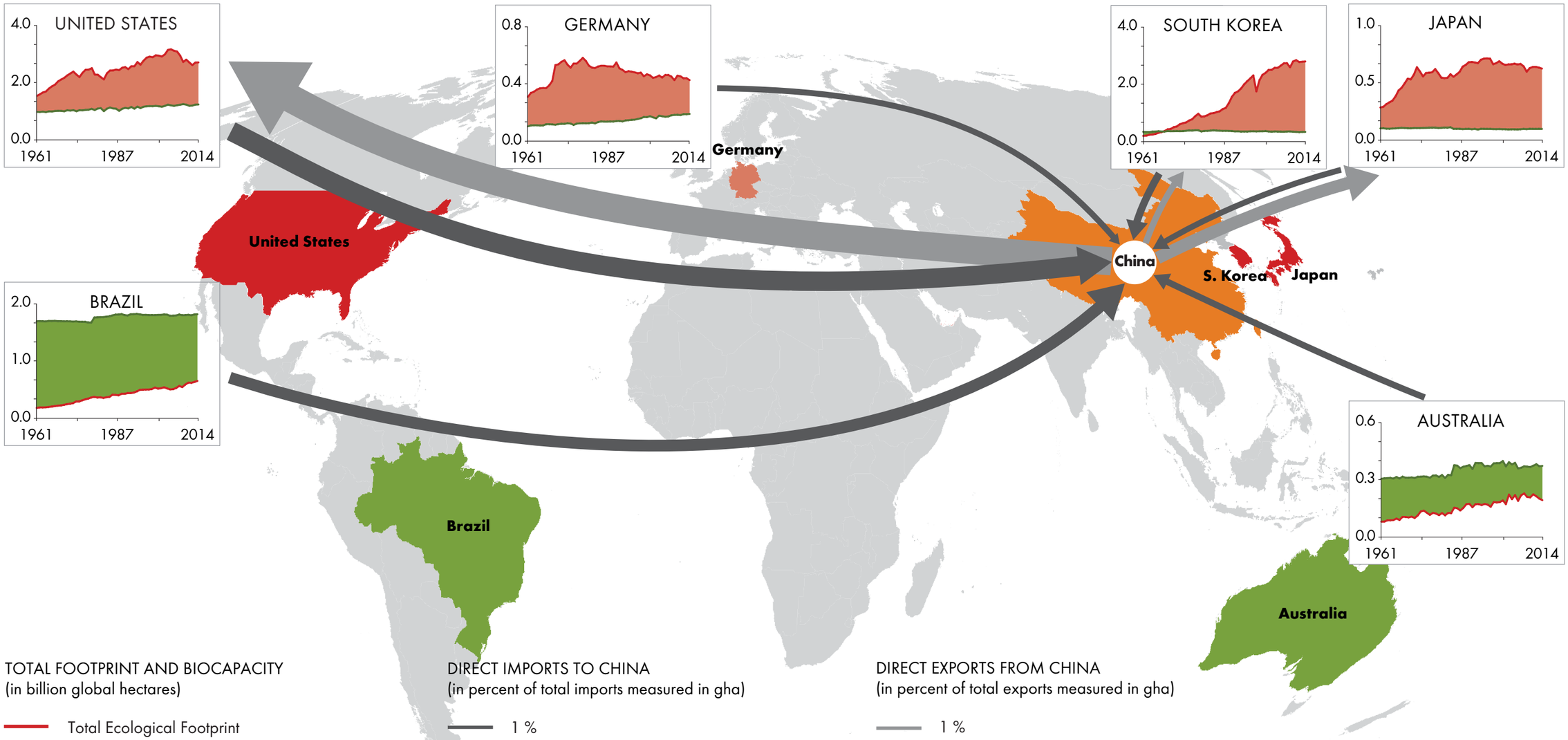
China Ecological Footprint and Biocapacity per capita
*data years 2013-2014 are nowcasted.

CHINA'S TOP TRADE PARTNERS: STABLE OR VULNERABLE?

China is tightly integrated into the global economy. The resources it uses originate from all corners of the world, while China itself provides resources to economies around the planet.

Therefore, fully understanding the risk exposure of China to resource constraints requires not only monitoring China's own Footprint and biocapacity. It also calls for tracking the ecological resource trends among its key trade partners, and supporting efforts abroad to maintain biocapacity China depends on. The map below highlights the Footprint and biocapacity trends of the top six importers and exporters of China. The arrows show how much Footprint is embodied in imports to and exports from China.

Most of China's top trade partners are either increasing their ecological deficit, or at the very least shrinking their reserves. This forewarns potential instability of these trade flows as resource budgets become more strained among all trade partners.



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MEASURING FOOTPRINT EFFICIENCY

CHINA AND SWITZERLAND

Two perspectives are fundamental to understanding a country's use of resources.

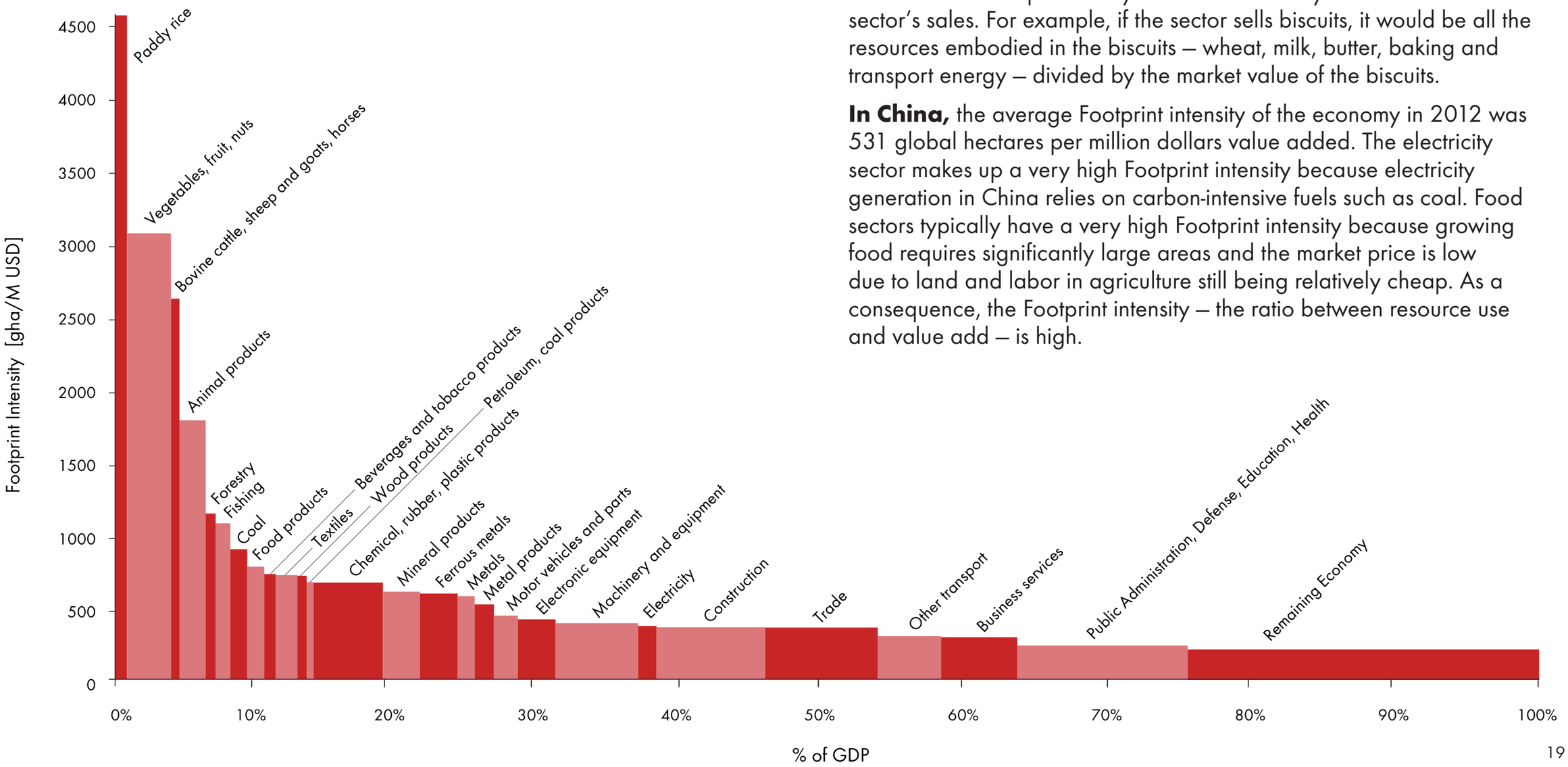
1) What are the resource demands associated with generating GDP (production perspective)?
2) What are the resource demands associated with spending GDP (consumption perspective)?

Each perspective sheds light on different core challenges. Are there sufficient resources to power economic production? Will residents be able to buy the kind of lifestyle they are used to with the money they earn? This analysis examines both dimensions. The production perspective is multi-faceted because one sector produces inputs for other sectors. The consumption side, on the other hand, is straightforward as it measures at the final point of consumption.

PRODUCTION FOOTPRINT ASSOCIATED WITH GENERATING GDP IN CHINA

China Footprint Intensity of Economic Sectors

2012



For the world as a whole, the Ecological Footprint of producing all goods and services is exactly the same as the Footprint of consuming these goods and services. All is produced to be consumed. Nations, however, do not consume the same amount that they produce because they can trade.

The graph below compares the Footprint intensity of China and Switzerland's 57 economic sectors. These sectors are tracked by Global Footprint Network's multi-regional input-output analysis (for 2012). For clarity, the graph shows the top 26 sectors and depicts the others as "remaining economy".

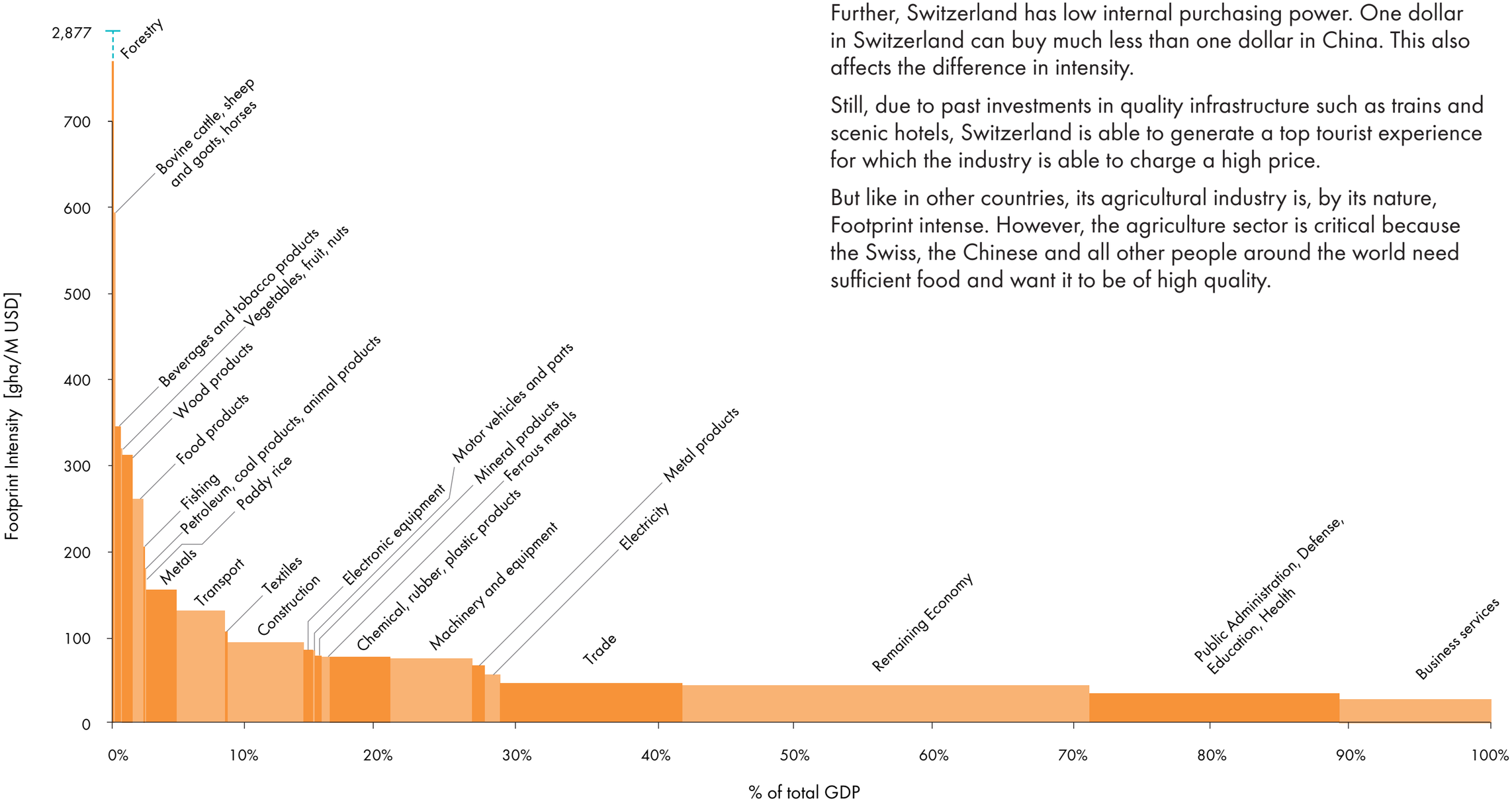
Footprint intensity is the Footprint embodied in the entire value chain of all the output sold by a sector divided by the value of a sector's sales. For example, if the sector sells biscuits, it would be all the resources embodied in the biscuits – wheat, milk, butter, baking and transport energy – divided by the market value of the biscuits.

In China, the average Footprint intensity of the economy in 2012 was 531 global hectares per million dollars value added. The electricity sector makes up a very high Footprint intensity because electricity generation in China relies on carbon-intensive fuels such as coal. Food sectors typically have a very high Footprint intensity because growing food requires significantly large areas and the market price is low due to land and labor in agriculture still being relatively cheap. As a consequence, the Footprint intensity – the ratio between resource use and value add – is high.

PRODUCTION FOOTPRINT ASSOCIATED WITH GENERATING GDP IN SWITZERLAND

Switzerland Footprint Intensity of Economic Sectors

2012



Switzerland is also analyzed through the lens of 57 economic sectors. These sectors are also tracked by Global Footprint Network's multi-regional input-output analysis (2012). For clarity, the graph shows the top 26 sectors and depicts the others as "remaining economy".

The Swiss economy's average Footprint intensity is nearly ten times lower than that of China: It is 63 Global hectares per million dollars value added. There are a number of factors that contribute to this large difference. Switzerland is powered by low-carbon electricity; many of its sectors are knowledge and skill intensive such as precision mechanics, pharmaceuticals, electronics and finance. Further, Switzerland has low internal purchasing power. One dollar in Switzerland can buy much less than one dollar in China. This also affects the difference in intensity.

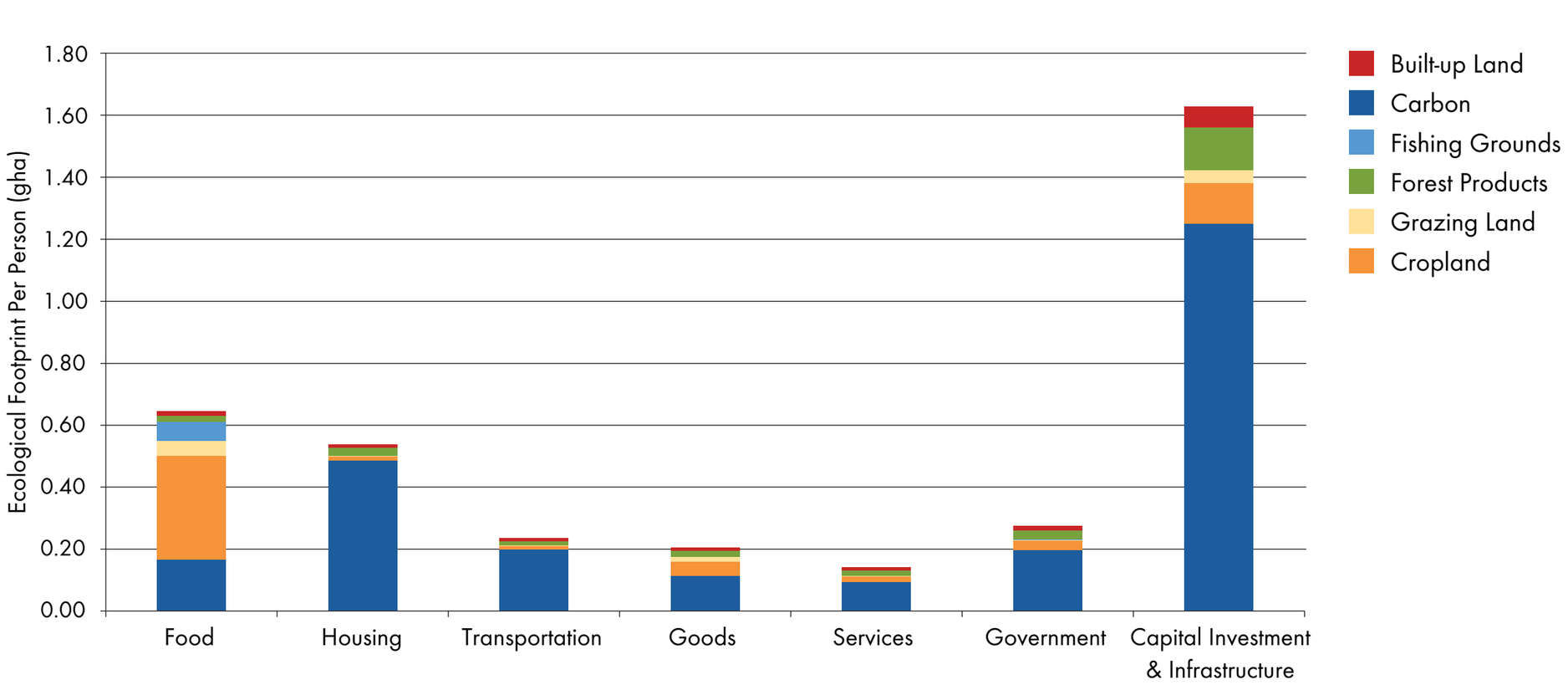
Still, due to past investments in quality infrastructure such as trains and scenic hotels, Switzerland is able to generate a top tourist experience for which the industry is able to charge a high price.

But like in other countries, its agricultural industry is, by its nature, Footprint intense. However, the agriculture sector is critical because the Swiss, the Chinese and all other people around the world need sufficient food and want it to be of high quality.

ECOLOGICAL FOOTPRINT OF CONSUMPTION

The Ecological Footprint of consumption measures the ecological resources and services required to accommodate the material demands of a population. This includes food, housing, mobility, and goods and services. It accounts for all demands, regardless of whether these are produced domestically or imported from other countries. Government services and investment in infrastructure, which benefit citizens directly or indirectly, are also included in the Ecological Footprint of consumption.

China's Ecological Footprint per capita by consumption type



Household Footprint is the component of consumption that is short-lived and paid for by households. In 2012, the household Footprint of consumption in Switzerland was 4.1 gha per person, out of a total consumption Footprint of 5.8 gha per person. In China, the household portion was 1.8 gha per person out of a total consumption Footprint of 3.4 gha per person.

To simplify, four core drivers shape the overall Footprint of consumption:

1

How we design cities determines both heating and cooling needs as well as transportation.

2

How we generate energy and provide water.

3

How we feed ourselves.

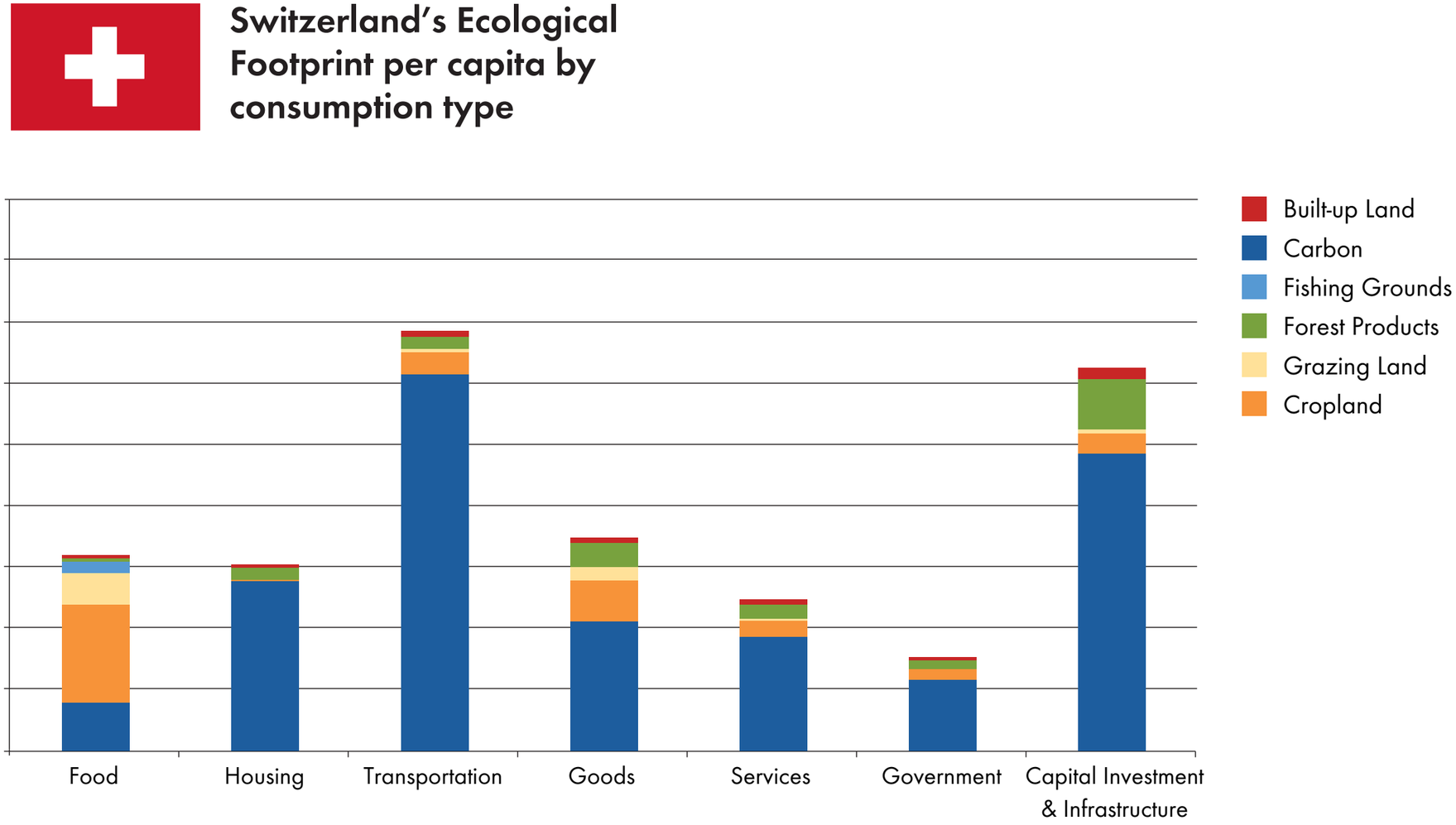
4

How many of us there are.

Proportionally, China has a very high investment in infrastructure development compared to Switzerland. Food and housing made up 67% of China's total household Footprint of consumption. In Switzerland, transportation was the leading contributor to the household Footprint of consumption, equivalent to 30%.

In both Switzerland and China, the carbon Footprint was the largest contributor in most household consumption categories.

The Ecological Footprint of consumption shows the average level of biocapacity needed on to support the lifestyle of China's residents. Given that the planet currently has a biocapacity of 1.7 global hectares per world citizen – and less as the world population increases – larger Footprints could become costlier and riskier, particularly if supply chains become disrupted or carbon emissions are restricted.



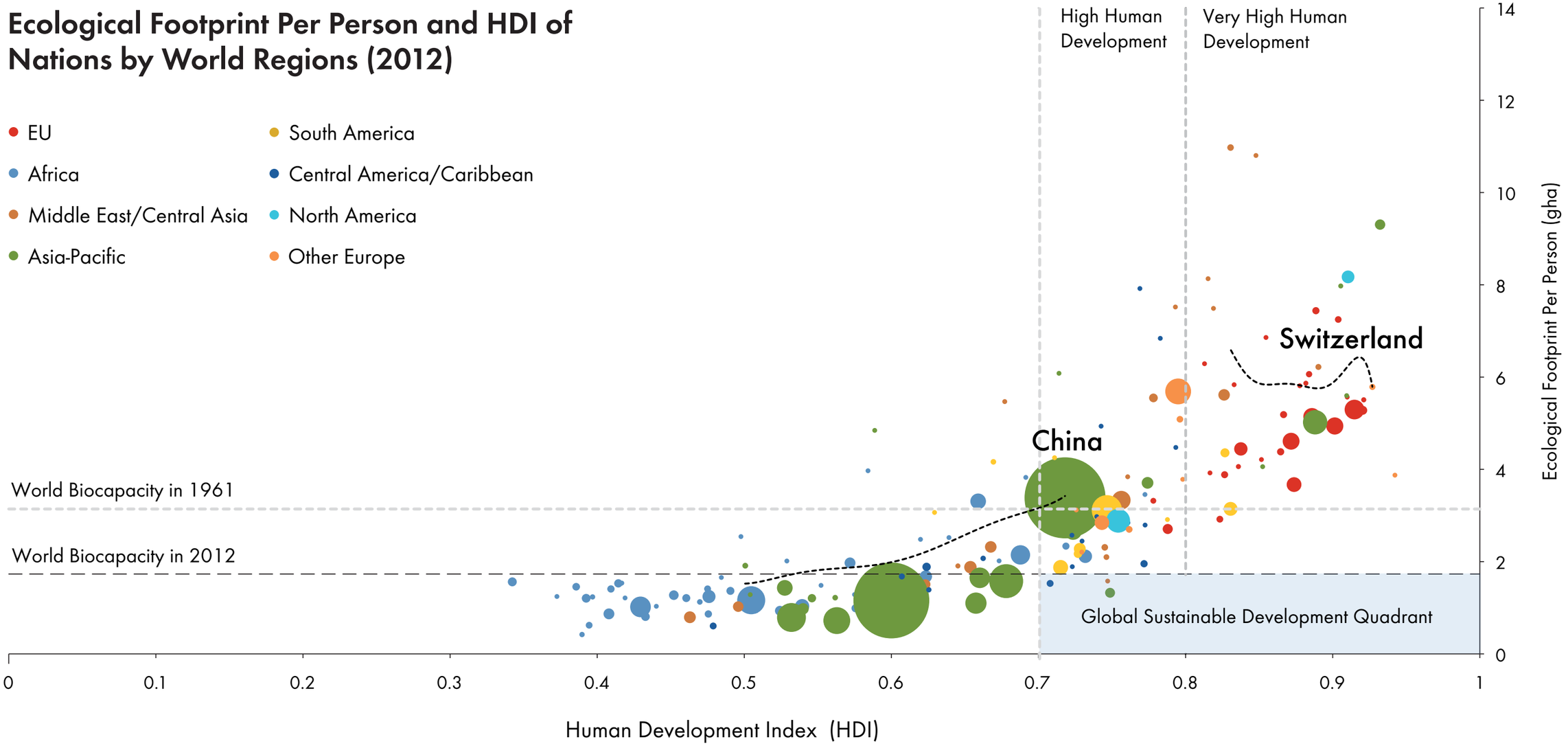
Switzerland's Ecological Footprint per capita by consumption type

ECOLOGICAL FOOTPRINT AND HUMAN DEVELOPMENT INDEX (HDI)

The paths illustrate the progress made at improving well-being as well as the associated demand on natural resources. While the situation of each country is different, this graph helps to illustrate the global challenge of securing high well-being for all, within the ecological constraints of one planet. To achieve global sustainable development, the global average should be in the blue box, which indicates high human development with a world average resource demand within the means of one planet.

The figure below shows Ecological Footprint and Human Development Index (HDI) for 2012. China and Switzerland's Ecological Footprint and Human development path from 1990 to 2012 are indicated by the black lines leading to China and Switzerland's current position on the graph. Circle size is relative to country population.

Ecological Footprint Per Person and HDI of Nations by World Regions (2012)



The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions. (Source: United Nations Development Programme)

3

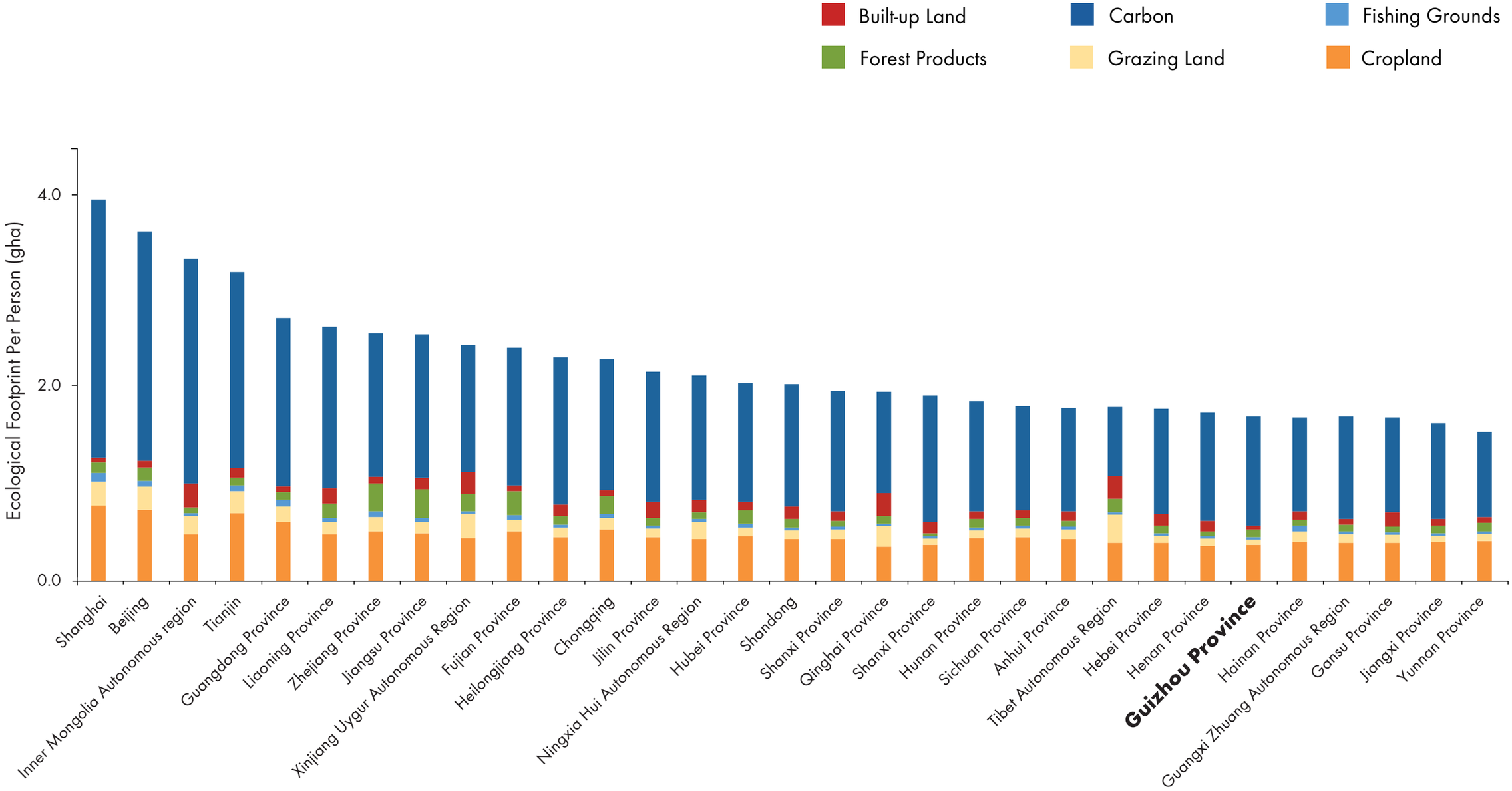
GUIZHOU

A MODEL FOR DEVELOPING AN ECOLOGICAL CIVILIZATION

Guizhou has embarked on a path of rapid development, facing a huge challenge of balancing economic growth with resource utilisation and environmental protection. The region has enormous opportunities to optimize this moment and to avoid the pollution and resource depletion that rapid economic development has brought to other provinces. But the choices are complex. How can Guizhou preserve the environment while improving lives and building new economic opportunities through tourism and other industries? How can it ensure that economic development is not undermined by damage caused by climate change impacts such as droughts, floods, and storms? To succeed with its ambitious green development, the province can learn from experiences from around the world, especially that of Switzerland, and also use data-driven decision-making tools to identify the best development opportunities.

HOW DOES GUIZHOU'S RESOURCE SITUATION COMPARE TO OTHER PROVINCES?

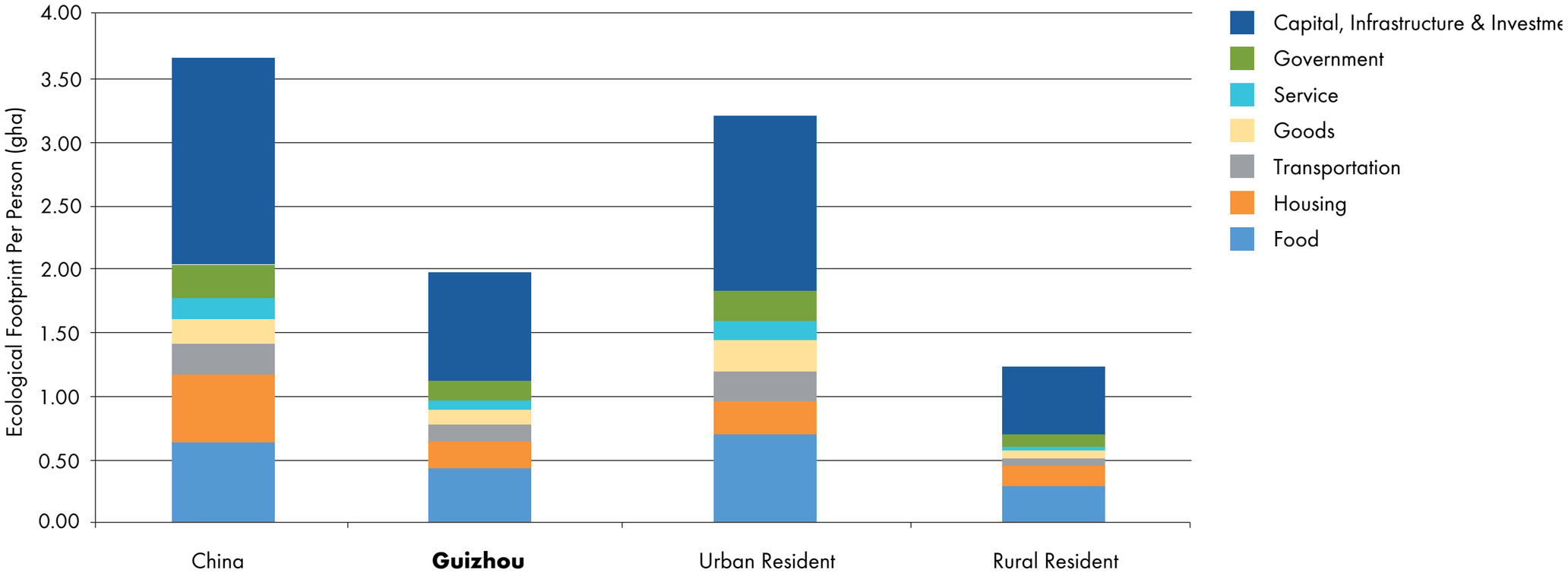
With a per capita annual income of 18,700 yuan (2,852 US dollars) and Ecological Footprint of 1.72 gha per capita (based on 2012 data). Guizhou has the fifth lowest per-capita income among China's provinces and the sixth lowest per capita Ecological Footprint (based on 2012 data). By aiming to increase income through improvements in efficiency, Guizhou is an ideal province to pilot ecological civilization development because it can build an economy that invests and builds upon its unique natural resources: a rich biodiversity and beautiful mountainous landscapes.



2012 Ecological Footprint of provinces in China. Source: WWF China LPR 2015, IGSNRR

Guizhou has a population of 35 million and average Ecological Footprint of 1.98 gha per person. In Guizhou, 51% of the Footprint comes from private and government sector investment in lasting assets while the remaining 49%, or 0.98 gha of the Footprint comes from household consumption, which includes food, housing, mobility, and goods and services.

Guizhou's Consumption breakdown by Economic Sector



The household consumption Footprint of city residents is 58% higher than that of households who live in the countryside. Food makes up 44% of consumption among city households. In addition, transportation, housing, and goods together make up a large portion of city households' total household consumption, at 47%. By contrast, food and housing comprise 75% of consumption among households in the countryside.

Investments by government and the private sector in lasting assets, such as construction of buildings, roads, factories, and equipment comprise a much large proportion of the overall Footprint of consumption (51%). The significance of this Footprint component is not only in its size, but more importantly, the way infrastructure and economic development is designed has a lasting impact on a population's future dependence on resources. Choosing the right infrastructure is one of the most influential opportunities for creating a true ecological civilization that can enable resource security for thriving lives.

GUIZHOU'S DEVELOPMENT PATH

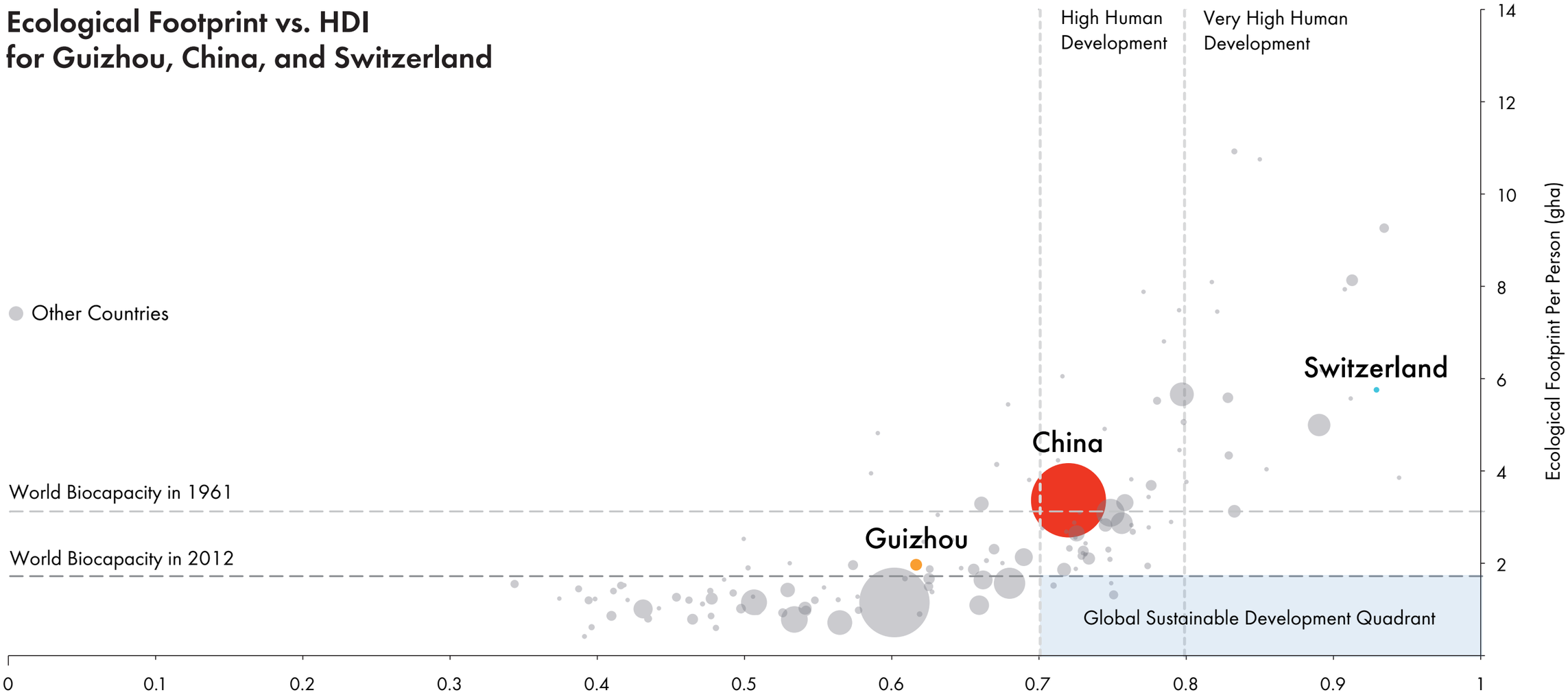
An Ecological Civilization embodies the goal of sustainable development: to create thriving society where all people live well, in balance with nature.

Sustainable development seeks to improve human development while maintaining natural resources and ecosystem services for use by future generations, and recognizes human dependence on secure access to ecological assets. The environmental bottom-line condition for sustainability, or living within the means of nature, can be evaluated with the Ecological Footprint. Human well-being, including socio-economic development, can be approximated using the UN Development Programme's widely recognized Human Development Index (HDI), a composite of health, education and income indicators.

By plotting Ecological Footprint against HDI, we can seea high-level snapshot of a country or population's current development position.

A new direction, guided by relevant metrics, is needed to leapfrog traditional economic development pathways to incorporate sustainable development practices under development in China and around the world, such as resource-efficient transportation, compact urban development, and high energy efficiency standards.

Ecological Footprint vs. HDI for Guizhou, China, and Switzerland



CHOOSING SUCCESS

Decision tools are needed to support government agencies and private investors in choosing the most effective policy and investment options. These are options that increase China's resource security while also generating financial benefits.

- Our frameworks help economic decision-makers react to resource constraints and demonstrate that it is possible and within their power to reverse these resource trends.

- Countries, provinces and cities become more resilient by choosing policy and investment options that enhance their resource security while also generating an economic net-benefit.

- Using **Ecological Footprint accounting helps analyze resource security.** It allows to identify which options reduce the resource dependence of an economy and by how much. The Ecological Footprint is a risk tool.

- The Ecological Footprint is complemented by **Net Present Value Plus (NPV+), an opportunity tool.** This tool evaluates the fiscal net benefits of a policy, project or program. Net Present Value Plus (NPV+), expanding on classical NPV, can help government agencies to evaluate the extent to which their investment is also able to generate returns in excess of the costs of the investment, thereby increasing society's wealth.

- NPV+ introduces two improvements: it builds on becoming clear first what the assumed future is within which the investment has to operate. Second it makes sure all relevant cost and benefits are counted.

- **Sustainable investments need to meet both the resource and the fiscal criteria.**

Ecological Footprint	Net Present Value (NPV+)
Are we using more resources than we have?	Will our investment be a financial net-positive?
Early warning The Ecological Footprint can help identify which issues need to be addressed most urgently to generate political will and guide policy action.	**Investment analysis** NPV+ helps governments and public agencies more accurately measure the long-term value of their investments in infrastructure and natural capital.
Headline and issue framing The Ecological Footprint can improve understanding of the problems, enable comparisons across regions and raise stakeholder awareness.	**Assumed Futures** NPV+ makes explicit, with users, their assumed future to create a more realistic context for capital decisions and to more fully assess risks and opportunities.
Policy development With the identification of Footprint "hot-spots," policy makers can prioritize policies and actions, often in the context of a broader sustainability policy.	**Policy orientation** By understanding where the best long-term value is, policies can be reoriented toward better outcomes.
Monitoring Footprint time trends and projections can be used to monitor the short- and long-term effectiveness of policies.	**Building resilience** Sound investments build wealth, avoid stranded assets and leave a better legacy for future generations.

4

IMPLEMENTATION

CONTINUED MONITORING OF LOCAL RESOURCE SECURITY THROUGH ECOLOGICAL FOOTPRINT ACCOUNTING

Human ingenuity enables us to build a resource-efficient economy that provides for a thriving society within the means of nature. In a world of climate change and resource constraints, such an economy will become any nation's strongest asset.

The current potential for Footprint reductions in China as a whole is vast. At the same time, for an entire country as immense as China to transform requires significant foresight. With its initiation and testing of Ecological Footprint accounting and related metrics, the pilot project in Guizhou is an example of progress. Moving forward, these tools allow us to evaluate opportunities and help us find options that are economically and politically desirable.

A clear public policy strategy, with identified benefits and a solid vision, can enable a successful transformation. Fortunately, China is no stranger to rapid change. In fact, its mastery of driving dynamic change gives it a significant advantage over most nations in the world.

BUILDING A ROADMAP FROM POLICY TO ECOLOGICAL CIVILIZATION

China has demonstrated the ability to rapidly expand its economy, and now is challenged to develop the province of Guizhou and the entire nation as an ecological civilization living in a state of economic and ecological harmony. Future development decisions will need to leapfrog traditional development paths and transition directly to a green economy. Switzerland's economy offers a number of examples that could help environmental and economic development of Guizhou, which can then in turn serve as a model for the rest of China.

Data-rich metrics about our natural capital are critical to giving decision-makers clarity about their choices and their progress.

Ecological Footprint accounting provides a headline indicator and insights to monitor and assess changes in the use and availability of natural resources.

Specific tools like NPV+ can help decision-makers measure the economic benefits of different policies in the context of changing energy and resource limitation risks.

Such tools empower decision-makers to simultaneously compare the tradeoffs between resource security and economic opportunities and develop strategies leading to a balanced path forward.

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KEY REFERENCES ON FOOTPRINT

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KEY TERMS

The **Ecological Footprint** (or Footprint) adds up all human demands on nature that compete for biologically productive space: providing biological resources, accommodating urban infrastructure or absorbing excess carbon from fossil fuel burning. The Footprint is compared with all the available biologically productive space **(biocapacity).** Both can be calculated at the global, national, local and personal levels. To make them comparable, they are expressed in a standardized unit: global hectares.

Footprint intensity: the amount of Footprint embodied in a product, or the products sold by a sector, measured in global hectares per million US dollars or gha/M$.

Global hectare (gha): a biologically productive hectare with world average productivity in a given year.

The **Carbon Footprint** is the portion of the Ecological Footprint associated with fossil fuel use. It measures the biologically productive space needed to sequester the carbon emissions from burning the fossil fuel. One metric tonne of CO_2 emitted per year corresponds to 0.38 global hectares of Footprint (for 2011).

Multi-Regional Input Output (MRIO) analysis is a technique that tracks the financial and material relationships between the sectors of an economy as well as of those of the trade partners. In this report MRIO was used to identify resource demands of sectors as well as trade flows.

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