Finding the Blue Path for A Sustainable Economy

VEOLIA WATER

A WHITE PAPER BY VEOLIA WATER

Executive Summary

The efficiency of water management and our ability to sustain population and economic growth are inextricably linked.

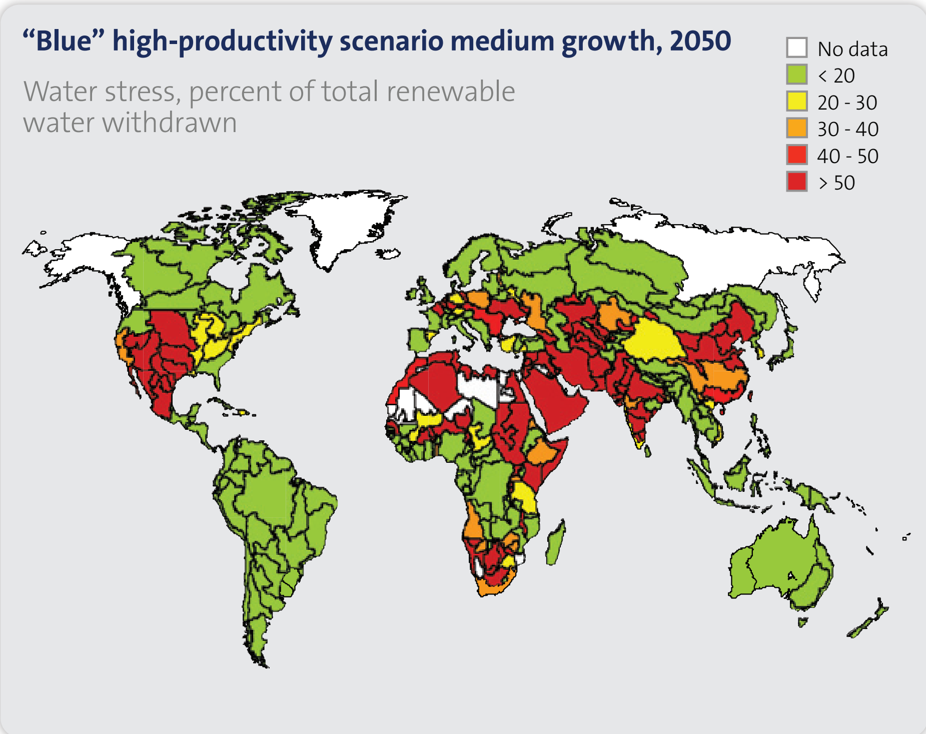
According to analysis performed by the International Food Policy Research Institute (IFPRI), a lack of efficient water management will significantly undermine society's ability to grow, while impacting the quality of life of millions of people and our planet's environmental water resources.

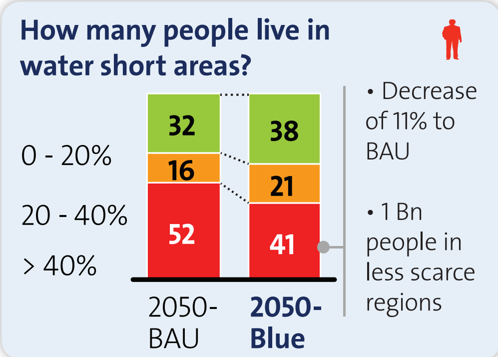
Today, 36% of the global population — approximately 2.4 billion people — already live in water-scarce regions and 22% of the world's GDP ($9.4 trillion at 2000 prices) is produced in water-short areas. Moreover, 39% of current global grain production is not sustainable in terms of water use.

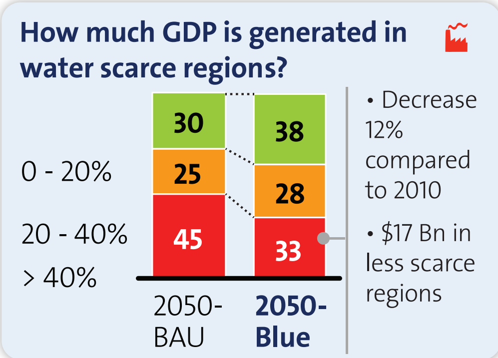
According to IFPRI's analysis, current "business as usual" water management practices and levels of water productivity[1] will put at risk approximately $63 trillion, or 45 percent of the projected 2050 global GDP (at 2000 prices), equivalent to 1.5 times the size of today's entire global economy. Moreover, 4.8 billion people (52 percent of the world population) will be exposed to severe water scarcity by 2050.

This dire scenario will, in turn, have a significant impact on investment decisions, increase economic and operational costs, and affect the competitiveness of certain regions. For China, India, and many other rapidly-developing countries, water scarcity has already started to materially risk growth. In these two countries alone, 1.4 billion people live in areas of high water stress today. Even many of the most advanced regions of the industrialized world (e.g. California) will have to increasingly cope with water scarcity and its effects on growth.

However, if sustainable behaviors and practices are adopted, more than 1 billion people and approximately $17 trillion of GDP could escape exposure to risks and challenges from severe water scarcity. This $17 trillion figure reflects an amount larger than the entire GDP of the United States in 2010. Implementation of sustainable water management practices would also reduce by 21 percent the number of children projected to suffer from malnourishment compared to a business-as-usual approach.







[1] *Water productivity is defined here as the GDP value of water, calculated by dividing the economic output of society by the amount of water used.*

Four Possible Scenarios for Economic Growth

To assess the impact of water shortages on economic growth, IFPRI and Veolia analyzed what economic and population growth levels can be sustained at today's water productivity and to what extent gains in efficiency and water productivity can enable higher levels of growth. To do this, we develop and implement four scenarios out to 2050 using four different water productivity and energy pathways. These four scenarios (BAU, Low-Carbon, Grey, and Blue World), as described further below are assessed against three levels of economic growth to examine the impact of growth on water availability and food security.

We find that a Grey water productivity scenario, which focuses on growth at all cost without accompanying investments in water use efficiency, will result in a significant increase in water stress. Compared to a BAU approach, a "Grey World" will result in an additional 450 million people and $5.6 trillion GDP (at 2000 prices) being at risk by 2050.

In a Blue World water productivity scenario, on the other hand, where countries invest in additional water productivity, economic growth is much more sustainable with approximately 1 billion people and $17 trillion GDP less at risk due to high water stress as compared to BAU by 2050. The Blue model productivity scenario helps both developing (e.g. China) and developed (e.g. California) economies reduce risk by moving towards sustainable water stress levels. However, for some growth regions like India, Blue productivity is important but not sufficient to mitigate unsustainable water use; these countries or regions will face difficult choices on priorities for water allocation. Importantly, a Blue world will also enable the high growth needed to reduce today's malnutrition levels. A medium-growth Blue World model offers the best balance for sustainability.

"Business as usual" approaches to water management will result in approximately $63 trillion, or 45 percent of the projected 2050 global GDP (at 2000 prices) being put at risk. This is the equivalent to 1.5 times the size of today's entire global economy. Further, 4.8 billion people (52 percent of the world population) will be exposed to severe water scarcity by 2050. Sustainable water management can de-risk more than 1 billion people and ~$17 trillion of GDP and offer important societal and health benefits.

Water: A barrier or an opportunity toward progress

The world's population has doubled over the past 50 years. Between 2000 and 2050, another 3 billion people will be added for a total global population of 9.2 billion people (United Nations medium variant projections). This rapid population growth, combined with changing lifestyles, has led to an even more rapid increase in water consumption and water use – or more specifically water overuse – in many areas.

At the same time, clean freshwater remains essential to sustain life, support a healthy environment and enable economic development. Economic growth drives increases in water demand for household, industrial and agricultural uses, particularly in the group of developing countries, while the functioning and quality of watersheds and irrigated lands are deteriorating, and ground and surface water pollution is increasing. Climate change is a further threat to future water availability.

The threat of water scarcity is global, yet most impacts of water shortages are felt at the local level. Thus, while global initiatives are important to help fund and inform broad-reaching investments and policy reform for water development, on-the-ground solutions have to be found at the regional and local levels to ensure that water remains supportive of rather than a threat to agricultural and economic growth and rural livelihoods.

Business-as-usual approaches are no longer an option. Water scarcity has been recognized as a key development problem, but the collective means to address these challenges exist.

Given the imperative of water for livelihoods, health and economic growth, two core questions on the linkages of water and growth arise:

1. What growth levels can be sustained at today's water productivity?
2. To what extent can gains in efficiency and water productivity (economic output per drop) enable higher levels of growth?

Methodology

These two questions are examined using IFPRI's detailed and linked global water and food model – the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) (Rosegrant et al. 2005). For this analysis, the model incorporated changes in water use efficiency related to the energy scenarios of the International Energy Association (WEO-2010 scenarios, IEA 2010), thus incorporating the water, food, and energy nexus in the modeling approach.

To assess the interlinkages between water and growth, four scenarios were developed following four alternative water productivity pathways. Parameters for each of the scenarios are presented in Table 1. Moreover, each of these scenarios was run with three alternative economic growth assumptions to assess outcomes for water scarcity as well as food security.

The four different megatrend global scenarios defined for this project were the following:

- **"Business-as-usual" (BAU) scenario:** currently projected improvements in water productivity are taken into account across all sectors (this scenario being used as the reference scenario).
  - Consumer and municipal water consumption shows moderate improvements in water efficiency gains and leakage reduction. 50% of potential water efficiency improvements would be achieved by industry.
  - Energy demands increase at ~19% in Organization for Economic Co-operation and Development (OECD) countries and +110% in Non-OECD countries, with corresponding water use while energy mix slightly shifts toward a renewable energy mix (high share of conventional thermal electric generation, IEA "New Policy" scenario)
- **"Grey" scenario:** the focus is put on production increases at all cost without investments in efficiency improvements.
  - No water productivity improvements achieved, with only minor energy efficiency gains reached (IEA "Current Policy" scenario)
  - Energy demand growing by ~20% in OECD and +130% in Non-OECD countries with corresponding water use, while energy mix shifts to nuclear and thermo electrical power generation ("Current Scenario" of IEA World Energy Outlook)
- **"Low carbon" scenario:**
  - A low-carbon energy mix impacts water productivity in terms of higher usage of biomass but also higher energy efficiency (IEA Green Energy "450" scenario)
  - On balance, a low-carbon energy scenario has slightly lower water productivity than BAU (the water impacts of increased biomass and hydropower outweigh water savings from efficiency gains)
- **"Blue World" scenario:**
  - Domestic sector shows high improvements in leakage reduction and water efficiency gains, with the majority of water productivity potential achieved in industry
  - Energy demand growing at ~19% in OECD and +110% in Non-OECD, with high share of renewable energy increasing from ~19% (2008) to 29% (2030) with biomass produced from waste material or otherwise without water impacts (IEA "New Policy" scenario with "Higher Productivity" scenario)

These four scenarios were run with three different economic growth assumptions. Two time periods, 2030 and 2050, were chosen to discuss the outcomes of this modeling effort.

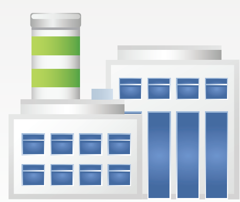
To assess the impact of economic growth on water shortages, we use the Water Stress Index, an index of total water withdrawals as a share of internal renewable water resources for 115 countries and economic regions and 281 food producing units (basically, large river basins or aggregated river basins within countries). According to the Water Stress Index, countries or river basins are moderately stressed when withdrawals are less than 20% of internal renewable water resources.

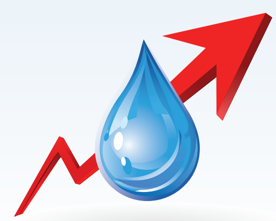
Countries and basins are considered "water stressed" at withdrawal levels of 20-40%. Under such withdrawal levels, stress is typically apparent during drought periods and with water quality impacts of water use. At withdrawal levels in excess of 40%, countries or river basins are considered "water scarce." Under these conditions, local adverse impacts of withdrawals are common and withdrawals are generally unsustainable. We used this ratio – withdrawals in excess of 40% – to classify growth at risk, that is, unsustainable growth vulnerable to environmental changes and growing competition.

A LOOK AT THE FUTURE. Four global water productivity megatrend scenarios were developed and utilized to establish results.[2]

Water Productivity scenarios

Grey	Low Carbon	Business As Usual	Blue
No water productivity improvements achieved, resulting reactive environmental behavior. Only minor energy efficiency gains reached. Energy demand growing by ~20% in OECD and ~130% in Non-OECD countries, with corresponding water use. Energy mix shift to nuclear and thermo electrical power generation as assumed by IEA World Energy Outlook for “Current scenario”.	Water impacts of optimizing for low-carbon energy. On balance, a low-carbon energy scenario has slightly lower water productivity than BAU. Water impacts of biomass (some irrigation) and hydropower (evaporation) from reservoirs outweigh water savings from efficiency gains. Energy efficiency causes energy demand to increase at a lower pace. Energy demand growing 0.7% p.a. (vs. 2.1% in BAU) Lower increase of water use from conventional energy.	Domestic sector shows moderate improvements in leakage reduction and water efficiency gains. 50% of water productivity gains are achieved in industry. Energy demand increase at ~19% in OECD and ~110% in Non-OECD countries, with corresponding water use. Energy mix with slight shift towards renewable energy mix, but with high share of conventional thermal electric generation.	Domestic sector shows high improvements in leakage reduction and water efficiency gains. Majority of water productivity potential achieved in industry. Energy demand growing at ~19% in OECD and ~110% in Non-OECD. High share of renewable energy increasing from ~19% (2008) to 29% (2030) with biomass produced from waste material or otherwise without water impacts.

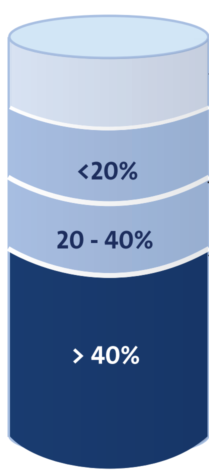




Low water productivity ⟷ **High water productivity**

Thresholds of water withdrawals represent degrees of sustainability within river basins[3]

Total withdrawals as share of internal renewable water resources



Moderate stress (< 20%)
- “Safe” withdrawals less than 20% of internal water resources
- Generally avoids local environmental impacts

Water stress (20 - 40%)
- Stress apparent during drought periods and with water quality impacts of water use
- Some transport of water within the region to meet demand

Water-scarce (> 40%) - "at risk"
- Large spatial variability of demand results in “unsustainable” withdrawals within river basin
- Local impacts of over-extractions more common

[2] *IFRI, Veolia Water* [3] *Science (Oki and Kanae, 2006)*

Only a Sustainable, Blue Path will support economic growth and help manage social, environmental and economic risks.

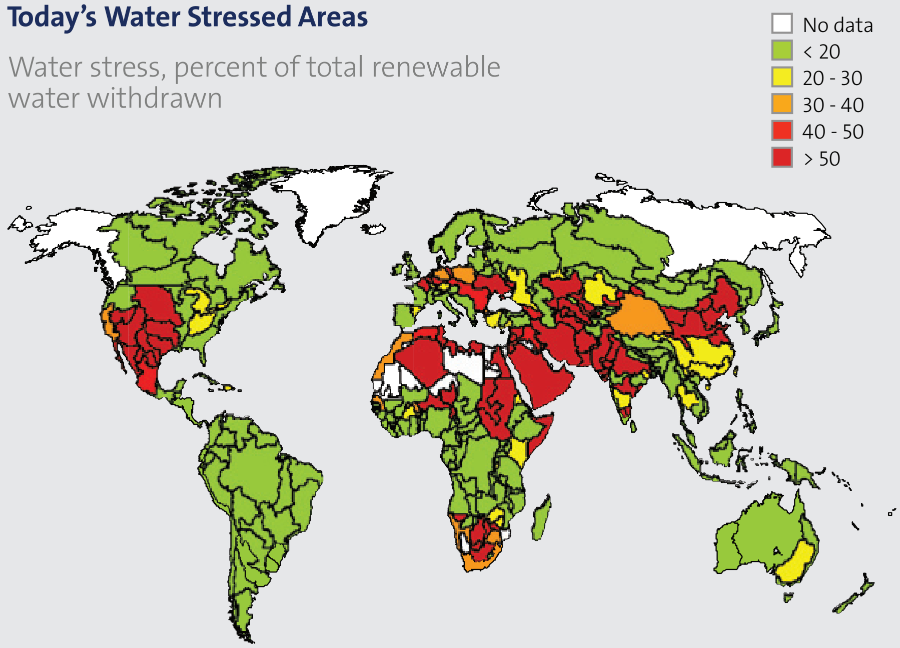
If sustainable behaviors and practices are adopted, more than 1 billion people and approximately $17 trillion of GDP could escape exposure to risks and challenges coming from water scarcity. This $17 trillion figure reflects an amount larger than the entire GDP of the United States in 2010.

1 Today: A Look at the World's Water Stressed Areas

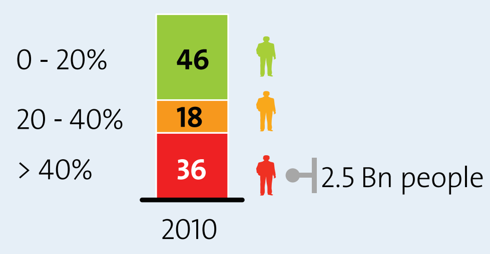
Today, 2.5 billion people, almost 40% of the world's grain production and almost one quarter of the global economy are presently at risk because of non-sustainable water use.

Today's Water Stressed Areas

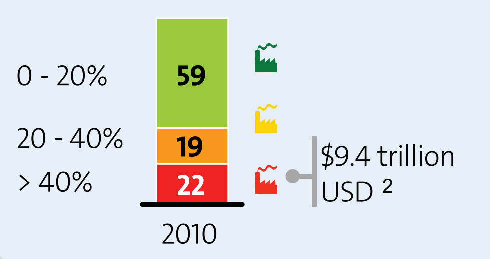
Water stress, percent of total renewable water withdrawn



How many people live in water short areas (%)?



How much GDP is generated in water scarce regions (%)?

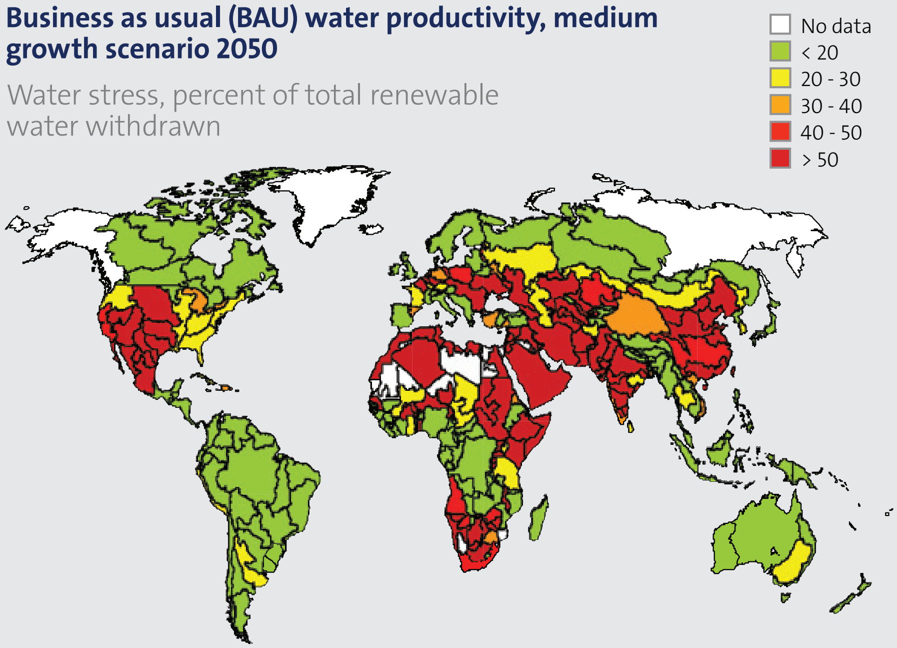


2 Business As Usual in 2050: More people and more GDP at risk

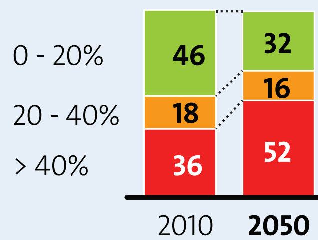
If our society chooses to ignore the reality of limited water resources, the number of people impacted will double from 2.4 billion people to 4.8 billion – 52% of the world's population! More people will drive a greater demand for food and economic development (i.e., water). Instead, approximately half (49%) of global grain production and 45% of total GDP ($63 trillion) will be at risk due to water stress by 2050. Consider that the total GDP at risk is 1.5 times the entire global economy today!

Business as usual (BAU) water productivity, medium growth scenario 2050

Water stress, percent of total renewable water withdrawn

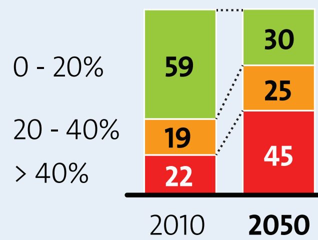


How many people live in water short areas?



- 4.7 Bn people, 70% of 2010 pop.
- Increase by 90% compared to 2010

How much GDP is generated in water scarce regions?



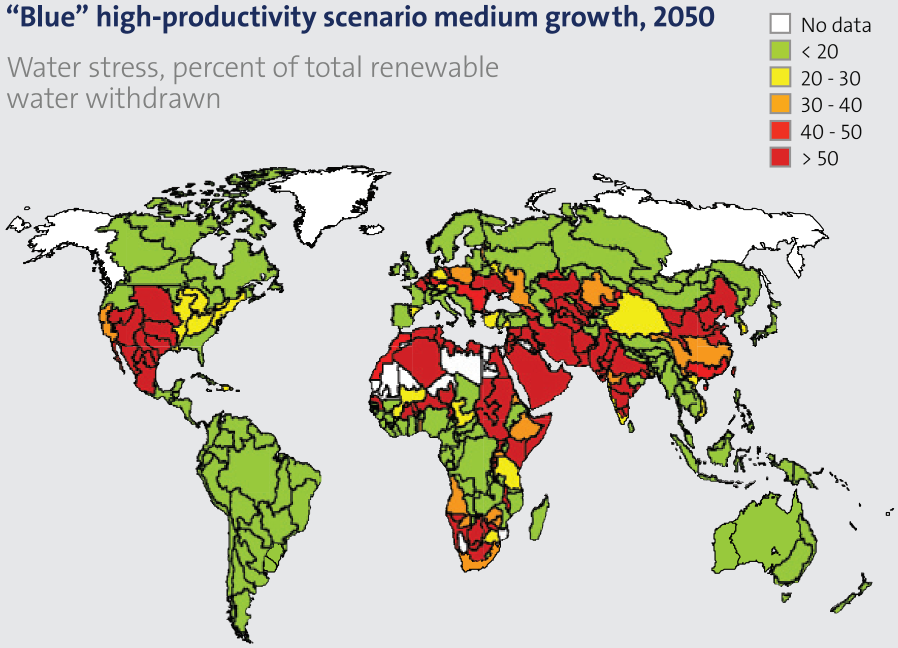
- $63 trillion 1.5 x 2010 total GDP
- Increase by 570% compared to 2010

3 Blue Growth: A Requirement to a Healthy World in 2050

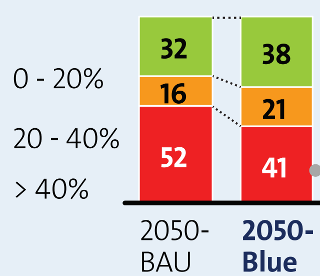
By wasting less, polluting less, reusing more, managing effectively and becoming more efficient in all uses of water – individual, collective, agricultural and industrial – we can achieve higher water productivity levels (economic output per drop) and reduce water stress. Continued evolution of technology and infrastructure improvements will enhance water supply capacity for cities and industries while helping deliver clean drinking water and sanitation services to rural populations and the urban poor. In so doing, more than 1 billion people will no longer be at risk of unsustainable water supplies. About $17 trillion in GDP will no longer be at risk due to high water stress. The "blue" productivity scenario helps both developing (e.g. China) and developed (e.g. California) economies reduce risk. Childhood malnutrition levels should decline by more than 20% compared to business-as-usual. Yet, this approach will be prove to be insufficient for regions such as India, which will still face difficult choices on priorities for water allocation.

"Blue" high-productivity scenario medium growth, 2050

Water stress, percent of total renewable water withdrawn

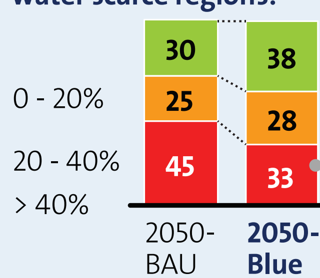


How many people live in water short areas?



- Decrease of 11% to BAU
- 1 Bn people in less scarce regions

How much GDP is generated in water scarce regions?



- Decrease 12% compared to 2010
- $17 Bn in less scarce regions

Outcomes

Today, many regions already experience water stress (and risk) due to population and economic growth.

Already 36% of the global population (2.4 billion people) lives in water scarce regions and 22% of the world's GDP ($9.4 trillion[2]) is produced in those areas. Moreover, 39% of global grain production is vulnerable to water scarcity. The outcomes described here focus on global trends, but are based on an assessment of changes in key drivers at the level of large river basins and countries. It should be noted that local outcomes will vary and could be more dramatic.

Business-as-usual investment and policy reform on water will not be sufficient to arrest growing water scarcity.

Under BAU water productivity and medium GDP growth, 52% of the global population, 45% of GDP, and 49% of global grain production will be at risk due to water stress by 2050:

- For China, India, and many other rapidly-developing countries, water scarcity will increasingly and negatively affect growth – with 2.7 billion people living in water-scarce basins in these countries alone by 2050, up from 1.4 billion today.
- Low-income countries will be particularly subject to water scarcity with 39% of low-income countries experiencing much more severe shifts towards water stress than wealthier, more industrialized countries.
- Moreover, risk to economic growth and food security as a result of water scarcity is not only a reality in developing countries, but is present in many key industrialized areas and countries, which will have to increasingly cope with water scarcity and its effects on growth. California, for example, is of particular note.

[4] *All GDP values are 2000 prices.*

Future growth and sustainability depend on gains in water productivity.

A Grey water productivity scenario, focusing on growth at all cost without commensurate improvements in water use efficiency, results in a significant increase in water stress with an additional 450 million people and $5.6 trillion GDP at risk by 2050 (an increase by 5% and 4%, respectively, from the BAU scenario).

In a Blue World water productivity scenario, on the other hand, countries invest in infrastructure, technologies, and policy reform to achieve higher water productivity levels aimed at reducing water stress. Such investments do not only focus on enhanced water supply capacity for cities and industries, but also aim at reaching the rural and urban poor with clean drinking water and sanitation. In so doing, these investments significantly de-risk growth for about 1 billion people, with about $17 trillion GDP less at-risk due to high water stress as compared to BAU:

- The Blue productivity scenario helps both developing (e.g. China) and developed (e.g. California) economies reduce risk by moving to sustainable water stress levels.
- For other growth regions like India, Blue productivity helps but is insufficient. These countries and regions will still face difficult choices on priorities for water allocation.
- Additional social benefits occur in a Blue productivity world; for example, childhood malnutrition levels decline by more than 20% compared to BAU as a result of investments in rural water access and consequent female secondary education linked to improved access.

A high-growth pathway will rapidly increase the number of people living in and the GDP generated in water-scarce areas.

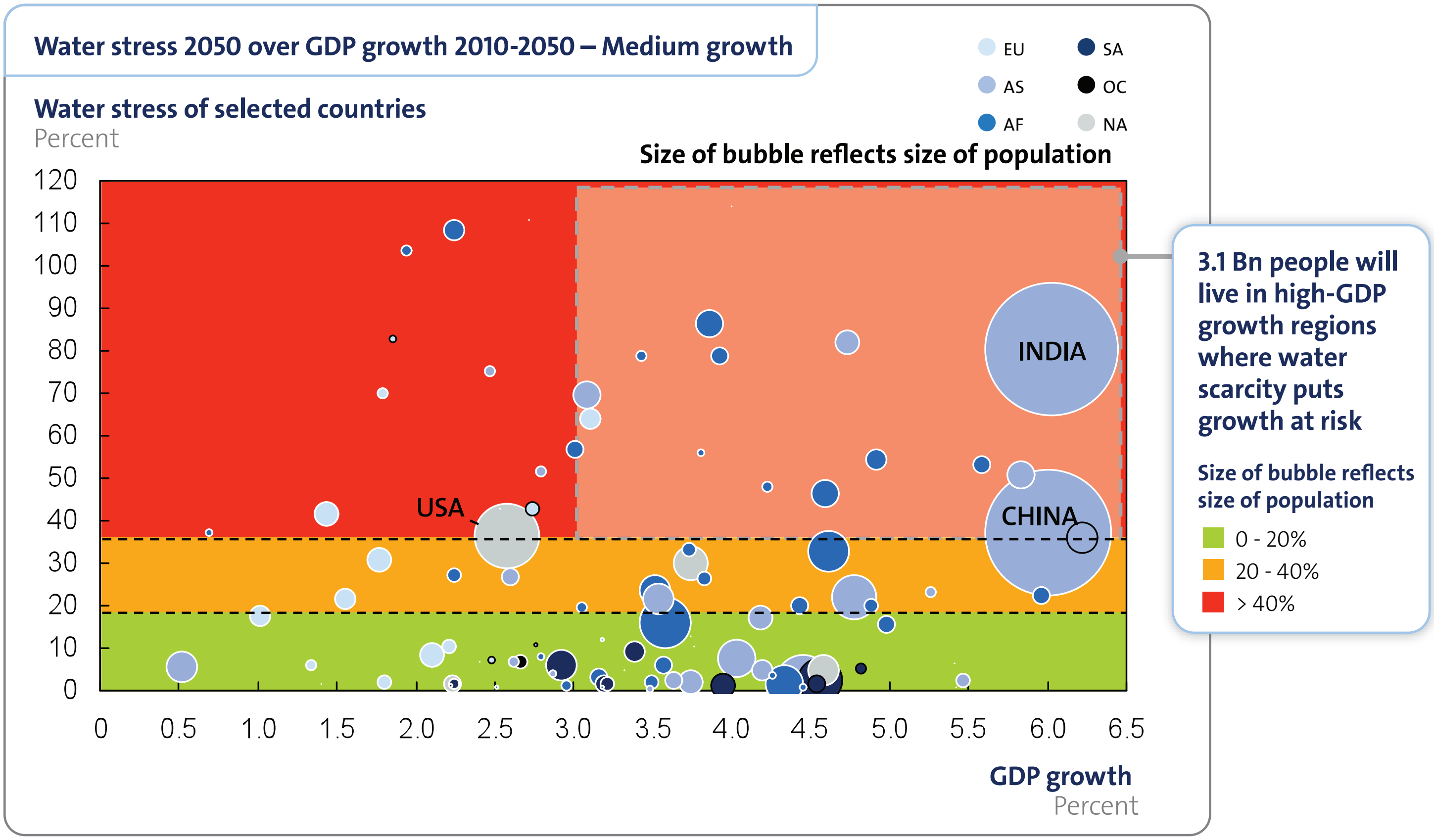
Under high GDP growth in a "Grey world," 60% of the global population and 58% of the global economy will be in water-scarce areas, seriously challenging the possibility of achieving this high growth. Only a high-growth "Blue world," where governments, the private sector, and civil society focus on increasing water productivity, reduces water scarcity levels to those of BAU under medium growth.

The Blue model is centered on improving water productivity and water management practices to produce more with less water. This includes greater public awareness; higher levels of water reuse by all users of water; improvements and evolution of water technology; water and wastewater infrastructure improvements; extension of services to rural and urban poor populations; and greater energy efficiency along with increased use of renewable energy.

Business as Usual: 2050

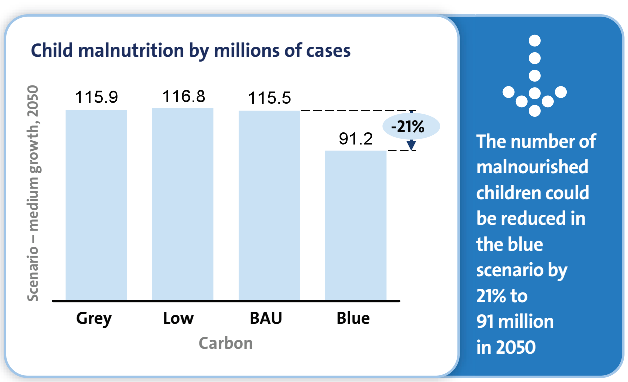
For China and India and many other rapidly-developing countries, water stress will pose a risk to growth

Water stress, percent of total renewable water withdrawn



Both high growth and increased water productivity are essential to reduce malnutrition levels.

Higher agricultural and economic growth facilitates increased food production and income levels, moving 700 million people to calorie availability levels in excess of 2,000 kilocalories per capita per day by 2050 compared to a low-growth scenario. At the same time, higher water productivity increases water availability for irrigation, lowering food prices; if linked with higher investments in rural water supply and sanitation and female secondary education, malnutrition levels can be reduced by 21% over BAU.



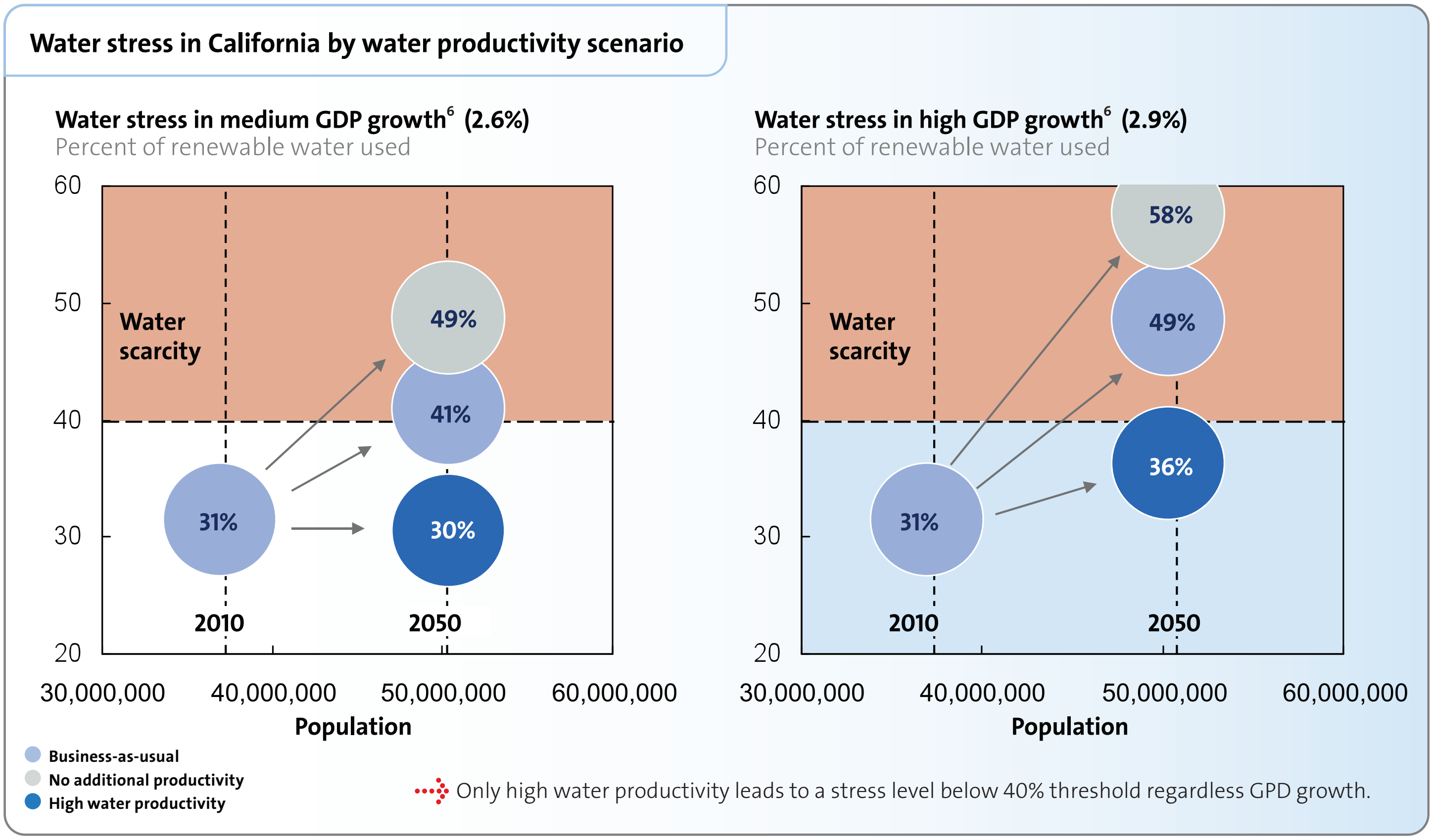
A low carbon development pathway does not necessarily reduce the water footprint.

On balance, water stress in a low-carbon world is similar to BAU levels, as water savings from energy efficiency balances increases in water use due to biomass cultivation. However, this only holds if second- and third-generation biomass will become available.

Water productivity investments are needed across all water-using sectors.

Most freshwater resources are depleted for use by the agriculture sector, and therefore, the potential for water productivity in agriculture is generally largest. We find, however, that productivity improvement in domestic and industrial sectors can also make significant contributions in reducing the share of population and GDP at risk of water scarcity and should be further explored.

California needs high-water productivity in order to achieve high economic growth [5]



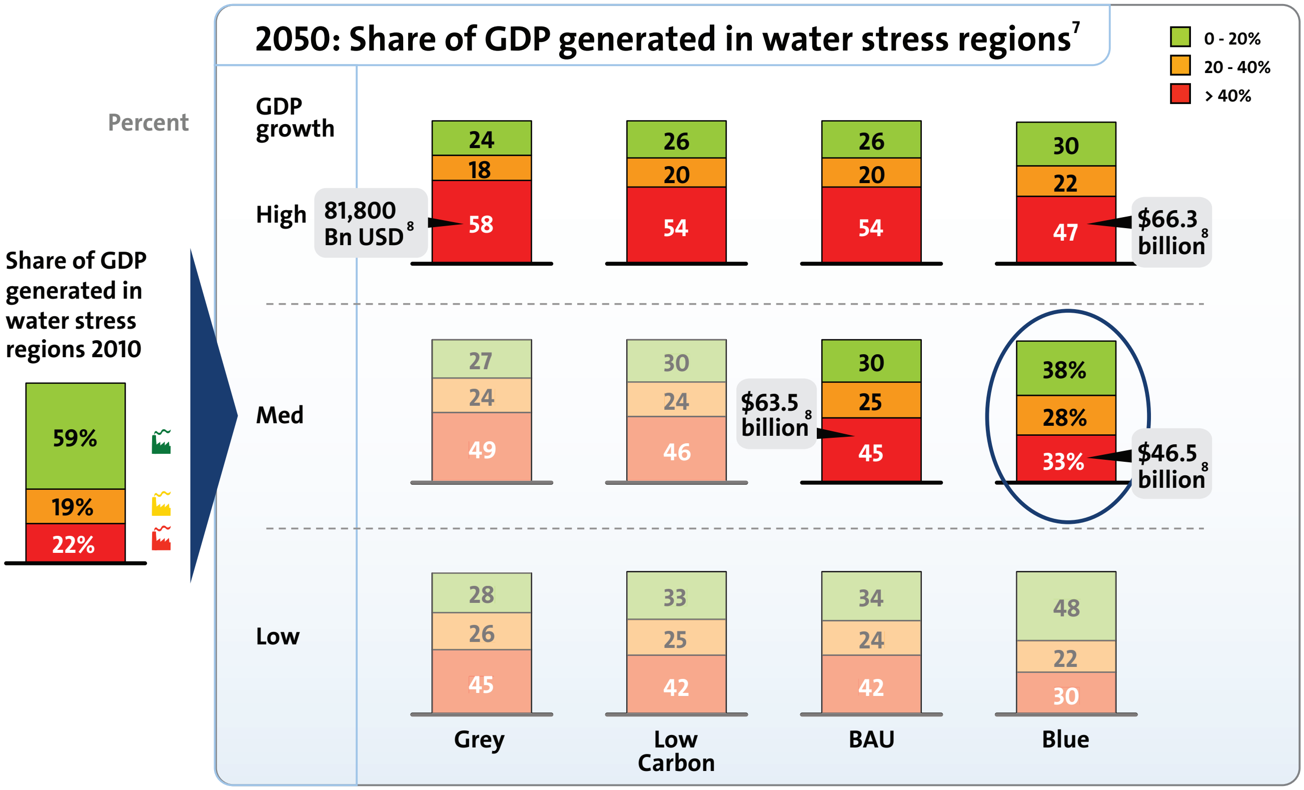
Conclusion

Growing water shortages already risk the livelihoods and economies of many countries. A Blue approach offers substantial and sustainable benefits. Using the world's current BAU approach, an even larger share and a much larger absolute number of people will live in regions with unsustainable water use levels.

This will put livelihoods, food supply, economic growth and the environment at risk. Some of the effects could include environmental shocks, greater competition across water-using economic sectors and political instability. However, alternative, sustainable development pathways, such as the blue scenario described here, are feasible and would help shift river basins and countries across the globe toward a more sustainable development path, while simultaneously reducing the risk of hunger and malnutrition. Such a Blue scenario would require rethinking among all water users, including agriculture, industries, and domestic water supply. Companies, cities and the public will need to move toward water conservation and efficiency improvements, coupled with aggressive but feasible investments and policy reform focused on increased water productivity. Thus, "going Blue" should be part of the global and local development agendas to help ensure that all people on our planet have an opportunity to enjoy productive and healthy lives.

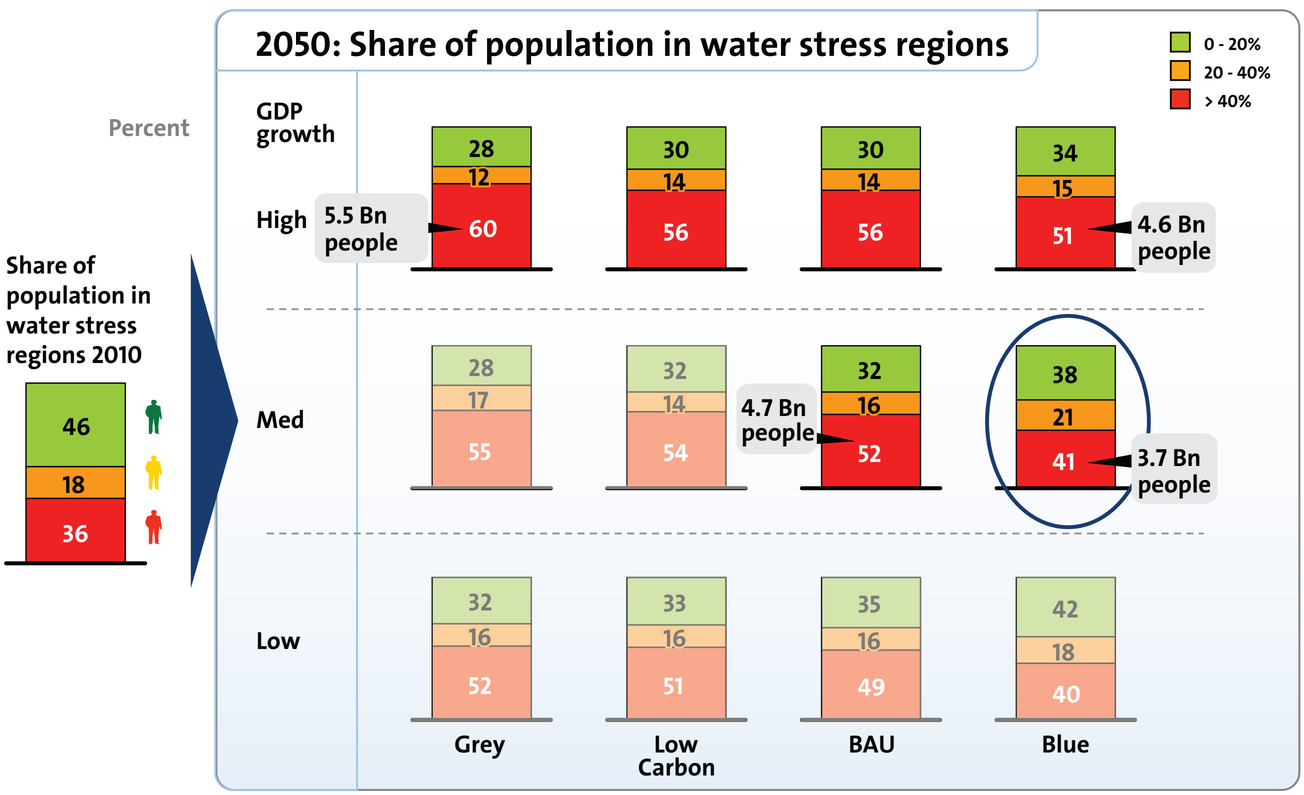
[5] *Source: IFPRI, Veolia Water*
[6] *Estimate based on Global Insight (2010-2040), extrapolated between 2040-2050*

The four models produce different results impacting GDP



A medium-growth Blue world represents the best compromise —balancing growth and sustainability. A blue scenario supports high growth at the level of BAU for medium growth.

The blue model also produces the most favorable results for people



[7] *Source: IFPRI, Veolia Water*
[8] *Year 2000 Prices*

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About Veolia Water

Based in Chicago, Veolia Water North America is the leading provider of comprehensive water and wastewater partnership services to municipal and industrial customers, and is part of the Veolia Environment companies in North America. With 30,000 North American employees, Veolia Environnement companies provide sustainable environmental solutions in water management, waste services, energy management, and passenger transportation.

Veolia Water, the water division of Veolia Environnement, is the world leader in water and wastewater services and technological solutions. Its parent company, Veolia Environnement (NYSE: VE and Paris Euronext: VIE), is the worldwide reference in environmental services. With more than 315,000 employees, Veolia Environnement recorded annual revenues of $46 billion in 2010. Visit the company's Web sites at www.veolianorthamerica.com and www.veoliawaterna.com.

About IFPRI

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