Resource Revolution: Meeting the world's energy, materials, food and water needs

McKinsey Global Institute
Sustainability and Resource Productivity Practice

Overview of conclusions
February 15th, 2011

Contents

- **Overview**
- Key exhibits

Key messages (1/2)

During the 20th century, real resource prices fell by almost half, despite a 20-fold expansion in global GDP.

The last decade has undone the effects of the previous 100-year decline in resource prices. With the exception of energy in the 1970s, resource price volatility is at an **all-time high**.

This is likely (but not certain) to continue over the next 20 years as **3 billion** new middle class consumers are added to the global economy (especially in China and India), with demand for key resources increasing by up to 80%.

Resource productivity – both on the demand and supply-side - has the potential to address up to **30%** of 2030 total resource demand.

Our estimates suggest that, excluding environmental externalities, the resource productivity prize could be worth **$2.9 trillion** per annum by 2030. Including these externalities and adjusting for subsidies, the prize would be worth **$3.7 trillion** per annum.

Just **15 types of opportunity**, from improving the energy efficiency of buildings to moving to more efficient irrigation, represent roughly **75 percent** of this prize.

While some supply expansion, especially for energy and steel, would still be necessary in a more resource productive economy, the strain on supply chains and environmental resources would be reduced.

Key messages (2/2)

Addressing climate change and ensuring universal energy access would require further action – requiring an additional ~**$400b** of annual investment over the next 20 years.

Tackling this resource agenda must start with **new institutional mindsets and mechanisms** that can develop more coordinated approaches to the challenge of resources.

In addition, there are 3 critical priorities for policymakers
1.Unleash the power of the market by **strengthening market signals**, including removing the $1.1 trillion of resources subsidies and supporting stability in long-term prices
2.This must be supported by **addressing (non-price) market failures**, including property rights, agency issues, access to capital and innovation
3.Create long-term resilience by building awareness of risks and appropriate safety nets, strengthening and deepening innovation systems, and addressing consumer mindsets

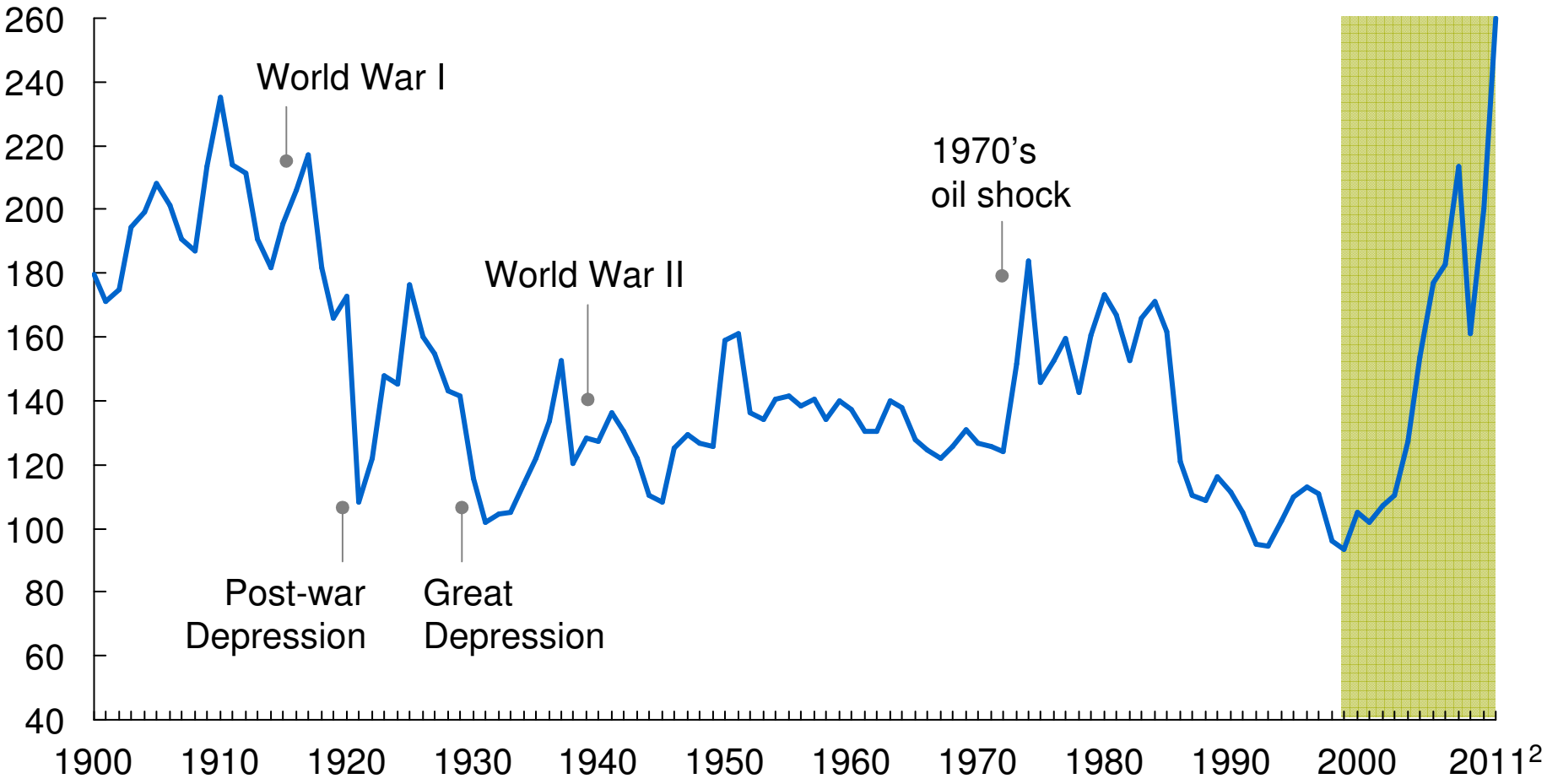
For the private sector, **9 resource-related trends** will shape competitive dynamics across a range of sectors. Successful firms must place resource issues at the heart of their business strategy, including mitigating resource risk in operations through building knowledge of relevant risks and capturing available efficiency opportunities, and aggressively going after new growth opportunities.

Contents

- Overview
- **Key exhibits**

Commodity prices have increased sharply since 2000, erasing all the declines of the 20th century

McKinsey Commodity Price Index (years 1999–2001 = 100)[1]



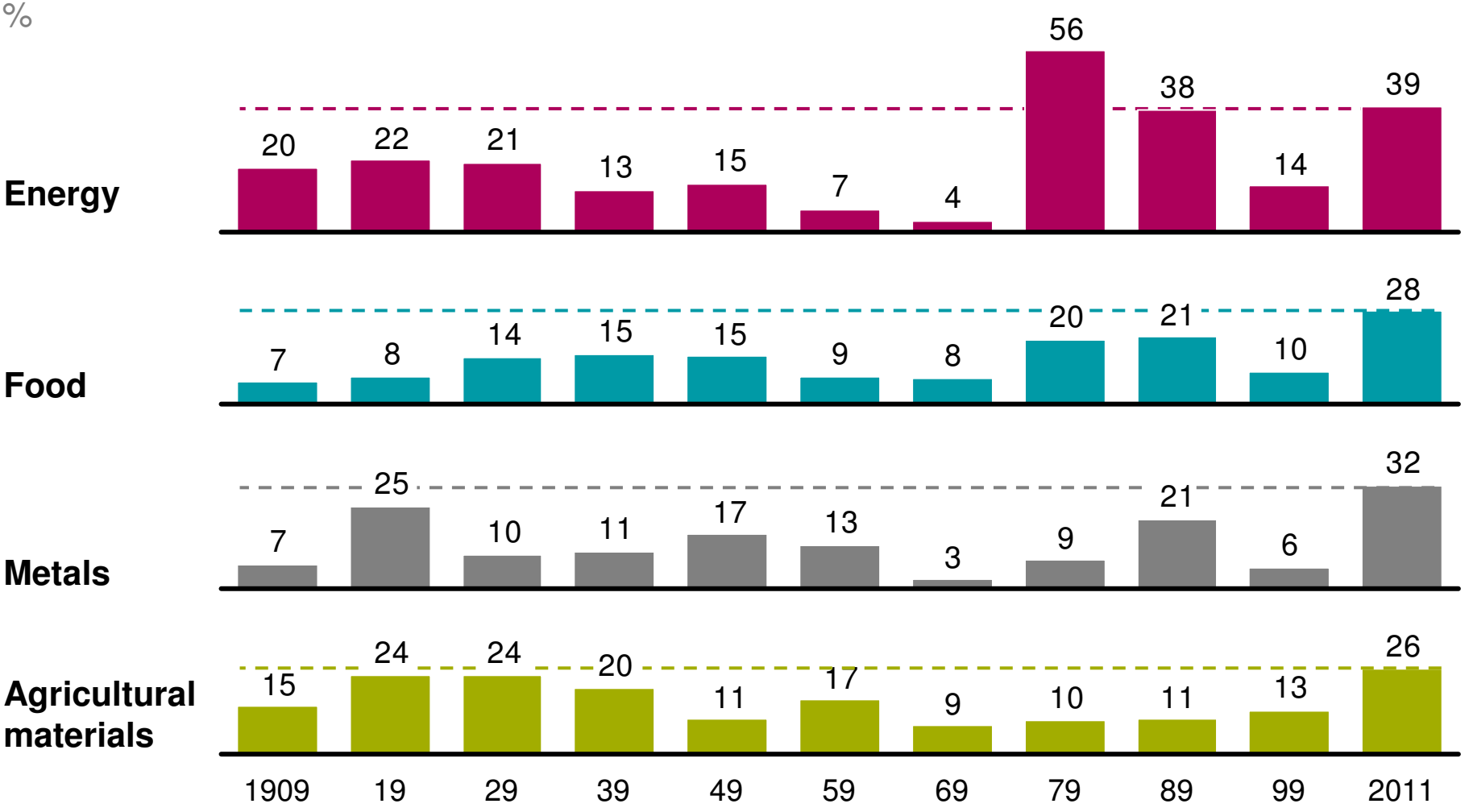
1 Based on arithmetic average of 4 commodity sub-indices of food, non-food agricultural items, metals and energy.
2 2011 prices based on average of first eight months of 2011.

SOURCE: Grilli and Yang; Pfaffenzeller; World Bank; International Monetary Fund; Organisation for Economic Co-operation and Development statistics; UN Food and Agriculture Organization; UN Comtrade

Resource price volatility is at an all-time high, with the exception of energy in the 1970s

Annual price volatility[1]

%

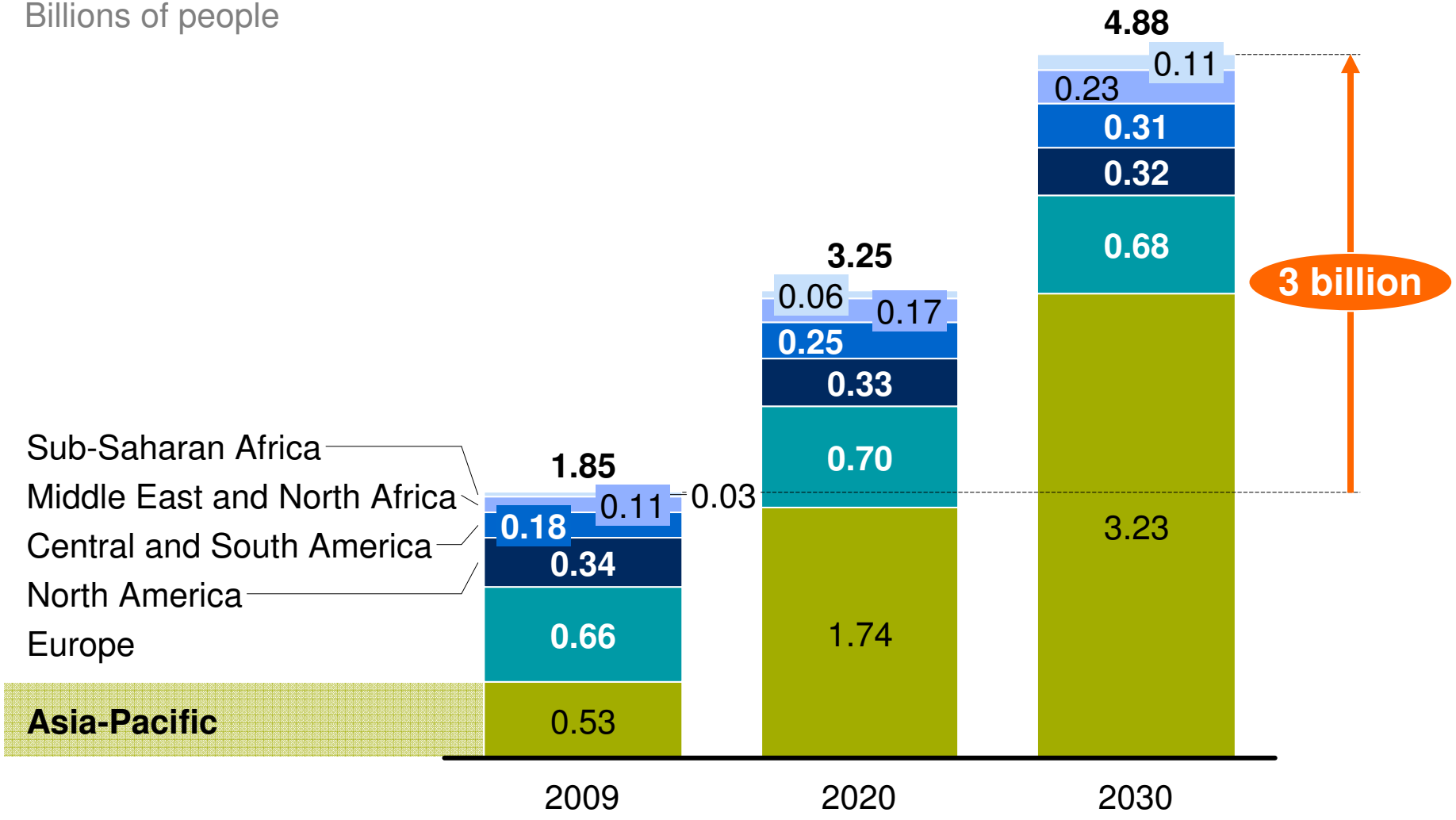


1 Calculated as the standard deviation of the commodity subindex divided by the average of the subindex over the time frame.

SOURCE: Grilli and Yang; Pfaffenzeller; World Bank; International Monetary Fund; Organisation for Economic Co-operation and Development statistics; UN Food and Agriculture Organization; UN Comtrade

The emergence of 3 billion middle-class consumers will fuel future demand

Global middle class[1]
Billions of people

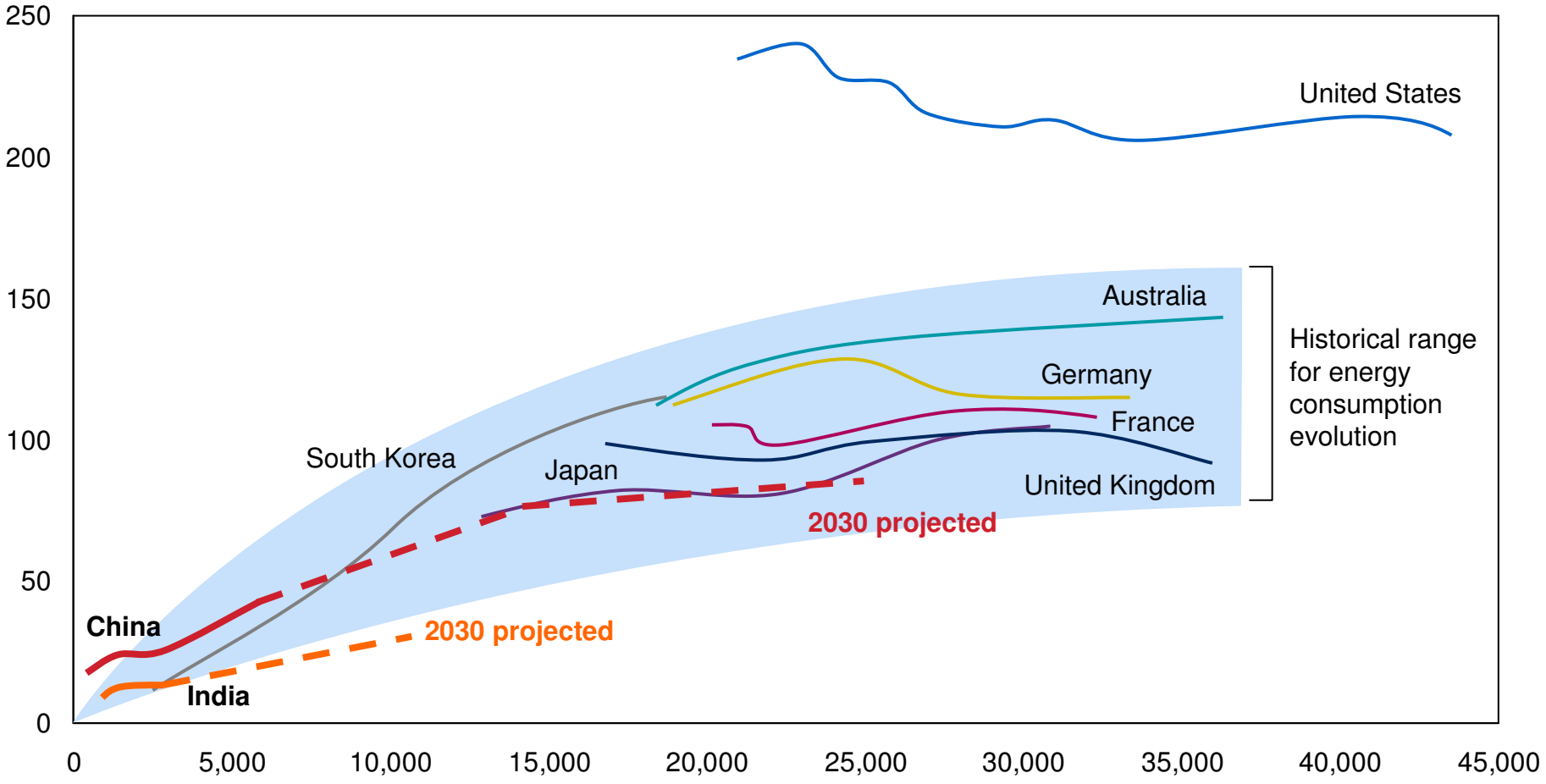


1 Based on daily consumption per capita ranging from $10 to $100 (in purchasing power parity terms)
SOURCE: OECD

Many countries have shown that as incomes rise, demand for resource increases—and a similar curve is likely in China and India

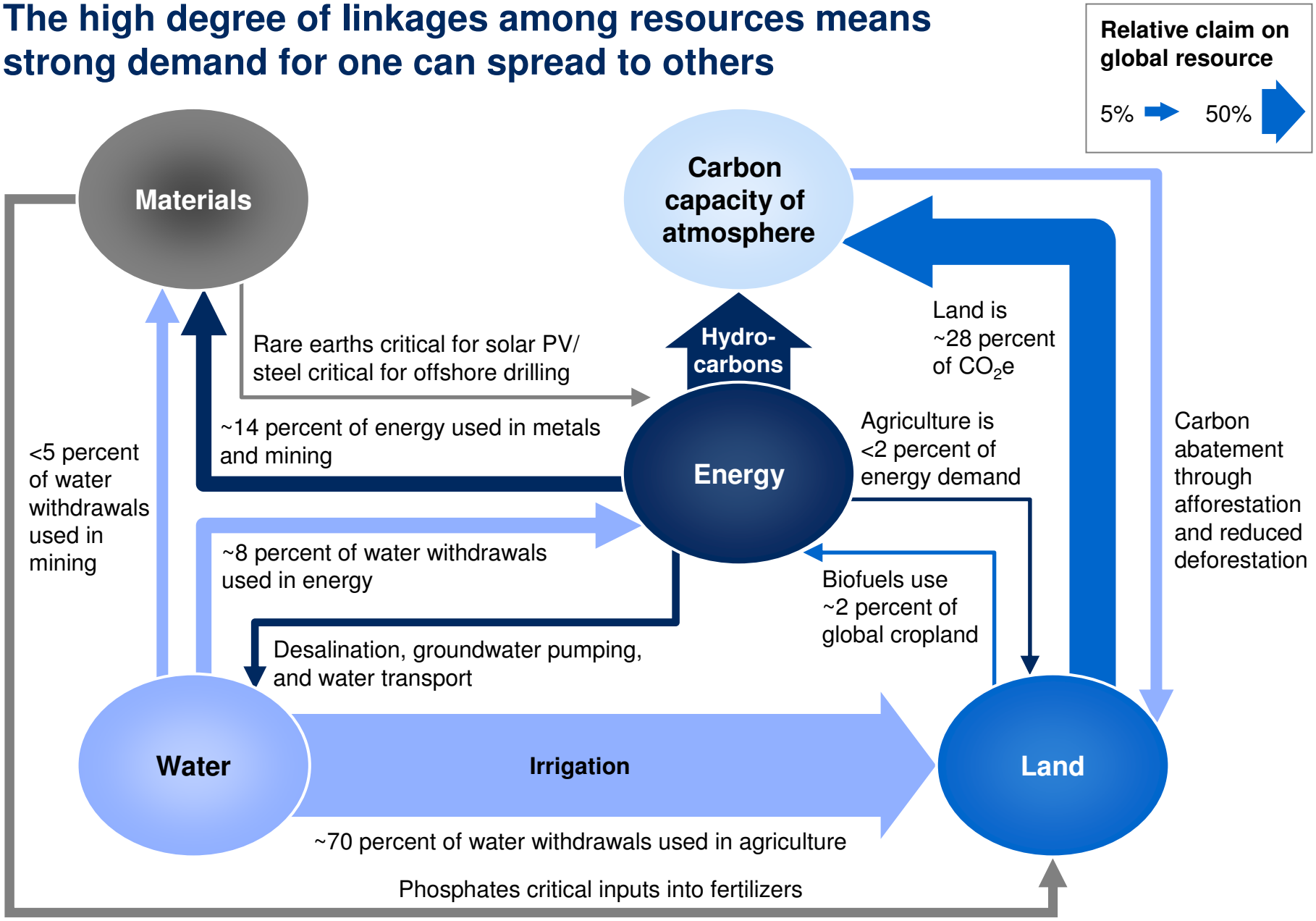
ENERGY EXAMPLE

Per capita energy consumption, 1970–2008, projected to 2030 for India and China
Million British thermal units per person



SOURCE: IEA; Global Insight; McKinsey analysis

The high degree of linkages among resources means strong demand for one can spread to others



SOURCE: McKinsey analysis

These resource trends pose several risks to global growth and welfare

IMF estimates that a **10 percent** increase in the price of crude reduces global GDP by 0.2%-0.3% in one year

World Bank estimates that recent food price increases drove **44 million people** into poverty

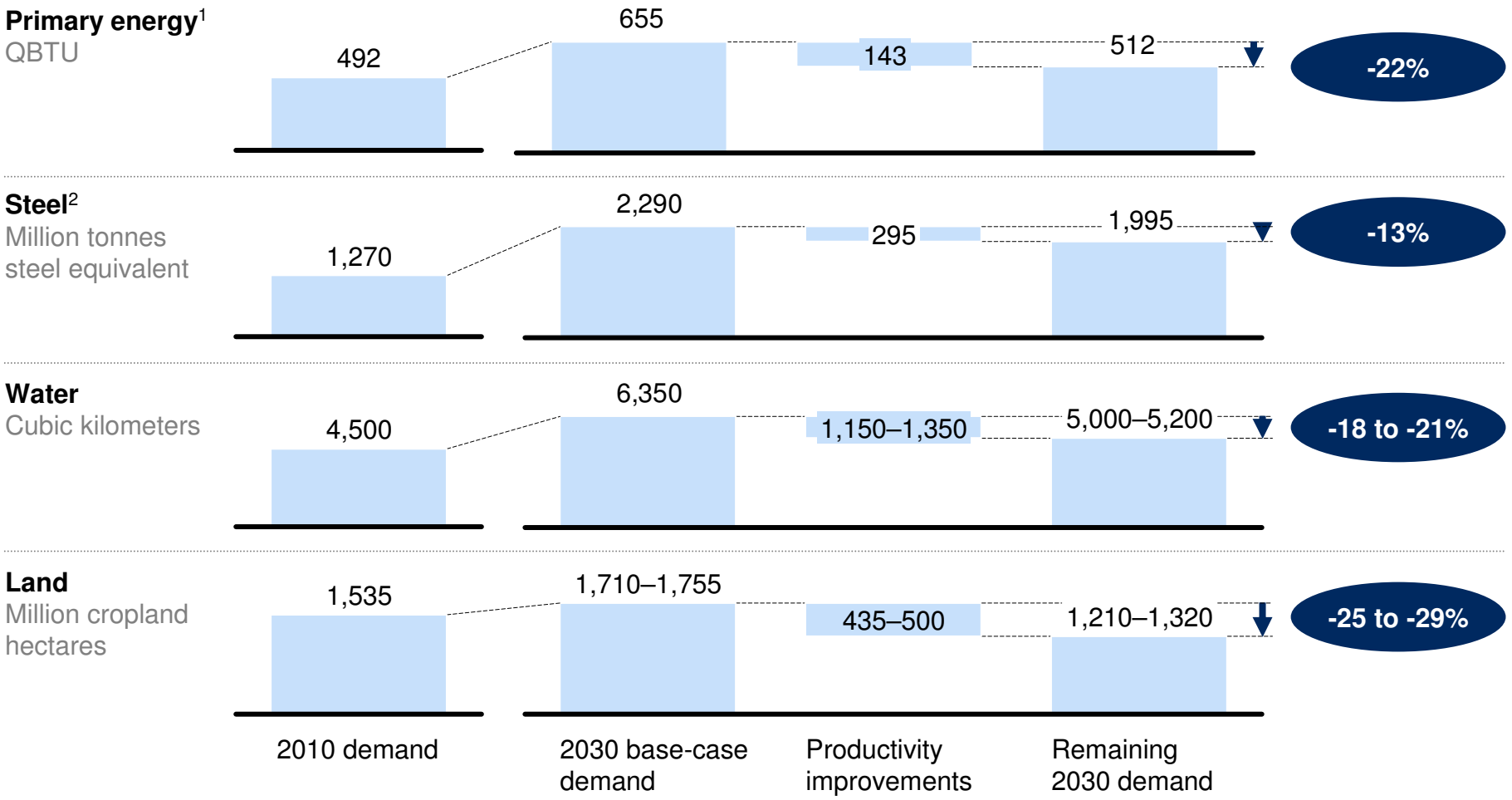
At least 8 countries commit **5 percent** or more of their GDP to energy subsidies. In 2005, government subsidies were estimated to account for 14 percent of India's GDP

Just four countries—Iran, Iraq, Saudi Arabia, and Venezuela—hold almost **50 percent** of known oil reserves

A recent study by the Economics of Climate Adaptation Working Group suggests that some regions are at risk of losing up to **12** percent of their annual GDP by 2030 as a result of existing climate patterns

"PRODUCTIVITY RESPONSE" CASE

In our productivity response case, there are opportunities that could meet 13 to 29 percent of resources demand



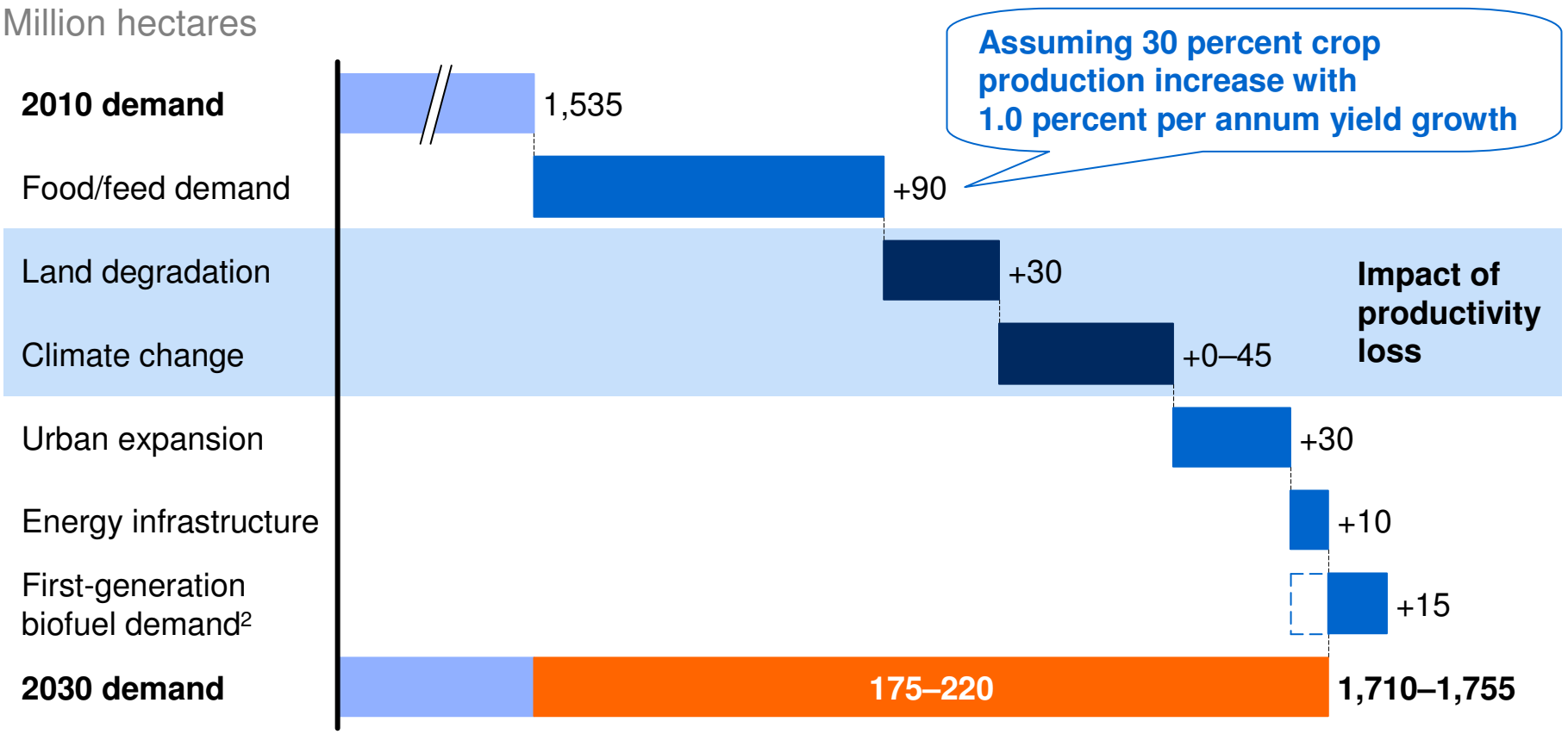
1 Productivity improvements include supply-side measures, such as enhanced oil recovery that lower effective remaining demand.
2 Supply-side levers such as improving recovery rates and the conversion rate in mining and coke do not save steel and are not reflected in this exhibit. We have included effective steel savings from higher scrap recycling.

SOURCE: McKinsey analysis

To meet 2030 food, feed, and fuel demand would require 175 million to 220 million hectares of additional cropland

Base case cropland demand[1] by 2030

Million hectares



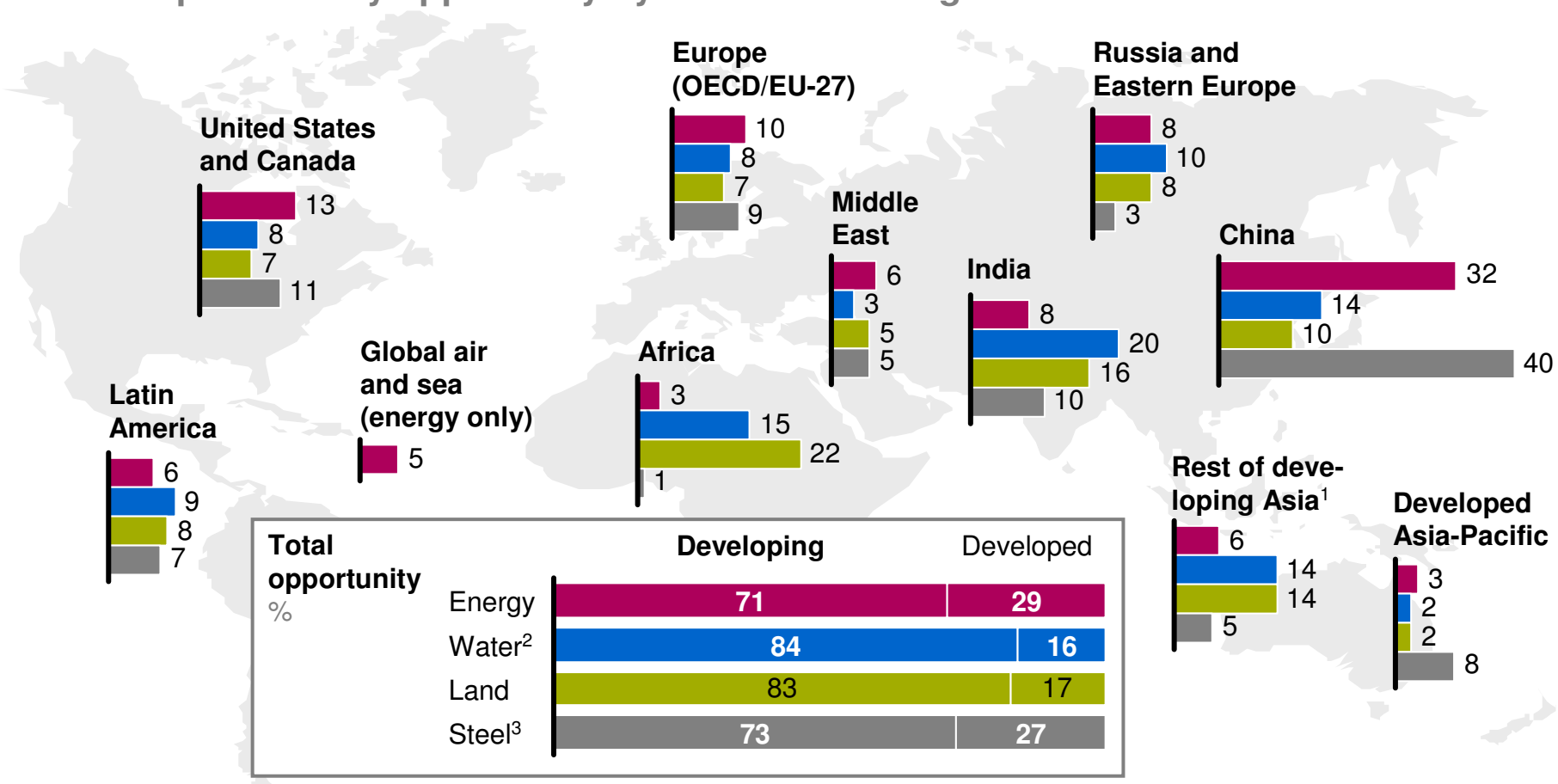
1 Defined as "arable land and permanent crops" by the UN Food and Agriculture Organization.

2 As 30–80 percent of biomass input for biofuel production is fed back to livestock feed, the cropland required to produce feed crops would be reduced by about 10 million hectares.

SOURCE: International Institute for Applied Systems Analysis; UN Food and Agriculture Organization; International Food Policy Research Institute; Intergovernmental Panel on Climate Change; Global Land Degradation Assessment; World Bank; McKinsey Agriculture Initiative; McKinsey analysis

Developing countries account for 70 to 85 percent of the productivity opportunities

% of total productivity opportunity by resource and region

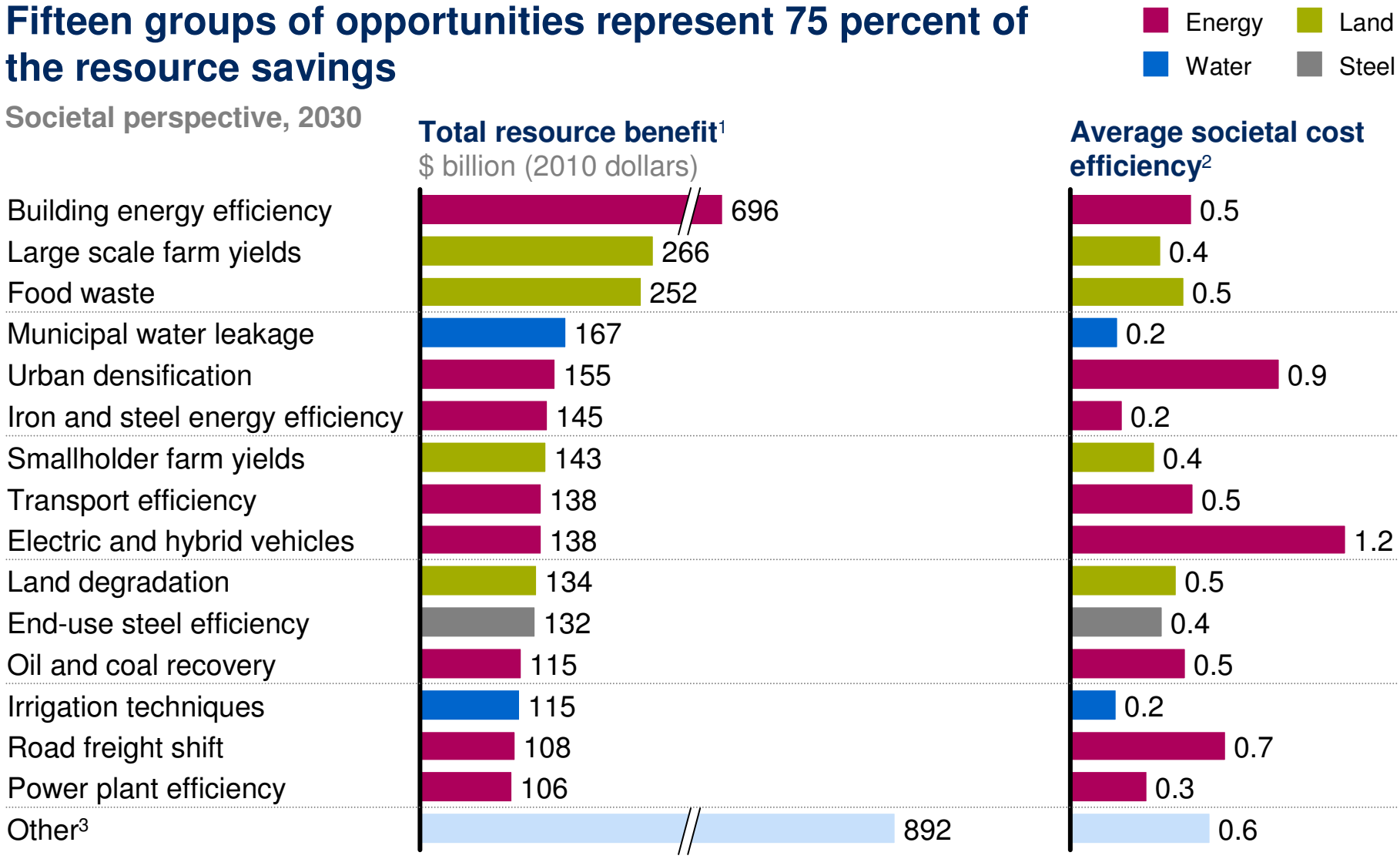


1 Rest of developing Asia includes Central Asia (e.g., Uzbekistan), South Asia (e.g., Bangladesh), Southeast Asia (e.g., Laos), and North Korea.
2 Includes water savings from water-specific levers as well as water savings from improved agricultural productivity.
3 For steel, the chart represents all the demand-side levers and the scrap recycling lever, but excludes supply- and conversion-side levers.

SOURCE: McKinsey analysis

Fifteen groups of opportunities represent 75 percent of the resource savings

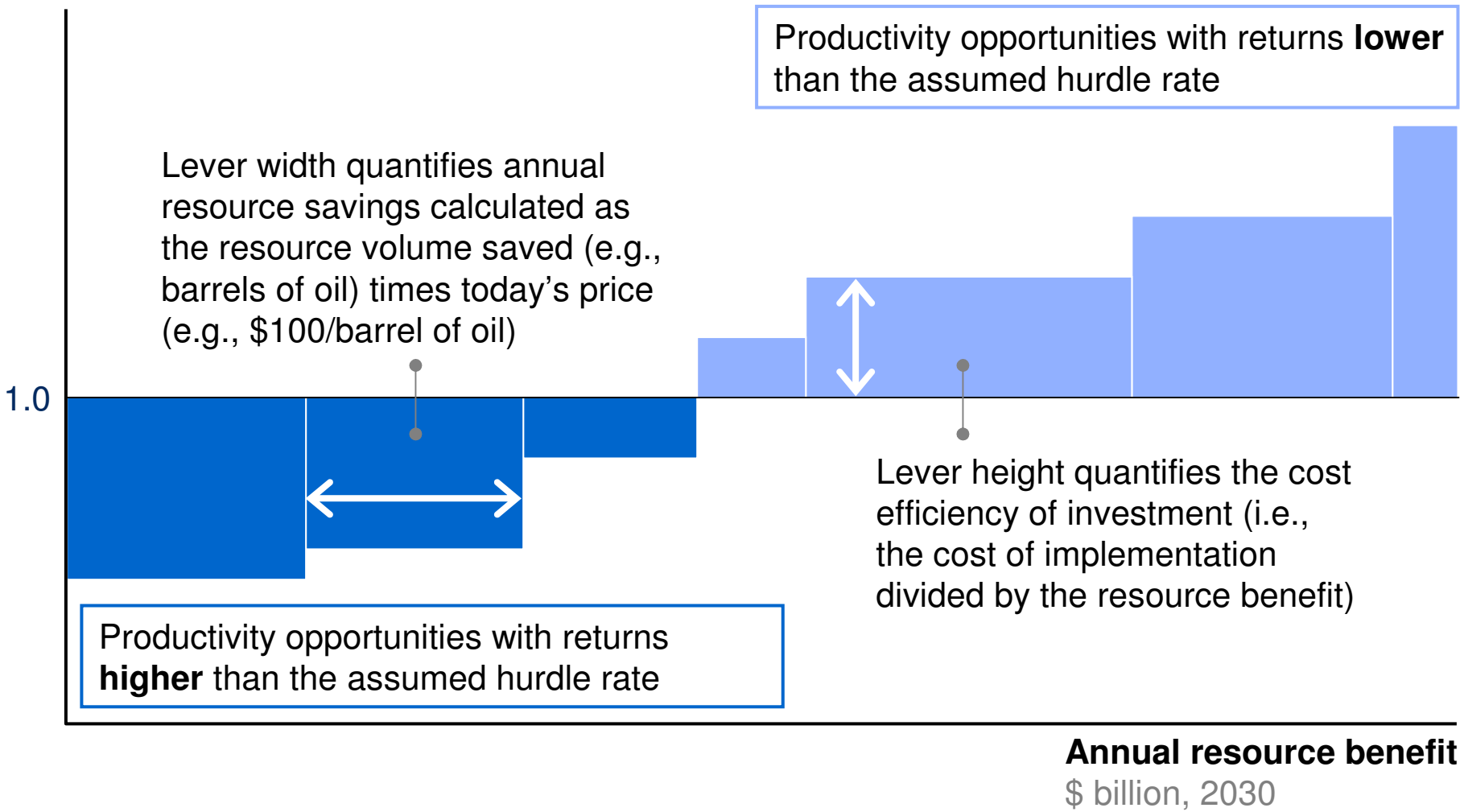
Societal perspective, 2030



1 Based on current prices for energy, steel, and food plus unsubsidized water prices and a shadow cost for carbon.
2 Annualized cost of implementation divided by annual total resource benefit.
3 Includes feed efficiency, industrial water efficiency, air transport, municipal water, steel recycling, wastewater reuse, and other industrial energy efficiency.

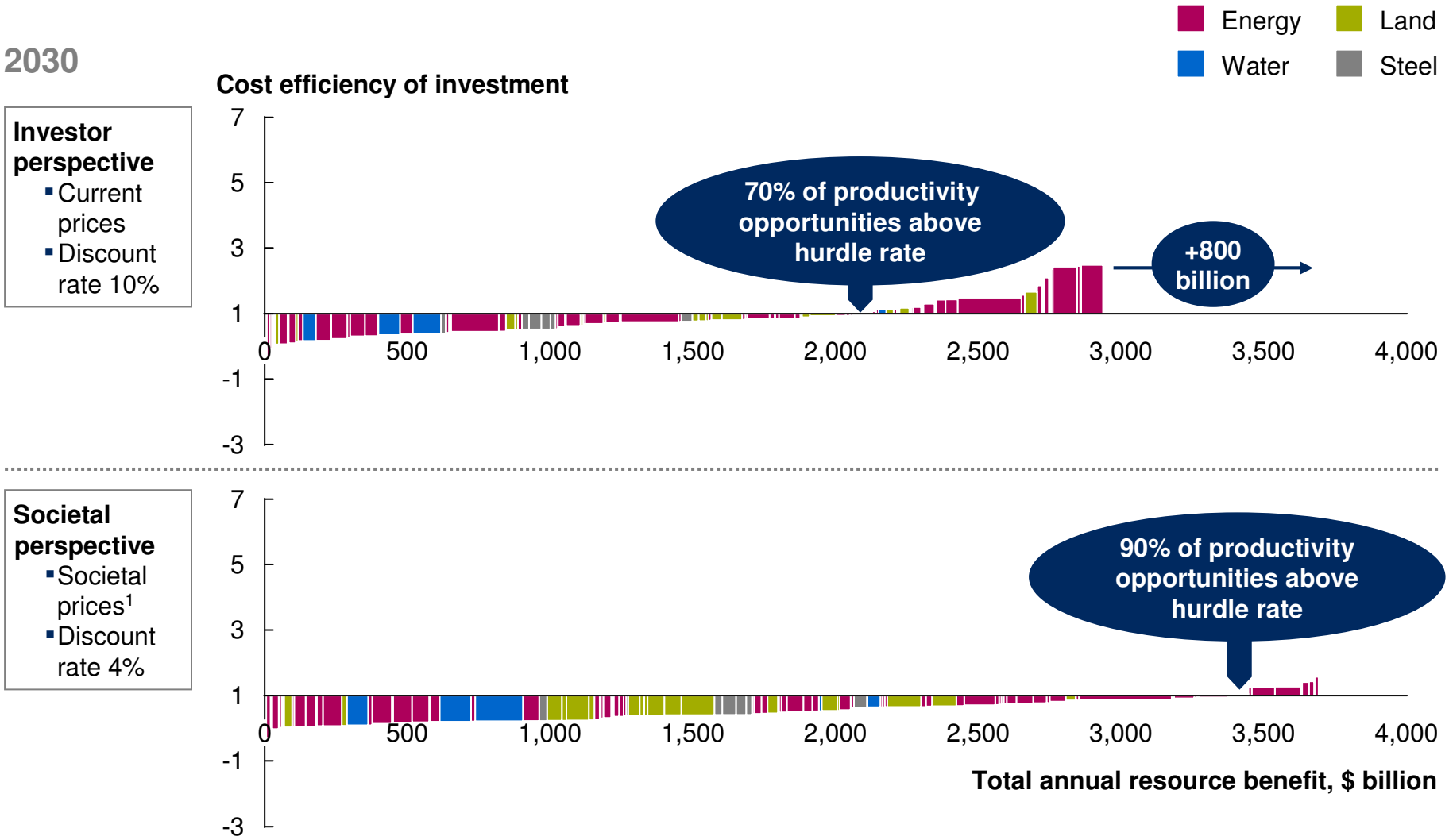
SOURCE: McKinsey analysis

We have developed an integrated resource cost curve to compare productivity levers across resources



SOURCE: McKinsey analysis

Resource productivity opportunities could create societal benefits of up to $3.7 trillion, with 90 percent of opportunities above the hurdle rate



1 Based on current prices for energy, steel, and food, less energy taxes, plus subsidies, and a shadow cost for carbon (at $30 per tonne of carbon dioxide equivalent).

SOURCE: McKinsey analysis

There are significant barriers affecting each of the three cases for meeting future resource demand

Large barriers
Minimal barriers
Some barriers

	Supply expansion	Productivity response	Climate response
Incentive barriers			
1 Capital intensity	Up to $3.1 trillion per annum	Up to $3.2 trillion per annum	Up to $3.5 trillion per annum
2 Return on investment		~50% of energy productivity levers have IRR<10%	Requires public subsidy (in short term) for renewables
Decision-making barriers			
3 Agency issues		Some agency issues in energy	Some agency issues in energy
4 Political risk	Risk of government interference (e.g., export bans, windfall taxes)	Some opportunities require difficult reforms (e.g., subsidy removal)	Highly challenging, requires international collaboration on carbon pricing
5 Information failures	Some information failures around remaining reserves	Low awareness of opportunities (e.g., energy)	Low awareness of opportunities (e.g., energy)
Implementation barriers			
6 Supply-chain bottlenecks	Weak infrastructure; risk of supply chain crunch	Some specific new skills required	Many renewable technol-ogies lack full value chain
7 Capital availability	Resource firms have generally easy access to capital for investment	Opportunities less familiar to financial institutions	Renewable opportunities perceived as higher risk, with weaker capital pools
8 Regulatory issues	Property right concerns (e.g., land tenure)	Property right concerns (e.g., land tenure)	Relies critically on subsidy / payment mechanisms for renewable energy / forests
9 Technological readiness	Challenging extraction may require new technologies	All opportunities based on existing technologies	Many renewable energy technologies are unproven
10 Entrenched behavior	No change in behavior	Requires change in behavior and mindsets	Requires change in behavior and mindsets

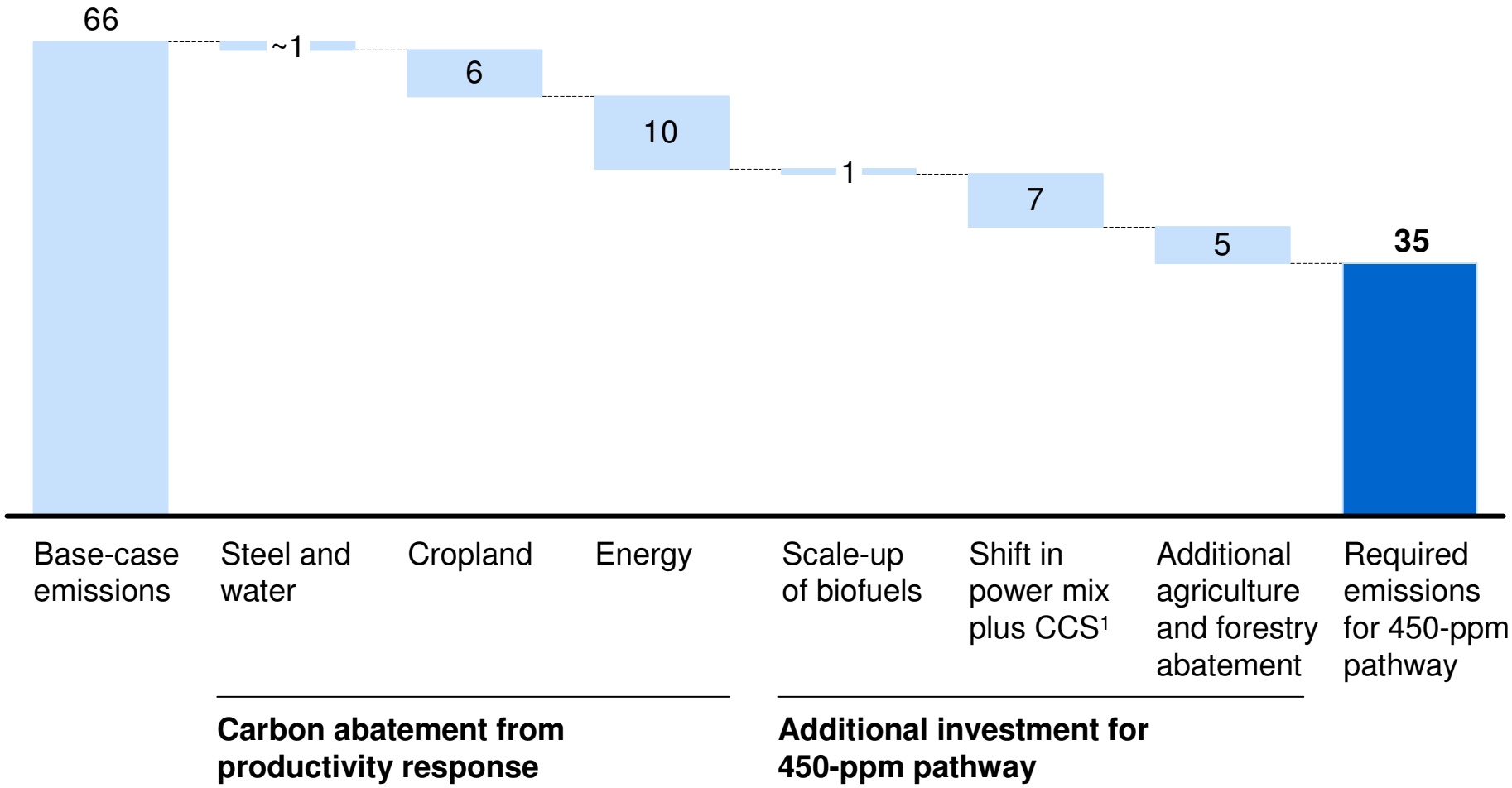
SOURCE: McKinsey analysis

"CLIMATE RESPONSE" CASE

Shifting the energy mix and pursuing additional carbon abatement in land can be used to close the remaining gap to a 450-ppm pathway

Carbon emissions footprint, 2030

Gigatonnes of carbon dioxide equivalent



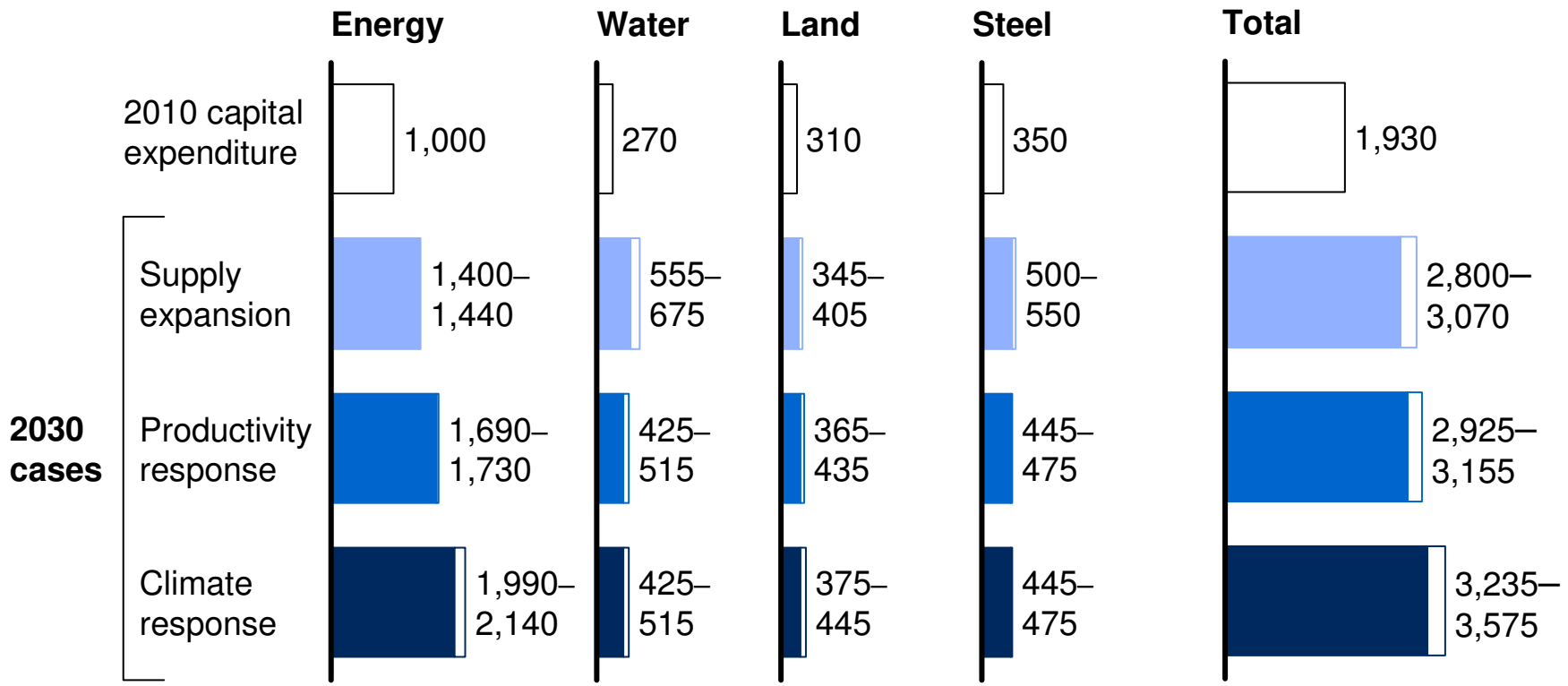
1 CCS = carbon capture and storage.

SOURCE: McKinsey analysis

Capital investment could increase significantly under all three cases

Average annual capital expenditure requirement, 2010–30[1]

$ billion (2010 dollars)



1 Does not include capital expenditure for base-case productivity improvements; includes impact of capital price spikes due to supply constraints.

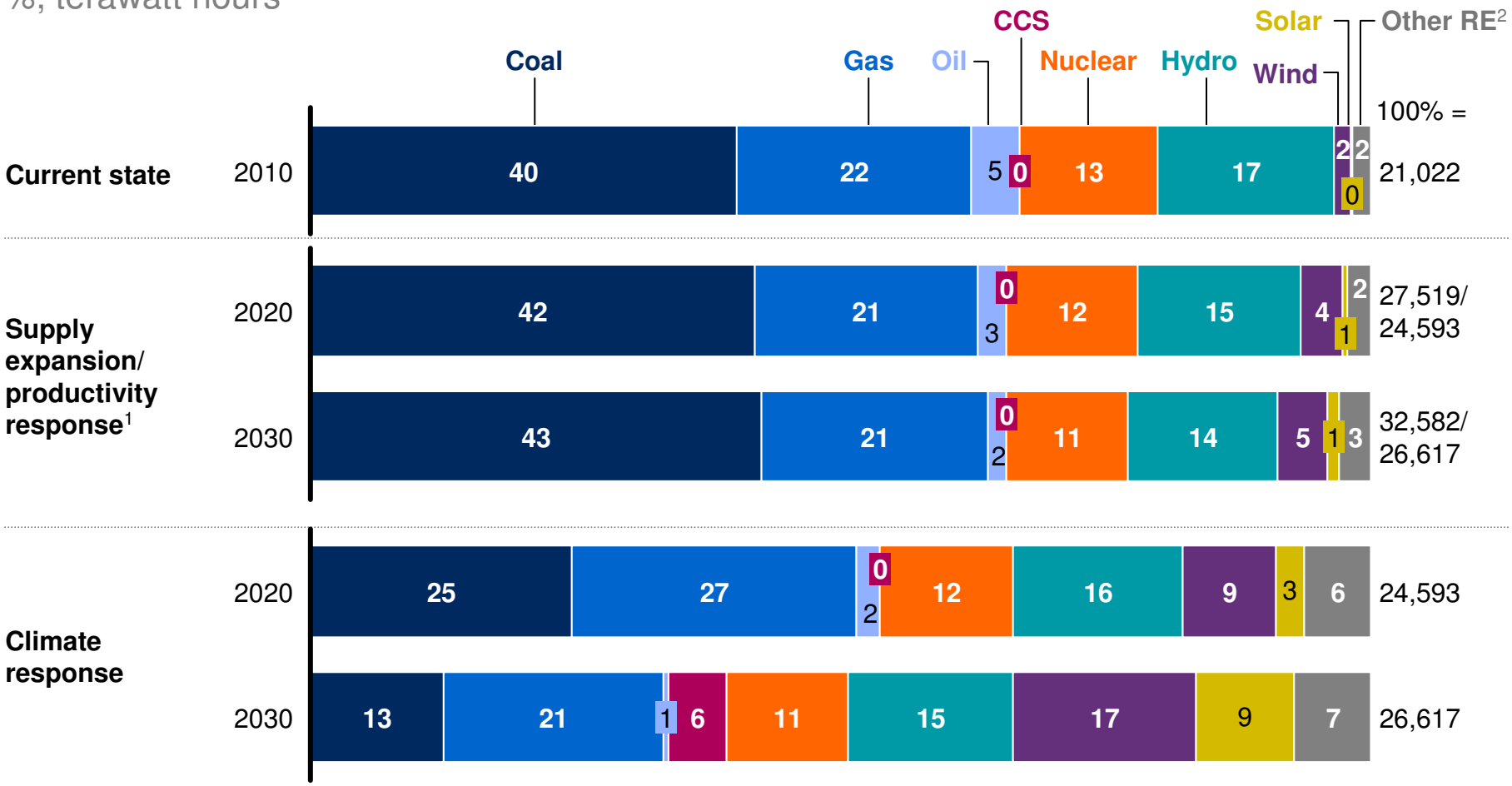
SOURCE: McKinsey analysis

"CLIMATE RESPONSE" CASE

Power mix shifts significantly in a climate response case

Share of global power production

%; terawatt hours



1 Same power mix assumed in both the supply expansion and productivity response cases. End demand varies between the two cases—the first number shown on the 100% line refers to supply expansion; the second number to productivity response.

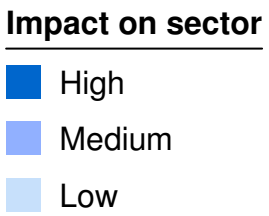
2 RE = Renewables. Other RE include dedicated biomass, geothermal, and marine.

SOURCE: McKinsey analysis

There are 4 broad areas of action to capture this resource revolution

	Description
1 **Adopt an integrated approach**	▪ Tackling this resource agenda must start with new institutional mindsets and mechanisms that can develop more coordinated approaches to the challenge of resources
2 **Strengthen market signals**	▪ Unleash the power of the market by strengthening market signals, including removing resource subsidies and supporting stability in long-term prices
3 **Address other market failures**	▪ Address property rights, agency issues, access to capital and innovation
4 **Create long-term resilience**	▪ Build awareness of risks and opportunities ▪ Create appropriate safety nets to reduce vulnerability of poorest members of society to resource price changes ▪ Address consumer and business mindsets

Disruptive trends in three broad categories could shape private-sector competitive dynamics and value creation



Disruptive force		Industry: CPG[1]	Industry: Mining	Industry: Oil and gas	Illustrative facts
Resource cost-related forces	More expensive resource input costs	High	High	High	The average cost per oil well doubled from 2000 to 2010
	Rising volatility and correlation	High	High	High	Annual volatility across resources is at its highest level of the past 100 years
	Rising environmental costs	Medium	Medium	Medium	Potential impact on yields of greater than 10 percent in next 20 years
Regulation-related forces	Rising geopolitical concerns	Low	Low	Medium	>80 percent of available arable land is in countries with infrastructure or political issues
	Public policy push to realize true cost of resources	Medium	High	High	Current subsidies for agriculture, energy, and water total up to $1.1 trillion per year
	The new social contract for access to resources	Medium	High	High	Maintaining social license to operate is a top-four issue for metals/mining executives
Resource-related techno-logical forces	Supply-chain efficiency opportunities	High	High	High	CPG players can reduce energy consumption by 20 to 50 percent on average
	Impact of technology on competitive advantage	Low	Medium	High	Learning curves for renewable power sources range from 10 to 20 percent
	Demand for resource-efficient products	Medium	Medium	Medium	Half of shoppers consider green attributes in their purchasing decisions

1 CPG = consumer packaged goods.
SOURCE: McKinsey analysis