Vision 2050

The new agenda for business

World Business Council for Sustainable Development

About *Vision 2050*

Under the *Vision 2050* Project of the World Business Council for Sustainable Development (WBCSD), 29 WBCSD member companies developed a vision of a world well on the way to sustainability by 2050, and a pathway leading to that world – a pathway that will require fundamental changes in governance structures, economic frameworks, business and human behavior. It emerged that these changes are necessary, feasible and offer tremendous business opportunities for companies that turn sustainability into strategy.

This report addresses three questions: What does a sustainable world look like? How can we realize it? What are the roles business can play in ensuring more rapid progress toward that world?

Vision 2050 is the result of a collaborative effort. The project was governed by four co-chair companies, and the content developed by 29 companies through working with each other, with hundreds of representatives from business, government and civil society, with regional partners and with experts. It also builds on WBCSD reports and work done by others. The report is complemented by murals, presentation decks and a toolkit. The Vision 2050 work provides a basis for interaction with other enterprises, civil society and governments about how a sustainable future can be realized. We hope to challenge companies to rethink their products, services and strategies, envisioning new opportunities that put sustainability at the center, to communicate with and motivate employees and their boards, and to develop leadership positions in the wider world. We invite governments to consider the policies and regulations needed to guide and organize society and give markets incentives to move toward sustainability, and people to make a difference in their daily lives.

A platform for dialogue – not a blueprint

This report does not offer a prescriptive plan or blueprint but provides a platform for dialogue, for asking questions. Its highest value may be in our narrative of the gap between *Vision 2050* and a business-as-usual world, and the queries and dilemmas it raises.

For business and others, the biggest unanswered questions are "How do we get there?" "What form of governance will make the changes needed happen at the speed and scale required?"

On these issues, we indicate our willingness, support and leadership, and invite all stakeholders – business, government and civil society – to join the exploration and effort.

> "Vision 2050 lays out the challenges, pathway and options that business can use to create an opportunistic strategy, both regionally and globally, that will lead to a sustainable world." **Mohammad A. Zaidi, Alcoa**

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The full project team and contributors are presented at the end of the report. The members benefited by working with external contributors, in particular the Global Footprint Network, the Alliance for Global Sustainability and a group of experts. The project has also collected regional viewpoints and tested its findings in some 30 dialogues across the world.

Message from the co-chairs

Many of the 29 WBCSD member companies that have laid out this vision have been operating for more than a century and have seen the future come and go, many times. As business leaders, we are used to planning for the future and making assumptions about what it will be like.

But never before has the future held as many questions, and with such serious consequences depending on the answers. And never before has the shape of the future depended so much on what we – business, government, citizens – do today.

The *Vision 2050* Project has been a collaborative effort among the 29 companies, supported by the WBCSD secretariat, the wider business community and regional network partners around the world, in mapping out not what we think will be, nor what we fear will be, but what could be. Given the megatrends of climate change, global population growth and urbanization, and given the best efforts of business, governments and society, *Vision 2050* is a picture of the best possible outcome for the human population and the planet it lives on over the next four decades.

In a nutshell, that outcome would be a planet of around 9 billion people, all living well – with enough food, clean water, sanitation, shelter, mobility, education and health to make for wellness – within the limits of what this small, fragile planet can supply and renew, every day.

This Vision is supported by a pathway, nine key areas of action, and "must haves" that will need to be navigated to achieve it.

The best news is that we found the pathway and its elements marked by massive opportunities: to do more with less, to create value, to prosper, and to advance the human condition. For us, these are a key takeaway, because, at the fundamental level, opportunity is what makes business grow and prosper. And many of these opportunities will be in emerging markets.

An equally firm finding is that business-as-usual cannot get us to sustainability or secure economic and social prosperity; these can be achieved only through radical change, starting now. To play its role, business will still need to do what business does best: innovate, adapt, collaborate and execute. These activities will change along with the partnerships that we form with other businesses, governments, academia and non-governmental organizations in order to get it right for all. And we must get it right.

We would like to thank our colleagues in the member companies who worked so hard and skillfully in producing this report, and to thank the members of the WBCSD secretariat and the many consultants, experts and regional contributors who supported and advised us.

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Executive summary

In 2050, around 9 billion people live well, and within the limits of the planet

Just 40 years from now, some 30% more people will be living on this planet. For business, the good news is that this growth will deliver billions of new consumers who want homes and cars and television sets. The bad news is that shrinking resources and potentially changing climates will limit the ability of all 9 billion of us to attain or maintain the consumptive lifestyle that is commensurate with wealth in today's affluent markets.

In the WBCSD's *Vision 2050* Project, 29 global companies representing 14 industries tackled this dilemma. They developed a vision, based on dialogues in 20 countries with several hundred companies as well as experts, of a world on-track toward sustainability by 2050. This will be a world in which the global population is not just living on the planet, but living well and within the limits of the planet. By "living well", we are describing a standard of living where people have access to and the ability to afford education, healthcare, mobility, the basics of food, water, energy and shelter, and consumer goods. By "living within the limits of the planet", we mean living in such a way that this standard of living can be sustained with the available natural resources and without further harm to biodiversity, climate and other ecosystems.

At first this Vision may read like a utopian ideal, considering how far it seems to be from the world of today. But that is neither the intention of this report, nor the reality. With or without *Vision 2050*, life in 2050 will be radically different for all of us. *Vision 2050* is the best available star to steer by today, based on the observations, projections and expectations of the companies and experts who contributed to this effort. This guiding star is an attempt to help leaders across governments, businesses and civil society avoid repeating mistakes of the past – making decisions in isolation that result in unintended consequences for people, the environment and planet Earth. *Vision 2050* seeks to provide a common understanding so leaders can make the decisions that deliver the best outcomes possible for human development over the next four decades. It is also a platform for ongoing dialogue, so we can continue to raise the important questions we must answer in order to make progress in this uncharted territory.

Attaining the Vision: The pathway

A pathway was developed and nine elements of this pathway detailed to connect this sustainable future with the present. The goal was to see what a real, global attempt at sustainable development – with all the radical policy and lifestyle changes this would entail – would mean for business and markets in general and for the individual participating sectors. The elements of the pathway demonstrate that behavior change and social innovation are as crucial as better solutions and technological innovation. All types of ingenuity will be needed over the next 40 years. Although distinct, the elements also show the interconnectedness of issues such as water, food and energy – relationships that must be considered in an integrated and holistic way, with tradeoffs that must be understood and addressed.

The critical pathway includes:

- Addressing the development needs of billions of people, enabling education and economic empowerment, particularly of women, and developing radically more eco-efficient solutions, lifestyles and behavior
- Incorporating the cost of externalities, starting with carbon, ecosystem services and water
- Doubling of agricultural output without increasing the amount of land or water used
- Halting deforestation and increasing yields from planted forests
- Halving carbon emissions worldwide (based on 2005 levels) by 2050, with greenhouse gas emissions peaking around 2020 through a shift to low-carbon energy systems and highly improved demand-side energy efficiency
- Providing universal access to low-carbon mobility
- Delivering a four-to-tenfold improvement in the use of resources and materials

> *"Humanity has largely had an exploitative relationship with our planet; we can, and should, aim to make this a symbiotic one."*
> **Michael Mack, Syngenta International AG**

Making these changes – and more – will enable us to consume just over one planet's worth of ecological resources in 2050, as opposed to the 2.3 planets we will be using if we continue on the business-as-usual path we are on today.

Vast opportunities

The transformation ahead represents vast opportunities in a broad range of business segments as the global challenges of growth, urbanization, scarcity and environmental change become the key strategic drivers for business in the coming decade. In natural resources, health and education alone, the broad order of magnitude of some of these could be around US$ 0.5-1.5 trillion per annum in 2020, rising to between US$ 3-10 trillion per annum in 2050 at today's prices, which is around 1.5-4.5% of world GDP in 2050.

Opportunities range from developing and maintaining low-carbon, zero-waste cities and infrastructure to improving and managing biocapacity, ecosystems, lifestyles and livelihoods.

Enabling these changes will also create opportunities for finance, information/communication technology and partnerships. There will be new opportunities to be realized, different external priorities and partners to be engaged and a myriad of risks to navigate and adapt to. Smarter systems, smarter people, smarter designs and smarter businesses will prevail.

A radical new landscape for business

There will be a new agenda for business leaders. Political and business constituencies will shift from thinking of climate change and resource constraints as environmental problems to economic ones related to the sharing of opportunity and costs. A model of growth and progress will be sought that is based on a balanced use of renewable resources and recycling those that are not. This will spur a green race, with countries and business working together as well as competing to get ahead. Business leaders will benefit from this change by thinking about local and global challenges as more than just costs and things to be worried about, and instead using them as an impetus for investments that open up the search for solutions and the realization of opportunities. The transformation will bring with it huge shifts in terms of regulation, markets, consumer preferences, the pricing of inputs, and the measurement of profit and loss; all of which will impact business. Rather than follow change, business must lead this transformation by doing what business does best: cost-effectively creating solutions that people need and want. The difference is that the new solutions will be based on a global and local market place with "true values and costs", the "truth" being established by the limits of the planet and what it takes to live well within them. Business, consumers and policy-makers will experiment, and, through multi-stakeholder collaboration, systemic thinking and co-innovation, find solutions to make a sustainable world achievable and desirable. This is opportunistic business strategy at its best.

Business leaders must also run their companies successfully under present framework conditions while helping to lead society toward the new framework conditions of sustainability, working closely with political and social leaders in doing this. It will mean new partnerships for business with governments and civil society groups and more systemic thinking and approaches to manage challenges and opportunities such as a doubling of urban populations by 2050.

Business leaders will need to manage companies through unprecedented transformational change, in parallel with governments getting the right policies and incentives in place.

It can be done

The participating companies strongly believe that the world already has the knowledge, science, technologies, skills and financial resources needed to achieve *Vision 2050* but the foundations for much of what is required will need to be laid at speed and scale in the next decade. At the same time, the map is far from complete. There are still many significant questions to be answered about governance, global frameworks for commerce, roles and responsibilities, and risks. Nevertheless, these can be answered in time for progress to be made.

1 Business-as-usual outlook to 2050

"The story is one of growth in populations and consumption (in most countries) compounded by inertia stemming from inadequate governance and policy responses. The result is degradation of the environment and social stress."

We have what is needed to live well within the limits of the planet: the scientific knowledge, proven and emerging technologies, financial assets and instant communications. Nevertheless, today our societies are on a dangerously unsustainable track. The story is one of growth in populations and consumption (in most countries) compounded by inertia stemming from inadequate governance and policy responses necessary to manage this growth. The result is degradation of the environment and societies.

Growth: Population, urbanization and consumption

Between now and 2050 the global population is expected to increase from 6.9 billion to more than 9 billion, with 98% of this growth happening in the developing and emerging world, according to UN estimates. The global urban population will double. Meanwhile, populations are aging and stabilizing in many developed countries. Local demographic patterns will become increasingly diverse.

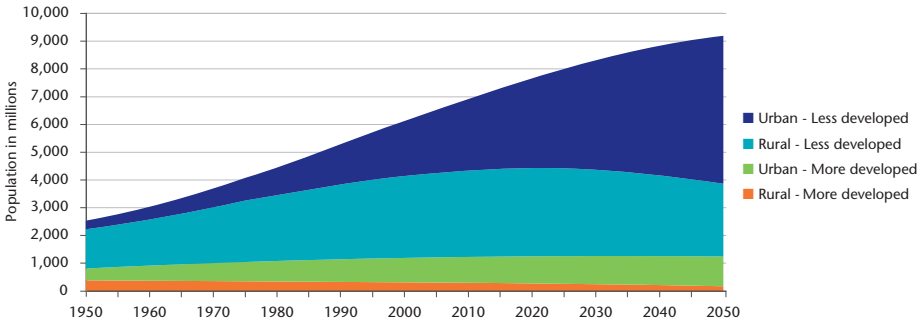
There have been improvements in recent decades in terms of economic growth in many parts of the world, as well as in areas such as infant and maternal mortality, food supply, and access to clean water and education. However, extreme poverty continues to persist.

Most of the economic growth will happen in developing or emerging economies. Many people will be moving up the economic ladder toward a middle class standard of living,

Figure 1.1: Outlook to 2050 – Growth

The world population is increasingly urban

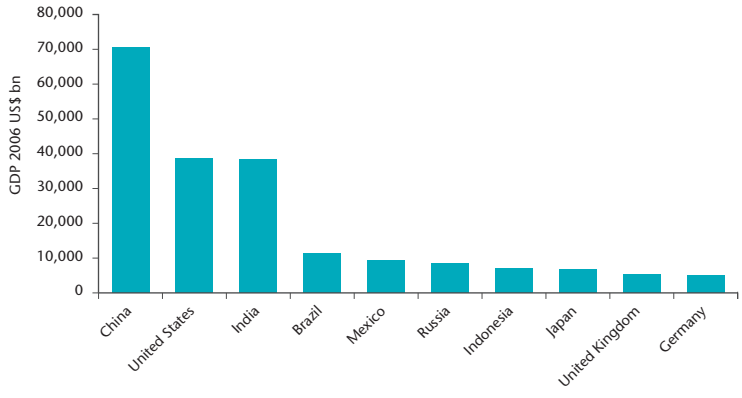
Global population by type of area and by region – 1950-2050



Source: UN Population Division, *World Population Prospects: The 2008 Revision*, 2008

Global economic power is shifting

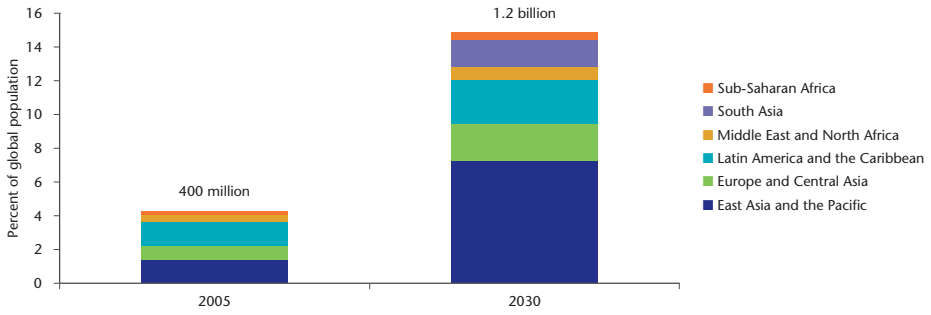
Top 10 economies by GDP in 2050



Source: Goldman Sachs, *BRICs and Beyond*, 2007

The global middle class is rapidly expanding

Population in low- and middle-income countries earning $4,000-$17,000 per capita (purchasing power parity)

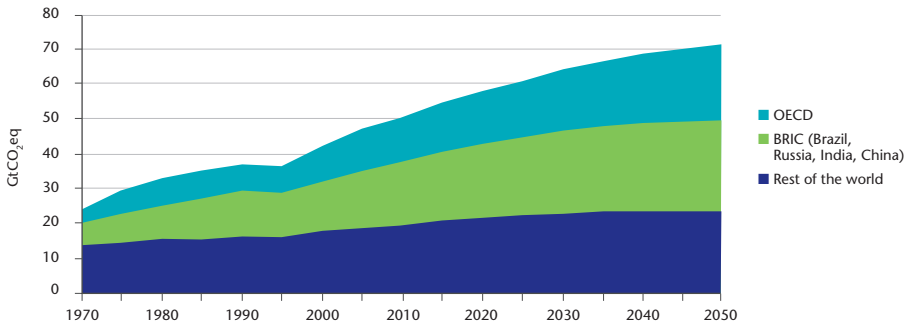


Source: World Bank, *Global Economic Prospects*, 2007

Figure 1.2: Outlook to 2050 – Degradation

Greenhouse gas emissions keep rising

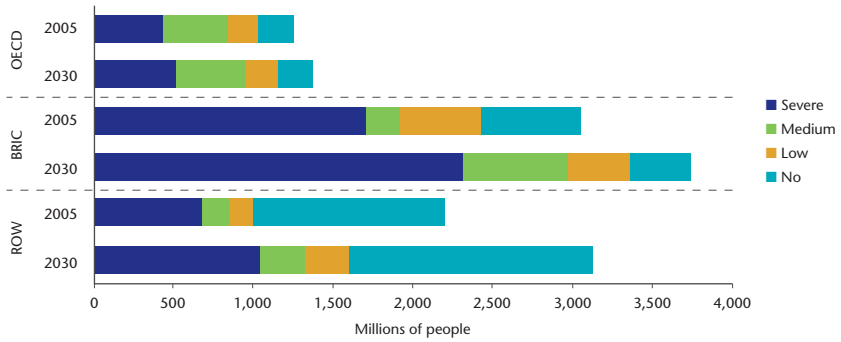
GHG emissions by regions



Source: OECD, *Environmental Outlook to 2030*, 2008

Environmental degradation jeopardizes people's quality of life

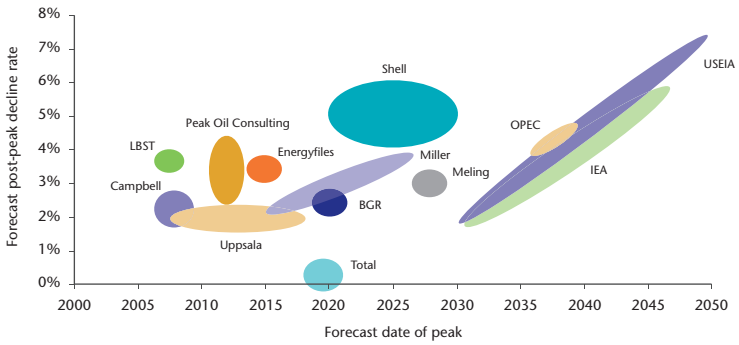
People living in areas of water stress by level of stress



Source: OECD, *Environmental Outlook to 2030*, 2008

The world could be running out of some resources

Global supply forecasts according to the implied ultimate recoverable resources of conventional oil, date of peak production and the post-peak aggregate decline rate



Source: UKERC, *The Global Oil Depletion Report*, 2009

consuming many more resources per capita. As this growth and development takes place, substantial changes will be required in all countries in order for 9 billion people to live well within the limits of one planet by 2050.

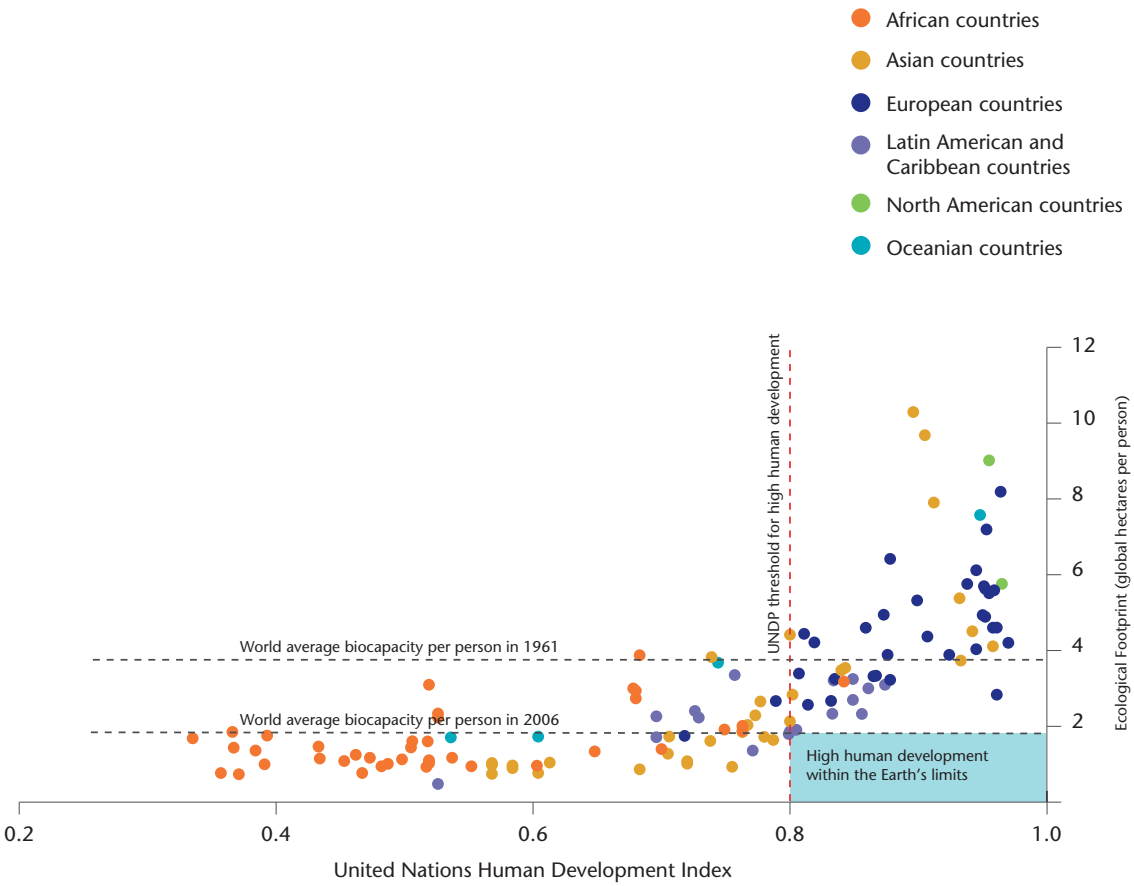
Inertia and inadequate governance

The governance and policy responses to manage this growth often happen in silos and are limited by short-term, localized political pressures, and thus fall short of the level of commitment needed to make significant progress. In addition, the choices countries, companies, communities and individuals make are often characterized by inertia due to short-term goals and self interest. Continuing to invest in polluting or energy-inefficient types of infrastructure and opting for high-footprint consumer lifestyle preferences are examples of such choices that perpetuate the status quo.

Degradation: Climate change and deteriorating ecosystems

The Millennium Ecosystem Assessment found that 15 of the 24 ecosystem services they evaluated have been degraded over the past half century. A rapid and continuing rise in the use of fossil fuel-based energy and an accelerating use of natural resources are continuing to affect key ecosystem services, threatening supplies of food, freshwater, wood fiber and fish. More frequent and severe weather disasters, droughts and famines are also impacting communities around the world.

Box 1.1: Meeting the dual goals of sustainability – High human development and low ecological impact



© Global Footprint Network (2009). Data from Global Footprint Network National Footprint Accounts, 2009 Edition; UNDP Human Development Report, 2009

The chart sums up the challenge of sustainable development: meeting human demands within the ecological limits of the planet. It is a snapshot showing how different countries perform according to the United Nations Development Programme's (UNDP) Human Development Index (HDI) and Global Footprint Network's Ecological Footprint. In countries to the left of the vertical line marking a score of less than 0.8 on the HDI, a high level of development, as defined by UNDP, has not been attained. Countries above the horizontal dotted line and to the right of the vertical line have achieved a high level of development but place more demand on nature than could be sustained if everyone in the world lived this way.

In order to move toward a sustainable future the world will need to address all dimensions of this chart – the concepts of success and progress, the biocapacity available per person, as well as helping countries either improve their levels of development or reduce their ecological impact (several countries face both challenges). In *Vision 2050* we have identified five types of major changes that will be required:

1. Buy into the vision: accept the constraints and opportunities of a world in which 9 billion people live well and within the limits of the planet
2. Redefine success and progress at national, corporate and individual levels
3. Get more out of the planet by increasing bioproductivity
4. Develop solutions to lower ecological impacts while maintaining quality of life in countries that have high human development but are overusing ecological capacity
5. Improve levels of human development in countries below the threshold for high human development without increasing their ecological impact beyond acceptable limits.

2 The Vision

"In 2050, some 9 billion people live well, and within the limits of the planet."

In 2050, some 9 billion people live well, and within the limits of the planet. The global population has begun to stabilize, mainly due to the education and economic empowerment of women and increased urbanization. More than 6 billion people, two-thirds of the population, live in cities. People have the means to meet their basic human needs, including the need for dignified lives and meaningful roles in their communities.

Diversity and interdependence

Countries and cultures remain diverse and heterogeneous, but education through secondary school and universal connectivity have made people more aware of the realities of their planet and everyone on it. The "One World – People and Planet" ideal is embedded and practiced globally, emphasizing interdependence among all people and dependence on the Earth. There are still conflicts, disasters, shocks, crime and terrorism, but societies are resilient, able to withstand disruption and quickly recover.

People, companies and governments are forward looking, problem solving, resilient and experimental – understanding that security is achieved through working together and adapting rapidly in a fast-changing world.

A different economic reality

Economic growth has been decoupled from ecosystem destruction and material consumption, and re-coupled with sustainable economic development and societal well-being. Society has redefined the notion of prosperity and successful lifestyles, as well the bases of profit and loss, progress and value creation to include more long-term considerations such as environmental impacts and personal and societal well-being.

The global economic landscape also looks different from that of the turn of the century. The term "developing country" is rarely used, as most economies are either developed or emerging. Asian and American countries and companies play a more significant role in and influence the norms of international trade, finance, innovation and governance alongside a few of the nations that have established their success in the previous 100 years. Multiple perspectives are integrated. Capital, ideas, best practices and solutions disseminate in all directions.

Multi-partner governance

Nations and the roles of governments continue to evolve. Governance systems skillfully make decisions at the most appropriate local level. Nations "pool sovereignty" where necessary to manage international systems and challenges such as disease, climate, water, fisheries, conflicts and commons. They encourage local governance and connect neighborhoods to a mosaic of partners, be they grassroots groups or international organizations, to help local groups manage issues like adaptation to climate change and access to water and sanitation. Much governance happens at community, city and regional levels. It is a complex, yet efficiently connected world.

In markets: Innovating and deploying solutions

Governance also enables and guides markets by clarifying limits and establishing frameworks that promote transparency, inclusiveness, internalized externalities, and other characteristics of sustainability. These systems define targets, create a level playing field and eliminate barriers, enabling business to innovate and to develop and deploy solutions. For business, this level playing field means that true values, including externalities such as environmental impact and the benefit of ecosystem services, are built into the marketplace for all competitors. Reward systems recognize sustainable behavior and as a result business can deliver solutions that are both sustainable and competitive. Consumers can choose sustainable products not just because they are sustainable but because they deliver better value.

Dealing with climate change

Society prepares for, and adapts to, climate change; this adaptation is achieved largely through joint efforts between different countries and communities. Integrated and systemic approaches are used to manage agriculture, forestry, water and urban transport, energy and communications.

Efforts to mitigate further changes in climate continue. Harmful emissions have been significantly reduced and a low-carbon society has been enabled through the efficient use of clean energy and resources.

Circular, closed-looped and networked designs that help people to live well within one planet drive successful industry and reduce the need for primary resource extraction. Closed-loop systems make the concept of waste obsolete. They use waste as an input and resource, eliminating waste accumulation on land, in air or in water. Used products and materials can be reengineered to function again for multiple and distinct purposes or reduced to raw materials for manufacturing other products.

The efficient use of materials, including waste and pollution management, is many times greater than at the turn of the century, enabled by collaboration and knowledge sharing. Improvements in areas such as water consumption efficiency and reuse, energy, wastewater treatment, forest management and agriculture keep humanity on track toward living within the carrying capacity of the planet. Ecosystem degradation has been reversed, and ecosystem services are valued, maintained and enhanced; biodiversity is being better managed, is flourishing, and continues to enable societies to prosper.

An evolved workplace and evolved employers

The leading companies are those that, through their core businesses, help society manage the world's major challenges. They have worked through the radical transformation of both internal corporate values and external market restructuring that has occurred in the three decades leading up to 2050, a transformation that many other companies have not survived but in which multitudes of new ones have been spawned.

As survivors, these companies are more flexible, more adept at engaging with diverse partners and customers, and more skilled at responding to rapid changes on all fronts. As operations, they have demonstrated a focused and proactive culture of eliminating energy and materials waste. They have discovered that this circular, closed-loop culture not only reduces pollution: it also makes them more collaborative and competitive. As employers, these businesses have helped train and develop a more creative society that is better able to manage the conflicting challenges of creating and maintaining sufficient jobs while improving labor productivity. Training has also resulted in a sufficient pool of talent available to implement the changes needed. People, as employees, have learned to be more flexible too, and to move easily to where jobs exist.

3

Pathway to 2050

"Swift, radical and coordinated actions are required at many levels, by multiple partners."

A pathway is a set of descriptions that illustrates the transition to a certain scenario, in this case *Vision 2050*. The pathway outlined in this chapter gives a macro perspective of the move toward a more sustainable world. Nine elements of this pathway, or critical areas in which actions need to be taken over the next four decades, provide a more detailed picture. The nine areas covered are values and behaviors, human development, economy, agriculture, forests, energy and power, buildings, mobility and materials. The pathway and its elements neither prescribe nor predict, but are plausible stories the companies have created by "backcasting", working back from the vision for 2050 and identifying the changes needed to reach it.

We see two timeframes: the Turbulent Teens, from 2010 to 2020, and Transformation Time, from 2020 to 2050. The Turbulent Teens is a period of energy and dynamism for the global vision of sustainability. It is a formative decade for the ideas and relationships that will take place in the 30 years to follow.
From 2020 to 2050, the traits formed during the first decade mature into more consistent knowledge, behavior and solutions. It is a period of growing consensus as well as wrenching change in many parts of society – climate, economic power, population – and a time for fundamental change in markets that redefines values, profits and success.

Turbulent Teens (2010-2020): Crisis, clarity, action

The global financial crisis at the end of the previous decade rocks people's faith in business and governments, spurring a quest for renewal of trust and cooperation. This takes the form of a mix of new alliances to rebuild trust and find answers to many of the tough questions society faces (see box 3.1). Government, academia, business and a range of stakeholders, including society work closely together on trade and economic development, the design of systems and metrics to measure progress, climate change solutions, technology deployment, improving forest and farm yields, urban renewal, health and education, and shifting values and behaviors toward sustainability.

During this period, it becomes clear that swift, radical and coordinated actions are required at many levels, by multiple partners. This new sense of urgency helps establish the conditions needed to move global growth onto a more sustainable path. Crucial among these is a carbon price and a network of linked emissions trading frameworks, along with policies to avoid deforestation and promote agricultural research. These developments also help finance the transition to a low-carbon economy in developing countries. Better management of ecosystem services and deployment of technologies improve eco-efficiency and bioproductivity. Greenhouse gas emissions peak and start to fall and biodiversity begins to flourish.

Rebuilding the economy, with new rules

Efforts begin to develop frameworks that decouple economic growth from resource consumption and ecosystem degradation. How to measure success and progress is reconsidered. Markets move toward true-value pricing and long-term value creation. Tax strategies shift towards incentivizing job creation and healthier products and discouraging negative external factors like pollution and environmental damage. The case for long-term investments and opportunities in areas such as renewables, energy efficiency and capacity building, particularly in poorer countries, becomes more valid. Born of environmental and economic crises and spread by education and the media, these initiatives encourage "One World – People and Planet" behavior in society and individuals.

Business works to make sustainability an easier choice

Business plays a key role in informing the development of frameworks, policies and innovations. Companies, policy-makers and customers experiment with ways to make sustainable living easier while improving human well-being. Products and services that translate aspirations and values into sustainable lifestyles and behaviors are increasingly co-created by enterprises and consumers.

Transformation Time (2020-2050): Success builds confidence and momentum

Actions begun in the previous decade gain momentum: it is a time

> *"The radical changes highlighted in Vision 2050 demand a different perspective from business leaders, requiring them to rethink how they operate to stay on-track for a sustainable future."*
> **Samuel A. DiPiazza, PricewaterhouseCoopers**

of more-efficient homes, farms, buildings and vehicles, low-carbon and renewable energy systems and smarter electricity grids and water management. There are continuing shifts in the "software" of society: governance systems, markets and business models. Governments, cities, civil society and business find themselves collaborating in new ways to deal with the challenges of the times.

Innovation, renewal and systems change

The new value-based economic architecture catalyzes an era of innovation in solutions and social change. Newly competitive, cleaner and more decentralized energy technologies are developed and disseminated to complement centralized systems. A greater focus on food efficiency, security and footprint allows societies to meet rising demand for food, including meat and fish. More recycled water is used for agriculture and energy and the concept of virtual water spreads further. Forestry and farming are better organized and more land-efficient. Other natural systems – reefs, wetlands, watersheds and open seas – are also better managed.

New business models flourish on networks, institutional renewal and systems change. Closed-loop systems create business opportunities. Co-creation, open source and other types of intellectual property regimes exist alongside more traditional licensing and patenting.

People are healthier and wealthier

Basic needs are increasingly met. Former least-developed countries begin to thrive in new trade regimes that benefit all. Education, healthy living and inclusion accelerate. There are sufficient jobs, and high levels of labor productivity through technological advances and skilled labor. Lifestyles that support "living well within the limits of one planet" are more popular.

A dynamic path for business

Successful businesses adapt to changing market realities and regulatory environments. They have learned when to lead and when to follow. And they have reached out to new resources, both natural and human, in order to transform themselves and their products to serve a new world.

Experimentation and creativity have been the most renewable and sustainable resources for this transformation. Creativity has been sought and found in product development, as always. It has also been sought from customers, governments, suppliers, neighbors, critics and other stakeholders. Where companies have succeeded in tapping new sources of creativity, success has come from these new directions, and it has happened because the business culture has been open to new ideas.

Box 3.1: Tough questions and dilemmas

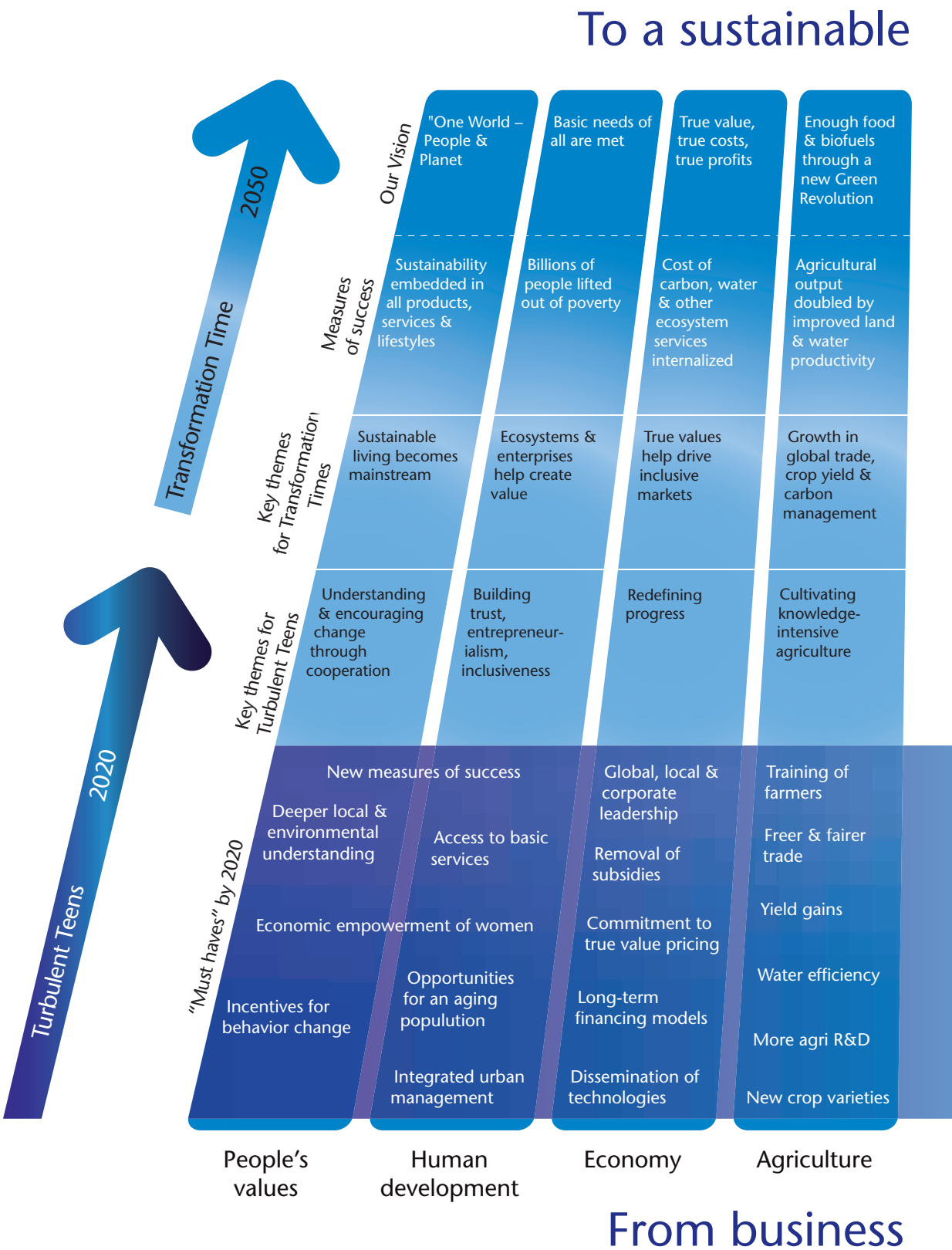
Over the next four decades societies will grapple with difficult questions and tradeoffs, for which answers will be need to be found through collaboration. Tough questions include:

- Who will (or should) be the first mover – people, governments or business? Or as we suggest in this project, do all need to move at once? Where is business ready to move forward with other stakeholders?
- How can business, governments and society work together to encourage the desired value shifts and behavior changes?
- Who will define the incentives and mechanisms?
- Who finances the transition?

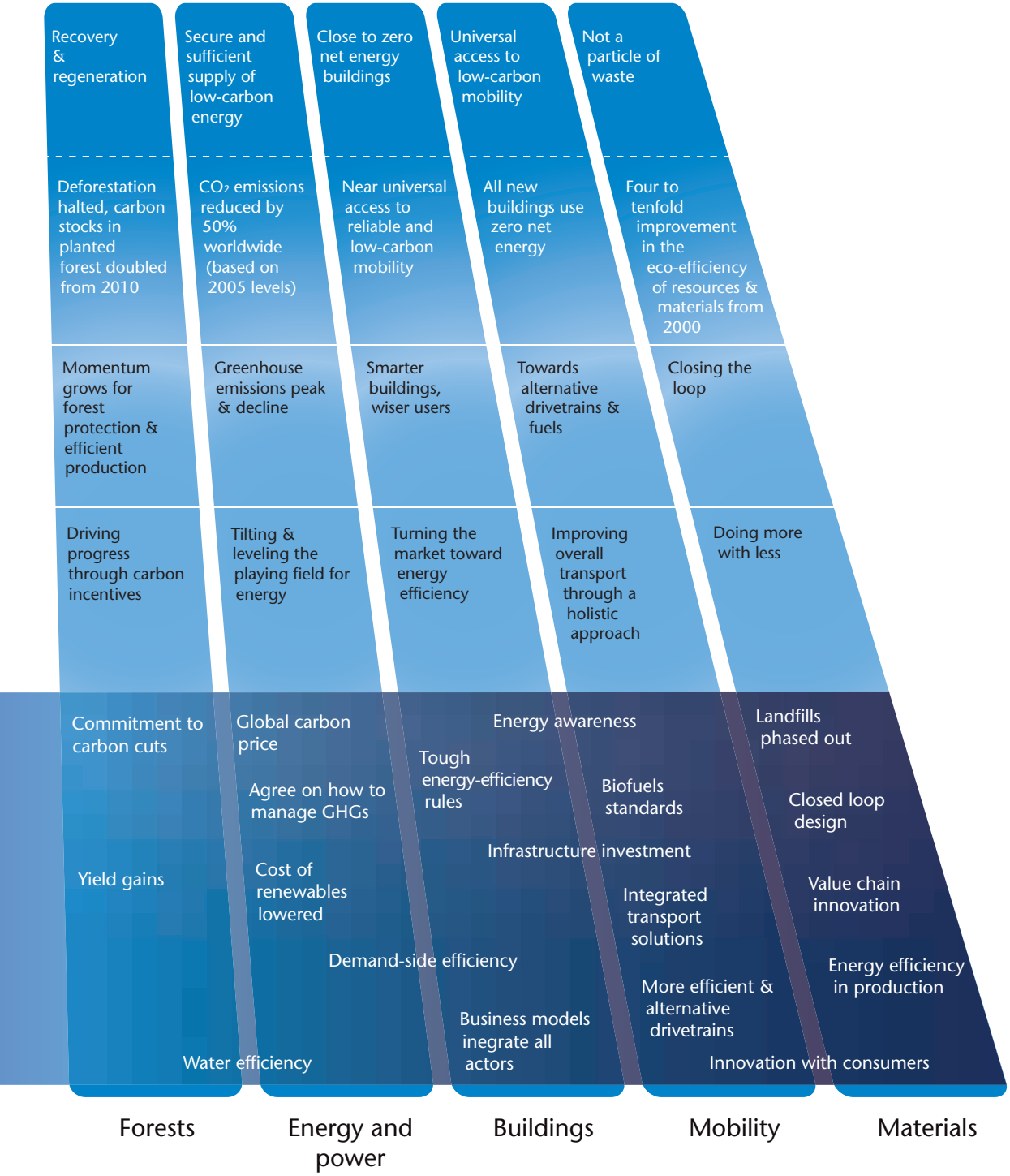
Trust and long-term thinking are "must have" ingredients for addressing such issues and building inclusive decision-making processes. These requirements raise some important questions:

- How can we achieve this level of trust?
- How can we give/create the right incentives for leaders of companies and countries to prioritize long-term stability and progress over short-term success?
- How can policy-makers and business carry out the economic restructuring needed both quickly and without incurring job losses and economic insecurity?

Figure 3.1: The pathway and its nine elements that lead us to Vision 2050



world in 2050



as usual

PEOPLE'S VALUES

Vision for 2050: "One World People and Planet" lifestyles

New ways of living have taken root all over the world, inspired by a change in the way success is defined and measured, as well as innovative forms of education and connectivity. The "One World – People and Planet" ideal is embedded and practiced globally, emphasizing interdependence among all people and dependence on the Earth.

Growing awareness of different people, cultures and age groups fosters greater social cohesion and understanding of what it means to be interdependent and responsible for one's own actions, for each other, for the planet and for future generations.

Turbulent Teens: Understanding and encouraging change through cooperation

Must haves:

- New measures of success and well-being at international, national and individual levels
- A deeper understanding of the environmental realities of the world, leading to changes in how people relate to the planet and one another, and how they define successful and desirable lifestyles
- The application of insights into what influences and drives certain behavior changes in different segments of society into the design of products and policy
- Policies, infrastructure, corporate leadership as well as products and services that make sustainability easier and address the needs of all segments of society
- Understanding of local environments, conditions, culture and aspirations

The global financial crisis at the end of the previous decade has rocked people's faith in business and governments and spurs a quest for the renewal of trust and cooperation.

Making sustainable living an easier choice

Understanding the factors that contribute to life satisfaction and happiness enables businesses and policy-makers to experiment with how to make sustainable living easier for all segments of society, while also addressing the dual goals of human development and well-being (see figure 3.2 and box 3.2). Businesses involve consumers in innovation, customization and product development towards sustainability. This dialogue also provides market access for groups that were previously excluded.

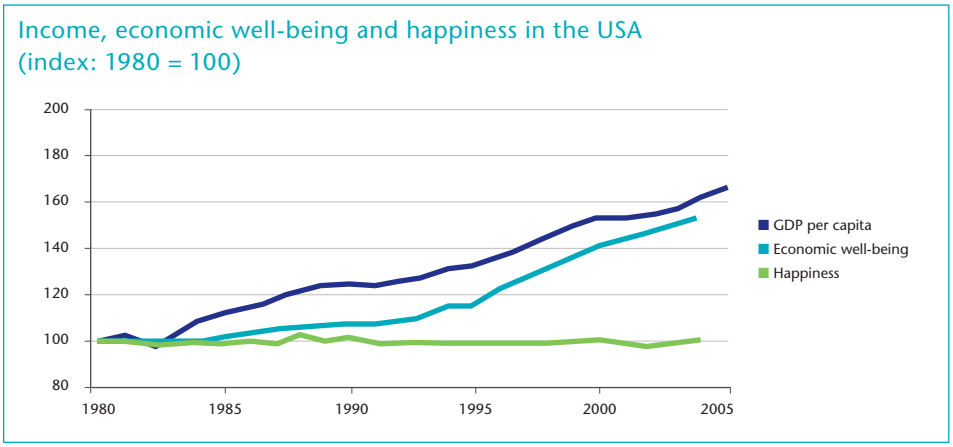
Policy-makers and businesses create new policies, products and services based on a better understanding of the varieties of human behavior and the range of tools and messages needed to influence and drive lifestyle changes. Products and services that help people translate their new values into lifestyles and behaviors are increasingly co-created in multi-stakeholder innovation networks.

To regain public trust and leadership, business develops new best practices surrounding transparency. Companies use new media and other communication strategies to engage their constituencies at more levels and in more interactive conversations. As a result, business does a better job of learning from its customers and its neighbors.

Transformation Time: Sustainable living becomes mainstream

Living well within the limits of one planet becomes fashionable, more mainstream and part of

Figure 3.2: Happiness does not completely depend on GDP



Source: Deutsche Bank Research, *Measures of Well-being*, 2006 (from GGDC, CSLS, GSS/Eurobarometer)

> *"We need to change the value sets. For instance, currently a reduction of GDP is seen as a sign of government failure. In the future, reduction in GDP, while improving quality of life, could be seen as a success."*
> **Vision 2050 Dialogue, China**

Box 3.2: Many key dimensions shape people's well-being

1. Material living standards (income, consumption and wealth)
2. Health
3. Education
4. Personal activities including work
5. Political voice and governance
6. Social connections and relationships
7. Environment (present and future conditions)
8. Insecurity, of an economic as well as a physical nature

Source: Joseph Stiglitz, Amartya Sen, Jean-Paul Fitoussi, The Commission on the Measurement of Economic Performance and Social Progress, 2009

value systems. Universal access to technology and connectivity spreads these values virtually everywhere, and they drive both innovation and opportunities.

Global education connects peoples, spreads ecosystem values

A global, local and intergenerational web connects people with each other and with the planet. In schools, people learn more about the importance of well-functioning ecosystems and societies as well as global and local citizenship. They are taught the importance of resilience and future thinking; how to understand systems, complexity and risk; and how to adapt to the changing world.

All countries begin to teach the life-or-death necessity of maintaining climate, water and other ecosystem services and the responsibilities of individuals and companies in maintaining them. Many schools use technology to help people in different parts of the world communicate in the form of virtual visits and virtual foreign exchange programs.

Sustainable choices win in the marketplace

Business adopts a new mission: to make sustainable living easy and seamless through products and solutions that address the demands of society without compromising customer needs. Business has integrated closed-loop and efficiency principles into new product strategies, and customers no longer have to choose between the "green" product and the one that meets their other consumer needs.

Healthy people, healthy societies, healthy business

Radical innovations in healthcare and food technologies allow people to pursue healthier lives and lifestyles. Empathy stretches across political and generational boundaries, connecting people with one another and with the planet.

Business has been an active partner in delivering solutions that meet the needs of both people and the environment, and in creating true efficiencies that add value and reduce costs. Business has collaborated with others to redefine concepts of value and cost to include externalities such as the environment. Business has also been part of the public dialogue on the social and governmental changes needed to lead society to this point of sustainable global living, and has shared knowledge, worked across boundaries and developed new models for commerce and individual entrepreneurialism.

> *"The economy should focus on fixing things at the base of the pyramid, since this is the largest social class in Brazil."*
> **Vision 2050 Dialogue, Brazil**

HUMAN DEVELOPMENT

Vision for 2050: Basic needs of all are met

The global population has begun to stabilize at around 9 billion, mainly due to education, the economic empowerment of women and urbanization. All can meet their basic needs, including the need for dignified lives and meaningful roles in their communities. More than 6 billion people live in cities. Cultures and people remain diverse and heterogeneous. The demographic profiles vary largely between regions, with both young and old societies adjusting to manage their varying demographic structures.

Turbulent Teens: Building trust, entrepreneurialism, inclusiveness

Must haves:

- Improved legal, regulatory and intellectual property systems to encourage investors, entrepreneurs and enterprises
- Fairer terms of trade and the removal of unfair subsidies
- Investment to improve infrastructure, particularly in poorer economies
- Better access to water, sanitation, energy, education, jobs, healthcare and mobility
- Business models that provide opportunities and care for aging populations
- More systematic approaches to urban design and management in cities
- Better use of local knowledge, strengths, capabilities and leadership
- Access to funding and affordable financing

Recession and recovery set the stage

At the beginning of this decade, the global recession overshadows progress. Governments, society and business agree that the best way to reverse its effects is to promote greener growth and to improve the living conditions of billions. They use a top-down and bottom-up approach to pursue human development objectives, providing security first, followed by sustainable growth.

Building trust with disenfranchised nations

Developed countries undertake a massive trust-building campaign with the developing world. This involves increasing aid on condition of improvements in transparency and accountability; completing a trade development round that allows poor nations to begin to trade out of poverty; and agreeing to a shared but multi-track approach to curbing greenhouse gas emissions.

These commitments enable huge resource sharing and capacity building efforts between developed, emerging and developing nations, as well as greater provisions for climate adaptation. They also encourage poor nations to improve their framework conditions for doing business.

Business reaches out, trading and training

Business discovers opportunities and avenues of contribution in this changing environment. Global companies find new ways to reach out to millions of people previously excluded from trade. In addition to pursuing traditional investment models, businesses develop more partnership frameworks to engage with diverse communities, building commerce and benefiting from new ideas and local insights. In partnership with governments and international organizations, businesses offer e-learning programs that teach technical and job skills. Broader and more flexible concepts of work as well as virtual mobility give people and companies different options and conditions for employment.

Delivering the infrastructure for human development

An effort to deliver infrastructure projects accompanies framework improvements in many countries. The effort focuses on cities, with an emphasis on closed-loop systems, secure and clean energy supplies and improved mobility, all part of a multi-decade effort to deliver infrastructure improvements in most parts of the world.

Governments prioritize health and skills programs to improve the ability of people to contribute to the economy and the planet. They reach out to include women, older people, minorities and others previously excluded from the process. The components of these programs are co-developed by business, entrepreneurs, non-governmental organizations (NGOs), academia, media and governments.

Wider education plays a key role

Initiatives are scaled up to educate all children, particularly girls, to

> *"One of the big issues for Argentina is the shifting of talents. Mobility will have an enormous impact on the local labor force because it is probable that Argentina will export talents."*
> **Vision 2050 Dialogue, Argentina**

secondary level. Online exchanges between different schools in different countries enable programs to encourage healthy lifestyles. Sharing knowledge about water purification, hygiene, safe food production and decreased pollution and waste becomes the norm. Technology is also used to increase access to medical care and build knowledge and skills.

In some countries, provisions continue to be made to support older populations. In addition to financial support, governments and other partners invest in lifelong learning and training schemes to encourage people to remain in the workforce longer. Insurance and tax incentives are created for those who take responsibility for preventing illness and providing opportunities for the elderly.

Transformation Time: Ecosystems and enterprises help create value

Resource-rich but income-poor countries are increasingly recognized as key to stabilizing the environment. Their biocapacity attracts funds from global sources to build skills, infrastructure and efficiency; to help adapt to changing climates; to manage ecosystem services; and to participate in the push to develop renewable energy.

New markets lift many out of poverty

New trade regimes begin to benefit many, creating new markets, industries and customers. They create jobs and economic opportunities for billions, lifting many out of poverty and providing a healthy return for investors.

Different types of businesses thrive, benefiting from and contributing to better business conditions in poorer countries. Multinational companies contribute to this growth by integrating local small and medium enterprises (SMEs) and local people into their supply chains, and by increasing and spreading literacy and skills. Social businesses, entrepreneurs and SMEs also continue to play a crucial role in economic development and value creation.

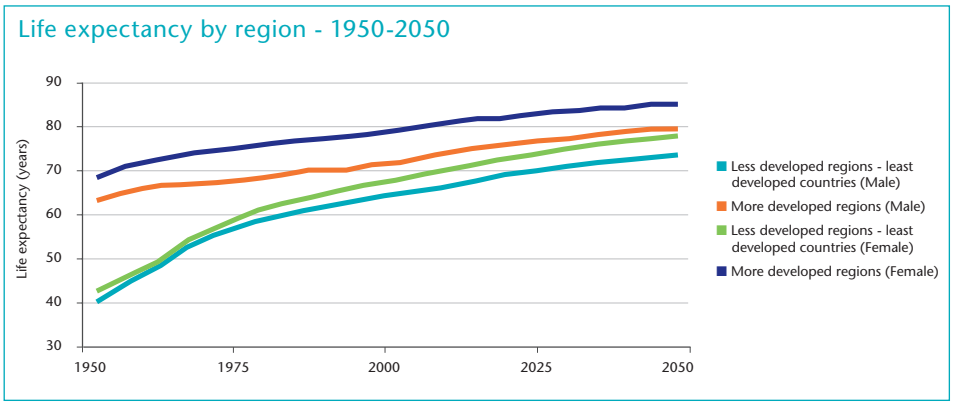
Progress in health and well-being

New technologies help preserve human dignity. Chronic, infectious and mental diseases are better managed. Care for older people is provided through family, community and professional health systems, and many countries provide security nets for the elderly to ensure they do not fall into poverty. Healthcare access and affordability have become fairer. Effective knowledge deployment between developed and developing countries, a continued focus on prevention and the maintenance of traditional and indigenous medical knowledge have enabled many regions to move more rapidly to optimal health systems. Life expectancy increases worldwide with people living longer (see figure 3.3).

Basic needs are increasingly being met, including universal access to hygiene, sanitation, clean water, air and energy, food security and healthcare. The effects of educating girls and women continue to be seen around the world in the form of decreasing birth rates, decreasing child mortality, and improvements in family health, income and prosperity.

Urbanization makes it more efficient to deliver these infrastructure and human development improvements. Better and more holistic planning of cities allows for greater efficiency in the allocation of capital and labor, as well as the provision of utilities and services to a larger number of people.

Figure 3.3: People are living longer



Source: UN Population Division, *World Population Prospects: The 2008 Revision*, 2008

> *"China should seek more help to change business-as-usual. Now that the international economy has globalized, and the ecosystem is an integrated system, we must set aside our differences and make every effort to reduce energy consumption."*
> **Vision 2050 Dialogue, China**

ECONOMY

Vision for 2050: True value, true costs, true profits

In 2050, economic growth is decoupled from environmental and material consumption and re-coupled to sustainable economic development and meeting needs. The bases of profit and loss, progress, and value creation are redefined to consider longer term environmental impacts and personal and social well-being. Prices reflect all externalities: costs and benefits. New rules for financing and innovative financial products stimulate widespread entrepreneurship and participation in an inclusive and innovative global economy. The economy creates sufficient jobs while improving labor productivity.

All this has required a radical shift in the way companies do business. Corporations have been leading advocates of this change and negotiators in the process.

Turbulent Teens: Redefining progress

Must haves:

- New measures of progress more reflective of true progress than traditional GDP
- True-value pricing, subsidy removals, and tax shifts to encourage sustainable business and behavior
- Innovative financing models and mechanisms that enable longer term investments in sustainable projects and diversify risk
- Effective ways to disseminate technologies
- Fiscal incentives

New measures of success create new markets, models

Government regulators, financial organizations, businesses and academics develop new frameworks to decouple economic growth from the use of natural resources. The concepts of *success* and *progress* begin to be redefined in ways that create new markets. The gross domestic product (GDP) measurement is reconsidered and supplemented by other measures that track sustainability (see figure 3.4). True-value pricing (i.e., reflecting external costs and benefits) begins to emerge as the basis of new, globally accepted accounting standards.

These developments have required significant collaboration and negotiation among all stakeholders. True-value pricing comes through the interplay between networks of regional schemes, different initiatives and is also complemented by additional regulation: tax, emissions trading, standards, etc. Deploying new pricing structures is a vast effort that includes ascertaining the financial value of intangibles, fostering acceptance among stakeholders, the associated political process, and roll-out and implementation.

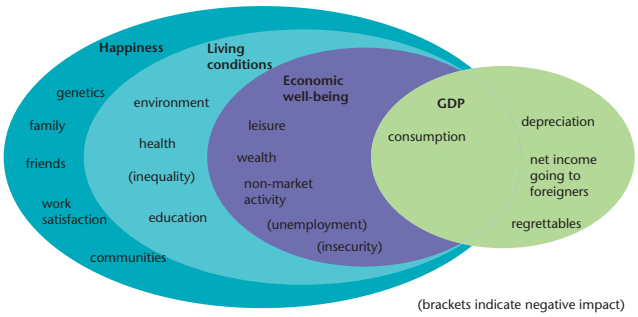
The new frameworks must be created quickly but still arrived at by broad consensus. Lobbying for short-term benefits by skewing rules and agreements is replaced by a common endeavor to create long-term, stable and level playing fields.

Financing based on long-term value

Valuation, investment and accounting criteria are reformulated as businesses and markets adapt to new incentives that couple traditional profitability with the creation of long-term value. Innovative financing mechanisms focus on longer term sustainable investments such as forest bonds. Financial products are certified before being put on the market, verifying their ability to contribute positively to the economy, society and the environment, particularly in reallocating risks. New standards for eligible asset allocation for pension funds and life insurance companies emerge as new legislation allows

Figure 3.4: Reconsidering success and progress

What does and does not measure GDP



Source: Deutsche Bank Research, *Measures of Well-being*, 2006

> *"The pressures from international institutions like the IMF on governments directly and business indirectly should focus more on sustainable development."*
> **Vision 2050 Dialogue, Turkey**

financial institutions increased freedom in allocating assets.

Incentives for the positive

Policy and pricing incentives shift from a focus on cost and loss to investment and opportunities. Investment, research, development and deployment (RD&D) and innovation are channeled toward renewables, energy efficiency and sustainable infrastructure development. Co-funding schemes between the private and public sector help address some of the risks associated with the sunk costs and long payback periods.

Perverse subsidies are removed. Tax regimes shift toward incentivizing positive externalities such as job creation and discouraging negative externalities like pollution and waste.

Accounting for the real world

Accounting standards begin to integrate positive and negative externalities, with investors rapidly incorporating these new measures into decision-making. This new accounting framework builds on the convergence of international financial reporting standards with reporting models such as the Global Reporting Initiative and the eco-valuation frameworks developed by various groups such as The Economics of Ecosystems and Biodiversity (TEEB). Stock exchanges begin to require companies to report along these lines.

Transforming technology deployment

Businesses and governments work together to remove roadblocks to technology deployment. Funds are created to license the exchange of intellectual property and sell technology on terms that are efficient and effective.

Transformation Time: True values help drive inclusive markets

The new frameworks continue to develop. The concept of progress is no longer viewed and measured just through economic data, but also in terms of environmental and societal impacts. The role of business as a solutions provider expands. Transparent collaborative efforts and new forms of public-private partnerships spread best practices and technologies. Markets reward positive actions and penalize negative ones, such as pollution.

Closing the gap with true-value economics

The global economy approaches a state that is based on true-value economics and quality of life. Innovative technology, knowledge and finance solutions developed and spread by business help increase global bioproductivity. These solutions help close the capabilities gap between developing and developed economies.

Resource-efficient solutions reach beyond barriers of class, politics, geography and economy. Effective economic structures and incentives create an economy that is more inclusive, productively involving the neediest and most vulnerable. There are sufficient jobs for all, including youth, the aged and women.

New efficiencies accelerate innovation

This economy is highly productive and innovative. Business responds to higher costs resulting from the internalization of externalities with new efficiencies in materials sourcing, product design, production, marketing and distribution. A well-developed, viable system that manages and monitors the carbon emissions of individuals, entities and countries is established, as is a stable global system for the fair trading of excess carbon allocations.

Pricing increasingly reflects true values and manages risk. A new set of sustainability enhanced, globally accepted accounting standards is adopted, ensuring transparency and continuing to drive eco-efficiency.

AGRICULTURE

Vision for 2050: Enough food, water and biofuels through a new Green Revolution

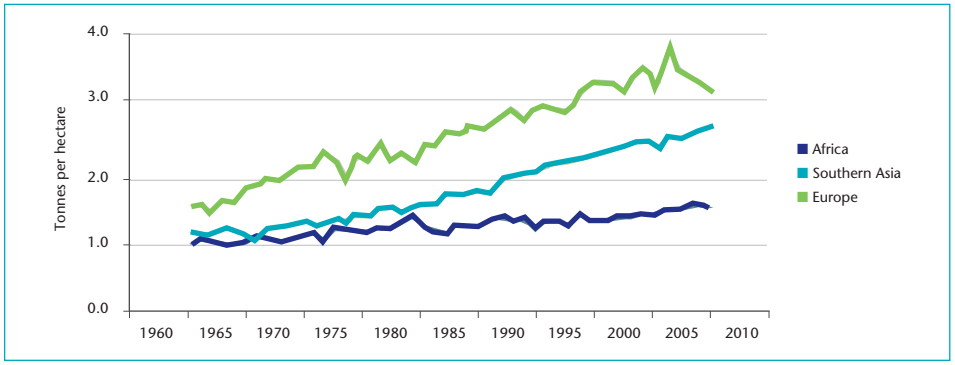
A 21st century version of the Green Revolution has helped the larger 2050 population meet its nutrition needs. Improved agricultural practices, water efficiency, new crop varieties and new technologies, including biotechnologies, have allowed a doubling of agricultural output without associated increases in the amount of land or water used.

The productivity gains allow agriculture to contribute to energy supply without jeopardizing food supplies or biodiversity. Research and development (R&D) investments made decades earlier have resulted in new biofuels that make better use of plant material. Biofuels contribute 30% of transport energy needs, of which half come from agriculture and the remaining half from forests and other forms of biomass.

Bigger yields reduce the land area under agricultural production. Better management increases the carbon sequestration potential of soils. Emissions and water use per unit output from agriculture and overall totals are radically reduced.

Restoration of degraded land for production of food, biofuel crops and timber is a common practice across the globe.

Figure 3.5: Africa's yield growth has lagged behind other regions



Source: Ministry of Foreign Affairs of Denmark, *Realising the Potential of Africa's Youth*, 2009 (FAOSTAT)

Turbulent Teens: Cultivating knowledge-intensive agriculture

Must haves:

- Global outreach effort to train farmers for knowledge-driven, 21st century Green Revolution
- More government involvement in agricultural research
- Future rate of yield gains at or above recent historic levels
- New crop varieties and enhancement solutions developed for extreme climate conditions

Green Revolution 2.0

A 21st century version of the Green Revolution begins. Unlike its input-intensive 20th century predecessor, this version is knowledge-intensive, and builds the capacity of farmers to manage agricultural land for higher productivity and natural resource and input efficiency. It also entails increased biological and genetic knowledge, which enable improved crop varieties and farming practices, including more efficient irrigation techniques. This has significant impact in many countries and continents, most notably in Africa, which missed out on the first Green Revolution and where agricultural productivity has been lagging (see figure 3.5).

In addition to knowledge, there is continued global improvement in the key resources farmers need: land, machinery and water, access to markets, credit, new knowledge, inputs and risk management. Incentives for farmers to achieve better yields per unit of land also provide greater impetus for agricultural productivity improvements.

Research delivers progress in food and biofuel

Governments increase their involvement in agricultural research, particularly on wheat and rice, which have had falling yields. Public-private partnerships act as conduits for increasing R&D, focusing efforts on major high-value crops, labor-saving technologies, and both capital-intensive farming and small farmers' needs. Research into technologies that allow the cellulosic portion of plants to be converted into biofuels begins to produce results, making them more competitive.

A new generation of technologies focuses on managing water,

"Despite Pakistan's dependence on agriculture, the sector has been in the doldrums. National yields here could be increased 300%."
Vision 2050 Dialogue, Pakistan

temperature extremes and saline or acidified soils. Work advances on engineering plant roots to absorb more nitrogen, producing the same yield with at least 50% less fertilizer.

Transformation Time: Growth in global trade, crop yield and carbon management

A concerted effort to reduce greenhouse gas emissions and water use in agriculture is underway. Rice is increasingly produced on dry land or watered with more efficient irrigation, thus nearly eliminating methane emissions from rice paddies. More than 80% of crops are planted on unplowed land. The original need for the plow to control weeds is replaced by simple herbicides. This helps to prevent loss of soil through erosion, build organic (carbon) matter in the soil, and reduce greenhouse gas emissions from organic decomposition.

Thirsty people benefit from fair trade and "virtual water"

Efforts to promote freer, fairer trade in agriculture are succeeding, and agricultural subsidies are discontinued. Those countries that can produce most efficiently and with least impact on the environment (the two now go hand-in-hand) produce more and export more. This encourages the concept of virtual water and its trading, where those countries with an abundance of water (e.g., Brazil) can use this resource to produce crops that they then export to water-constrained countries. Wastewater and rainwater management are improved to increase the level of rain-fed agriculture and reduce the need for irrigation. Management of adjacent forests and forested watersheds for provision of water for crops occurs in concert with agronomical practices.

Restoration of degraded land for production of food, biofuel crops and timber is a common practice across the globe.

Food security, safety, efficiency and footprint

World food security is an evermore important agenda item for policy-makers, both for food safety concerns and to eliminate secondary trade barriers. Governments consult with the general public to build trust that food is being produced in a sustainable and ethical manner. Internationally acceptable, science-based registration standards for agricultural technologies are agreed upon.

The interdependence between natural and man-made systems such as that between food, energy and water is better understood and considered in decision-making at individual, corporate and national levels. For example, a resource-related ecological footprint is also adopted for agriculture that includes land, water and energy-efficiency measures. Food efficiency also becomes an important focal point, encompassing efficiency from field to plate, nutritional efficiency (e.g., grain vs. meat) and the consumption/purchase ratio of purchased food.

African productivity improves fivefold

With better seed, fertilizer and crop protection chemicals, as well as education, dissemination and improvements in governance, African farm productivity improves fivefold. The growth of highly efficient irrigation increases globally from 2% of total to 10%.

New plant varieties with better nitrogen efficiency become available, along with better information systems to improve nutrient application. This reduces NOx greenhouse gas emissions from agriculture. On-farm recycling of nutrients such as phosphorous is maximized. Infrastructure continues to develop to allow farmers to sell their output on global markets. This in turn stimulates increased productivity. Improvements that have been underway in Brazil and China spread to Africa, allowing Africa to reduce its import requirements and make a significant contribution to global agricultural production.

FORESTS

Vision for 2050: Recovery and regeneration

The forests of 2050 have regained much of their capacity to protect against climate change and biodiversity loss and to meet the resource needs of society. Forests cover 30% of world land area. The total stock of carbon sequestered in forests is more than 10% greater than 2010 levels. Deforestation has significantly reduced. Primary forest coverage is held intact and expanded somewhat. Primary forests are no longer used for wood, wood products, new farmland, or biomass. This practice sequesters carbon and protects biodiversity, water and additional ecosystem services.

Yield and harvest from planted forests have increased threefold from 800 million cubic meters to 2.7 billion cubic meters to meet demand for wood, paper and biomass. The land area has increased by 60%. Some limited additional volume of wood continues to flow from modified natural forests which are managed at lower levels of intensity, thus providing another carbon bank (see figure 3.6).

To stave off impacts from climate change and human interference, all three forests classes are managed to ensure provision of sustainable products and services and to protect forest health.

Turbulent Teens: Carbon incentives drive progress

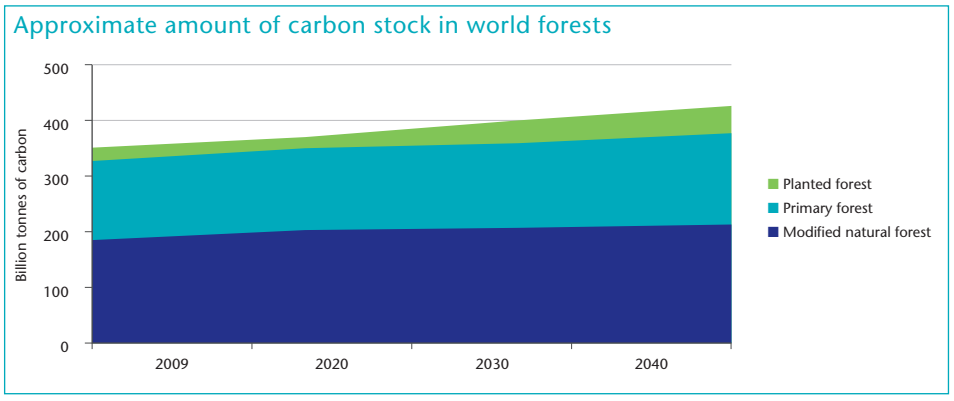
Must haves:

- A deeper global understanding of the role of forests in climate protection and natural resource production
- Institutional and market support for improved forest protection and management
- Commitments to deep carbon reductions by industrialized countries, creating demand for REDD+ (= Reducing Emissions from Deforestation and Forest Degradation in Developing Countries + Conservation and Sustainable Management) carbon credits
- A start to implementing REDD+ actions:
  - Provide financial incentives to local people for conservation and expansion of ecosystem services from primary and modified natural forests
  - Procedures for setting emissions levels
  - Methodologies for monitoring, reporting and verification
  - Processes to promote the participation of indigenous peoples and local communities
- A shift in production from modified natural forest to planted forests by improving yields of the latter

A growing understanding of deforestation's impacts

Awareness of deforestation and its role in climate change builds, due to the findings and recommendations of the REDD+ process. This understanding leads to greater acceptance of the role of forests in climate equilibrium. By the end of the decade REDD+ has helped establish the pillars necessary for new forest roles: financial incentives for preserving primary forest paid for by donor countries and institutions; methodologies for monitoring, reporting and verifying preservation; and processes to promote the participation of indigenous peoples and local communities in preservation. Industrialized countries commit to deep carbon reductions, requiring them to use the REDD+ carbon credits.

Figure 3.6: More carbon could be stored in the world's forests



Source: Weyerhaeuser Company, 2009

Planted forests yield greater harvests

Yields of planted forests are increased through best practices such as enhanced management of vegetation and fertilization and better site selection and species match. Genetic improvements and remote sensing technologies for inventory and management are also important. Remote sensing is used to monitor forest loss, health, structure and function. A sustainable forest management approach becomes the norm.

Transformation Time: Growing momentum for forest protection and efficient production

Break-even prices for alternatives to deforestation

Carbon prices and markets for ecosystem services support alternatives to extensive primary forest clearing, protect habitat and biodiversity, enhance carbon storage, build institutional capacity in remote forest regions, and approach the breakeven point for competing agricultural resources. In addition to market-based mechanisms, environmental safety funds are established to support the restoration and maintenance of underlying bio-physical systems. Carbon credits awarded for avoided deforestation are not simply traded off against lower emissions reductions from fossil fuels. Wood prices incorporate the value of wood products in storing carbon long-term.

Demand for forest products

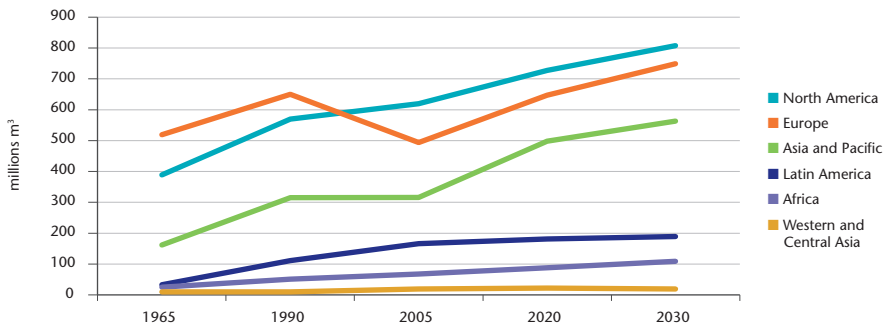
Wood – one of the oldest materials – has taken on a new role because of its ability to store carbon long-term. Green building initiatives experiment with innovative uses for wood beyond traditional regions and building styles. Consumption of roundwood grows by 50% to meet an increased demand for building materials and other wood products, driving greater production (see figure 3.7). There is more use of forest biomass for power generation and fuel production.

Yield from planted forests is increased through genetic improvements that emphasize a mix of plant traits (drought tolerance, insect resistance, product characteristics) and adaptation to different forest types and locations.

Urban forests provide shade, cleaner air

By the middle of the period deforestation is close to zero. In cities, widespread plantings of trees and other vegetation form urban forests. These natural areas are economic and environmental assets, absorbing carbon, providing shade and wind protection, improving air quality and providing recreational amenities.

Figure 3.7: Increasing consumption of industrial roundwood



Source: FAO, *State of the World's Forests 2009*, 2009

ENERGY AND POWER

Vision for 2050: Secure and sufficient supply of low-carbon energy

Global energy demand has increased, but secure and low-carbon energy is widely available and used efficiently. Global emissions from the energy and power sector have been reduced to 14 Gt of CO_2 per year, roughly an 80% reduction from business-as-usual projections. The energy sector's environmental footprint has been cut. The energy mix comprises around 50% renewables and about 25% each for nuclear and fossil fuels equipped with carbon capture and storage (CCS) from 2030 onwards (see figure 3.8).

The power grid has real-time adaptive, often cross-continental, capabilities to handle intermittent output from renewable power sources. Production and demand-side energy efficiency play vital roles, brought about by increased conversion efficiencies, greater conservation and supporting social systems and infrastructure.

Turbulent Teens: Tilting and leveling the playing field for energy

Must haves:

- International consensus on the effective management of greenhouse gas emissions
- Global price for carbon
- Effective policies to lower the costs of renewable electricity production and improve the efficiency of other forms of production
- Incentives and information measures to drive demand-side energy-efficiency gains
- Sufficient and secure demonstration, deployment and acceptance of promising technologies, such as CCS and nuclear
- Greater focus on demand-side efficiency and the behavior changes that go with it

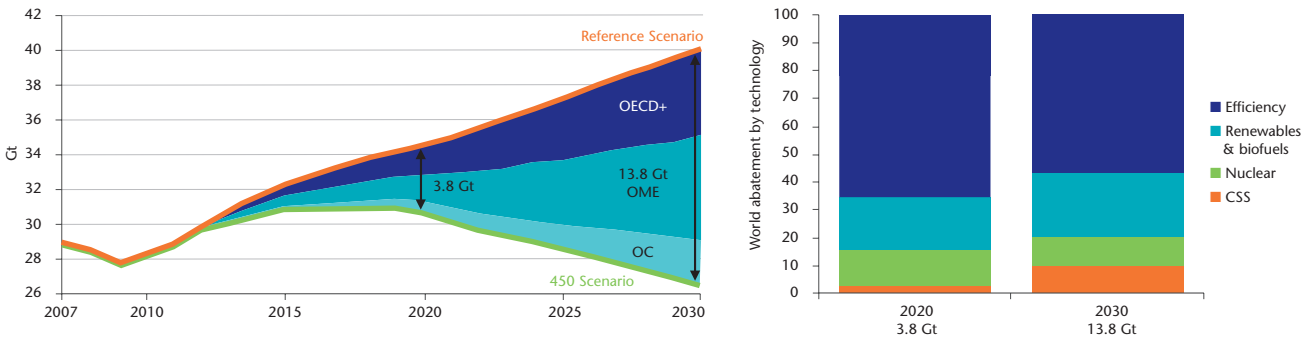
Early in this decade, consensus is reached on a strategy for reducing greenhouse gas emissions significantly. The playing field for energy is tilted towards a low-carbon future, and leveled between sources. A global price for carbon is established, and a framework set for the movement of this price, enabling global carbon benchmarks and economically viable, large-scale CO_2 emission reduction efforts. Carbon markets link as they develop at regional and national levels. Fossil fuel subsidies are eliminated.

Carbon pricing is complemented by a mix of policy measures: public funding for RD&D in promising technologies, regulation, international cooperation and legislation to establish continental-scale grids and competitive electric markets, as well as more tax measures to encourage private sector research and mechanisms for effective technology transfer. This incentivizes some of the energy and capacity shifts needed for long-term emission reductions (See figure 3.9).

Developing the required technologies is seen as an economically wise investment, creating new opportunities and markets and as a chance to develop or replace existing capital stock with cleaner infrastructure.

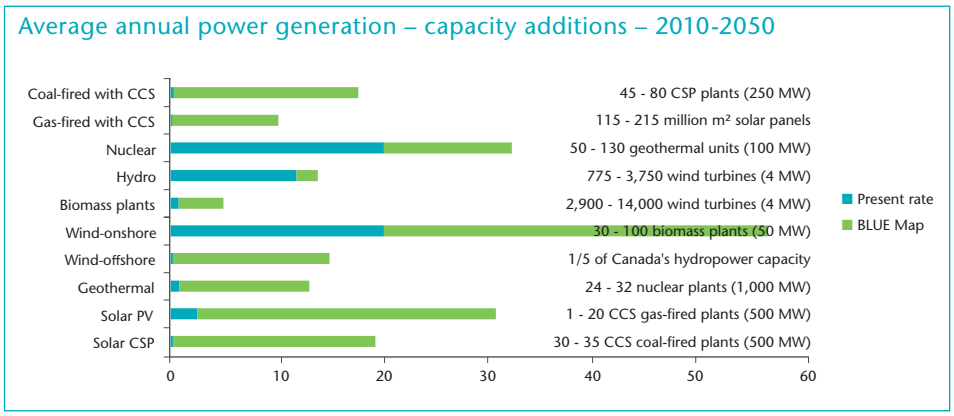
Figure 3.8: A new energy mix to reduce CO_2 emissions

World abatement of energy-related CO_2 emissions in the 450 scenario



Source: International Energy Agency, *World Energy Outlook 2009*, 2009 © OECD/IEA 2009

Figure 3.9: Huge capacity additions needed to deliver the new energy mix



Source: International Energy Agency, *Energy Technology Perspectives 2008*, © OECD/IEA 2008

New business models and adequate incentives encourage utilities to focus more on long-term carbon reductions, security of supply and offering energy-efficient advances to customers.

Wind power becomes competitive

Government support ensures that onshore wind electricity becomes cost competitive. International agreements lead to cross-border grid connections. Carbon offset schemes increase hydroelectricity projects in developing countries.

The carbon price constrains fossil fuel consumption, encourages efficiencies and promotes low carbon sources of energy. The advanced use of low-carbon fossil fuels, in particular natural gas, is progressed by smarter energy networks that distribute electricity and heat when ample and stable demand exists. Some of these networks use fuel cell systems with hydrogen.

Deployment of Generation III nuclear reactors continues. Some 10 demonstration CCS plants are operating by 2015. All new fossil fuel plants are CCS-ready, and an international legal framework for transportation and storage of captured carbon is established.

Transition Time: Greenhouse emissions peak and decline

Emissions of greenhouse gases peak early in the first decade. International collaboration encourages RD&D at the scale and pace needed. New forms of public-private partnerships are established to quickly screen, fund, develop and demonstrate promising technologies. Capacity building ensures that foreign investment is enhanced by stable policy and legal systems and institutional frameworks.

Solar becomes competitive

RD&D efforts make offshore wind and solar photovoltaics cost-competitive. Investment costs for these two technologies dive below those of coal, oil and gas. Governments, academia and business work to ensure the requisite talent, skills and grid connections are in place.

The middle of the period sees a rapid scale-up of renewables. Electricity storage technologies have advanced considerably. Ultra-high voltage alternating current transmission lines support this development. CCS-adapted power stations become commercially viable and grow to account for nearly 12% of power production by the end of the 2030s.

Nuclear still plays an important role

Nuclear power generation has been a key technology in climate change mitigation efforts. The nuclear fuel cycle is secure and stable, and makes reuse of the energy resource possible. An independent safety authority for nuclear power is established, which leads to agreements on the safe management of nuclear waste and the expansion of the technology.

Growing clean in the developing world

The diffusion of clean, cost-effective technologies in the developing world has been helped by protection of patent rights, streamlining planning processes, and rewarding business for low-carbon investments through transparent fiscal incentives and direct public support. Toward the end of the period one-third of all coal-fired power plants close before normal end-of-life because they are not suitable for carbon sequestration. Net zero emission performance and design progressively become the norm for new plants. Generation IV nuclear reactors become commercial.

BUILDINGS

Vision for 2050: Close to zero net energy buildings

New buildings are zero net energy, and existing ones are being retrofitted toward the same goal. This has been achieved through integrated building design, affordable, high-performing materials and equipment and new financing solutions. Progressive policies, incentives and building codes have assured that all of the above innovations are used in building design.

Opportunity drives innovation in the building sector: buildings offer the most economical paths to saving energy and reducing CO_2 emissions. Many new jobs have been generated, and the building sector has become more knowledge intense. Energy issues have become a high priority for owners and tenants: i.e., costs and incentives shape decisions. Energy codes for new and existing buildings are stringent and enforced. Energy performance labels on all buildings provide transparency.

Developers include high energy-efficiency goals in projects to meet building codes and increase their value to buyers. All parties are included at early stages of project planning and sharing of risks in tender applications. This overcomes sector fragmentation and conflicting incentives for different players.

Integrated whole building retrofits decrease costs and obtain synergistic benefits. Appliance energy waste has been minimized through efficiency and use optimization. All residential and commercial premises have individual metering and controls, and information flows between utilities and appliances.

Business, as a large, highly visible customer of the building industry, has played a leading role in all this. Corporate buildings are showcases for energy and emissions saving technology. Corporations document best practices and open their facilities to raise awareness and educate the public.

Turbulent Teens: Turning the market toward energy efficiency

Must haves:

- Tougher, internationally recognized energy efficiency requirements in building codes as well as incentivizing and monitoring their implementation
- New tax incentives and subsidies for energy efficiency investments with longer payback periods
- Business and contractual terms that involve designers, contractors, utilities and end users early as part of an integrated team
- Regular government audits of energy performance, with further tightening and improvements
- Sustained campaigns to increase awareness of energy use in buildings and promote behavior change

Aggressive policies and tax incentives move markets

Aggressive energy policies lead market trends in building energy use toward sustainability. Policy-makers include strict energy efficiency requirements in building codes and commit to enforcing and tightening these requirements over time.

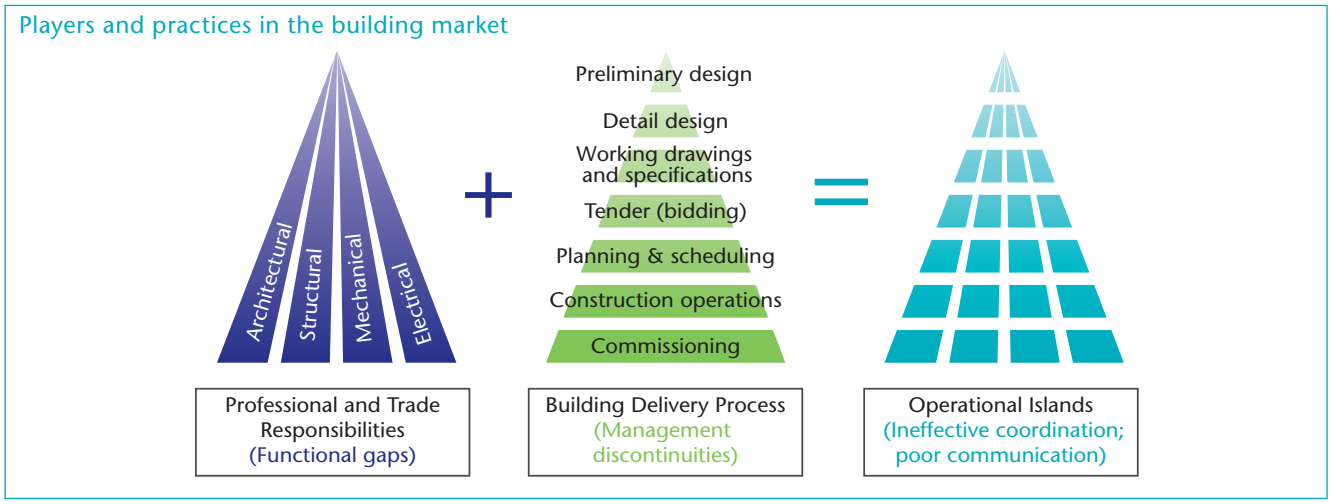
Governments provide tax incentives and subsidies that enable energy-efficiency investments with longer payback periods. Examples include property tax linked to a building's energy classification, where the extra revenues collected are redistributed as subsidies. Utilities make the initial technology investments for householders and then distribute the cost as a surcharge on monthly energy bills.

The building industry retools for energy efficiency

The realization of business opportunities, tougher codes, fiscal incentives and integrated planning quickly cause the building industry to develop energy-efficiency training for all involved in the sector, as well as vocational programs for those who build, renovate and maintain buildings. They also lead to the creation of a "system integrator" profession to support retrofitting of residential properties, which is sorely required (see figure 3.10). These professionals assess energy-efficiency requirements and develop a whole-house plan, select appropriate contractors, and manage the retrofit process.

In multi-family residential buildings, tenants are given access to energy controls for each individual dwelling unit and charged for energy use individually to foster awareness and conservation.

Figure 3.10: System integration is key to achieving energy efficiency in buildings



Source: WBCSD, *Energy Efficiency in Buildings*, 2008

Regular building audits by governments to measure performance, identify improvement opportunities, and establish implementation priorities become the norm in most developed countries by 2020. Energy audits in commercial buildings are incorporated into existing fire, health and safety inspections. Audit results must be displayed on premises. Buildings that are found to waste excessive amounts of energy face mandatory renovation.

Research and communication spread best practices

Governments fund increasing amounts of R&D of effective energy-efficient building technologies. Findings from the first generation zero-carbon, low-waste buildings and communities are spreading to mainstream construction.

Businesses, governments and NGOs partner to run sustained campaigns to increase awareness of energy use in buildings and promote behavior change. Campaigns range from formal advertising to viral marketing and indirect routes such as motivating children to persuade their parents. Leading actors demonstrate their commitment to addressing the challenge by cutting the energy consumption of their own buildings.

Transformation Time: Smarter buildings, wiser users

By 2020 mandatory standards for buildings' thermal integrity and heating systems are set across the OECD. These standards become global by 2030 and continue to tighten over the following decades.

Energy-saving behavior is common

Energy charging structures are introduced to encourage lower energy consumption and to incentivize on-site renewable generation. Discounts for larger electricity users are eliminated and penalties imposed for excessive use. Strict energy-efficiency requirements for appliances become widespread. Included in these is a maximum power use requirement for standby and mandatory energy meters in buildings. International standards are set to discourage trade in sub-efficient appliances. By 2030 countries are completing the mandatory energy labeling of all appliances.

Smart buildings optimize energy use

Buildings have entered the "Smart Era". Energy codes for new buildings are strictly enforced, and all appliances manufactured are energy-efficient. New and refurbished buildings are designed to use information and communication technology such as sensors, automated shading, and load and pricing information, which help buildings operate at an optimal level of energy use. Intelligent grids enable real-time adaptive management by computers of locally generated renewables and district electricity loads. Utilities use information gathered remotely to highlight deviations from best practice in regular usage statements.

MOBILITY

Vision for 2050: Universal access to safe and low-impact mobility

Access to mobility is available to all, increasing social and economic activities. Transport volume more than doubles in passenger and tonne kilometers, but is tempered by information and communication technologies (ICT).

Holistic mobility management involving all key actors lowers the number of transport deaths to close to zero, and negative environmental impacts are substantially reduced: In line with IEA scenarios CO_2 emissions are reduced by some 30-40%.

Vehicle efficiency improves; advanced technologies such as electric vehicles and highly fuel-efficient aircraft based on light materials, superior aerodynamics and engine efficiencies are deployed. Depending on the technological potential in passenger and freight transport, the GHG intensity of light duty vehicles is reduced by 80% through downsizing, lighter weight, more efficient drivetrains, and low-carbon fuels. Other modes – road freight, aviation and shipping – decrease their intensity by at least 50%.

Alternative fuels – sustainable biofuels, hydrogen and electricity produced from low-carbon sources – reduce transport-related CO_2 emissions. NOx and particulate emissions from vehicles are almost eliminated. Policies speed up research, development and deployment of these technologies. Close cooperation among decision-makers, planners and industries improves transportation infrastructure. Intelligent transportation systems (ITS) enhance the efficiency, speed and reliability of public and private transport, and increase the comfort and acceptance of co-modality. People's desire for eco-efficiency and the availability of real-time information enable them to choose well among transport modes and use their vehicles efficiently.

Turbulent Teens: A holistic approach improves overall transport

Must haves:

- Infrastructure investments keep up with growing demand for passenger and freight transport
- Integrated urban planning, especially in fast-growing cities
- ITS connects vehicles to each other and to infrastructure
- Development and deployment of efficient internal combustion vehicles improve new-vehicle carbon intensity up to 30-40%, enabled by better policies and fuels
- Policy-makers and industry partner to speed up research into and deployment of alternative drivetrains and advanced biofuels
- Vehicle users adopt more efficient driving behavior, stimulated through information campaigns
- International standards for sustainable biofuels are adopted, and monitoring systems installed
- Biofuels for aviation are tested and used
- Integrated rail networks spread
- Improved energy efficiency in shipping is achieved through holistic approaches to transport chain performance

Transport stakeholders holistically increase overall transport efficiency. This includes vehicle manufacturers, suppliers, the fuel industry, policy-makers, infrastructure providers, vehicle buyers and users, logistics planners, public transport providers, city planners and others.

Appropriate policy frameworks are developed; research in alternative fuels (i.e., sustainable biofuels, electricity and hydrogen) and drivetrains is enhanced. Business spurs rapid innovation.

Road traffic becomes safer

The decade begins with a visionary global effort to reduce road deaths to zero by implementing the latest safety technology in all cars, preparing the necessary infrastructure, and implementing safety measures for drivers. Safety councils are implemented in major cities. ITS is integrated with the socio-economic environment.

Access to transport begins to become available to the one billion rural people who lack it, and policies promote business cases for such access. Light, low-cost, sustainably powered vehicle designs and the low-cost, cleaner energy sources developed for these markets trickle up to developed countries, boosting energy savings there.

Policies improve fuel efficiency and alternative fuels

R&D support, regulatory instruments, market-based programs and voluntary programs further climate and energy security goals. Governments share best practices and harmonize efforts in collecting data and setting standards. Vehicle R&D accelerates. The market

share of electric and plug-in hybrid electric vehicles is increased by concerted policy incentives and spreading charging infrastructure. The energy industry advances in the development and regional management of efficient, environmental, renewable and dispersive energy models.

Advanced biofuels are developed that do not compete with food crops, do not degrade ecosystems, and have a good life cycle carbon footprint. Improved awareness of biofuels' sources fosters broader acceptance. Advanced processes like biomass-to-liquid or cellulose ethanol are developed to commercial scale.

Low-carbon air travel launched

The aircraft fleet expands with demand. Planes made of composite materials become cheaper and more suitable for mass production. Improved air traffic management takes advantage of advances in aircraft capabilities, data precision, communications and network sharing technologies to reduce fuel use further. Fuel production and distribution infrastructure spread. The end of the decade sees the first commercial flights with sustainable biofuels.[1]

EU and Japan lead rail and marine transformation

The Trans-European Rail network expands, and improves interoperability among the continent's rail systems. Tram-train integration allows urban light rail vehicles to operate on European inter-city heavy rail networks. Advanced railway systems, including Japan's high-speed railway control technologies, are introduced in more countries. Similar progress follows in North and South America, Asia and Africa.

Governments agree on special environmental ocean areas where emissions of NOx and SOx from ships are limited, cutting ocean pollution. Energy efficiency increases significantly through planning and routing changes, as well as engine development.

Transformation Time: Towards alternative drivetrains and fuels

Fossil fuel use for transport drops. Alternative drivetrains like hybrids, plug-in hybrids, battery electric vehicles and fuel cell vehicles, together with energy carriers such as electricity or hydrogen produced from low-carbon sources increasingly dominate, enabling ever-increasing well-to-wheel efficiency. As 2050 nears, alternative drivetrains and hybrids dominate sales.

Public transport becomes more integrated

City and transport planning is better integrated globally. Cities introduce ITS. Public transport becomes more attractive and integrated, increasing its share. Emerging megacities and urban areas leapfrog non-integrated city planning.

Alternative fuels take hold

The costs of advanced biofuels become competitive. Sustainable biofuel use in aviation increases to 30% by 2030. Biofuels begin to be significant in shipping, at first in auxiliary engines and later for main engine propulsion. Biofuels and gas, hydrogen or methanol fuel cells are important. Onboard CO_2 capture is in its nascent phase.

Practical technologies are developed for manufacturing liquid fuels from CO_2 in the air and hydrogen produced from renewable sources (such as photovoltaic & wind generation). Also, nuclear fusion can provide safe, inexpensive, low-carbon energy that can be turned into primary energy and hydrogen to be used for mobility. It should be introduced 10 years earlier than planned.

Traffic control begins on certain sea routes, while the practice of ships returning empty from a voyage is phased out. Efficient river and canal transportation systems receive more cargo.

Access to rail and other forms of mobility continues to improve

High-speed electric rail is a major means of city-to-city travel in most developed countries. Liberalization of the rail sector allows for the export of competencies and technologies. ICT continues to reduce demand for some forms of travel through virtual connectivity and various professional services.

Engine efficiency improvements complement the decarbonization of shipping fuels. Fleet planning, speed reduction and weather routing further reduce fuel use and costs. Polar ice cap melting results in shorter transport routes between Europe and Asia.

MATERIALS

Vision for 2050: Not a particle of waste

Material demand, consumption and production have been transformed to match the limits of non-renewable resources. Closed-loop recycling, making the concept of waste obsolete, is normal business practice, and societies have a circular approach to resources. Used products and materials including wood can be reengineered to function again for multiple and distinct purposes or reduced to raw materials for manufacturing other products.

The eco-efficiency of materials has on average improved by a factor of 10. Advanced materials enable resource hyper-efficiency in key sectors, for instance in lightweight transport and renewable energy. Greenhouse gas emissions, energy and water use are no longer constraints on the materials industry.

Turbulent Teens: Doing more with less

Must haves:

- Carbon price and increased use of other forms of true-value pricing
- Landfills made obsolete or phased out by tightening legislation
- Improved energy efficiency in production of steel, cement, aluminum, etc.
- Design principles and production processes required for closed-loop circular systems
- Business model innovation by reviewing value chains, redesigning products and services, re-engineering processes and revalorizing products
- Co-innovation between producers and consumers to reduce material consumption
- CCS enabled by legal and regulatory framework; demonstration plants for catalytic conversion of carbon dioxide to hydrocarbons (fuels and chemicals)
- Wastewater is considered a resource

Business accelerates its reduction of the amounts of material per unit of value by collaborating and innovating widely. End products are more efficient, last longer and use less material. The substitution of services for products is an increasingly popular business model.

Landfills become obsolete through legislation and higher material value. Mining existing landfills to extract resources becomes an emerging business. Combustible waste substitutes for many fossil fuel applications and also provides raw materials for production processes.

Materials producers find ways to cut GHG emissions. Cement and metal producers focus on co-firing, efficiency, and on developing CCS as a bridging technology. R&D efforts reduce capture costs. Industry also sponsors research to capture CO_2 emissions via bioreactors and catalytic conversion.

Urban mining delivers new materials streams

Packaging is optimized. Goods are increasingly designed to be reused or recycled, to last longer and to deliver more functionality. Recycling is fully integrated into business models. Technology development continues to improve recycling yields. "Urban mining" (recycling aluminum, steel, concrete and aggregates) is a growing business.

In the chemical industry, greenhouse emissions are abated by more efficient motor systems, shifting fuel sources from oil to gas and from coal to biomass, and by process innovations and intensification. The chemical industry finds more socially beneficial uses for oil than as fuel. The industry also begins to switch from fossil to renewable input materials for the production of plastics, polymers and other products.

New rules change the material cost structure

Industry associations cooperate with governments, manufacturers and suppliers to harmonize regulations. Business and governments agree on rules of accounting to establish the true value and cost of primary and secondary materials.

Business rethinks material use

Businesses develop new models for manufacturing, designing products, and capturing recycling opportunities. Dematerialization and service-based consumption become major trends in marketing and product design. Businesses constantly re-engineer manufacturing to drive recycling, reuse and revalorizing materials. New logistics remove unnecessary intermediaries. Life cycle costs become the dominant model for material and product planning.

Education, awareness and collaboration among policy-makers, business, academia and the general public strengthen skill sets in areas such as life cycle analysis and optimization, energy management, process and product innovation, logistics optimization, environmental science and human needs assessment.

Transformation Time: Closing the loop

There is increasing acceptance of the fact that people need to limit their use of non-renewable materials to around five tonnes per person per year, down from 85 tonnes in the US in 2009.

Circular, closed loop designs become more mainstream for industry (see figure 3.11). Wood is increasingly regarded as a recyclable material. All waste is inventoried so it can be recycled later, when technology and/or market conditions make it feasible. Governments tighten policies to eliminate or restrict toxic substances. A solution to the safe storage of radioactive waste is accepted and practiced.

A complete range of new products and services is now being offered, based on high longevity, low embodied water, and low-energy and material content. By 2020 OECD country laws mandate recycling and optimized packaging.

Many CO_2-intensive material production facilities use CCS. New plants in some cases have reached zero net emissions levels. Older plants with high greenhouse gas emission rates are closed. Co-combustion of renewables and waste has increased to 50% of fuel needed for industrial production.

Workforces adapt to a service-intensive business model

The material sector is moving from a commodity-based to service-based portfolio. Working toward innovative and sustainable production processes takes cross-sector participation from skilled workforces. The boundaries between the various business sectors are fading.

Several different metals are approaching their mining limits. This influences their use patterns and spurs transition to alternative solutions.

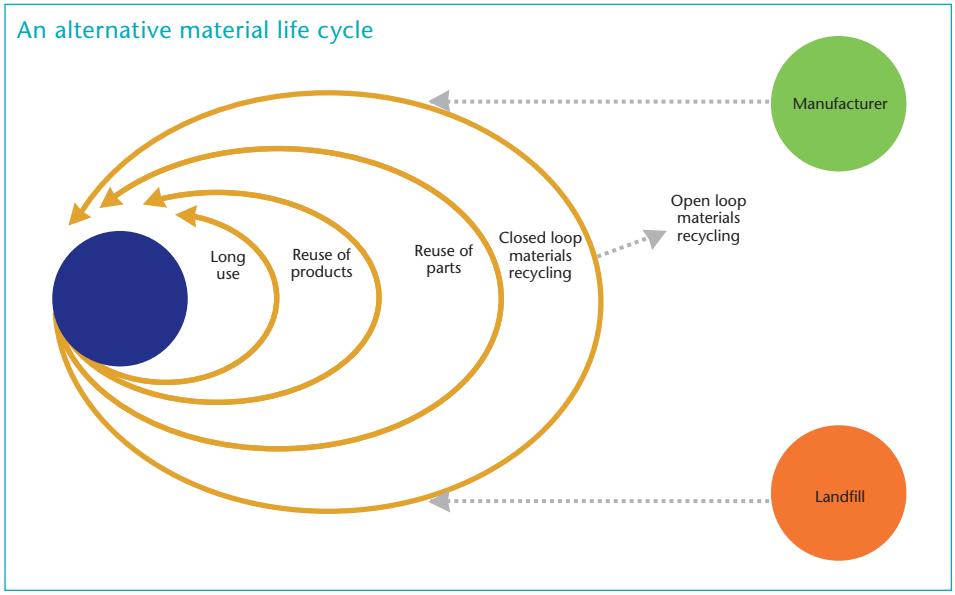
Payment systems are in place for ecosystem restoration. The material supply sector is now seen as a biodiversity and ecosystem services creator, able to both produce eco-efficient products and create and offer environmental services.

Businesses succeed by embracing the life cycle

Environmental pressure has made it more costly to produce commodities through standard processes. Thus the opportunities presented by rising prices have been offset by the penalties of rising costs.

Successful materials companies have reduced energy inputs to save on energy costs, emissions costs and tax penalties. Recycling is a key strategy: in industries like aluminum, recycling saves energy by a factor of 20 over primary production. The strategy includes developing and engineering materials for life cycle value. This closed loop value web happens not just because of the virtues of materials, but because of the design, metallurgy, engineering and logistics that go into it.

Figure 3.11: Eliminating waste by closing the material loop



Source: WBCSD

NOT GUARANTEED: THE RISKS TO ACHIEVING VISION 2050

There is little historical precedent for carrying through such a transformation so peaceably, swiftly and successfully as implied in *Vision 2050,* which is a transformation of massive proportions in the way 9 billion people live on the planet. As *Vision 2050* demands that great changes take place in all areas, risks abound.

Below we lay out some of the ways that the pathway and its elements might not reach *Vision 2050*, first by looking at how the underlying strategic assumptions might be invalidated and second by highlighting some of the potential surprises.

Risks in the elements of the pathway

People and values: Can we all agree? Underlying *Vision 2050* is the idea we are all broadly united in our desire to tackle the range of sustainability issues, and we want and can forge a single global society. This vision is encapsulated in the core value: "One World – Planet and People". However, given the scale of change, not all might agree. Many could fail to understand and act. *Vision 2050* assumes that once the logic and case are made, action follows; but more information may not result in better judgments.

Economy and governance: Swimming against the tide of mainstream economics. *Vision 2050* demands a fundamental change in how we value the environment and the choices we make. The aim is to ensure we can discover true value, true costs and thus true profits. This requires the capacity to price all externalities and diversify their use through markets. A key basis for achieving success is unremitting innovation. However, this may not come quickly enough due to the inability to shift off the existing pathway of a growth-led, trickle-down economy, and the continued dominance of mainstream economic assumptions. Failing to create a global economy with more (4 billion plus) meaningful jobs by 2050 could lead to social and political dislocation. Technology lock-in due to over-zealous policies could make the achievement of efficiency targets more difficult. Innovation may reproduce, and even increase, social gaps and divides.

Vision 2050 posits having adequate global governance to address global problems. Major risks center on the inability of key states to agree on how this system should work. The world could be increasingly fragmented, unable to agree on or manage change.

Food and water: Politics, water shortages could uproot the Green Revolution. A new Green Revolution is central to *Vision 2050*. This idea rests on cross-border trade growth and global technology diffusion. However, food security is a major concern, carrying the risk of food trade protectionism. And the ethics and aesthetics of new food and water technologies could catalyze social unrest, similar to genetically modified organism deployment in the EU. We assume in *Vision 2050* that changes in climate to 2050 do not significantly reduce water availability. However, climate change might lead to more pervasive drought conditions and significantly reduced freshwater availability in some regions, for example parts of Africa and Southern India.

Forests: Is it too late already? Ensuring that forests recover and regenerate, through a halt to deforestation and greater yields from crop cultivation, is essential. Risks are that continued rapid deforestation, particularly in the Amazon basin, could irreversibly damage land and river quality and other planetary-level life support systems.

Energy and power: Progress may be victim to power struggles. *Vision 2050* requires that a secure and sufficient supply of low-carbon energy be developed. States may be unable to agree on targets and adopt a global carbon regime. Even if agreement is reached, this will require rapid development and diffusion of solar, wind, nuclear and CCS technologies at unprecedented rates. A risk is that this may not happen in time and that local populations will respond adversely to renewable, grid, nuclear and CCS developments.

Buildings: In a bad market, incentives could fall. Reaching zero net energy performance for buildings by 2050 requires the improvement of

the environmental performance and efficiency of existing housing stocks over the many and varied jurisdictions around the world. The risk is that continued market failure and a lack of incentives will be insufficient to encourage the retrofitting of existing stocks and the building of new stocks of requisite efficiency.

Mobility will not become sustainable without a systemic approach. Universal access to low-carbon mobility will require meeting the mobility needs of individuals through technological developments as well as communications technologies that temper the growth of physical mobility. A reliance on vehicle technology alone, however, will not be sufficient to overcome mobility challenges due to the expected growth of freight and passenger transport and rebound effects. A holistic perspective that factors in low-CO_2 fuels, changes in customer behavior, integrated urban planning as well as new technologies is required.

Materials: Recycling can be expensive. The materials vision is that waste becomes obsolete and materials efficiencies can be improved four- to tenfold by 2050. High costs and recycling difficulties may prove to be insurmountable for many countries.

Wild cards that could take the world off the Vision 2050 track

Many of the risks to *Vision 2050* are probably manageable, but in a more extreme form they may not be. And many large risks cannot be known now, but will emerge over time. These wild cards may seem to be of low probability, but could turn out to be very significant.

New understanding of how the earth works: The possibility remains that the complex non-linear global systems could harbor pernicious positive feedback loops. For example, global warming could lead to large-scale melting of permafrost, releasing massive amounts of methane, exacerbating climate change.

A world of new ideological blocs, failing states or resource wars: Much of the last century was shaped by the rivalry between two ideological power blocs. A similar adversarial competition in this century could be catastrophic, given the degree of cooperation and trust needed to tackle many of our shared global problems. For some states, rapid population growth, weak economies, conflict and environmental degradation may lead to mass migration to wealthier regions, exacerbating cultural tensions, resource pressure and economic challenges. With potential scarcities looming in essentials like water, crude oil and other resources, there is the potential for aggressive action by some to secure resources.

Disagreement on valuing the environment: Difficulties in agreeing on the basis for valuation of ecosystem services and approaches to remediation could impede and even derail sustainability efforts.

Unintended consequences of new technologies: We are on the brink of new revolutions in nanomaterials and bioengineering. There are many questions about how these new technologies should be managed. The urgent need for solutions to sustainability problems will put tremendous pressure on science for fast development and early release, with all the risks that implies.

Extended economic recession or economic depression: Long-term analysis of the global economy points to a major economic dislocation every 60 years or so. We are at that point. Could the financial and economic crisis that started in 2008 be seriously extended?

Natural disasters: With 6 billion of the 9 billion people in 2050 concentrated in cities, tsunamis, earthquakes and other such terrestrial phenomena could have very costly effects. It is also possible that climate events like floods and droughts could become more severe and frequent as the climate responds more and more to greenhouse gas.

Preparing for the worst

We have a variety of ways of addressing "wild cards," including analysis and anticipation, early warning systems, strategic disposition of resources, insurance, agreements and sanctions. But it is those not identified, or believed to occur infrequently, that could be our biggest challenge.

ECONOMIC ESTIMATES

The potential magnitude of the global business opportunities that could arise from realizing a sustainable future is considerable. This section looks at estimating the global order of magnitude of potential sustainability related business opportunities in key sectors in 2050.

PricewaterhouseCoopers (PwC) has, as part of their contribution to the *Vision 2050* project, prepared an illustrative analysis of the order of magnitude of some of the global business opportunities that might arise if the vision of a sustainable future in 2050 is realized. They adopted a top-down macroeconomic approach, making use of existing bottom-up analysis by the International Energy Agency (IEA) in the climate change area. The analysis focuses on required additional investment or spending in two key areas highlighted in the *Vision 2050* study: natural resources, and health and education. Other sectors were not included due to the absence of any clear basis for producing quantified estimates, but they would be expected to add further to the scale of business opportunities. The approach is described below.

Approach

Natural resources: Estimates of required additional investments in the energy sector related to reducing carbon emissions are based on projections in the IEA's 2008 *Energy Technology Perspectives* report; estimates for other natural resource sectors are benchmarked against these energy estimates, taking into account the relative size of different sectors and a broad judgmental assessment of the required scale of the transformation in each sector to achieve desired *Vision 2050* outcomes.

Health and education: Estimates are based on raising emerging economy health and education GDP shares to 2005 G7 (Canada, France, Germany, Italy, Japan, the UK and the US) levels by 2050 (bearing in mind that G7 education and health spending shares of GDP will probably have increased further by then), then making a broad judgmental assumption on the proportion of the increased health and education spending in emerging economies that will translate into increased spending on private sector goods and services.

Illustrative estimates (see table 3.1) suggest that the sustainability related global business opportunities in natural resources (including energy, forestry, agriculture and food, water and metals) and health and education (in terms of social sustainability) could build up steadily to around US$ 3-10 trillion annually in 2050 at constant 2008 prices, or around 1.5-4.5% of world GDP at that time. By 2020 the figure could be around US$ 0.5–1.5 trillion per annum at constant 2008 prices (assuming a broadly linear build-up of these opportunities over time as a share of GDP).

Table 3.1: Illustrative estimates of the global order of magnitude of potential additional sustainability related business opportunities in key sectors in 2050

Sectors	Annual value in 2050 (US$ trillion at constant 2008 prices: mid-points with ranges shown in brackets)	% of projected world GDP in 2050
Energy	2.0 (1.0-3.0)	1.0 (0.5-1.5)
Forestry	0.2 (0.1-0.3)	0.1 (0.05-0.15)
Agriculture and food	1.2 (0.6-1.8)	0.6 (0.3-0.9)
Water	0.2 (0.1-0.3)	0.1 (0.05-0.15)
Metals	0.5 (0.2-0.7)	0.2 (0.1-0.3)
Total: Natural resources	**4.1 (2.1-6.3)**	**2.0 (1.0-3.0)**
Health and education	2.1 (0.8-3.5)	1.0 (0.5-1.5)
Total	**6.2 (2.9-9.8)**	**3.0 (1.5-4.5)**

Source: PwC estimates drawing on data from IEA, OECD and the World Bank

ECOLOGICAL ESTIMATES

In collaboration with the Global Footprint Network, we calculated the *Vision 2050* ecological footprint against business-as-usual. We found that by 2050, despite increases in population, humanity will be using the equivalent of just over one planet, based on the changes we embrace in *Vision 2050*, as opposed to the 2.3 planets we would be using if we continued on the business-as-usual path we are on today (see figure 3.12). The world will be in a much better position if we maintain the course implied in the pathway and its elements, with the possibility of getting to one planet by around the end of the 2050s, early 2060s.

Vision 2050 assumptions suggest a reversal of the growing consumption and ecological degradation paradigm (see figure 3.14). We would see a significantly lower ecological footprint in 2050 and indeed steady improvements in biocapacity after around 2015.

Approach

The *Vision 2050* ecological footprint assumptions are compatible with the measures detailed in the pathway developed by the project. They are based on median population projections for 2050 of 9.2 billion (United Nations – UN), a 50% reduction from 2005 levels of carbon emissions by 2050 (IEA, ETP 2008, *Blue Map Scenario*), improvements in forest yields through managed forests and an increase in forest areas after 2030 (*Vision 2050* project assumptions), an increase in average global crop yields of 2% a year or more above recent historical levels as a result of the dissemination of best practice and high levels of innovation (*Vision 2050* project assumptions). Global average food consumption is similar to current Costa Rican food consumption levels (Food and Agriculture Organization – FAO). The assumptions for the business-as-usual path are the same for population and food consumption, while those for carbon emissions, forests and crop yields differ. Carbon emissions increase with increased population and economic growth (IEA, ETP 2008, *Business-as-Usual Baseline Scenario*); forest areas continue to follow the 1950-2005 linear trends while forest plantation and crop yields remain constant. Carbon emissions are shown in the ecological footprint through the carbon footprint component. This translates the amount of carbon dioxide emissions into the amount of productive land and sea area required to sequester said carbon dioxide. The date by which we hit one planet is calculated based on a linear extrapolation of trends between 2040 and 2050.

Figure 3.12: *Vision 2050* ecological footprint against business-as-usual – How many Earths and global hectares do we use?

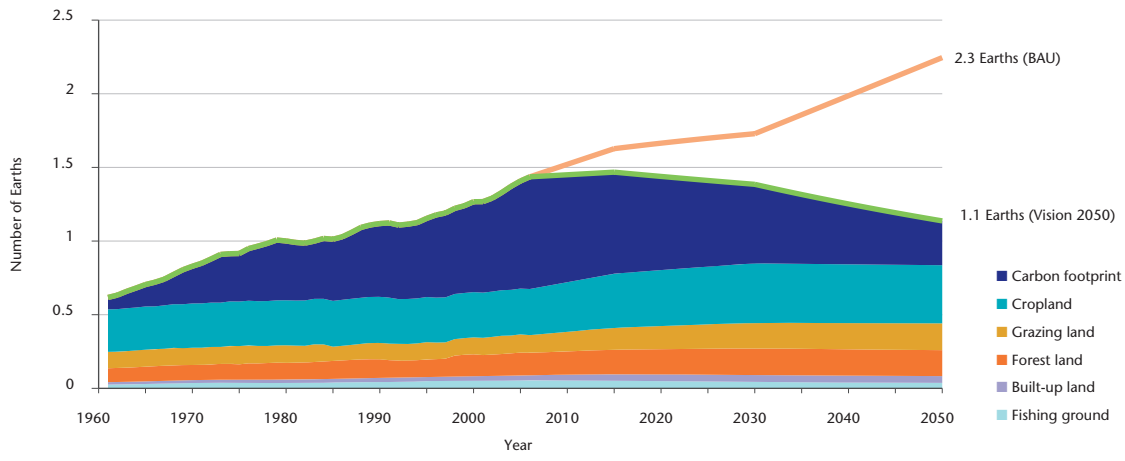
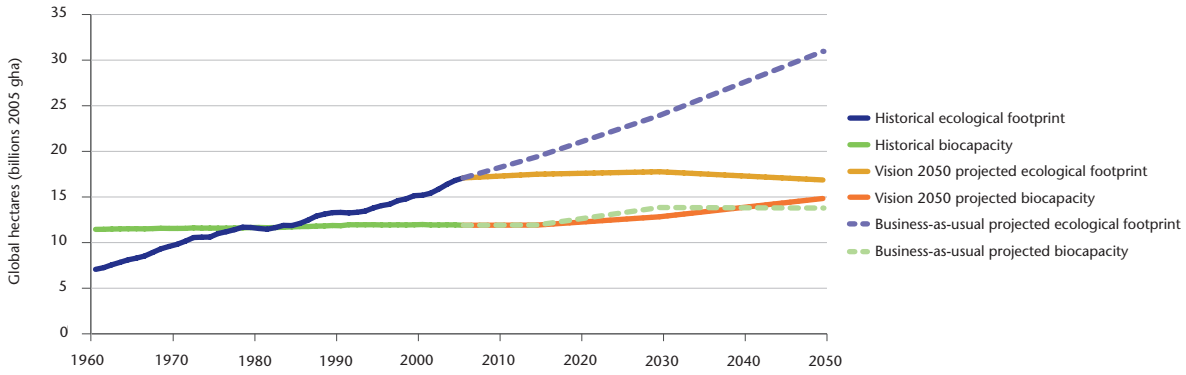


Figure 3.13: Vision 2050 ecological footprint against business-as-usual – Lowering the ecological footprint and improving biocapacity



4 Opportunities

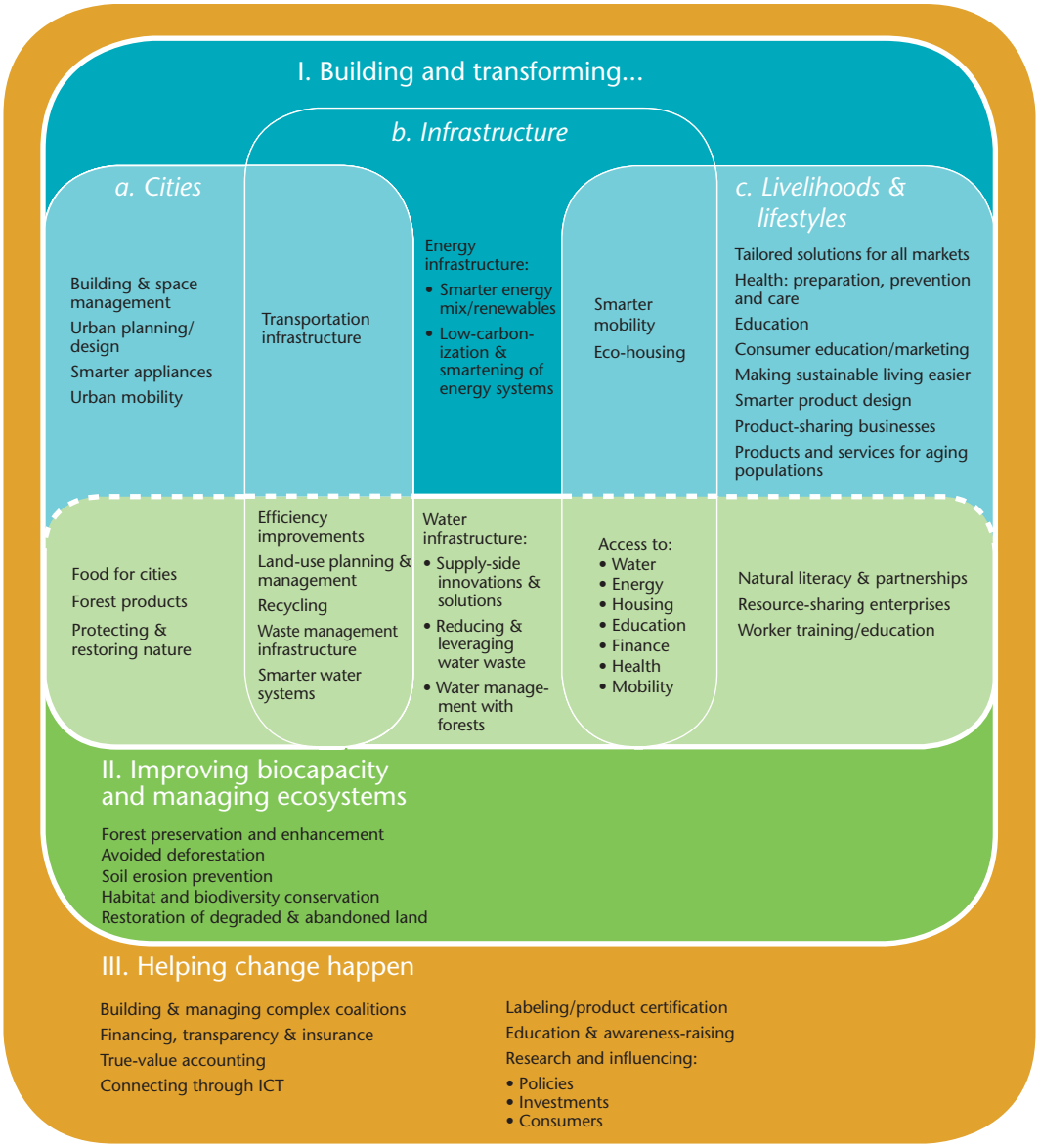
"The pathway toward a more sustainable future presents vast opportunities in a range of business segments as global challenges become the key strategic drivers for companies over the next decade."

This chapter highlights some of the business opportunities that will arise in the period up to 2020 as societies move on to the pathway towards a sustainable future. As the world continues on this path beyond 2020, these opportunities will continue to grow in size.

Business opportunities are defined as anything from which business can derive quantifiable benefits (through objective or subjective means) as well as the things that business and people are willing to pay for.

Box 4.1: Business domains for the next decade – Opportunities and overlaps

This figure provides a relative mapping of opportunity spaces. Some of these opportunities are discussed in more detail in the following text. Overlaps in this diagram indicate areas that are ripe for multi-sectoral collaboration as well as where there might be greater demand for specified products and services.

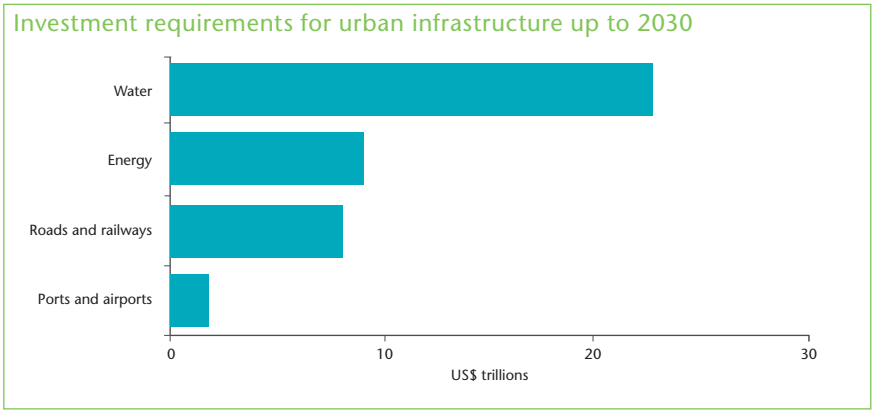


BUILDING AND TRANSFORMING CITIES

More people now live in cities than in rural areas, and this urbanization trend is expected to continue, most notably in the emerging and developing world. Urbanization will provide opportunities for business around the globe but particularly as developing countries transition from agri-centered economies to product and service economies. Some estimates suggest that by 2030 US$ 40 trillion will need to be invested in urban infrastructure worldwides (see figure 4.1).

The dynamics of urbanization – a combination of expanding cities and immigrating populations – will accentuate the effects of energy, land and resource shortages in and around cities. At the same time there will also be new, currently unknown social challenges that will lead to new solutions and opportunities. Cities will need to be designed and retrofitted to minimize waste in all forms, to encourage biodiversity and ecosystems to flourish, and to provide inhabitants with the basic elements of human well-being in a resource- and energy-efficient manner. Re-envisioning the design and management of buildings, spaces and infrastructure systems will be central to this urban evolution.

Figure 4.1: The development of cities presents significant opportunities



Source: Booz Allen Hamilton, *Strategy+Business*, n°46, 2007 (from Booz Allen Hamilton, Global Infrastructure Partners, World Energy Outlook, OECD, Boeing, Drewry Shipping Consultants, U.S. Department of Transportation)

One size does not fit all

The urban needs of the future will not be uniform. Needs and opportunities will be assessed separately for existing cities as well as new settlements arising in

Table 4.1: Four categories of cities with different attributes and prospects

		Brown	Red	Green	Blue
Example		**London, Seoul**	**Mumbai, Soweto**	**Masdar, Dongtang**	**Dhaka, New Orleans**
Development		**Gradual:** With significant investment in existing yet often outdated infrastructure, these cities can be slow to change	**Ad-hoc:** Built on an ad-hoc basis, often in rapid response to economic growth, population expansion, or influx. Housing and infrastructure are inadequate	**Deliberate:** Greenfield construction allows every aspect of design to be optimized for sustainability	**At-risk locations:** These cities built in coastal locations are at risk from rising sea levels
Assets		Cultural history, adequate (if outdated) infrastructure & buildings	Resilience, diversity, ability to manage scarcity	Clean slate for innovative, holistic solutions	Potential for innovative solutions to prepare and adapt for climate change
Opportunity	**Buildings**	New construction and retrofit	Affordable and low ecological impact housing	Holistic design	Adaptation
	Waste	Waste mining, recycling and collection			
	Water and Sewage	New construction and retrofit	Leapfrog	Closed loop design	Maintaining supply
	Energy	Cleaner energy	Access to reliable energy	Smarter systems	Maintaining supply

response to growing and migrating populations. While each city has its own unique assets, challenges and culture, four basic categories of cities, or parts of cities, will require distinct investments in planning, design and management with each presenting different types of opportunities (see table 4.1).

The rest of this section covers specific opportunities and how they apply to these different types of cities. Some are generic but will require tailored solutions, innovative partnerships for planning and delivery, and multi-party funding structures.

Urban planning/design

Sustainable urban design: adapting existing built infrastructure and creating new communities from the ground up.

Green cities, like Masdar in Abu Dhabi in the United Arab Emirates, are planned cities, designed and built from scratch. Estimated to cost US$ 22 billion, Masdar relies on governments and private sector players to raise the capital needed to create a model for sustainable cities of the future. New developments in other cities, whether they are red, blue or brown, also provide similar opportunities – perhaps on a smaller scale. Such developments may, however, face some constraints around legacy systems or lack of appropriate incentives.

City designers, urban planners and building architects collaborate to make best use of new knowledge and technologies that capture natural heating, cooling and lighting to achieve a sustainable, zero waste, zero carbon ecology. These cities will house populations at an appropriate density and diversity of facilities and services. All spaces serve a function or a service, and will be designed for flexibility, allowing for multiple uses and adaptation over time.

"Greenfield" building allows maximum leeway to design according to the needs and capacity of the future. The bounds of this design stretch beyond individual buildings to encompass community design. While making changes to existing building infrastructure is typically a slow process, greenfield projects allow for progress at speed and scale in a short period of time. They also provide opportunity for the widest range of private enterprise involvement: where settlements are created from scratch, business can be involved in many ways.

One of the most sizable opportunities in city development will be materials for whole new buildings and infrastructure. Materials and designs that feature renewable resources, recycled materials and/or low-impact processes will be needed in new green cities, and will also play a central role in adapting brown, red and blue cities to the needs of the future. Technologies that help monitor, report and control the energy footprint of new and retrofitted buildings will help cut costs and comply with energy policies. Creative design will incorporate innovative technologies and materials into livable, workable, minimal-impact structures that make maximum use of limited space and resources.

Building and space management

The design, construction, maintenance and retrofit of buildings and the allocation of urban space to ensure there is room for both nature and people will provide significant opportunities as they play a critical role in the path to a sustainable 2050.

Brown cities, like London, UK or Seoul, Korea, are thriving metropolises where the majority of buildings, constructed years before energy performance was a concern, could be upgraded to reduce the city's greenhouse gas emissions and also deliver significant cost savings to building owners and tenants. Countries committed to reducing their carbon footprint are increasingly offering government-funded incentives to build new, greener buildings, and to upgrade energy-inefficient dwellings. Retrofitting technologies and processes, as well as improved building materials and information exchange systems, like smarter meters that monitor usage and use price signals to identify the best operating times, will be attractive to those who are seeking to reap the benefits of "green building" tax incentives and cost savings from better energy and resource efficiency. Successful technology will adapt to fit a wide variety of existing buildings.

Blue cities such as Dhaka, Bangladesh and New Orleans, USA, situated in low areas and frequently hit by vast storm systems, present a unique set of needs as climate change progresses. Systems that measure and monitor different types of weather-related risks will be as important as measures to retrofit and adapt existing buildings. New structures capable of withstanding extreme and changeable conditions will be designed and constructed.

Cities with booming populations but inadequate resources often struggle to provide even the most basic living conditions for citizens. These **red cities,** like Mumbai, India, present significant opportunities for companies able to develop and provide affordable, dignified, safe and low eco-impact housing. Structures will need to be designed and adapted to suit specific spaces and climates, and will offer alternatives to slums, with affordable and rapidly scalable solutions for sanitation and shelter. There will be a great need for strong, low-cost materials and construction capabilities that take advantage of local skills and economies of scale to keep the cost of building and owning these homes low. Microfinance will help to lower the barrier to property ownership, and hiring local labor will provide a means of sustaining economic development within the community. Pairing these materials, competencies and services with an understanding of local customs and use of space will give businesses the ability to deliver solutions that improve the lives of many people in these cities, and foster a sense of ownership and community pride while leaving a minimal ecological footprint.

End-use energy efficiency in buildings

The necessity to lower greenhouse gas emissions, alleviate security of supply issues, and allow consumers to deal with price volatility will lead to a drive to improve end-use efficiency across all areas. Efficiency improvements will occur both due to legislative decree and through the cost effectiveness of individual measures.

Numerous studies have shown that the cheapest, easiest and largest reductions in energy demand can be made in buildings. This applies to energy used for heating and cooling and also for electrical appliances. The key opportunity is based on the knowledge that standards will continuously tighten, thus allowing companies that can provide the cheapest low-energy solutions to thrive. The WBCSD estimates that the net cost for transformation of the global building stock to reduce its carbon footprint in line with Intergovernmental Panel on Climate Change recommendations for climate stabilization by 2050 is approximately 7% of annual building construction costs. The fundamentals for achieving efficiency improvements are to have the right combination of affordable technology (e.g., technologies that increase building envelope thermal integrity), consumer credit for investments and awareness of the retrofit or new-build options that are available.

Urban mobility

Urban mobility offers myriad business opportunities as urban planning integrates mobility with the socio-economic environment, creating appropriate transport options while tempering per capita travel demand. More efficient vehicles are needed for expanding global markets. Adequate investments in transport infrastructure will create a diverse mix of options and efficient traffic flow, while intelligent transportation systems (ITS) will allow people to combine different means of transport that minimize waiting times. Options include light duty vehicles, trains, buses, various cycles, walking and ICT-enabled connectivity. However, consumers need accurate information to make transportation decisions. Urban freight transport has special requirements in respect to flexibility and load capacity.

The WBCSD 2009 *Mobility for Development* report lists four enablers to improve uncontrolled, uncoordinated and under-resourced urban areas:

- Capacity to finance: Public and private financial resources for new urban infrastructure
- Governance and policies: A governance structure with clear responsibilities for planning, implementing and controlling changes

- Capacity to coordinate and secure stakeholder support: Coordination among all stakeholders
- Capacity to implement: Skills to execute and operate major infrastructure investments.

These four enablers apply to all cities – but on different levels. Brown cities have well-developed transport infrastructure and have introduced measures to reduce congestion and, improve air quality and safety. Yet new investments, services and products are required, especially as infrastructure becomes outdated.

Most of these cities have adequate finance, governance structures and coordination functions, but lack space. Thus it is more effective to improve existing mobility systems than build new. More efficient transport systems and measures like congestion charges result in mobility shifts but not decreases in demand.

Business opportunities include new transport services that help to improve efficiency, such as ITS and building new public transport systems:

- Regional transport management centers
- Traffic management and congestion avoidance using sensors
- Systems and services integrating cars, buses and railways
- Vehicle-to-vehicle communications, road-to-vehicle communications, and automated operation and automated platooning using IT.

Public-private partnerships can help to overcome finance issues, especially for public transport in rapidly growing cities in developing countries. They can help such cities achieve the finance, governance and coordination needed to build integrated transport systems, especially in new, informal areas, while retrofitting older areas. People in these cities and surroundings need reliable access to low-cost and efficient mobility systems and services, as well as vehicles adapted to their individual needs.

Space can be an issue for red cities, as uncoordinated growth makes the introduction of public transport like metro systems more expensive and complicated. Bus rapid transport is often an affordable solution to retrofit the public transport in these cities.

Green, or newly designed, cities can leapfrog many of the challenges by applying a fully integrated city planning approach. Such cities usually have access to financial resources and the ability to design effective governance structures. There are business opportunities here in providing “smart mobility” (the option to choose the most appropriate transport mode) in combination with a smart grid.

There will be demand in most cities for zero-emission and quiet vehicles like plug-in hybrids, electric vehicles and fuel cell vehicles. These will require charging stations, information and communication technologies and billing solutions to ensure a seamless interaction between cars, operations centers and the power grid. A wider variety of vehicles (2-, 3- and 4-wheelers) will help customers match vehicle to purpose and at the same time improve overall efficiency. Demand for freight and public transport vehicles that have reduced emissions and noise will also increase.

BUILDING AND TRANSFORMING INFRASTRUCTURE

OECD/Global Insight estimates required infrastructure investments at US$ 10.3 trillion until 2015. Just under a third (US$ 3.2 trillion) of this will be for new capacity (e.g., China's high-speed rail and India's power generation), while US$ 7.1 trillion is needed for reinvestment (e.g., US interstate highway system and refurbishment of water plants in the European Union). There are two main reasons for this large demand: first, the wave of assets created in the 1950s in the European Union (EU) and other developed markets is beginning to reach maturity and will need to be upgraded; second, many emerging markets remain near the bottom of the table in relative physical stocks of infrastructure, so there is much to build. This demand is likely to lead to significant opportunities for business across the infrastructure spectrum.

Energy infrastructure

Smarter, low-carbon energy systems

Meeting the energy needs of the future will require collaboration among many constituents and technologies, and involve locally relevant solutions and delivery mechanisms. Many opportunities await business. Generally successful solutions will be flexible, *smarter* and diverse.

On the supply side, opportunities exist in electricity production from efficient gas turbines, combined heat and power and soon-to-be-cost-competitive technologies such as onshore wind. Opportunity abounds for other renewables in countries where sufficient incentives such as feed-in tariffs encourage investment. As more and more countries increase the incentives offered for the production of renewable energy and as international agreements on carbon reductions restrict greenhouse gas emissions, investment opportunities in renewables can only increase. The market size for renewables such as solar, wind and biofuels is expected to more than double from around US$ 115 billion in 2008 to just over US$ 325 billion within a decade, according to Clean Edge Research.[2]

In many rural areas, where people depend on biomass for energy, increasing environmental limits and awareness of health impacts will make this fuel increasingly undesirable and drive opportunities in innovation and dissemination of new technologies for heating and cooking. Innovation in using local renewable energy endowments, whether solar, wind or geothermal, will drive demand for digitized power grids to manage loads. There is a need for an estimated US$ 13 trillion investment in upgrading transmission and distribution networks worldwide by 2030[3] thus providing ample demand and opportunity for solutions in this area. The use of geographically dispersed sources of electricity generation will require high voltage DC transmission lines and ultra high voltage AC lines to move energy to centers of end-use. Substations with energy storage devices will manage the integration of intermittent and base load supplies. When combined, this infrastructure amounts to the essentials of smart grids.

As energy prices fluctuate, demand will grow for solutions that help users better manage consumption. Electric systems and appliances will rely on multi-way information exchange and telecommunications to make best use of energy and resources. In buildings, smart meters will enable information exchange. Electric vehicles and other appliances will be programmed to receive pricing information signals via smart meters and will adjust energy use accordingly, using various communication channels between agents of supply and demand. Smarter appliances such as kettles and refrigerators in the home will respond to pricing signals and decide when it is most economical and necessary to operate. These pricing signals, which form the basis of a dynamic energy pricing regime, will encourage time shifting of energy use to spread electricity loads more evenly over any one day.

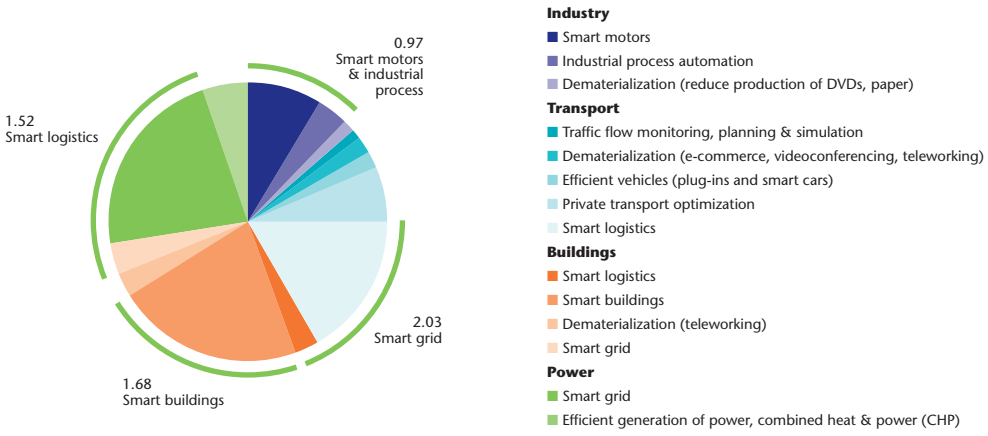
These multi-way information exchanges, like smart grids and smart meters, incorporate a high degree of embedded information technology (IT), power electronics, and telecommunication components. Given that there are at least half a billion grid-connected buildings worldwide and hundreds of thousands of kilometers of grid, this represents a significant opportunity for these sectors. The numbers of storage devices needed also constitutes significant opportunities for battery manufacturers.

Box 4.2: ICT will play a key role in the transition to a low-carbon economy

Information and communication technologies (ICT) can make a major contribution to the global response to climate change by enabling energy and emissions savings in transportation, building, industrial, power and other systems. According to some estimates ICT could deliver up to a 15% reduction of business-as-usual emissions in 2020 (7.8 $GtCO_2e$ = gigatonnes of CO_2 equivalent), representing a value of Euro 553 billion (US$ 872.3 billion) in energy and fuel saved and an additional Euro 91 billion (US$ 143.5 billion) in carbon saved assuming a cost of carbon of Euro 20/tonne, for a total of Euro 644 billion (US$ 1,015 billion) savings. This savings in CO_2e is more than five times the size of the sector's own footprint, and its size demonstrates the important role an advanced communications platform can play in the transition to a low-carbon economy.

In Europe, mobile technology could cut the annual energy bill by at least Euro 43 billion and effect a reduction in annual greenhouse gas emissions by at least 113 $MtCO_2e$ by 2020 according to a report by the telecoms company Vodafone, in collaboration with Accenture. This represents 18% of the UK's annual CO_2e output in 2008 and approximately 2.4% of expected EU emissions in 2020. Twenty percent of this abatement will come from the substitution of physical goods, processes or travel with "virtual" alternatives, such as videoconferencing or online shopping.

ICT-enabled abatement out of the total business-as-usual emissions in 2020



Source: Climate Group, *Smart 2020*, 2008

Water infrastructure

Population growth, urbanization and climate change will put stress on water resources and accelerate the need for new solutions for treating, conserving and improving access to water in all environments. The diversity of local water endowments, agricultural and industrial practices and population growth rates mean that a great variety of solutions will be needed.

Gap between supply and demand

On the supply side, construction of standard infrastructure at current rates of investment will leave a significant supply deficit by 2030 (see figure 4.3). Presuming that freshwater for hygienic and sanitation purposes is prioritized, the implications of an overall supply gap are that regions will have to compromise on how active they can be and the type of water they use in other water-intensive areas such as agriculture, industry and primary resource extraction.

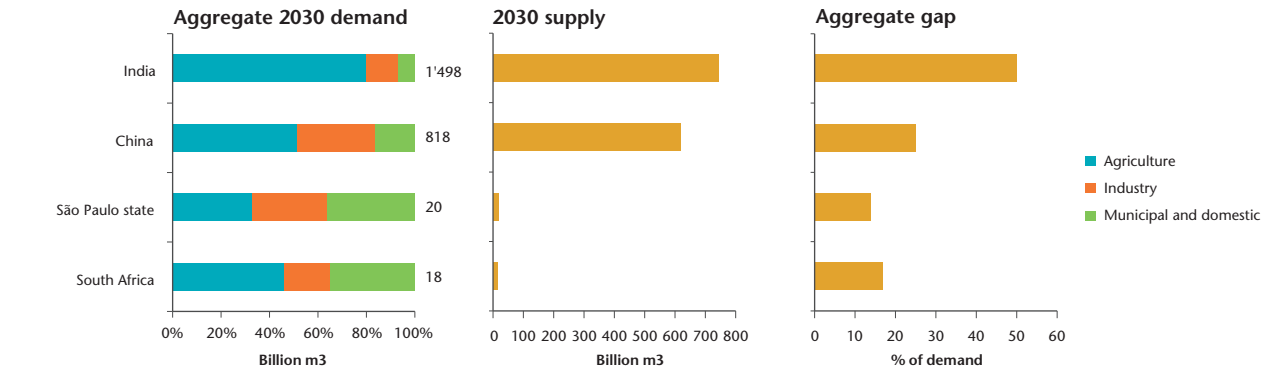
Supply-side innovation and solutions

The opportunities for structural change in the supply and use of water across all regions are substantial and offer many ways for business to engage through the delivery of solutions.

Newer supply-side opportunities range from energy-intensive desalination plants, to improvements in distribution systems, to the construction of storm-water-type infrastructure in cities for the

Figure 4.2: Demand for water will outstrip supply – Action is needed to plug the gap

Base-case demand, supply and corresponding gaps for certain regions



Source: McKinsey/Water Resources Group, *Charting our water future*, 2009

collection of rainwater. The often prohibitive cost of these measures must be offset against the pressure they alleviate on water withdrawal from rural catchments. Innovation that leads to more economical solutions, e.g., desalination, could play a major role in closing the supply-demand gap. Distribution efficiency can be improved, especially in red and brown cities where infrastructure may be old, inadequate or non-existent. Decentralized solutions such as the organization of rainwater collection on a building-by-building basis, as is currently the practice in some Australian cities, can also be further spread.

Regardless of cost reductions in newer supply-side options, there will be a need to continue to deliver large-scale basic infrastructure. For example, to meet the drinking water and sanitation target of the Millennium Development Goals (which still leaves 1.8 billion people with inadequate sanitation), an investment of US$ 11.3 billion per year is needed. Such improvements and investments will also have an economic benefit. Lack of sanitation is the world's biggest cause of infection and is a major cause of lost work and school days because of illness. Statistics also show that on average, every US dollar invested in water and sanitation provides an economic return of eight US dollars.[4] Access to safe water and sanitation for those in red cities and aging brown cities is of course linked to the provision of more affordable housing.

Reducing and leveraging wastewater

Related to sanitation development, sewage will be increasingly seen as a resource. In particular, the world cannot afford not to extract the phosphorous from this waste, given that primary supplies of this fertilizer are approaching their peak. This will provide opportunities for developing circular water systems that recycle water within municipality systems rather than releasing it into rivers and seas. Sewerage alone is not adequate, however; increasing nitrogen loading of surface waters demands treatment as well. To conserve energy, recycled water purification need only be commensurate with specific applications. Opportunity lies in the design and management of these new, closed water systems.

Green cities can construct advanced sewage systems that allow for nutrient recycling and ensure rainfall collection. The construction of such water systems in existing cities is more costly, but necessary to varying degrees. In addition to providing direct, individual health benefits, these measures can also benefit business by enhancing water supply security in urban areas. If climate change begins to have physical effects on cities, creating wetlands can enhance city cooling and flood prevention and also increase urban biodiversity.

Efficiency, conservation and recycling on the demand side

On the demand side, numerous measures can reduce absolute water use through efficiency, conservation and recycling measures. Globally, agriculture is responsible for 70% of freshwater use compared to 17% for industry and 13% for domestic and municipal uses. Many measures and techniques related to irrigation and how water is applied in agriculture

can be improved, which again would help to close the supply-demand gap.[5] In China, for example, the least cost methods are industrial efficiency measures, and are distributed among the thermal power, wastewater reuse, pulp and paper, textile, and steel industries. In India, efficiency measures are mostly in agriculture, where improving "crop per drop" metrics in both irrigated and rain-fed crop production can achieve massive savings. Improving this metric is particularly pertinent in this region given the potential impact melting Himalayan glaciers could have on seasonal water supply to the great rivers of the region.

Water is and will be a billion dollar business at the national level and a multi-million one at the city level. If a supply-oriented approach is taken to meeting the coming gap, up to US$ 200 billion in investments per year will be required up to 2030. However, focusing on demand-side measures can achieve the same effect for US$ 50 to US$ 60 billion per year.[6] This approach obviously leads to cost savings. It also leads to additional revenues in individual sectors, e.g., agriculture. It will not, however, arise out of traditional market dynamics but will require a concerted effort by all stakeholders.

Waste management infrastructure

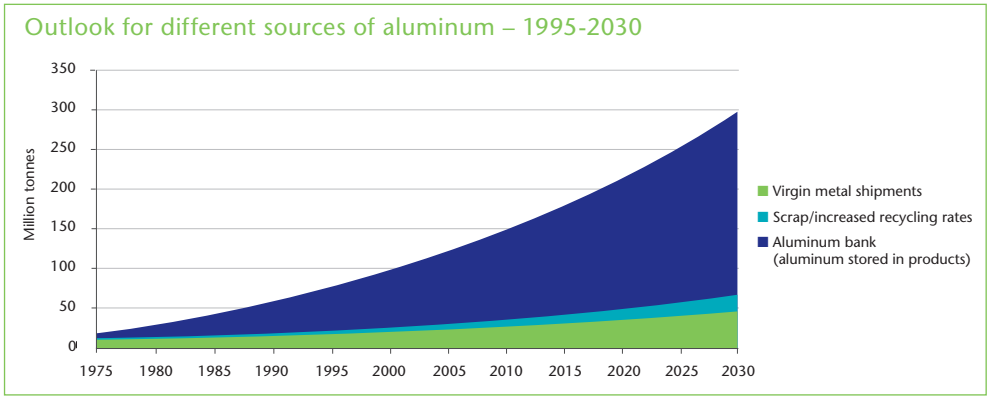
Booming urban populations coupled with space constraints, escalating costs for energy and materials, and growing environmental concerns will transform today's waste management into resource cycling. As societies evolve and seek to develop zero waste economies, excess inputs and outputs (today's waste) will be redeployed/reused.

The opportunities and economics of rubbish

Mining waste offers the chance to recapture a wealth of materials and reduce the demand for raw resources. As new materials become increasingly scarce and environmentally costly, economics will drive growth in solutions for recovering landfill waste and byproducts, such as methane gas. Some materials with high value and efficient collection are already recycled at high rates. For example, over 90% of non-consumer related aluminum is recycled, coming from sources such as buildings, cars and airplanes (see figure 4.3). However, there is great opportunity for those materials and applications with lower recovery rates. The global aluminum foil market is currently around 2.8 million tonnes, of which only 10% is recovered. At US$ 2,000/tonne this is worth around US$ 5 billion.[7] Improving the recovery rate by just a few percent could be worth hundreds of millions. There will be growing demand for new, more sophisticated systems of collecting and harvesting value from waste. As a zero-waste mindset replaces "end of life" mentality, there will be a wide array of opportunities for recycling, including specialized systems for mining and collecting the usable components of discarded waste, and separating it according to demand for materials.

Today the mining of usable discarded waste varies from being done informally in red cities by poor individuals to being done automatically in advanced brown cities via recycling centers. These methods will be strengthened by public-private partnerships and appropriate technology. As recycled components and materials increase in value, there will be greater demand for strong transport, logistics and distribution services. In the many cities in which reusing and recycling rubbish is done informally by the poorest, these actors will see their business grow due to increasing salvage values and the success of public education on recycling. It will be important for these

Figure 4.3: Metals and materials will increasingly be mined from products in use



Source: Hydro Aluminium, *Aluminium for a Viable Society*, 2004

actors to maintain their income as recycling becomes more mainstream. In brown cities, changing economic values will drive similar growth in services that make it more convenient to reuse and recycle.

Though future consumption will be less resource intensive, a vast amount of valuable materials discarded in landfills remains.

Transportation infrastructure

The new mobility options becoming available require building new, and properly maintaining existing, infrastructure in terms of roads, rails, ports, airports and pan-regional hubs to connect these modes. Integrated planning is needed to ensure that infrastructure matches local demand. The latter will change with economic development, aging populations, etc. Long-term planning will promote the introduction of appropriate mobility options for local and personal needs – environmental, social and economical. This entails:

- Adequate infrastructure for public and private transport
- The elimination of bottlenecks in existing infrastructure (urban and rural)
- Interfaces for co-modality in passenger and freight transport
- Modern traffic technology, e.g., smart traffic lights, detection technology
- Innovative transport for freight cargo on major interregional routes
- New systems, like linear motor cars and ITS, that allow large passenger transport volumes on inter-regional routes at speeds of up to 500km/hour at frequencies of every two to three minutes (A linear motor is an alternating current electric motor. Instead of producing a torque rotation it produces a linear force along its length. An example for a specific linear motor car is Maglev in Shanghai and there are also plans for Japan for 2025).

Opportunity: Building intelligent transportation systems (ITS)

Infrastructure will need to improve in quality as well as quantity. ITS will play an important role in making infrastructure more efficient and productive by providing such relevant information as:

- Up-to-date traffic conditions and forecasts, based on which optimal routes and travel times can be planned
- Combined data on traffic flow, alternative transportation options and interfaces between modes, e.g., car to bike, helping people select the most appropriate options
- Real-time information on positions of trucks, capacity of terminals, etc., helping to optimize logistics.

New, high-quality services are needed to collect data on traffic conditions, plans for road construction, etc. and process up-to-date reports and forecasts. Public institutions require this information for optimizing the timing of construction and identifying bottlenecks or making infrastructure more resilient with respect to accidents or unusually high traffic. At the same time, processed information is brought to drivers "on-trip" in near real-time.

Access to ITS can enable new services that help users to best meet their mobility needs. These services can range from mobility management and combining public and personal transport to transport services like call-a-bus and freight management. The services are adapted to local needs and preferences, such as aging populations, densely populated central districts of cities, rural areas, etc.

Business opportunity: Building new vehicles, developing innovative technologies

Meeting mobility demands means not only building new infrastructure but also increasing vehicle stock – cars, trucks, ships, planes. In order to reduce energy demands, the emissions of GHGs and local pollutants and noise, new drivetrains are needed, allowing the use of alternative fuels, especially electricity or hydrogen. Thus new charging and fueling infrastructures are needed. Connecting cars and trucks with each other and to the infrastructure via modern ITS – car-to-car and car-to-infrastructure – can further improve efficiency and capacity, through platooning of long-haul trucks or autonomous operations. Vehicles can become a source of information on current traffic conditions, thus feeding into the overall traffic information system and using local information instantaneously, for example, in traffic assistance systems.

"Russia is facing the threat of the extinction of some occupations, where qualifications are difficult to attain, and the jobs are tough and often not the best paid. The teaching profession is one such profession."
Vision 2050 Dialogue, Russia

BUILDING AND TRANSFORMING LIVELIHOODS AND LIFESTYLES

As populations grow, age and climb up the economic ladder, significant opportunities will exist to help improve people's livelihoods and lifestyles in a more sustainable way. Improving access to health and education as well as a more outcome-focused approach to such services will improve the livelihoods of billions of people in both rich and poor countries. Aging populations will also require specific solutions to ensure they are cared for as well as able to continue pursuing opportunities and contributing to society. There are also ways in which businesses can profit from creating and delivering products and services to the rising number of people in the middle class in a way that makes sustainable products the easier choice.

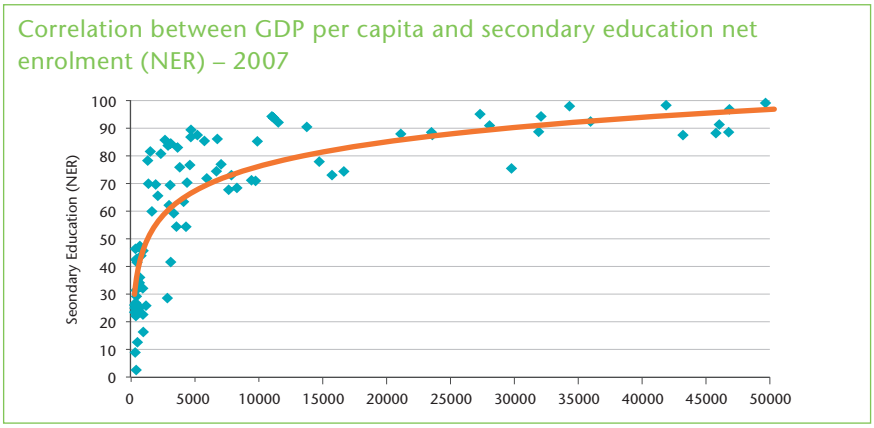
Education

Building local capacity and developing talent

Education is critical for the low-carbon, service-centric economy of the future. Without access to adequately skilled labor pools, business cannot operate successfully. Education is critical to the foundation of sustainable societies. It empowers people and helps them make more informed choices, improves health, increases household income (see figure 4.4), and also reduces crime and birth rates.

Investing in educating women has particularly positive effects.

Figure 4.4: Education is linked to income generation and wealth creation



Source: International Monetary Fund, *World Economic Outlook Database*, 2009; UNESCO Institute for Statistics, 2009

According to the World Bank adding one year of schooling for girls reduces incidences of malnutrition and can contribute to a 5-10% decline in infant mortality. Doubling the proportion of women with secondary schooling can reduce fertility rates from 5.3 to 3.9 children per woman. Some benefits will also be economic: providing girls with an extra year of schooling increases their wages by 10-20%. There is also evidence of more productive farming methods attributable to increased female schooling.[8]

Countries with the lowest literacy levels and school enrollment rates will need more primary schools, whereas emerging economies will bridge the gap in higher education between themselves and more developed regions. Apart from the construction itself, these new facilities, especially universities, will require a range of services, from catering and cleaning to IT management and security. This will have a multiplier effect on the economy, given the need for related goods and services such as student housing, road construction and banking services.

Information and communication technology will play an important role in improved education. Schools and students will look for affordable, energy-saving computers and software that allow them to access broader educational content and to enrich their educational experience by interacting with other students all over the world. Mexico's Monterrey University, for example, provides online classes for Mexicans around the world to learn in their native Spanish. As they expand their reach and influence, top universities will have bigger needs, necessitating a frequent upgrade of speed and secured broadband Internet access, as well as powerful servers and supercomputers.

Educational content for a sustainable world

Sustainability will be embedded into educational content. This will help encourage a change in the way people understand their social, technological, ecological

and political environments. Besides reading and writing, additional types of literacy will be taught, with environmental and societal benefits. Natural literacy, for example, will catalyze a desire to protect and restore nature. Solution literacy will empower people and make them better able to identify the best sustainable solution depending on local contexts. This will help facilitate the shift in consumption and lifestyle, creating new markets for sustainable products and services.

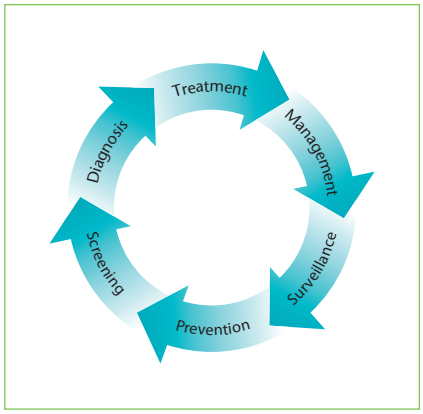
In higher education, people will be trained with the skills to manage technological breakthroughs and global issues. Firms will find more talent trained in new energy and environmental technologies and natural sciences, as well as in systems integration and open innovation. MBA curricula will balance the focus on performance with more content on ethics, political sciences, international development and anthropology. The higher educational level in many emerging economies will continue to allow firms to recruit talent with a broader variety of background and culture.

Health: Preparation, prevention and care

Huge investments in prevention and treatment

The increasing incidence of chronic diseases, communicable diseases, mental illness and pandemics, as well as health gaps between geographies and people put entire population segments and regions at economic disadvantage. Bridging this gap will therefore have a notable impact on the capacity of future generations to contribute to their own development. Business has key roles to play in this effort, along with governments and civil society organizations. Huge investments will be made to fight diseases and treat their sufferers, with a need for affordable diagnosis, drugs and vaccines, and additional healthcare facilities, particularly in developing regions. However, to be sustainable, this response will need to go beyond cure and focus on prevention. This will entail the development of new products and services that will help people avoid getting sick, and will control health system costs. Healthcare in most countries will transition from a hospital-centric-reactive "ill-care" focus to a patient-centric care cycle approach that covers all phases of illness, including prevention, diagnostic, treatment, recovery, aftercare and return to everyday life (see figure 4.5).

Figure 4.5: Moving to a patient-centric care cycle approach



Source: Philips, *Innovative Solutions across the Stroke Care Cycle*, 2008

Furthermore, the integration of "Western" high-tech medical knowledge with traditional, indigenous forms of medicine and care, particularly from emerging markets, will deliver benefits in different healthcare application areas and illness phases.

Increased access to better healthcare and prevention will have positive effects on the economy and businesses. It will keep the workforce healthy, improving productivity. It will also raise household incomes and improve the quality of life of individuals.

Bridging the health gap: Products and services for developing regions

Massive testing, treatment and vaccination campaigns will be launched, supported by tens of billions of dollars in investments from multiple funding sources. This will provide opportunities for pharmaceutical companies that develop and deliver affordable diagnosis, drugs and vaccines adapted to local conditions.

Developing countries will be significant markets for pharmaceutical firms. The support of partnerships with non-pharmaceutical companies and/or non-profit actors will allow increased access to consumers. These business opportunities will be bolstered further by effective action against counterfeit drugs.

Bridging health gaps will require the building of additional primary, secondary and tertiary healthcare

facilities, depending on local needs, from simple medical facilities in rural areas to hospitals offering a full range of care in big cities. The number of private clinics will rise considerably, and their development will be facilitated by the establishment of efficient health insurance systems.

All this will require a range of services, some of which will be outsourced to private firms (e.g., catering, cleaning, security), and also advanced and affordable medical equipment.

Staying healthy

The shift from cure to prevention will be a top priority, entailing new business opportunities in medical and non-medical products and services.

There will be greater demand for reliable sources of information on the Web and for health management software that helps people to better manage their personal health. There will be tremendous opportunities for the food industry, with the development of foods and beverages that improve health and nutrition, for organic food, and restaurant chains or catering firms offering these products. There will also be demand for fitness and sport infrastructure, coaching services and high-tech sports equipment.

Financing

Better cost and performance management will require broader involvement of private insurance companies and healthcare providers working with governments to offer high-quality care. There will also be opportunities in developing innovative solutions in microfinance and microinsurance schemes to allow people outside national health insurance systems to have access to better healthcare. This can help to ensure that individuals are able to access the treatment they need while limiting the cost to society or the national coffers.

Risk factors

The global effort to reduce environmental risk factors will lead to greater demand from people in emerging economies for safe water, sanitation, clean air and housing, and green energy. Improved sanitation facilities could reduce diarrhea-related deaths in young children by more than one-third. If hygiene promotion is added, such as teaching proper hand washing, deaths could be reduced by two-thirds. It would also help accelerate economic and social development. More generally, business opportunities will go to companies able to develop safe products that cause no health damage.

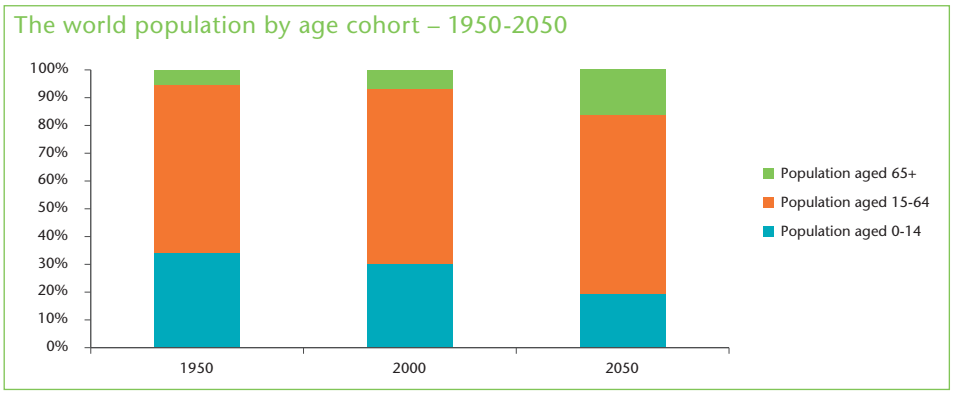
Early responses to emerging communicable diseases and pandemics will be necessary. Governments and businesses will make big investments in the search for early diagnosis, drugs and vaccines, as well as management systems that help them coordinate complex responses globally. There will be great opportunities for responsible firms that can rapidly dispense safe products to billions of people, while collaborating with governments and researchers.

Products and services for aging populations

By 2020 people aged 65 and above will account for about one-fifth of the total global population(see figure 4.6). This ratio will be even larger in developed countries such as Italy, Germany and Japan. This older demographic is likely to be better educated, more comfortable with technology, and healthier than today. It will also be highly represented in political decisions. Although the story in the developing world will still largely be one of youth, some emerging populations will age considerably as their economies develop and offer better healthcare and life services.

Each month around 1.9 million people in the world will join the ranks of the over 65s.[9] These people will seek goods and services that enable them to maintain independent, integrated lives. Meeting their needs will have an impact on all aspects of societal and economic well-being. It will only be sustainable if older people are given the opportunity to live independent and dignified lives, are fully integrated into society, and are able to contribute to meeting global challenges. The impacts on social budgets and future generations' quality of life will also place pressure on social systems, straining pension, healthcare and education systems: challenges all requiring innovation and change.

Figure 4.6: The world is aging



Source: UN Population Division, *World Population Prospects: The 2008 Revision*, 2008

Specialized products and services

Specialized products and services will be developed to enable people with high-dependency needs, especially those with reduced mobility and/or severe illnesses, to live with dignity. This will be more and more important in emerging economies that are beginning to experience rapid increases in life expectancy.

There will be significant opportunities for inclusive design, i.e., solutions that create a supportive environment of buildings, products, services and interfaces. Examples range from consumer goods (e.g., smaller packages) to nutrition (e.g., functional foods and drinks) to ICT (e.g., computers with easy computer-human interfaces and one-button mobile phones).

In many developed countries, classical pension systems may struggle to offer the same security nets as they did at the end of the 20th century. Safe and sustainable financial products will give older people greater income security and allow them to complete their pensions. In developing countries, micro-life insurance solutions will be developed to provide savings capacity and ultimately security and income in old age.

Solutions for staying at home

The greater proportion of aging people in the population should drive demand for a new generation of green housing and assisted living in developed countries. For older people choosing to live at home, companies, often in association with public sector agencies, will develop in-home products and services that help them manage their daily lives and stay healthy and well-connected to society.

A person who wants to stay at home for as long as possible has to be relatively healthy. There will be a high demand for services, such as health coaching and advice on nutrition, that can help aging people avoid preventable ailments and improve their well-being. People suffering from non-disabling chronic or mental diseases will need affordable medical equipment and services that they can use from home.

More generally, a range of in-home services that help manage all aspects of daily life, including catering, housekeeping or other essential services, will be needed to serve this growing market. Practical services will provide support to families and help them take care of older friends and relatives. Homes will be smarter, with computer-based appliances and services. Specially designed online platforms will allow older people to shop and manage their finances, insurance and bills from home; home robots will play a key role in keeping older people safe and their homes clean.

Work and social life: More involvement

In developed and emerging economies, the age of retirement will likely be pushed back as the younger workforce shrinks. Many elderly people will choose to continue to work beyond retirement. Flexible working models and schemes, up-skilling and lifelong learning provisions will help to boost productivity and enable older and younger people to share their experience and knowledge with each other.

The desire to continue to enrich knowledge and further develop skills even after retirement will create demand for both online content that allows people to learn and for public or private schools and universities to continue to open their doors to the elderly.

Aging people will also look for suitable technology and communication tools that help them stay in touch with society, friends and family anywhere in the world. Online social networks will be popular as they will provide access to different communities and offer the possibility to share experiences with other cultures and younger people.

Mobility: Technology plays a role

Solutions for improved mobility will be developed, facilitated by robot-assisted mobility, motorized scooters, and adapted vehicles and public transport developed through public-private partnerships. Tailor-made traveling services and facilities will make traveling abroad more accessible and easier.

Making sustainable living easier

Why consumer taste and choice matter

The global middle class is growing. The investment bank Goldman Sachs estimates that some 1.7 billion people today can be considered middle class – with incomes between US$ 6,000 and US$ 30,000 in purchasing power parity (PPP) terms; this figure is likely to reach 3.6 billion by 2030, with most of this growth in emerging economies. In China, rapid income growth means that an estimated 75% of the population will be considered middle class by 2025, up from 37% today. In India the share of population that is middle class will go from an estimated 6% in 2009 to around 46% in 2025. In Vietnam, over the same time period, the middle-class share of the population will go from 7% to 51%.[10] Unless these new consumers and the existing ones choose the right products, and use them properly, it will be hard to achieve the vision of 9 billion people living well within the limits of one planet.

Universally people want products and services that improve their lives. People will change their lifestyles only in exchange for better ones. The products and services will have to meet two sets of needs, sustainability and consumer preference, which may be at odds with each other.

There is little room for tradeoffs between these factors. Product and service providers will need to make sustainable living easier. This is a formidable challenge and opportunity for business in terms of innovation and understanding human behaviors, value systems and consumer preferences. Technological innovation will only be a piece of the puzzle. Social innovation, for example in the form of new business models, new customer behavior and action, and new ways of interacting between providers and users, will also be crucial to developing attractive, effective and accessible solutions.

Understanding behavior change

People will not change behavior or lifestyles homogeneously. Influencing change requires an understanding of human behaviors and cultural legacies, as well as different ways of informing consumers.

The application of better insights into what motivates, influences and triggers behavior change based on population segments will have impacts across the board. This understanding will focus product innovation on developing goods and services that satisfy a number of needs at the same time – with a focus on minimizing waste and impacts on the environment without compromising on performance quality or experience. For example, studies show that if you tell people (or show people through smart metering) how much electricity they are using compared to their neighbors, energy consumption can be reduced in some neighborhoods by 2-6%.[11]

Product and service design will anticipate unsustainable elements of human behavior and will help consumers modify behavior in ways that are easy, desirable and seamless. Many products will be shared or leased, rather than owned, as business models evolve to offer functionality or service rather than the product per se. Multi-purpose devices and technologies will be developed that enable new interactions between the real world and the world of data, allowing consumers to make more informed choices.

Communicating the change

As consumers increasingly search for convenient ways to pursue

sustainable lifestyles, there will be a greater demand for detailed product information. Consuming low-impact products is impossible without knowing which products are in fact low-impact and understanding how to use them. Product on-pack labeling will be just one way of communicating to consumers. It will only motivate or influence behavior when it is part of a comprehensive communications and consumer engagement plan. IT/ICT will also play an important role, allowing consumers access to this information and enabling them to review and share feedback with each other and with the businesses that create and sell these products. These systems will present opportunities for businesses that gain greater insight into consumer demands and co-create products with consumers, and for customers who find themselves more empowered to communicate their interests and expectations. At the same time, the power of customer networks presents an added element of risk to businesses: better communication will accelerate the failure of products and services that do not meet consumer expectations; all the more reason for businesses to fully engage their constituencies throughout product development.

Businesses and governments will do their best to build the case for sustainability in consumers' minds, and it will have some positive effect. But success will take more than massive public service campaigns. Governments will need to encourage markets in the right directions with requirements like recycling, standards, taxes, subsidies and other carrots and sticks.

Co-creating value in webs

No business is an island. Neither is it a single supply chain with simple linear inputs and outputs. The more apt and more valuable metaphor for business today is the network, or web, of relationships and systems, each with its own inputs and outputs. Its value is determined less by the products and services that it delivers than by the way the customer uses them.

New business and distribution systems

In the context of a market based on changing values, networks have some important implications. On both the supply and demand side, networks ideally entail collaboration among business, governments and society (including consumers) to define sustainable products and lifestyles. In a networked business universe, companies can take advantage of technology's greater connectivity to involve more customers in developing and designing products and creating value for themselves.

On the supply side, the network model presents new opportunities for industries to find ways to close loops, saving resources and cutting costs. One sector's waste can be another's raw material, a discovery only possible if the two are connected. Product and service development problems that cannot be solved through traditional supply chain models may be addressed through co-development networks of consumers, academia, other businesses, individuals and other players. Within each context, different economic actors – suppliers, business partners, allies, customers – work together to co-produce value and match the various capabilities of participants more efficiently and effectively than possible individually. Sharing knowledge and practices in these networks also removes barriers to sharing other information.

IMPROVING BIOCAPACITY AND MANAGING ECOSYSTEMS

Based on today's estimates for population growth and eating patterns, agricultural productivity will need to grow 2% annually to feed and clothe the world's population by 2050, a growth rate similar to the Green Revolution of the 1950s and 60s. The Food and Agriculture Organization estimates that there is a need to increase global agricultural production by 70% to almost 100% in developing countries by 2050, and that net investments in agriculture must top US$ 83 billion per year, up roughly 50% from current levels. People will also consume wood, paper and other forest products at similar increased rates.[12]

Meeting these growing levels of demand for nature's services while limiting ecological impact provides a number of areas in which business can prosper. Companies will work with governments, NGOs and local communities, among others, to develop and disseminate solutions that improve biocapacity, protect and restore nature and improve people's understanding and awareness of the environment.

Improving biocapacity

Given finite land and water resources, new opportunities will arise in agriculture, water management, forest management and other sectors to develop new technologies and best practices that improve crop yields, conserve soil and water and manage nutrient input. Specific

Table 4.2: Closing the production gap in agriculture through investment – Opportunities by impact, geographical reach and type of investment

Investment opportunities				
	Description	**Impact**	**Geography**	**Type of investment**
1	Irrigation	Raises productivity in certain regions	Regional, global	Technology, manufacturing
2	Fertilizer	Raises productivity in certain regions	Regional, global	Technology, manufacturing
3	Machinery	Enable more efficient farming	Local	Engineering, manufacturing
4	Commercialization	Raises productivity in certain regions	Global	Logistics, manufacturing
5	Infrastructure	Major challenge to agricultural expansion, especially in emerging economies	Global	Governments, engineering
6	Land expansion	Increase acreage for production	Global	Private lands, public lands
	Biotech crops	Crop protection, drought resistance, disease resistance, lower water and fertilizer input	Choice by region	Biotech, agronomic
Investment enablers				
	Description	**Impact**	**Geography**	**Type of investment**
1	Education and practices	Adoption of technology and management	Local	Necessary for smaller farmers
2	Policy	Significant impact on agriculture	Global	Necessary for smaller farmers

Source: Deutsche Bank Climate Change Advisors, *Investing in Agriculture : Far-Reaching Challenge, Significant Opportunity*, 2009

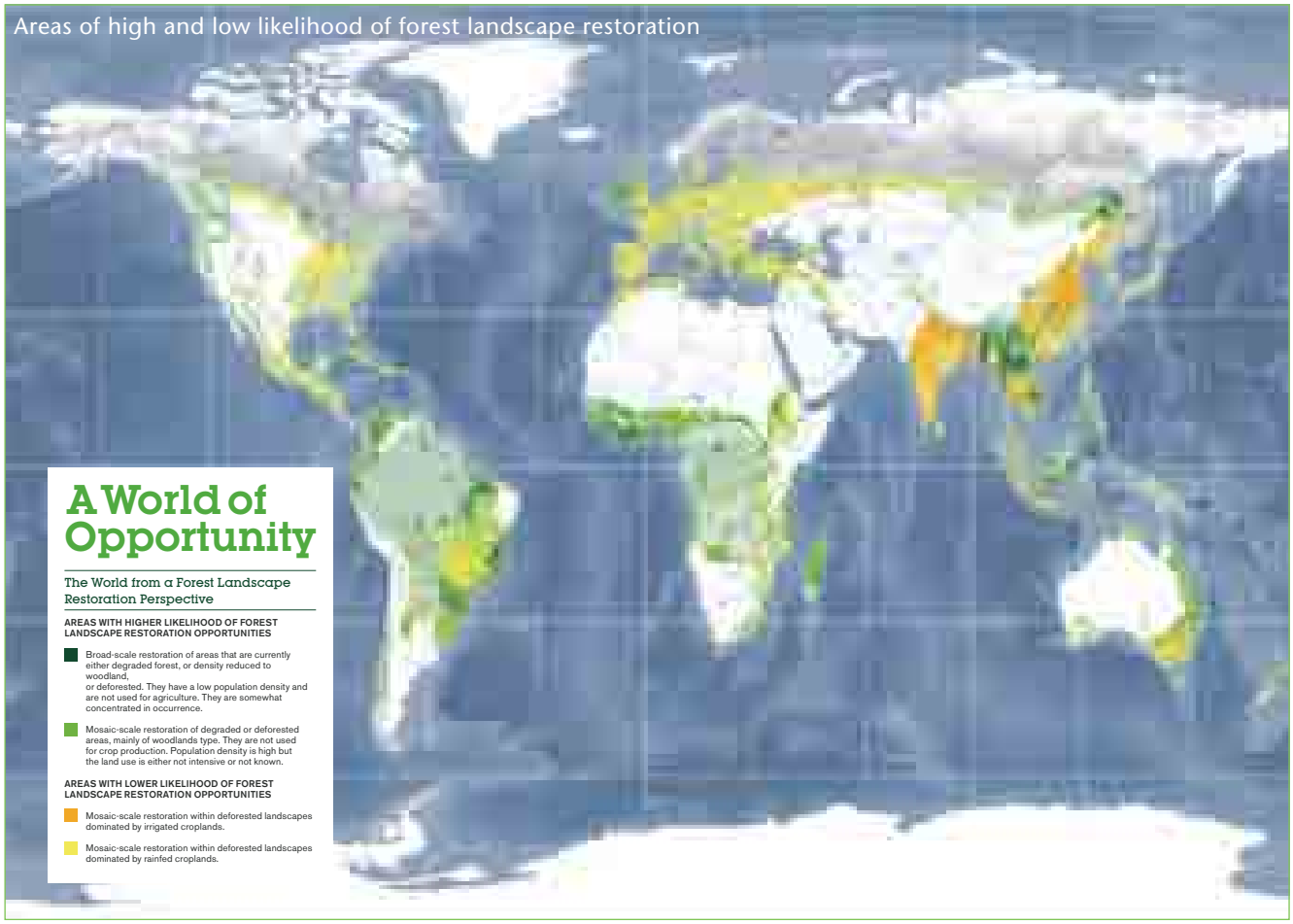
types of investment in agricultural practices and processes will help raise productivity and close the production gap (see table 4.2). There are also significant opportunities in restoring forestlands for carbon capture and biodiversity.

Boosting biocapacity through sharing technology and best practices

Better performing seeds will be developed to increase yield per drop of water and nutrients, and resistance to pests and diseases. New agriculture and forestry techniques will improve the management of competing vegetation and application of nutrients. Best practice solutions will increasingly be disseminated via new knowledge platforms. Shared distribution networks between different companies and sectors of society will help bridge distribution gaps to ensure that remote farmers are able to access the best technology and know-how that are already in place in various parts of the world.

To reduce soil erosion and improve water quality, the application of many known techniques will be necessary. These include using conservation tillage, strip cropping, terracing, contour planting, conversion of some croplands to nonfarm uses, planting trees on croplands and implementing agro-forestry systems. Revegetation of eroded watersheds will also improve soil properties, recharge aquifers and provide clean water. To manage the demands of such changes, opportunities will arise in the agricultural machinery sector, as well as in the development of knowledge exchange platforms, real-time information exchange (weather) and the further capacity building of farmers.

Figure 4.7: A whole world of opportunity exists for restoring the forest landscape



Source: WRI, http://www.wri.org/map/worlds-forests-restoration-perspective

Protecting and restoring nature

Restoring wild land and space for biodiversity

The bioproductivity of cultivated land will be increased in a way that allows the return of spaces to wildlife and complements the productivity of natural systems. Planting trees, improving forest bioproductivity, restoring degraded land, and avoided deforestation will help mitigate climate change, and, through conservation payments plus payments for ecosystem services, contribute to economic development (see figure 4.7). Furthermore, less value will be lost to degraded ecosystems. The ongoing TEEB (The Economics of Ecosystems and Biodiversity) study suggests that the degradation of biodiversity and ecosystems due to deforestation means that each year the world loses natural capital worth between US$ 1.9 and 4.5 trillion.[13]

Payment for ecosystem services is an emerging and rapidly changing area spread out across geographies and institutions. Information on ecosystem services markets is limited and constantly changing, but future payments for ecosystem services markets look promising. Some estimates suggest that the payments for products from certified forests could grow from an estimated US$ 15 billion in 2010 to around US$ 50 billion in 2050. For certified agricultural products, estimates suggest that payments for ecosystems markets could grow from US$ 42 million in 2005 to around US$ 97 billion in 2012 (assuming an annual growth rate of 15%), potentially increasing by a factor of ten to US$ 900 billion in 2050 (assuming an annual growth rate of 5% between 2020 and 2050).[14]

Table 4.3: Ecosystem markets have the potential to flourish

Payments for ecosystems services (PES) market	**Current size** (US$ per annum)	**Potential size by 2020** (US$ per annum)	**Potential size by 2050** (US$ per annum)
Certified forest product	US$ 5 billion (Forestry Stewardship Council only)		US$ 50 billion
Certified agricultural products	At least US$ 42 billion (global retail sale)	US$ 210 billion (assuming a growth rate of 10% per year between 2012 and 2020)	US$ 900 billion (assuming a growth rate of 5% per year between 2020 and 2050)
Compliant carbon forestry		US$ 5 million- 5 billion	US$ 0 - 5 billion
Voluntary carbon forestry	At least US$ 21 million	US$ 10 million to 5 billion	US$ 10 million to 5 billion
Compliant biodiversity offsets	US$ 3.4 billion	US$ 10 billion (more if other countries adopt practice)	US$ 20 billion (more if other countries adopt practice)
Voluntary biodiversity offsets	US$ 10-17 million	US$ 100 million - if corporations take to the concept	US$ 400 million - if corporations take to the concept
Government-mediated biodiversity PES	US$ 3 billion	US$ 7 billion	US$ 15 billion
Voluntary watershed management payments	US$ 5 million	US$ 2 billion	US$ 10 billion
Government-mediated watershed PES	US$ 5.2 billion	US$ 6 billion	US$ 20 billion
Genetic resources (Access & Benefit Sharing)	US$ 15-30 million	US$ 100 million	> US$ 500 million

Source: Forest Trends and the Ecosystem Marketplace, *Payments for Ecosystem Services: Market Profiles,* 2008

New business concepts for improving biocapacity and managing ecosystems will almost certainly create opportunities for rural communities and help address rural poverty. Better management of and growing markets for ecosystem services and for promoting biodiversity should provide significant opportunities for rural entrepreneurship and employment.

Natural literacy and partnerships

Public education embedding natural literacy

Increasing people's knowledge of natural systems (natural literacy) will allow individuals and business to make more informed choices regarding their consumption patterns. This can be achieved through greater use of environmental accounting and reporting and holistic communication using labeling as one form of communication and education. National and international programs that certify products will also be a necessary component of labeling and could represent a significant market opportunity.

Partnerships and policies, innovation and investments

Satisfactory financial and legislative structures will ensure protection of primary and unmodified natural forests alongside the development of markets that allow ecosystem products and services to be priced and their value included in national and company accounts. Such markets will present significant and potentially lucrative opportunities for consultants as well as businesses and individuals that provide such services (see table 4.3). Furthermore, an environmental fund could be established to act as a safety net to support the restoration or maintenance of the basic functioning of the underlying bio-physical system.

Legislation to mandate the collection of rain that falls on urban areas to meet urban water needs and reduce pressure on rural water catchments could make a significant contribution to water management and urban water shortfalls, as could seawater desalination plants.

Finally, capitalizing on this opportunity will require a lot of international institution building. Governments and business, along the entire food and fiber supply chain, will work through policies, legislation, markets, trade barriers, subsidies, biotech policies, regulation, incentives and rights.

HELPING CHANGE HAPPEN

There are a number of areas that are both business opportunities and enabling conditions; things companies can do to make many of the opportunities listed above more accessible. For instance, the development of new financial instruments and structures to finance change at the magnitude required, and to adapt to the changing climate will be vital. Examples include innovative approaches to financing, as well as new forms of risk sharing and transfer (beyond traditional insurance models). Different types of partnerships involving a variety of actors from different geographical regions, industries, sectors of society and specialties will be pivotal in both the development and implementation of many of the opportunities inherent in the move toward a more sustainable world.

Financing, transparency and insurance

The urgent and radical transformations described in this report need substantial financing. However, traditional financing models will not suffice and more innovation is needed to create instruments that are robust enough to adapt quickly to the conditions of need, i.e., scalable, practical, affordable, easy to implement and suitable for mass replication.

Financing infrastructure transformation

Major infrastructure investments will be needed, perhaps adding up to over US$ 10 trillion between 2008 and 2015.[15] Most of this remains unfunded, as there is a large gap between infrastructure needs and public capacity.

With less capital available around the world, governments, industry sectors and individual businesses are being forced to collaborate in ways they have not done before. Critical to their business' future success, even sector-wide groups are considering how they can deploy their core competencies and products and services to bridge gaps that need to be filled.

For example, the life insurance and pension industry believes it could play a role in bridging the infrastructure financing gap if the right framework conditions existed. European life insurance and pension providers manage 40% of the assets of the global insurance market, with around Euro 5,750 billion (or US$ 8,600 billion) in corporate shares, bonds and other assets invested as of 31 December 2008. Only a very small portion of this portfolio is invested in infrastructure, most of which is in developed countries. If there were appropriate regulatory and risk assessment frameworks available, it is possible that over time, 2-5% of assets under management by the European life insurance industry could be allocated to developing country infrastructure projects.[16] The European Union's Solvency II process is reviewing the framework for capital requirements, and industry players need to be part of this process to advocate for the appropriate framework changes.

Similarly, while public-private financing partnerships have successfully funded many countries' highways, railroads, power plants, reservoirs, and other infrastructure projects, new models of partnerships are emerging that appear promising. In addition to the traditional model, private investors are constructing much-needed infrastructure projects, which are then leased and sold to the government for a limited period and thereafter taken over by them.

Microfinancing to drive economic development continues to grow

Nobel Prize winner Mohammed Yunus showed with Grameen Bank (a bank that is owned by its borrowers) that creativity in lending to underserved markets can be financially and socially beneficial. Traditionally designed to provide financial support to the poorest in developing nations, microfinancing (loans of typically less than US$ 250) has evolved into an important source of funding in developed economies as well. Studies have shown that financial support to low-income households improves household economic welfare, particularly basic needs and enterprise stability and growth. Further, programs specifically targeting women have higher returns and more societal benefits. Microfinancing empowers women by supporting their economic participation, thus promoting gender equality and improving household and community well-being.

The Microcredit Summit Campaign reported that of the 107 million poorest clients reached by the end of 2007,

83% were women.[17] Successful models like the Grameen Bank and Kiva.org, a web-based person-to-person micro-lending platform, have been replicated worldwide to address this need. Despite the success of these ventures, there is still a huge market need not yet met. In Africa and the Middle East, just over 10% of the poorest families (those living on less than US$ 1 per day, adjusted) were reached and provided with microloans as of 2007 (see figure 4.8). What new models can extend the reach of these microfinance programs?

While most multinationals are not in the microfinance business, some innovators are experimenting with new ways to impact these underserved markets while also benefiting their own businesses. For example, rather than providing cash for poor people to start microbusinesses, some companies are lending products instead; e.g., Unilever's Shakti program in India provides qualified women with small, specially packaged personal hygiene products, like soap, to sell so they not only have a means of earning a living but also are able to help improve the sanitation of their communities.

Supporting MSMEs through new sources of capital

Micro, small and medium enterprises (MSMEs) are prominent in all economies. In OECD economies they account for over 95% of companies, 60-70% of employment,[18] 55% of GDP[19] and generate a substantial share of new jobs. In developing countries, more than 90% of companies outside the agricultural sector are MSMEs, generating a significant portion of national income. Not all these MSMEs are in the formal sector; some occupy the informal sector, which varies in size from an estimated 4-6% in developed countries to over 50% in the developing world.[20]

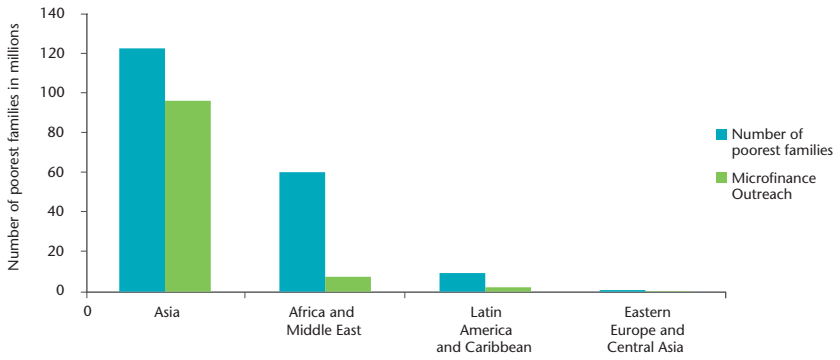
Job creation is a critical part of enabling 9 billion people to live well in 2050. Given the proven role of MSMEs in job creation, there will be growing need for dependable and affordable sources of capital to support small organizations.

While there are numerous large multinational commercial lenders, governmental development agencies and NGOs available to help finance these MSMEs, they are not enough; new financing models are needed. Just as microfinance has become a deep well of capital for women below the poverty line, new sources of capital for MSMEs are needed to systemically and rapidly generate the jobs needed to realize *Vision 2050*.

Multinationals can help address MSMEs' financing needs in other ways that are mutually beneficial. Since MSMEs often use the financing they secure to increase their selling and production capabilities, leading multinationals can support MSMEs through (1) access to markets for their products through diversity supplier/local content initiatives, (2) access to talent and expertise to help them cost-effectively grow more smartly through their leadership development programs, and (3) access to resources; often sharing underutilized capacity through strategic programs.

Figure 4.8: Low penetration of microfinance points to pools of untapped customers

Breakdown of access to microfinance and the number of poorest families by region



Source: The Microcredit Summit Campaign, *State of the Microcredit Summit Campaign Report*, 2009

Transparency demands will grow exponentially

With significantly more capital flowing among increasing groups of collaborators, there will be growing demand for transparency, which involves reporting, accounting and assurance services.

Microinsurance: A vast market with 10% growth

According to a report by Lloyd's 360 Risk Insight and the Microinsurance Centre (Nov 2009), the size of the potential market for microinsurance and other commercial opportunities in developing countries is estimated to be between 1.5-3 billion policies.[21] Today, around 135 million people are covered by microinsurance, around 5% of the potential market. Annual growth rates have been over 10%. Despite this growth, penetration rates are low in many emerging and developing parts of the world, particularly in Africa and Latin America, suggesting significant scope for solutions and services to fill the gap (see figure 4.9).

The Microinsurance Centre estimates that over the next decade the microinsurance market could grow sevenfold, to one billion policyholders.

Demand is increasing for a range of products, including life, health, accident and disability, property and agricultural (crop) insurance, as more becomes known about the benefits of hedging against disasters coupled with the greater incidence of disasters. China, for example, may become a "peak zone" for insurers' catastrophe exposure as the density of values exposed to disaster risk and insurance penetration increase with economic growth. There is also the need for innovative solutions to improve efficiency and reach to help make microinsurance a more viable business. Microinsurance is a low-margin, high-volume business, so reducing administrative costs in insurance policy issuing and claims handling will be key.

Building and managing complex coalitions

As the need for greater collaboration increases among the public and private sectors, there will be growing demand for those able to build and manage complex coalitions.

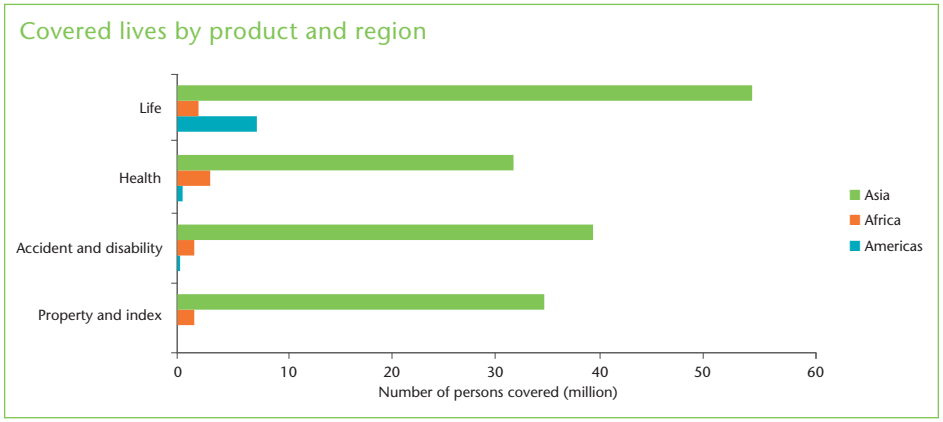
Inter-dependency and blurred lines

The systems and structures that support human and ecosystem well-being – including housing, mobility, energy, water and waste management – do not operate in isolation. The interconnected and interdependent nature of these elements will be increasingly important, informing the understanding of challenges and the development and design of solutions. Similarly, the range of issues to be faced during the transition to a sustainable future will cross borders, sectors and industries.

Many sources of influence, information, assets and capabilities will be required, supplied through complex coalitions made up of a number of different actors and areas of expertise – public, private, civil and academic sector individuals and organizations. These new structures will blend the best of each sector's knowledge, assets and capabilities in seamless partnerships to tackle many of the challenges we face.

These partnerships will form at local, regional, national, and international levels, and will grow not only in size but also in depth, strength and impact. They will be far more strategic and pervasive than the one-off, tactical relationships we have witnessed to date and as a result of the different development priorities of those involved, more

Figure 4.9: Protecting lives, livelihoods and assets through microinsurance



Source: Allianz/The Microinsurance Centre, http://knowledge.allianz.com/en/media/graphics/36/pdf

likely to deliver both economic and social improvements (see figure 4.10).

Diversified knowledge and multiple perspectives

The nature and number of partners involved in strategically developed coalitions can provide multiple perspectives and areas of expertise that makes issues easier to spot. A broad base of knowledge and experience will enable organizations to identify and prepare for risks and challenges before they have an impact. The experiences and capabilities of increasingly diverse networks will also permit more informed planning, which will increase the likelihood of buy-in from a broad base of constituents. Given the degree of change on the horizon, this buy-in will be critical, and will ease implementation.

Longer-reaching networks and leveraging diverse experience

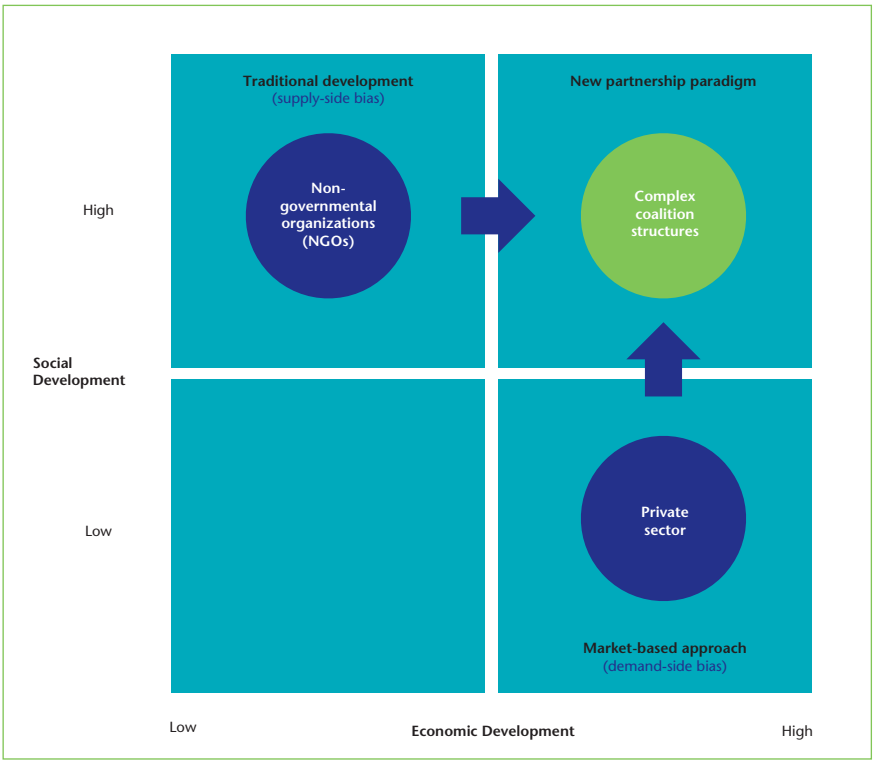
Beyond the benefit of diversified knowledge, complex coalitions will also increase the scope of the collective network of relationships, giving members access to a greater wealth of experience and information, and in many instances blurring the very lines that divide the sectors. For example, as it develops new technologies and ideas, academia will collaborate more with business at earlier stages to integrate and mainstream these ideas. NGOs will continue to serve as the challengers of regulators and business, and as a conduit to collect and spread best practices, capacity and attention to those traditionally underserved parts of the world. Due to this expanded source of information and support, the combined result will be greater than the sum of its parts.

Connecting through ICT

These complex coalitions will be enabled and made more effective through developments in the way that people, governments and business use information and communication technology to connect. ICT will continue to increase the speed and scale of information exchange and will play a significant part in efficiency improvements, e.g., the greenhouse gas emission reductions described earlier (see figure 4.2).

Connecting people to people: Vast opportunity lies both in the unmet demand for basic communications infrastructure, as well as in innovative new platforms for improved quality of interaction. Regardless of the particular enabling technology, on a societal level, the increased interaction across borders and cultures will speed the dissemination of ideas and opportunity. It will also help increase affordable access to services to underserved markets. Mobile communication technologies and access to faster, more reliable and convenient forms of Internet access will continue to drive innovation in business models and economic development in the emerging and developing world. An extra 10 mobile phones per 100 people in a typical developing country,

Figure 4.10: Building complex coalitions for social and economic development



Source: Accenture, *Development Collaboration, None of our Business?* 2009

for example, boosts GDP growth by 0.8%, according to the World Bank.[22]

Connecting consumers to the companies: As consumers increasingly search for convenient ways to pursue sustainable lifestyles, there will be greater demand for detailed product information. Consuming low-impact products is impossible without knowing which products are in fact low-impact, as well as understanding how to use them. ICT will play an important role, allowing consumers to both access this information and to review and share feedback with each other and with the businesses that create and sell these products. This system will present opportunity for businesses that gain greater insight into consumer demands and co-create products with consumers, and for customers who find themselves more empowered to communicate their interests and expectations.

Connecting companies: As technology gets more open-sourced, and emerging countries contribute more and more to innovation, the nature and scale of innovation will change. Cloud computing and virtualization will proliferate. These technologies, which enable users to obtain their computer resources (such as processing, storage, software) virtually, and pay only for what they use, will allow organizations to substantially reduce the cost and amount of physical infrastructure that is needed for computing. In turn, this will optimize the amount of materials needed for packaged hardware and software and allow enterprises to right-size their server capacity almost instantly without significant infrastructure investment, facilitating the nurturing and success of entrepreneurial and innovative ideas and businesses. Systems of data security are also likely to evolve as organizations try to limit their data vulnerability. As levels of demand continue to grow, measures to drive efficiency in the ICT sector itself will be used to reduce the footprint of the Internet through new designs for data centers, innovative cooling methods and more use of renewable energy.

Connecting society: Sophisticated early warning systems as well as ongoing risk monitoring and management at all levels, whether at the level of the organization, city, region or country, are likely to evolve in light of greater environmental and economic interdependence and uncertainty. These systems will offer opportunities not only for the provider of the service, but also to the users who stand to gain substantially from increased monitoring and information-sharing capabilities. With more sophisticated means to anticipate and preempt risks, different entities can hope to operate and adapt more efficiently and flexibly.

Business must transform and adapt

The different types of activities inherent in these new types of connections will appeal to many businesses – but will require a certain level of re-engineering both in terms of organizational structure and culture.

Forming coalitions, particularly complex ones, is a natural activity for NGOs and academics, but less so for business because it typically functions in an environment of clearly drawn lines, roles and responsibilities. To participate fully in the benefits of diversified knowledge and closer relationships with customers and communities, businesses may have to think differently. Corporations with closely associated non-profit social investment foundations may already have a built-in resource that lives in the world of broader partnerships and may be able to learn from them. Within many companies there are individuals with expertise at engaging critics as customers rather than adversaries, not out of job description, but more likely in spite of it. As business evolves, these contrarians and their skills will become more valuable. Finally, operating this way will require significant culture change, the kind that needs leadership from the very top of the company.

5 Conclusion and way forward

"It is a call for further dialogue, and it is a call for action. Collaboration, conviction and courage will be required to visualize and implement the radical changes needed"

"Sustainability will become a key driver for all our investment decisions."
Idar Kreutzer, Storebrand ASA

Crisis. Opportunity. It is a business cliché, but there is truth in it. The perfect storm we face, of environment, population, resources and economy, will bring with it many opportunities.

In this report we've identified many of these, and ways in which to leverage them as the world addresses its challenges: infrastructure to build, medicine to discover, technology to develop, new strains of food to create and grow to feed a growing population.

What has driven this report, from its beginning, is one opportunity that trumps them all: our *Vision 2050* of 9 billion people living well within the limits of one planet. While we have the world's attention, while the global focus is on environment and economics, we can act boldly to break the unsustainable model of growth-by-depletion. By 2050, we can replace it with a model of growth based on the balanced use of renewable resources and recycling those that are not.

The pathway to this sustainable world contains opportunities and risks, and will radically change the ways in which companies do business. Many companies will change and adapt, while others will be challenged to make the transition.

Moving toward *Vision 2050* will require business to engage more closely than ever before with both government and civil society. Key questions will need to be deliberated and sorted: Who defines the incentives and mechanisms? Who finances the transition processes (especially research and development, and enhanced technology deployment)? Who will or should be the first mover in various activities? How will success be defined?

Complex systems will provide the foundation

Our findings suggest that there is no simple, single path, but rather the need to design, build and transform complex systems (e.g., energy, finance, food, forests, transport and cities) that will in turn provide the foundation for survival and human development throughout the 21st century and beyond.

History can teach us much. Revisiting the key concepts, assumptions and approaches that have underpinned past business and market success, and its role in enabling societal progress and human development over the past 50 years, will be important. As in the past, this will require external enabling conditions. It will also require enlightened leadership and imagination, because there will be much uncharted territory where history has less to offer us.

Business cannot do it alone

The window for action could be closing, and much will need to be done in the next decade. Progress must be secured across many different domains, sectors and regions. Business will be a key player in this endeavor, yet business by itself, or as we know it today, will not be enough. Government, civil society and the public at large must be equally committed. Delaying action will make the already ambitious targets that much harder to achieve.

In reaffirming the role of business in a society on track to a sustainable world, we have stressed that there will be significant opportunities that warrant further exploration, as well as risks to manage. These fall into three key areas:

1. New business opportunities derived from *Vision 2050* for the decade ahead. This learning helps set the new internal agenda for business: strategic priorities, skills and capacity building, new business development and possible portfolio priorities.
2. New external relations priorities, derived from a review of business opportunities and an analysis of what is required by government and other stakeholders to realize these business opportunities. This will help business define its new external agenda: stakeholder relations priorities, new topics to engage on and a new agenda for business associations.
3. New risks to monitor and address, based on the actions of other stakeholders and on critical and pertinent risks from the risks and wild card analysis.

The journey begins now

This report represents the first step in a 40-year journey. It is a call for further dialogue, and it is a call for action. Collaboration, conviction and courage will be required to visualize and implement the radical changes needed for long-term prosperity while succeeding in current conditions. Business leaders will want, and need, to lead toward sustainability, and we invite political and civil society leaders to join us in this challenging and exciting journey.

References
Acronyms
Glossary
Acknowledgements

References

1 Air transport Action Group (ATAG), *Beginner's Guide to Aviation Biofuels*, 2009
2 Clean Edge, *Clean Energy Trends 2009*, 2009.
3 International Energy Agency, as cited in Global Environment Fund, *The Electricity Economy*, 2008.
4 United Nations Development Programme, *Human Development Report 2006*, 2006.
5 McKinsey, *Charting our water future: Economic frameworks to inform decision-making*, 2009.
6 McKinsey, *Charting our water future: Economic frameworks to inform decision-making*, 2009.
7 CRU and Alcoa analysis, 2008.
8 World Bank, *Girls' Education in the 21st Century : Gender Equality, Empowerment, and Economic Growth*, 2008.
9 US Department of Health and Human Services/US Department of Commerce, *An Aging World : 2001*, 2001.
10 Goldman Sachs, *BRICs and Beyond*, 2007.
11 Richard H. Thaler & Cass R. Sunstein, *Nudge Improving Decisions about Health, Wealth & Happiness*, 2008.
12 FAO, *Increased agriculture investment is critical to fighting hunger* (www.fao.org/tc/tci/whyinvestinagricultureandru/en/).
13 The Economics of Ecosystems and Biodiversity (TEEB), *TEEB Climate Issues Update*, 2009.
14 Ecosystem Marketplace, *Payment for Ecosystem Services: Market Profiles*, 2008.
15 Global Infrastructure Partners, KPMG, Cohen & Steers, UBS, OECD, Drewry, Boeing, US DoT (McKinsey & Company survey).
16 European Insurance and Reinsurance Federation (CEA), *European Insurance: Key Facts*, 2009.
17 The Microcredit Summit Campaign, *State of the Microcredit Summit Campaign Report 2007*, 2007.
18 OECD, *Policy Brief*, 2006 (www.oecd.org/dataoecd/53/27/37704120.pdf).
19 OECD, *Promoting SMEs for Development*, 2004.
20 World Bank, *Concept of Informal Sector* (lnweb18.worldbank.org/eca/eca.nsf/Sectors/ECSPE/2 E4EDE543787A0C085256A940073F4E4?OpenDocument).
21 Lloyd's/MicroInsurance Centre, *Insurance in Developing Countries: Exploring Opportunities in Microinsurance*, 2009.
22 World Bank data, as cited by the World Bank Group, *Information and Communication Technologies at a Glance*, 2009 (www.ifc.org/ifcext/media.nsf/AttachmentsByTitle/AM09_ICT/$FILE/AM09_ICT.pdf).

WBCSD Resources

Vision 2050 builds on the input from many WBCSD reports. For further information on any of the areas discussed in this publication please see the selected list of resources below.

People and values

Thinking Globally, Acting Locally, 2009
Sustainable Consumption, 2008
Global Scenarios 2000-2050, 1997

Economy and governance

Corporate Ecosystem Valuation, Building the business case, 2009
The Corporate Ecosystem Services Review, 2008
From Challenge to Opportunity: The role of business in tomorrow's society, 2006

Food and water

Water for Business: Initiatives guiding sustainable water management in the private sector, 2009
Water, Energy, and Climate Change, 2009
Adaptation: An issue brief for business, 2008
Agricultural Ecosystems: Facts and trends, 2008
Business in the World of Water: WBCSD water scenarios to 2025, 2006
Health Systems: Facts and trends-affecting business decisions today, 2006

Forests

Sustainable Procurement of Wood and Paper-based Products, 2007
The Sustainable Forest Products Industry, Carbon & Climate Change, 2007

Energy and power

Tackling climate change on the ground – Corporate case studies on land use and climate change, 2009
Towards a Low-carbon Economy, 2009
Power to Change, 2008
Establishing a Global Carbon Market, 2007
Investing in a Low-carbon Energy Future in the Developing World, 2007
Policy Directions to 2050, 2007
Pathways to 2050: Energy and climate change, 2005

Buildings

Transforming the Market: Energy Efficiency in Buildings, 2009
Energy Efficiency in Buildings: Business realities – Facts and trends, 2007

Mobility

Mobility for Development, 2009
Mobility 2030: Meeting the challenges to sustainability, 2004

Materials

Cement Technology Roadmap 2009: Carbon emissions reductions up to 2050, 2009
Recycling Concrete, 2009
Managing End of Life Tiers – Issue brief, 2008

Acronyms

BLUE MAP	IEA Scenarios
BRIC	Brazil, Russia, India, China
CCS	carbon capture and storage
CO_2	carbon dioxide
CSP	concentrating solar power
EEA	European Environment Agency www.eea.europa.eu
ETP	Energy Technology Perspective
EU	European Union
FAO	Food and Agriculture Organization
G7	Finance ministers from Canada, France, Germany, Italy, Japan, United Kingdom, and United States
GDP	gross domestic product
GHG	greenhouse gas
Gt	gigatonne
GW	gigawatt
IEA	International Energy Agency www.iea.org
IMF	International Monetary Fund www.imf.org
IPCC	Intergovernmental Panel on Climate Change www.ipcc.ch
ICT	information and communications technology
ITS	intelligent transportations system
MSME	micro, small and medium enterprises
Mt	million tonnes
NGO	Non Governmental Organization
NOx	nitrogen oxide
OECD	Organisation for Economic Co-operation and Development www.oecd.org
PPM	parts per million
PPMV	parts per million by volume
PPP	purchasing power parity
PV	photovoltaic
RD&D	research, development and deployment
REDD	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
REDD +	REDD + Conservation and Sustainable Management
ROW	Rest of the World
SME	small and medium enterprises
SOx	sulfur dioxide
TEEB	The Economics of Ecosystems and Biodiversity www.teebweb.org
UN	United Nations
UNDP	United Nations Development Programme www.undp.org
UNEP	United Nations Environment Programme www.unep.org
UNFPA	United Nations Populations Fund www.unfpa.org
WBCSD	World Business Council for Sustainable Development www.wbcsd.org
WEO	World Energy Outlook www.worldenergyoutlook.org
WHO	World Health Organization www.who.int
WRI	World Resources Institute www.wri.org

Glossary

biocapacity	Capacity of a given biologically productive area to generate an on-going supply of renewable resources and to absorb its spillover wastes.
biodiversity	The variety of living organisms from all sources including terrestrial, marine and other aquatic ecosystems, as well as the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems.
biofuels	Fuels produced from biomass crops and wastes. The main biofuels are synthetic diesels, which can be burned in compression ignition (diesel) engines, and bio-ethanol, which can be burned in spark ignition (gasoline, or petrol) engines.
biomass	Products from biological materials used as a source of thermal energy, covering a wide range of energy crops such as corn, soybeans, sugar, poplar, willow and switchgrass, as well as agricultural waste, forestry residues and animal matter. Biomass can be used for conversion into liquid fuels, such as ethanol, methanol, biodiesel and F-T diesel, and also electricity and hydrogen.
bioproductivity	Amount of biological productivity required to renew the biotic resources humans use (food, timber, etc.) and to absorb their waste (mainly to compensate for their CO_2 emissions from energy use).
cap and trade	Cap and trade (also known as emissions trading) is an administrative approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants. A central authority (usually a governmental body) sets a limit or cap on the amount of a pollutant that can be emitted. Companies or other groups are issued emission permits and are required to hold an equivalent number of allowances (or credits) which represent the right to emit a specific amount. The total amount of allowances and credits cannot exceed the cap, limiting total emissions to that level.
carbon capture and storage (CCS)	A long-term alternative to emitting carbon dioxide to the atmosphere is capturing it as its source of emission and storing it. Geological carbon storage involves the injection of CO_2 into subsurface geological formations.
carbon emission	Polluting carbon substances released into atmosphere, e.g., carbon dioxide and carbon monoxide produced by motor vehicles and industrial processes.
carbon neutral	Emitting no net carbon into the atmosphere.
carbon sequestration	Long-term storage of carbon-containing substances in the atmosphere to reservoirs such as forests, soils and oceans.
closed-loop recycling	Production system in which the waste or byproduct of one process or product is used in making another product.
concentrating solar power (CSP)	Systems that use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. The concentrated light is then used as a heat source for a conventional power plant or is concentrated onto photovoltaic surfaces.
drivetrains	Components that transmit the flow of power from the engine to the wheels.
ecological footprint	A measure of human demand on the Earth's ecosystems. It compares human demand with planet Earth's ecological capacity to regenerate. It represents the amount of biologically productive land and sea area needed to regenerate the resources a human population consumes and to absorb and render harmless the corresponding waste. Using this assessment, it is possible to estimate how much of the Earth (or how many planet Earths) it would take to support humanity if everybody lived a given lifestyle.
ecosystems	A community of organisms living in an environment as an interdependent system, including plants, animals, fish, birds, micro-organisms, water, soil and people.
ecosystems services	The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious, and other non-material benefits.

externalities	Externalities refers to situations when the effect of production or consumption of goods and services imposes costs or benefits on others that are not reflected in the prices charged for the goods and services being provided.
fossil fuels	Carbon-based fuels that have accumulated in geological deposits over very long periods, including coal, oil and natural gas.
freshwater	Naturally occurring water having a low concentration of salts, or generally accepted as suitable for abstraction and treatment to produce potable water
global hectare (gha)	A productivity weighted area used to report the Earth's biocapacity, and the demand on biocapacity (the ecological footprint). The gha is normalized to the area-weighted average productivity of biologically productive land and water in a given year. Different land types have different productivity, therefore a gha of, for example, cropland, would occupy a smaller physical area than pasture land. Also, as world bioproductivity varies slightly from year to year, the value of a gha may change slightly from year to year.
greenfield	A piece of usually semirural property that is underdeveloped except for agricultural use, especially one considered as a site for expanding urban development
greenhouse gas (GHG)	Gases in the Earth's atmosphere that absorb and re-emit infrared radiation. These gases occur through both natural and human-influenced processes. The major GHG is water vapor. Other primary GHGs include carbon dioxide, nitrous oxide, methane, ozone and CFCs.
green revolution	Name given by the US Agency for International Development Administrator, William Gaud, in 1968 to the dramatic increase in crop productivity during the third quarter of the 20th century, particularly in many poorer countries, as result of integrated advances in genetics and plant breeding, agronomy, and pest and disease control.
human development index (HDI)	The HDI is a summary composite index that measures a country's average achievements in three basic aspects of human development: health, knowledge, and a decent standard of living. Health is measured by life expectancy at birth; knowledge is measured by a combination of the adult literacy rate and the combined primary, secondary, and tertiary gross enrolment ratio; and standard of living by GDP per capita (PPP US$).
life cycle assessment	Investigation and evaluation of the environmental impacts of a given product or service caused or necessitated by its existence.
net zero	A general term applied to a building's use with zero net energy consumption and zero carbon emissions annually.
primary forests	Forests of native tree species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.
resilience	The ability to deal with change and continue to develop.
roundwood	Wood in its natural state as felled, with or without bark. It may be round, split, roughly squared or in other forms.
smart building	Current works defining a smart building concentrates on multiple subsystems – environment control, telecommunications, power and new materials from manufacturers described as "intelligent". All of these subsystems converge to attain the common goal of reducing the operating cost of a building but still maintaining maximum efficiency for the occupants, which includes the desired internal environment.
true-value pricing	Pricing that comprises the full cost and benefits of the product/service – economic, social and environmental
virtual water	Water used in the production of goods and services.
wastewater	Water that is of no further immediate value to the purpose for which it was used or in the pursuit of which it was produced because of its quality, quantity or time of occurrence. However, wastewater from one user can be a potential supply to a user elsewhere. Cooling water is not considered to be wastewater.
well-to-wheel	Specific life cycle analysis of the efficiency of fuels used for road transportation.

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Vision 2050 regional engagement dialogues and workshops:

Throughout the project, a number of core workshops and dialogues were conducted in major regions around the world. The aim was to ensure that the findings from *Vision 2050* reflect a global perspective. The mapping here shows the regions engaged in this highly collaborative and productive effort – which was made possible through the support of the WBCSD Regional Network partners and various other stakeholder groups.

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About the WBCSD

The World Business Council for Sustainable Development (WBCSD) brings together some 200 international companies in a shared commitment to sustainable development through economic growth, ecological balance and social progress. Our members are drawn from more than 36 countries and 22 major industrial sectors. We also benefit from a global network of 60 national and regional business councils and partner organizations.

Our mission is to provide business leadership as a catalyst for change toward sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues.

Our objectives include:

Business Leadership – to be a leading business advocate on sustainable development

Policy Development – to help develop policies that create framework conditions for the business contribution to sustainable development

The Business Case – to develop and promote the business case for sustainable development

Best Practice – to demonstrate the business contribution to sustainable development and share best practices among members

Global Outreach – to contribute to a sustainable future for developing nations and nations in transition

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Disclaimer

This report is released in the name of the WBCSD. It is the result of an 18-month collaborative effort among representatives from 29 member companies, supported by the WBCSD secretariat. Like other WBCSD projects, *Vision 2050* has involved a broad range of stakeholders in locations around the world. Developed in close consultation with the project members and several other consultants/advisers, the report was reviewed by all project members to ensure broad agreement with its principal views and perspectives. However, this does not mean that every member company necessarily endorses or agrees with every statement in the report. Use of and reliance on the report shall be at the discretion of the readers.

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