wbcsd education

“Living benefits” in sustainable cities enabled by business solutions

WBCSD Leadership Program 2016

Contents

Executive summary

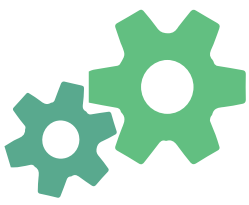
What is a sustainable city, and what constitutes a sustainable lifestyle? What is the vision for the sustainability of our cities in the future? What are the living benefits that cities should provide to their citizens? How can business be expected to play a role in providing these living benefits?

Based on our research into the interplay between cities, inhabitants and businesses, this report identifies examples from cities around the world that have made significant progress in solving pressing challenges that can serve as stepping stones to ever more sustainable solutions. It also explores the potential for businesses to play a larger role in these solutions, with the ultimate goal of enabling urban dwellers to adopt and maintain sustainable lifestyles.

We have performed this work using a framework of urban sustainability focal areas that were identified based on our research of where the key challenges of urbanization lie. These focal areas include mobility and transportation, green building, green spaces, water and sanitation, waste, food systems and governance. The focal areas serve as the foundation for our vision for sustainable cities, which we have defined as resilient cities that can readily adapt to economic, social and environmental change while maintaining a decent quality of life for their inhabitants. In a sustainable city, development is executed with environmental, social and economic factors in mind, providing people with infrastructure, systems and enterprises that enable them to adopt and maintain sustainable lifestyles.

We have identified several mechanisms and strategies that cities and businesses can employ to support sustainable development and provide desirable "living benefits" to urban inhabitants. Several companies have started to lead the way by creating or adapting existing business models to solve urban issues. Circular economy business models, such as ride-sharing, have experienced tremendous growth over the past five years. Businesses with the foresight to capitalize on these opportunities could benefit greatly from their positions as first-movers or early adopters.

In this report, we have explored some of these living benefits in action, but the opportunity for business to become involved and profit from the evolution of cities remains considerably untapped. This report highlights key examples and perspectives that business should consider in developing strategies for growth and delivering value in the context of urban sustainability.



"All mega-trends present opportunities and risks to businesses. Urbanization, with two-thirds of the world's population expected to reside in urban areas, presents tremendous opportunities to embrace innovative business modes, evolving technologies and public-private partnerships."

Brendan LeBlanc,
EY Liaison Delegate

Introduction

There are 7.4 billion people currently living on the planet, and the ongoing urbanization megatrend continues to drive more and more people to move into urban environments, placing increased strains on new as well as existing cities. While increasing, urbanization brings many advantages to inhabitants, it also increases pressure on existing complex challenges, including congestion, indoor and outdoor air quality, access to natural environments, water quality and sanitation, waste management systems, food quality and availability, and effectiveness and efficiency of governance systems. With some exceptions, many cities around the world struggle to address these systemic issues; most have developed in a manner that is proving to be unsustainable with current populations, let alone able to sustainably support anticipated future growth.

Too often those examining the economic heath and sustainability of cities do so in silos, with the focus habitually placed on governments and city planners. While progress certainly cannot be achieved without these players, there is a clear and compelling business case for companies to contribute to solving the unique challenges cities currently face and will continue to face in the future. A more effective approach to solution creation would allow forward-looking companies to capitalize on first-mover benefits and opportunities, as well as ensure the long-term improvement in quality of life for urban dwellers and consumers. Businesses should do this by focusing on providing attractive "living benefits" for city dwellers that serve to both address current sustainability challenges and create long-term economic viability.

We conducted our research through the eyes of the inhabitants, exploring various living benefits provided by business solutions that are integral to adopting sustainable lifestyle behaviors. Based on our research into existing urban challenges and exemplary sustainable cities, we have chosen to focus our assessment on seven areas:

1. **Mobility and transportation**
2. **Green building**
3. **Green spaces**
4. **Water and sanitation**
5. **Waste**
6. **Food systems**
7. **E-governance**

Vision for sustainable cities

What is a sustainable city? Sustainable cities are resilient cities that can readily adapt to economic, social and environmental change while maintaining a decent quality of life for their inhabitants. Therefore, sustainable urban development must be executed with environmental, social and economic factors in mind. In a sustainable city, people are supported by infrastructure, systems and enterprises that enable them to adopt and maintain sustainable lifestyles.

A sustainable lifestyle refers to patterns of behavior that support the efficient and mindful use of resources such that future generations will have the continued ability to maintain a decent quality of life. In other words, lifestyles that support future sustainable cities must support equality and balance efficiency and sufficiency in order to live within global resource limits.

A vision for a sustainable city is based on the premise that there are key features and aspects of how a city is developed, both from an infrastructure and social perspective, that underpin its ability to support sustainable urban lifestyles for its current and future inhabitants.

Cities, while always unique, face many similar challenges. This report focusses on some of these development areas that are relevant for all cities.

Mobility and transportation

From modest downtowns to booming megacities, all cities need to manage congestion and traffic. The most well-known model cities today are admired for their alternative transportation infrastructure, be it the bike culture in Copenhagen or the impeccably punctual train systems connecting the cities of Japan.

Green building

Urban dwellers work, live, eat and sleep in structures that have the potential to be environmentally harmful or beneficial to inhabitants. Many new green building advancements have emerged over the past decade[1] that aim to leverage technology and environmentally safe materials to create "smart" buildings and homes that balance comfort and convenience with efficiency and conservation.

Green spaces

Many cities are often negatively termed "concrete jungles" and struggle to provide inhabitants with the benefits associated with natural "green" spaces. This can be particularly challenging in cities with existing infrastructure that was not designed with natural spaces or expanding populations in mind. It is hard to envision an ideal sustainable city that is not flourishing naturally, as well as socially and economically.

Water and sanitation

Water and waste management are fundamental to the functioning of any city. Access to clean and safe water is both a necessity and a basic human right[2] and is an essential part of any sustainable city vision.

Waste

Proper waste management is also a foundational component of a functioning sustainable city, as exhibited by many cities around the world that have adopted "zero waste" policies and goals.

Food

Food systems are often treated as a topic separate from urban development; yet they could not be more integral to culture, business and sustainability. While much of today's food stock is currently produced outside of cities in vast agriculture and livestock zones, the bulk of this production will continue to flow into cities to support ever-growing urban populations. Food production and food systems will be crucial factors in determining the sustainability of future cities.

E-governance

Inclusive governance models will be needed not only to support, but also to engage, inhabitants in the ongoing development and creation of more sustainable cities. Traditional governance roles and structures will need to innovate to meet evolving challenges and the needs of inhabitants.

Through the aforementioned focal areas, we define and examine the living benefits that can be provided to inhabitants through innovative business solutions by looking at exemplary cities and communities that have made substantial progress in these areas. We explore some of the challenges faced by cities in the development and implementation process, strategies for success, and possible ways businesses could further these successes through innovative products and services.

1. Urban mobility and transportation

Many of the world's most enviable urban transportation systems are also inherently the most sustainable. One example is the city of Buenos Aires, Argentina, which implemented two major bus rapid transit service systems and converted a 20-lane avenue (the widest avenue in the world) into a 10-lane avenue, with the remaining space devoted to a surface subway.[3] This change reduced the amount of time it takes to get across the city by 50%. Sophisticated integrated transportation systems that link air, rail and road (and, where relevant, waterways) together enable inhabitants to both increase the convenience of mobility and reduce their reliance on personal vehicles, thereby reducing the amount of greenhouse gas emissions emitted for personal travel. Many of these integrated transportation systems not only offer vehicle alternatives, but also employ state-of-the-art technologies that use alternative powertrains (such as electric or fuel-cell vehicles) and smart grid technologies to create a cleaner, safer transportation experience. Working to shift transportation trends toward a more sustainable pattern can provide the following benefits for urban inhabitants:

- *Health and increased quality of life:* Using an integrated transportation system can extend the life expectancy of users by 2 to 9 years, promote weight loss, and improve air quality.[4]
- *Equity and accessibility:* Increasing the ability to travel using different types of transportation methods to reach various types of locations[5] also improves access to travel for certain demographics, such as senior citizens and the physically disabled, increasing equality among cities' populations. "Mobility hubs", where multiple transportation methods and routes intersect to form a high-traffic transfer point, can also be developed to include other services, such as shopping and healthcare, which would otherwise be less accessible to inhabitants.
- *Decreased congestion:* If planned and operated correctly, integrated transportation systems should relieve traffic tension and build up to create a more efficient and pleasant mobility experience.
- *Air quality and reduced noise pollution:* New transportation technologies can reduce sound pollution and improve air quality.
- *Safety:* Shifting the common transportation method from personal vehicles to public transport mechanisms inherently reduces the number of vehicle fatalities, which claimed approximately 1.25 million lives in 2013[6] in urban areas.

Key considerations and strategies for success

Advancing the sustainability of urban mobility requires a number of factors, including the adoption of new technologies, acceptance and behavioral change on the part of inhabitants, and governmental policies and support for new programs. Key considerations and strategies for success include:

- *Safety and security:* Cyclists will not opt to take their bike over their vehicle if the roads are not safe and designed to accommodate bike travel. Cities like Amsterdam and Copenhagen are great examples of cycle-centric transportation models where nearly everything is accessible and safe to access via bike. Designated and partitioned bike lanes are an effective method of improving cycle safety.
- *Accessibility and ease of use:* Not only do public transportation options need to be accessible, they also must be easy to use and integrate various technological platforms, such as mobile device applications (apps), as well as kiosk and online purchasing options making purchases more accessible to everyone. For example, rail or metro passes that can be purchased through mobile devices will likely increase ridership in younger generations who regularly use mobile apps.
- *Fair and affordable pricing:* Social inclusion must be considered when developing pricing models for public transportation systems, meaning that rates should be adjusted for certain demographics, such as elderly individuals, children and students.
- *Infrastructure:* Urban planning must include provisions for sustainable transportation options, including designated car-free areas and connected cycling and walking paths.

Living benefits in action

- ***Copenhagen, Denmark:*** In Copenhagen, integrated transportation solutions are already being implemented on a large scale and used by inhabitants. The city's solutions have had significant effects on CO2 emissions (a reduction of more than 20% compared with 1995 levels) and have simultaneously improved the livability of the city.[7] The city has designed and retrofitted urban areas to make them more accessible for bicycles and pedestrians, which has reduced congestion significantly and helped to improve the health of inhabitants. One billion DKK have been invested in bike lanes and super-cycle highways since 2005; and 45% of Copenhageners bike to work or school every day.[8]
- ***Toyama, Japan:*** The city has implemented its Toyama Compact City Strategy in anticipation of changing social needs in light of low birth rates and an aging population. The main mechanism for creating a compact city centered on public transportation is a light-rail transit system with lower floored cars, barrier-free station platforms, and decreased noise pollution to cater to the elderly population.[9]

There are a number of ways that business can both promote the use of sustainable transportation and profit from it. Ride-sharing companies such as Uber, Zipcar, Blablacar and Lyft have already demonstrated the potential profitability of the sharing economy. Ancillary services such as Wi-Fi or food and dining onboard or at transportation hubs also represent potential opportunities.

Companies can further support the sustainable transportation economy by influencing and incentivizing employees to use alternative transportation methods or carpooling. For example, it is not unusual to see preferred parking spaces reserved for carpools or electric vehicles in parking lots. Similarly, offering flexible working arrangements that allow employees to work remotely can also be a part of the solution. Companies such as BT, Cisco, Google and Microsoft (Skype) have created innovative platforms for online communication that continue to enhance the virtual meeting experience.

2. Green building

With increasing urbanization, how people are housed is an ongoing challenge for city planners and businesses. Even more challenging is how to accommodate the influx of inhabitants in a sustainable way, minimizing negative impacts on the environment and urban dwellers. How can quality of life be established or maintained for a greater population in a greater density? How can buildings be built smarter than before? Can buildings clean the air instead of contaminating it? Can cities help inhabitants live longer and healthier lives?

Despite the complexities and challenges of urban planning and construction, there are also many opportunities for both governments and businesses to capitalize on increasing urbanization while also driving forward the sustainability agenda. These efforts could result in the following benefits for inhabitants:

- *Improved air quality and human health:* Production and use of innovative and environmentally friendly building materials (e.g. paint, timber and permeable concrete) could improve air quality and subsequently lower the social costs of healthcare.
- *Convenience and conservation:* Buildings and homes that are integrated and enhanced with technology (smart buildings or smart homes) offer conveniences such as remote access and control while simultaneously enabling them to lessen their environmental impact by programming the home to respond to sunlight and external temperatures (e.g. by closing blinds and adjusting the angle of windows).
- *Safety and security:* Smart homes provide enhanced safety and security benefits through access to real-time monitoring and protection systems.

Key considerations and strategies for success

Many existing urban environments suffer from compromised air quality, which is taking a toll on the health of inhabitants[10] and leading to increased healthcare costs. Some solutions are gaining traction, such as air-cleaning paint products that will help address the urban challenges associated with air quality; but there are questions as to how long the paints remain active and when they need to be replaced.[11] Companies that can demonstrate lasting duration of absorption effects will be able to capitalize on opportunities to increase indoor and outdoor air quality in cities.

Cities also face a challenge in minimizing the impact of construction on existing residents, especially cities that are engaged in building in order to keep pace with the inflow of newcomers. Construction takes significant amounts of time and leads to traffic disruptions, noise, air pollution and vast amounts of waste.

Alternative materials, such as wood, could be one of the solutions to this challenge. In 2001, the introduction of solid wood panels, or mass timber construction, opened the door for tall wood buildings to become an alternative to steel and concrete when building tall multi-family buildings.[12] Tall wood buildings can be erected quickly, with strength and weight ratios that compare other forms of construction[13] and have been proven to be appropriate even in areas of high seismic activity.[14] Tall wood buildings can be constructed offsite using modular approaches, thus reducing traffic and noise disturbance. By building taller, additional residents may be housed. Advancements in engineering are making tall wood buildings a reality—a building method historically limited to single family homes and low-rise apartment buildings is now being considered for buildings of 30 stories or more.

One of the key challenges for tall wood buildings is the need to revise building codes based on current technology. Current building codes do not reflect the necessities of the current growth in the market nor allow for builders to evaluate if new materials or recycled materials should be used in building.

The environmental life cycle impacts of wood buildings have also been shown to be 10% less than those of conventional buildings.[15] These impacts vary based on the climate the building will occupy, as cement buildings may insulate well in colder climates (saving on heating) but wood buildings show positive results in warmer climates.[16]

The other challenge is that the wood used in tall buildings is a laminate product, meaning layers of wood have been laminated, glued or nailed under pressure to form larger and stronger wood products. It is necessary to explore how to arrive at a building structure that will meet the performance requirements for strength and weight but that is efficient to manufacture[17] and transport. The use of laminate wood products addresses the risks related to deforestation, which today are significant, since laminate products are often made from timber that cannot be used for other products. Tall wood buildings only remain a viable option for cities of the future if sustainable forestry practices are adopted and followed.

Natural-based fibers, such as Tencel developed by Lenzing, may have the potential to overcome challenges associated with natural fibers, such as inconsistent quality and the amount of processing needed to break down the natural resource to a usable fiber.[18] Tencel is produced from wood and through the production process becomes pure cellulose, which can be added to concrete and other products to increase strength. The mixing of concrete with other fibers (such as synthetics or steel) has long been employed by the construction industry to reinforce building materials.

Smart homes also offer solutions but face their own challenges:

- The technology is in continuous development and behavioral change is required for adoption as many people are not familiar with the technology and may be resistant to adopting it.
- Infrastructure to store and transmit data must be built into the city and its buildings, such as data cables, wireless transmission devices, spaces for data to be safely stored.
- Data security must be absolute given the nature of the information being collected (e.g. health details or when you are absent from home) in the monitoring of homes.
- Smart homes must be able to learn from their inhabitants by monitoring their behavior in order to adapt to the needs of the residents.

Homes that can integrate energy management (automatically raising or lowering blinds for shading and the thermostat based on reading outdoor temperatures) will increase the efficiency of buildings, thereby reducing their impact on the environment. In addition, homes that can monitor vital health information about the occupants, including heart rate, sleep patterns and stress, will provide the information needed for inhabitants to make life choices to improve quality of life. Smart homes can even increase safety for those living with dementia.[19]

For businesses to capitalize on smart homes, the technology will need to learn about and adapt to occupants' lifestyle and needs. Future technologies should also provide an aspect of safety, monitoring for falls and alerting emergency services—all while reassuring users that data is safe and secure. Opportunities exist not just for those developing the monitoring technology but also for those who can safely and reliably transmit and store the data. To ensure the data can be moved around the city, businesses will need to work with city planners to incorporate the needed infrastructure into buildings. In order for the city to obtain the living benefit of smart homes, they must be affordable. The costs associated with upgrading existing buildings will be significant and the role of government in bearing these costs must be considered. There is evidence that the costs of poor housing on the healthcare systems are significant.[20] This could be leveraged to mobilize governments to fund the upgrades required.

Living benefits in action

- The US Environmental Protection Agency (EPA) estimates that indoor air quality is, on average, two to five times worse than outdoor air quality.[21] This is due to off gases from furniture and flooring and chemical use, such as cleaning products and smoking. Poor air quality contributes to respiratory and heart disease.[22] There are examples of cities exploring new technologies to improve general air quality, for instance Manila and London. The testing of paints designed to absorb and convert automobile-produced nitrogen oxides (NOx) to small quantities of calcium nitrate, water, and carbon dioxide (CO2) have shown NOx reductions of up to 60%.[23] As air quality improves, the living benefit of improved health and lower costs of healthcare become apparent.
- Building from alternative materials or using materials that extend the life of current building materials decreases the cost and duration of construction, thus reducing disruption to the urban community and increasing the capacity for more construction to address shortages in housing. Tall wood buildings are not science fiction. The University of British Columbia will open an 18-story student residence in Vancouver, Canada, in September 2017, built using tall wood building technology.[24]
- A living benefit in the cities of the future would be homes that monitor and take care of inhabitants. This improves the health and safety of the city (since old homes cannot detect falls or security concerns) and the livability of a city as it will allow aging populations and the ill to remain integrated into the social framework of the city as opposed to being housed in an institution. Smart homes may be an integral part of the solution, as the world faces an aging population. Examples are seen around the world, from housing for dementia patients in Tonesberg, Norway, to Welfare Techno Houses in Japan.[25]

There are ways in which business can enable building approaches that deliver living benefits and be a profitable part of the solution:

- Emissions-cleaning paint products have been shown to work,[26] but further investments are needed to address the challenges outlined above.
- While still in the development stage, some concrete producers are also finding ways to use concrete for carbon capture and storage;[27] this would allow the emissions-intensive concrete production process to offset some of the carbon produced. In addition, when buildings are demolished, the wood materials can be used as aggregates for concrete, reducing future raw materials costs.

3. Green spaces

According to the United Nations, the population living in urban areas worldwide is projected to reach to 6.4 billion by 2050.[28] As the number of cities and their populations continue to grow, governments are employing policies and initiatives to increase the span and breadth of accessible and safe green spaces due to known benefits ranging from physical and psychological health to social cohesion, ecosystem service provision, and biodiversity conservation.[29]

For example, access to public open space and parks has shown that it provides numerous health benefits for inhabitants, both perceived and actual, including:

- *Ecological benefits:* Urban green spaces supply cities with ecosystem services ranging from maintenance of biodiversity to regulation of urban climate, and serve as a protection center for reproduction of species and conservation of plants, soil and water quality.
- *Pollution control:* Green space may filter air, remove pollution and attenuate noise.
- *Energy conservation:* Using vegetation to reduce the energy costs of cooling buildings has been increasingly recognized as a cost-effective reason to increase green space and tree planting. Plants improve air circulation and provide shade. This provides a cooling effect and helps to lower air temperature.
- *Property value:* Areas of the city with enough greenery are aesthetically pleasing and attractive to residents, visitors and investors. Urban green spaces can be one of the factors that attract significant foreign investments that assist in rapid economic growth.[30]
- *Recreation and well-being:* Green spaces are key elements for recreation and to experience nature. They enhance the quality of life of people living in the surrounding area and provide locations for a variety of leisure activities when developed as a multi-use recreational open space. Green spaces are tied to social capital and enable people to interact in ways that lead to trust, mutual understanding, shared values, and a supportive culture.
- *Human health:* Time spent in natural environments can relieve mental fatigue and even reduce feelings of violence or aggression. Health studies have also shown that contact with nature can lower blood pressure and cholesterol levels, enhance survival after a heart attack, and enable a more rapid recovery after surgery.

Key considerations and strategies for success

The successful development and deployment of green spaces is predicated on a number of factors, including having sufficient funding, community support and demand, high public safety rates, and low homelessness rates. However, effective governance and city planning can enable cities to make the most out of green spaces. Far-sighted planning and investments will be needed to ensure that cities are developed in a safe, productive and environmentally friendly fashion.[31] It is estimated that developing emerging cities in a compact, green and connected manner could potentially reduce the capital costs of infrastructure investment by 6% (or US$ 3 trillion globally) between now and 2030, while simultaneously creating significant annual returns due to energy savings, higher productivity and reduced healthcare costs.[32]

Despite challenges faced by green space developers, such as funding and competing land use bids, research has shown that urban green spaces provide benefits beyond aesthetics and social capital. One example is the housing market in Denmark, which shows that the value of homes with close access to park areas can increase by up to 10%. Articulating and measuring these benefits is a key strategy for the continued development of urban green spaces.

Living benefits in action

Some of the cities with the highest percentage of public green space include Singapore, Sydney, Vienna, Hong Kong, Stockholm and London.[33] Melbourne has the most park coverage in a central business district. It has also built a major new park in the city center within the past decade, covering more than 300 acres.[34] Several other notable examples include:

- ***Portland, Oregon, USA:*** The city's approach to urban planning and outdoor spaces has often earned it a spot-on lists of the greenest places to live. It runs an intricate system of light rail, buses and bike lanes to help keep cars off the roads, and is home to 92,000 acres of green space and more than 74 miles of hiking, running and biking trails.[35]
- ***Boston, Massachusetts, USA:*** Boston is home to one of the oldest and most history-rich green spaces in the United Stated: the Boston Common. Though the grounds have held many historic purposes, including cattle grazing, public hangings and, most famously, camping grounds for British troops during the American Revolution, the Common's current use is now recreation.[36] Also in the city of Boston, both harbor front and riverfront have been turned into open green space for residents and visitors to explore. Known as the Harbor Walk, this area is filled with activity from Boston's active boat district.[37]

Companies can benefit from the development and maintenance of green space in a number of ways. Most obviously, landscaping and construction companies have a clear opportunity when it comes to both planning and developing the design of the initial green space as well as the ongoing maintenance activities. Once created, community green spaces can be used in a number of ways by local business, including outdoor fitness or yoga classes, tourism, or mobile food and beverage services to make the space more dynamic and create more value for outdoor space users.

4. Water supply and sanitation

Water, sanitation and hygiene are essential for human welfare and livelihoods. A lack of safe drinking water and inadequate sanitation is an unacceptable situation for human and economic development; it violates basic requirements of human dignity and safety and has enormous impacts on health, education and the ability to lead fully productive lives. While there is still much progress to be made, approximately 2.3 billion people gained access to improved drinking water between 1990 and 2012.[38] Further, the number of children dying from diarrheal diseases, which is strongly associated with poor water quality and inadequate sanitation and hygiene, has steadily fallen over the two last decades, from approximately 1.5 million deaths in 1990 to just above 600,000 in 2012.[39] However, an estimated 748 million people continue to lack access to safe drinking water and it is estimated that 1.8 billion people use a source of drinking water that has fecal contamination.[40]

The sixth goal of the United Nations 2030 Sustainable Development Goals (SDGs) is centered on ensuring the availability and sustainable management of water and sanitation for all. The World Bank has made many efforts in client countries to increase access to improved water sources, growing it from 70.9% in 1990 to 87.5% in 2012. Access to improved sanitation grew from 37% to 57.5% over the same period. To continue delivering sustainable and efficient water and sanitation services, World Bank-financed projects emphasize financial and environmental sustainability, impacts on poverty and gender, and climate risk.[41]

To describe safe water access as a "benefit" to inhabitants is a bit of a misnomer: it should not be considered a benefit but rather a fundamental human right. Still, the advantages of a sustainable and safe water management include:

- *Human health:* It helps avoid water-borne illness and disease.
- *Protection against drought and flooding:* Effective water management should account for possible outcomes of future climate change and its impact on cities.
- *Recreation and maritime activities:* Water sports, trading and pastimes, such as fishing, are dependent on the ability to maintain clean and safe water sources.

Key considerations and strategies for success

A lack of policies and proper governance, funding for programs and access to adequate supplies of uncontaminated water are the key challenges inhibiting the development and implementation of a safe and sustainable water supply. Policies can make or break sustainable water markets by either encouraging or hindering the development and deployment of smart water management.

Water supply is unpredictable in many cities worldwide and water quality problems can be caused by pollution and unsanitary practices. The rapid pace of industrialization and emphasis on agricultural growth, combined with inadequate enforcement of laws and regulations, has led to significant water contamination in some areas. There are many integrated management solutions available, such as those being developed and employed in Israel, which are founded on big data analytics and enable the real-time analysis of the full life cycle of network events, water quality, and faulty assets. Innovative technologies such as these, alongside supportive regulation and enforcement, are key ways to combat issues of cleanliness and security. Using a "polluter pays" approach, for example, is one way to regulate water contamination and ensure that the cost burden of water contamination does not fall disproportionately and unfairly on inhabitants.

This also requires the convergence of various governmental departments associated with water management. Water and sanitation programs have operated largely in isolation from programs in health and education. A wider approach is needed where water and sanitation issues are looked at with the aim of reducing diseases, improving hygiene, improving educational levels and reducing poverty. Governments can provide grants to communities and private organizations undertaking innovative work in water supply, sanitation, rainwater harvesting and integrated watershed management. Capacity development, sharing of best practices through study visits, national/regional meetings and workshops, documentation of successful approaches, and pro-poor policy development in the areas of water management, water supply and sanitation will be central to the solution.

Governments and corporations can also provide more incentives through funding and research for water management solutions. Adequate subsidies and tax incentives can facilitate changes in behavior within the water sector as well as with inhabitants. Progressive water pricing policies would also increase the financial resources available to invest in rehabilitating and modernizing water infrastructure.

Living benefits in action:

- ***Israel's water management program:*** Israel, one of the most water scarce countries in the world, has experienced drought in recent years and is currently combating other water supply pressures. In 2006, Israel established the Novel Efficiency Water Technologies program, which was effectively implemented in 26 government-funded water projects. This has helped Israel to mitigate its water scarcity issue by employing a dynamic management strategy that incorporates desalinization and purification technologies, drip irrigation, flow control, and reclamation practices.[42]
- ***Copenhagen:*** The city of Copenhagen is largely surrounded by water and interlaced with canals. These water sources are government-managed and completely safe to enjoy recreationally.[43] The drinking water in Copenhagen is also among the purest in the world.[44] However, this is the result of many years of effort and billions of Danish kroner. According to Copenhagen's head of Water and Environmental Impact Assessments, it took 3 billion Danish kroner (about $440 million) to build overflow barriers, reroute wastewater, and create underground water storage vessels to ready the harbor for swimming.[45] A sophisticated alarm system developed by a private Danish company predicts when and where an overflow will occur based on existing water levels, tides and rain forecasts, and alerts city employees via mobile phone so they can shut down swimming areas immediately if needed.[46] Though shut downs are rare, the technology is essential for public safety and peace of mind.[47]
- ***Singapore's water efficiency program[48]:*** WaterWise is a program aimed at improving the operational efficiency of Singapore's water supply system. It is cloud-based platform that provides real-time water distribution monitoring. It can operate as a self-contained system by using its own analysis and management interfaces, or it can be integrated into a water utility's existing infrastructure, such as a global information system (GIS) platform.
- ***India, Swachh Bharat Mission (SBM)[49, 50]:*** SBM is a national campaign by the Government of India aiming to ensure all inhabitants in rural and urban areas have access to improved sanitation and ending the practice of open defecation by 2019. The program includes the elimination of open defecation, conversion of unsanitary toilets to pour flush toilets, municipal solid waste management, and bringing about a behavioral change in people regarding healthy sanitation practices. Under the program, community toilets will be built in urban residential areas where it is difficult to construct individual household toilets. Public toilets will also be constructed in designated locations, such as tourist places, markets, bus stations and railway stations.

Innovative technologies can be used to sustainably manage water supplies in cities. A company called TaKaDu in Israel provides water infrastructure monitoring as a service and acts as the "online eyes and ears" of the network.[51] The company's software allows water utilities to minimize water loss and to improve operational productivity without any network changes and or capital expenditure. Smart water management solutions such as supervisory control and data acquisition[52] and meter data management are primarily used in urban areas, due to technological advancements.

As demonstrated by the city of Copenhagen, employing a *smart water network* allows cities to better anticipate and react to different types of water network issues. The technology includes:

a) Smart leakage management: reducing the volume of water lost from distribution networks.

b) Smart metering and customer service: smart meter reading equipment, customer services and billing.

c) Smart water quality monitoring: detecting changes in drinking water quality in the distribution network by monitoring individual parameters or composite indicators.

d) Smart network optimization: improving energy efficiency, asset management, process management, and works management in the operation of a water network.

5. Waste management

According to the United Nations, the population Due to the often compact and complex infrastructural layout of cities, urban areas face unique challenges when it comes to waste management, including logistical hurdles—how and where do you store the trash—and managing consumer behaviors—how do you incentivize inhabitants to waste less and properly sort the waste they do generate? Former World Bank urban development specialist Dan Hoornweg estimates that by 2100, the growing global urban population will be producing three times more waste compared with 2013 levels.[53] That level of waste generation translates to serious fiscal and environmental costs. In fact, according to the World Bank, the projected rise in the amount of waste, from 1.3 billion tons per year in 2012 to 2.2 billion tons per year by 2025, is projected to raise annual global costs from $205 billion to $375 billion per annum.[54] What was once considered an immaterial cost to businesses and households alike will likely become a substantial financial burden. It is clear that solutions for effective and affordable waste management must be developed and deployed to mitigate the risk of these projections. Solutions would solve several issues and provide benefits to system users in the following ways:

- Public health: The avoidance of gastrointestinal and respiratory infections[55] as well as toxic effects of improper hazardous waste disposal will have positive effects on public health.
- Water and air quality: The safe and secure disposal of waste will avert the negative impacts of open dumping and burning, such as pollution of freshwater, groundwater and seawater used for human consumption and maritime activities, as well as local air pollution.
- Circular economy opportunities: The age-old saying "one man's waste is another man's treasure" is rooted in the concept of the circular economy, where reuse and repurposing represent opportunities for innovation, creativity and art.

Key considerations and strategies for success

Raising capital for investment in new technologies and modern facilities continues to be a challenge in both developing and developed countries.[56] While proper waste management does not come without a price, it is important to understand the full cost of inaction, as well as the opportunity cost. When managed appropriately and strategically, waste can actually serve as an asset rather than an unwanted outcome. Advancements in waste-to-energy technology are improving the ability to use waste functionally rather than landfilling or burning it. Disposal of any kind should be contemplated as the last resort and worst case scenario. Applying circular economy thinking to waste streams will enable the innovative and creative reallocation and repurposing of waste, so that the material does not even enter the "disposal" phase of its lifecycle.

But there is an opportunity even earlier in the product or material life cycle—during the design phase. Businesses have the opportunity to design products intended to serve multiple purposes and have multiple lives or, in other words, provide a greater utility for consumers. The Ellen MacArthur Foundation (EMF) is focused on promoting circular economies, with the goal to generate cyclical, cradle-to-cradle "metabolisms" that enable materials to maintain their status as resources and accumulate intelligence over time (upcycling), generating a synergistic relationship between ecological and economic systems, a positive recoupling of the relationship between economy and ecology.[57]

A key concept behind this model is that waste can be reduced or avoided entirely throughout all stages of material or product life cycles. As noted in the *Toolkit for Policymakers* published by the EMF, many circular economy opportunities have sound underlying profitability, but there are often non-financial barriers limiting further scale-up or holding back development. Policy-makers can play an important role in helping businesses overcome these barriers.[58]

Even in applying circular economy thinking, there may be areas where waste is unavoidable. In these cases, innovations and improvements in traditional waste management practices are needed to first minimize and then eliminate inevitable environmental and social repercussions.

Living benefits in action

– ***The Netherlands:*** A whopping 64% of waste in the Netherlands is recycled, with most of the remainder sent to incinerators to be turned into energy, and a very small percentage ending up in landfills.[59] This waste management system approach has been termed "Lansink's Ladder," named after the Member of the Dutch Parliament who proposed it, and in 1944 it was formally incorporated into Dutch legislation.[60] TNT Post conducted a survey in the Netherlands and found that separating waste is the most popular environmentally friendly measure employed, with more than 90% of inhabitants separating their waste.[61] Lack of space and growing environmental awareness spurred the Dutch government to take action to reduce the landfilling of waste, which in turn gave companies the confidence to invest in more environmentally friendly solutions.[62] The main mechanisms employed by the government to achieve this investment were mandatory and prohibitory provisions and taxes.[63]

All over the world, many businesses exist today that may not appear to be centered on waste but in fact are. Examples include antique shops, thrift stores, art, ride-sharing, reclaimed wood and other home-building materials. Opportunities exist for new and expanded mobile apps for the sharing economy, with examples such as ThredUP, Craiglist Pro, and TrashNothing. Waste-to-energy technologies and related services are also a potential area for growth, along with peripheral business services such as transportation. Food waste is one of the most prominent waste challenges today, with exemplary cities such as San Francisco leading the way with their city-wide composting program. Such programs could be expanded to other cities, which could spur additional opportunities in the home-composting, transport and resale markets.

6. Food systems

According to the United Nations World Food Programme, some 795 million people around the world do not have enough food to lead a healthy, active life.[64] Currently, the poorest communities are concentrated in rural areas; but this trend is expected to shift over the next 40 years to urban centers.[65] Furthermore, food demand is expected to increase by as much as 35% globally over the next 15 years,[66] with a simultaneous shift toward diets that are more animal-based product intensive, such as meat and dairy.[67] In fact, the World Resources Institute predicts that animal-based product consumption could rise by as much as 30% by 2050.[68] Currently, the Food and Agriculture Organization of the United Nations estimates that animal agriculture is responsible for 18% of greenhouse gas emissions worldwide, more than the emissions from all transportation combined.[69]

These trends pose unique challenges for cities to meet growing food demand in a sustainable way and will need to be resolved in order to support population and lifestyle projections. These challenges include logistical and infrastructural barriers to food transportation and availability, supply stability, and competing alternatives to local, seasonal and plant-based foods. The ideal sustainable city should employ food system practices and policies that allow it to offer a variety of sustainable food solutions to its inhabitants in terms of urban production, shops and marketplace offerings, restaurant dining, as well as schools, hospitals and other public service institutions.

Cities that effectively implement programs, policies and infrastructure to support a healthy and sustainable urban food system will deliver benefits to inhabitants, including:

- Increased access to produce through urban farming and benefits from growth of green spaces (see section on Green Spaces);
- Convenient access to fresh and local produce and proteins at an affordable price to enable healthy lifestyle choices.

Key challenges and strategies for success

There are several logistical and social challenges preventing sustainable urban food systems and animal protein alternatives from becoming more commonplace:

- Existing food systems and infrastructure can be difficult to transform. In order for sustainable food options to become more accessible, they need to be just as abundant as, if not more abundant than, current options. This is challenging given the increasing trend in developing countries toward adopting western diets, as well as the availability of viable and desirable animal protein alternatives.
- Likewise, the demand for sustainable and healthy food options is largely a factor of socio-economic status, education and awareness, which are all interrelated attributes. According to research done in 2014, some lower income Americans could be actively avoiding organic foods because they are trying to save money on food purchases, rather than avoiding them because of health reasons or dietary preferences.[70]

Indeed, the cost of sustainable food options is often a barrier in the market. Some governments, such as the Danish Parliament, have employed legislation to promote sustainable agriculture. Subsidy programs, tax incentives and earmarked funds are examples of beneficial regulatory mechanisms that could be used to boost supply and demand for sustainable foodstuffs. Non-regulatory solutions could include cross-border or multi-city cooperation agreements, such as the Food Smart Cities for Development EU program led by the city of Milan, or other knowledge-sharing models that promote awareness and marketing for sustainable food system models.

Living benefits in action

- ***Toronto, Canada:*** In 1991, the Toronto Food Policy Council (TFPC) was established as a subcommittee of the Board of Health to advise the city on policy issues relating to food. The TFPC has also developed the Toronto Food Strategy team, which maps healthy food access across the city. In addition, this team has created a program called Foodworks and a food handler and employability project, launched a mobile Good Food Market application, and is researching healthy food retail and community food procurement.[71]
- ***Circular economy:*** The Ellen MacArthur Foundation's 2015 "Growth Within" report revealed that approximately 31% of food is wasted along the value chain.[72] In the United States, the city of Boston, Massachusetts, is home to a non-profit grocery chain called the Daily Table, whose mission is to provide wholesome and affordable food to all community members through a network of growers, supermarkets and manufacturers, who together donate excess foods, which would otherwise be wasted, to their stores.[73]
- ***Denmark:*** The Danish consume more organic produce per capita than any other country, due partly to strong government support for organic production. This trend is continuing to grow.[74] In February 2015, the Danish government announced a plan to double the amount of organic farmland by 2020—earmarking approximately US$ 60 million to facilitate the effort and increase organic production and supply.[75] The country's minister of agriculture also committed to increasing the amount of organic food served in public institutions; and its Ministry of Defense pledged to do the same for food served at its bases.[76]
- ***China:*** The Chinese government has outlined a plan to reduce meat consumption by 50% by publishing new dietary guidelines that encourage a lower level of meat consumption. The main goal is to improve public health while simultaneously reducing greenhouse gas emissions.[77]

There are several ways in which business can enable sustainable food systems and be a profitable part of the solution. New technologies in urban farming have expanded the possibilities to bring the farm and the city closer together. Hydroponic farming systems use both less soil and water than traditional farming methods.[78] LED lights have now been adapted specifically to foster plant growth, allowing for crop stacking and indoor farming.[79] Not only do these solutions provide accessible food sources in close proximity to city dwellers, which can minimize costs associated with transportation and bring new jobs to the area, but they also serve the dual purpose of creating additional green spaces within an otherwise concrete landscape.

As illustrated in the Daily Table and Copenhagen examples, there are numerous ways business can sustainably and profitably partake in the existing food system, such as the resale of blemished but otherwise edible produce on a mass scale.

According to Lux Research, growth in alternative protein sources is poised to accelerate, potentially claiming up to a third of the protein market by 2054.[80] Although this percentage should arguably be higher to minimize environmental impacts, businesses nevertheless have a significant opportunity to be a part of both the solution and to capitalize on the growing market by developing new and desirable meat alternatives.

7. E-governance and services

Electronic governance (or e-governance) can be described as carrying out the functions of governance using information technology (IT). E-governance can improve efficiencies in the storing and retrieval of data, transmission of information, and processing of data. Other key benefits of e-governance include:

- *Increased transparency and accountability:* The automation of governmental processes through information and communication technology (ICT) can increase transparency and enforce accountability. E-governance helps build trust between governments and inhabitants, an essential factor in good governance, by using Internet-based strategies to involve inhabitants in the policy process. With e-governance, laborious and documentation-heavy processes can be made more simple, intuitive and accessible. Communication with the inhabitants in terms of government decisions and policies can be more streamlined and accessible as well.
- *Increased access and increased ease of access:* E-governance can help in regions with no electricity, computers or Internet access; mobile phones are increasingly helping spread mobile government, banking or health.[81] Automated platforms increase access to government for inhabitants, both geographically and demographically. E-governance helps simplify processes and makes access to government information easier.
- *Enhanced engagement and trust:* Through engagement, e-government can improve the overall trust relationship between inhabitants and public administrations. By improving information flows and encouraging active participation, e-governance is increasingly seen as a valuable tool in creating a more peaceful and inclusive society.

The graphic below illustrates some common examples of e-governance mechanisms through various lenses[82]:

Health	Communication	Business
• e hospital • Tele medicine	• Online complaint system • Online delivery of land records • Online grievance mechanism	• Online tax collection • E payment

Social Benefit	Security	Governance
• Pension • Mobile banking • Insurance	• Online monitoring • Mobile emergency services	• GIS • E procurement

Key considerations and strategies for success:

There are several potential barriers in the implementation of e-governance, such as:

- *Resistance to change:* This can explain much of the hesitation that occurs on the part of constituents in moving from a paper-based to a web-based system for government interactions. Governments need to raise awareness about the value and direct benefits of electronic systems in order to reduce some of the existing resistance.
- *Digital divide:* An inequitable separation between individuals, communities and businesses that have access to information technology and those that do not remains. Social, economic, infrastructural and ethno-linguistic factors significantly influence and contribute to the digital divide. Providing awareness and infrastructure by government can reduce the digital divide.
- *Privacy and security:* When dealing with sensitive personal information, the security access process is complex and requires legal consideration. With the implementation of e-governance projects, effective measures must be taken to protect such information. Providing clear security standards and protocols can strengthen the development of projects that contain sensitive personal information and improve user acceptance.
- *Cost:* One of the most significant factors that inhibit the progress of e-governance implementation, particularly in developing countries where people are living below the poverty line or where the infrastructure does not yet allow for widespread access to the Internet, is cost. By providing low-cost infrastructure, local governments can reduce overall costs.

Living benefits in action

- ***India:*** Launched in 2006 by the Government of India, the National e-Governance Plan (NeGP)[83] aims to improve the delivery of government services to inhabitants and businesses with the following vision: "Make all government services accessible to the common person in his/her locality, through common service delivery outlets and ensure efficiency, transparency & reliability of such services at affordable costs to realize the basic needs of the common man." It created a user-friendly interface between inhabitants and the government. The vision of the Digital India program is centered on three key goals: digital infrastructure as a core utility to every inhabitant; governance and service on demand; and digital empowerment.
- ***Seoul, Korea:*** The Seoul Metropolitan Government's new website offers a single platform through which inhabitants can access information on all public services. U-Seoul Safety Service uses location-based services and CCTV, allowing parents to check children's travelling route and notify authorities in case of emergency. U-Health Care is designed to provide health check-ups and prioritized medical attention for the disabled and the elderly whose mobility is restricted.[84]
- ***Dongcheng, China:*** Dongcheng implemented a pilot program using mobile-based technologies that break the city into smaller zones and track complaints, such as water supply, potholes, and wastes, within these zones. Each zone is constantly updated with issues inhabitants are submitting, allowing government employees to address multiple complaints at once.[85]

Key examples of e-governance business solutions include:

- *MCA21 Programme:* To provide awareness and use of effective technology, the Ministry of Corporate Affairs India (MCA) has enabled 100% electronic filing, electronic payment mechanisms, use of digital signature certificates for all transactions, and the delivery of more than 90% of services by MCA offices.[86]
- *E-Choupal Model:* To provide infrastructure, ITC has implemented the E-Choupal model, an information center connected with the Internet. E-Choupal has helped link its largest labor force with local inhabitants, international markets, and final consumers at much reduced transaction costs.[87]
- *Reliance Jio:* A digital service initiative, Jio's mission is to realize the Digital India vision, ensuring that Indians have the highest quality and the highest quantity data access anywhere in the world at the most affordable prices. Through Jio, quality education reaches the most inaccessible corners of the country, quality healthcare, powered by e-healthcare, ensures that people have access to healthcare, and e-banking ensures financial inclusion.[88]

Opportunities and recommendations

There are numerous mechanisms and strategies that cities and businesses can employ to support sustainable development and provide desirable benefits to urban inhabitants. Some of these key recommendations within each focal area are summarized below.

Urban mobility and transportation

As infrastructure is integral to sustainable mobility, the public and private sectors must work together to create integrated urban spaces that improve accessibility, comfort and safety for travelers. Investments in technological innovation should continue to be made to support alternative solutions and "smart" traffic and transportation systems. These enhance the user experience while simultaneously using resources more efficiently.

Buildings and construction materials

Cities and businesses need to think outside the box when it comes to building materials, examples such as modular wood construction will improve air quality and decrease construction time, both of which are direct living benefits for urban dwellers.

Green spaces

Businesses have a key role to play in both the development and maintenance of green spaces, particularly as green spaces become more and more integrated with other functional city areas, such as shopping (e.g. outdoor courts and plazas) and residential communities (e.g. living roofs and parks). Because green spaces tend to increase the attractiveness and even the property value of surrounding areas, there is often a shared interest in their creation and upkeep. This shared value should be both articulated and measured to support funding decisions, expanding upon the traditional return-on-investment analysis. Public-private-funding or crowd-funding should also be encouraged.

Water supply and sanitation

Governments and businesses should work together to support local innovations in technology and develop community capacities through programs that demonstrate innovative approaches, focus on the community level, provide reliable management systems, exchange good practices between communities (study visits, national/regional meetings and workshops), document successful approaches, and develop pro-poor policies in the areas of water management, water supply and sanitation.

Waste

Waste should be contemplated at the beginning of a given process, not at the end. For products, considerations for waste should be made in the design phase, and products should be designed and packaged with their "next life" in mind. If done strategically, businesses can profit from the reuse, disassembly and/or resale of products or product components.

Food systems

The food-related challenges faced by growing populations and shifting consumption patterns are truly an opportunity disguised as a challenge. Businesses should allocate recourses to innovate and invent new solutions, be it product-based or institutional, that will literally "feed the masses". Products or technologies that can be scaled up at the same rate of population growth and urbanization could very well expect a similar trend in profits. Simultaneously, governments should consider ways to incentivize or otherwise attract businesses that are focused on providing local, organic, and/or vegetable-based food options to inhabitants.

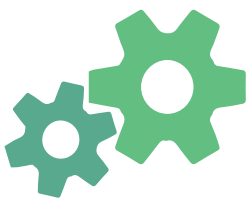
E-governance and services

Governments, with the partnership of businesses where practicable and cost-effective, should make e-governance services available via a range of ICT channels, provided that they ensure ease of use, as well as availability and accessibility of information and services. Public information systems should be open and inhabitant/community-centric. Service capacity can be increased through the development of effective community, civil society and private sector partnerships.

Conclusion

A focus on urban sustainability will be of crucial importance over the next several decades, both for existing cities as well as those that are rapidly growing or even just being built today. The majority of this city growth will take place in developing countries. This report does not contemplate the philosophical question of "should we develop?". We have chosen to focus on how the world could develop and adapt cities in a way that will sustain them and their populations for generations to come.

Too often the challenge of climate change and other environmental topics are couched as negative issues when, in fact, there are huge opportunities for innovation and prosperity. Businesses with the foresight to capitalize on these opportunities will benefit greatly from their first-mover positions. This report provides insight for companies interested in understanding the interplay between cities, inhabitants and businesses, the challenges and complexities that remain to be solved, and the power businesses hold to effect change and enable the future sustainable prosperity of cities worldwide. We recommend that future WBCSD Leadership Program participants continue to explore the concept of business as an integral part of the solution to the challenges brought on by population growth, resource scarcity, climate change and urbanization.



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