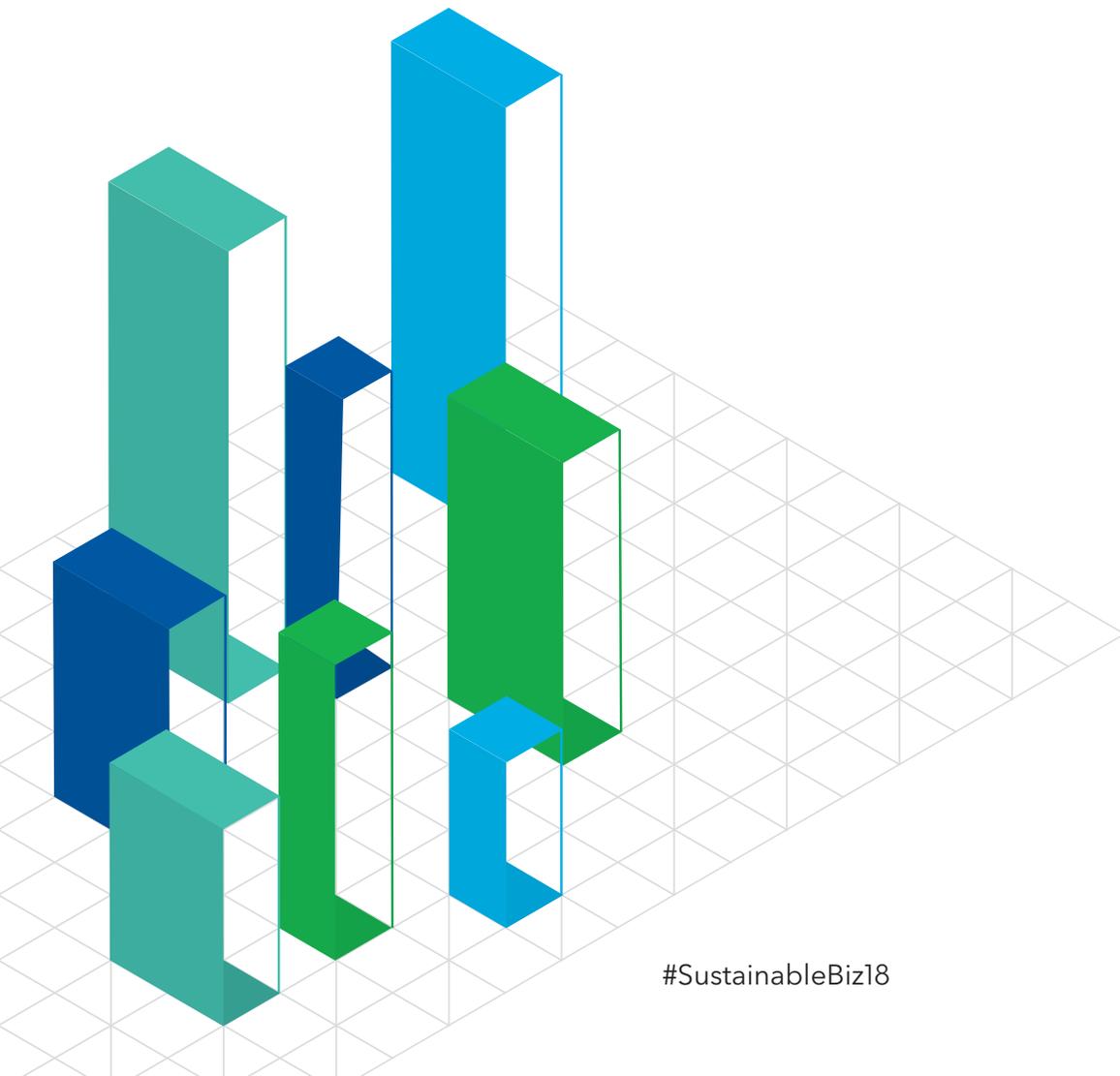


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# AI Technologies Advance Future Sustainability Efforts



#SustainableBiz18

# AI Technologies Advance Future Sustainability Efforts

Climate change and steady population growth are creating an uncertain future because of the stresses they place on the world's available resources. These pressures will become increasingly severe, as the global population is projected to increase from the current 7.7 billion people to nearly 10 billion by 2050. Climate change will be a contributing factor, as it increases the frequency of natural disasters and reduces the land area available for agricultural production.

## The emergence of artificial intelligence as a positive force for sustainability comes at a critical juncture.

The Paris Agreement and the U.N.'s Sustainable Development Goals together represent a comprehensive framework that works to address the critical problems of dealing with these massive societal changes while maintaining and improving quality of life. The realization of that potential, however, will require ambitious effort, an extraordinary level of cooperation, and a host of innovative ideas.

Advancing technology is increasingly relevant to these issues, and the emergence of artificial intelligence as a positive force for sustainability comes at a critical juncture. AI's ability to integrate and analyze huge amounts of data positions it to help address some of the major societal challenges we face. Maximizing that potential, however, will need new approaches.

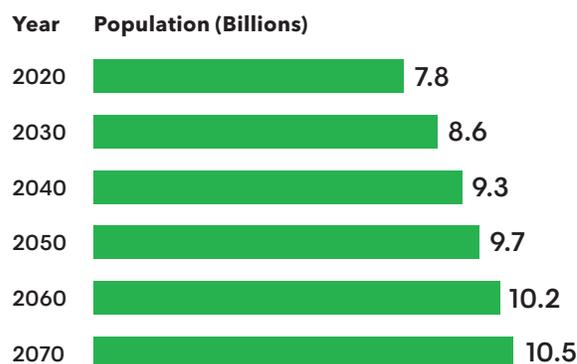
Innovative structures, some of which are already in play, will need to bring together the organizational connections and resources that can fully leverage the technology's transformative potential. For example, public/private partnerships are bringing together business sector expertise and innovative ways of funding.

Smart city initiatives can use transport data and financial incentives to reduce congestion, lower greenhouse gas emissions, and improve quality of life in urban areas. Major changes are happening in the energy and agricultural sectors, led by innovative businesses and previously unavailable data inputs, to increase efficiency and implement sustainability at the ground level.

"Things add up, and that's the entire story of sustainability," said Brad Smith, Microsoft's president and chief legal officer.<sup>1</sup> "That is something [to which] everybody has the opportunity to contribute."

### Soaring Global Population

Between now and 2050, the world's population is projected to grow by more than 25%.



Source: U.N. World Population Growth Projection<sup>2</sup>

### Pairing for Collective Action

Collectively, AI and sustainability are already being applied in concrete ways. Farms can more effectively use pesticides and herbicides to increase crop yields.<sup>3</sup> Local authorities can better predict and prepare for natural disasters and identify the worst instances of aging infrastructure.<sup>4</sup> Countries have the ability to track and measure pollution sources in real-time to lessen the impact they have on natural resources.<sup>5</sup> AI is also helping the autonomous car industry reimagine ways to ease stop-and-go traffic and resulting carbon emissions.<sup>6</sup>

<sup>1</sup> Brad Smith, president and chief legal officer, Microsoft, "Disrupting Sustainability," Bloomberg Sustainable Business Summit: Seattle, May 17, 2018, <https://www.bna.com/2018-sustainable-business-summit-seattle/>

<sup>2</sup> United Nations, DESA/Population Division, <https://esa.un.org/unpd/wpp/Graphs/Probabilistic/POP/TOT/>

<sup>3</sup> Matt McFarland, "Farmers Spot Diseased Crops Faster with Artificial Intelligence," *CNN Tech*, Dec. 14, 2017, <http://money.cnn.com/2017/12/14/technology/corn-soybean-ai-farming/index.html>

<sup>4</sup> Celine Herweijer, partner, PricewaterhouseCoopers, "Fourth Industrial Revolution for the Earth—Harnessing Artificial Intelligence for the Earth," January 2018, <https://www.pwc.com/gx/en/sustainability/assets/ai-for-the-earth-jan-2018.pdf>

<sup>5</sup> Toufiq Rashid, "Government Plans Hi-Tech Mapping of Ganga to Identify Pollution Sources," *Hindustan Times*, May 5, 2018, <https://www.hindustantimes.com/india-news/govt-plans-hi-tech-mapping-of-ganga-to-identify-pollution-sources/story-BhYZPho2oyNB6ilDZfgfmK.html>

<sup>6</sup> Tom Alberg, cofounder and managing partner, Madrona Venture Group, "A Road Map for the Autonomous Age," Bloomberg Sustainable Business Summit: Seattle, May 17, 2018

These are just a few examples. In all cases, organizations can use AI and machine learning to integrate data from myriad sources—satellites, industrial facilities, and advanced internet of things sensors, among others—to help inform actions that will foster sustainability across sectors.

## Organizations can use AI and machine learning to integrate data from myriad sources.

AI can help decision makers absorb and prioritize incoming data, and identify the most critical needs to act upon or, in the case of a natural disaster, determine where to start.<sup>7</sup> This ability to integrate data from disparate sources, and the accompanying insight it can give into prioritizing action, can be likened to credit card fraud prevention: AI software detects unusual patterns and helps card providers warn consumers of potential issues in real time, so they can act to avoid an undesirable outcome later.

On a larger scale, AI tallies billions of data sets, transcending analysis that previously was limited or, at best, anecdotal.<sup>8</sup> AI's interpretive ability is being powered by a growing number of data centers worldwide, resulting in massive energy consumption. Here, too, sustainability has to be considered.

### Opportunities in Energy Management

"In the world today, the data centers of the large technology companies consume roughly 2 percent of the world's electricity—that's a huge responsibility," said Microsoft's Brad Smith. The company's data centers alone use more energy than the entire state of North Dakota. This massive scale, he said, creates an opening for new approaches.

The advanced chip designs and switching capability that have accompanied AI's onset will help reduce electrical consumption needed for future data processing. Nonetheless, moving these functions to cloud technology "can result in a 90 percent improvement in both energy and carbon efficiency," Smith said, "compared to, say, running your servers in a closet or your own [on-premises] situation."

### CONTENT FROM MICROSOFT

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Reducing energy consumption is important. Reliance on renewables, such as hydroelectricity and solar energy, is also crucial, Smith said. "Responsibility opens the door to opportunity, and focus enables us to address both of these things."

### Greater Predictive Capability

The surfeit of data in cloud-based centers previously could not be analyzed on an integrated basis, but AI now makes large-scale interpretation possible in critical areas like climate prediction.<sup>9</sup> As climates become less stable, the frequency of extreme weather conditions will grow.<sup>10</sup> This makes the need for predictive analytics even greater.<sup>11</sup>

AI can help sort the huge number of data points behind weather systems so climate issues can be more accurately forecast and addressed. In Hong Kong, authorities can better prepare for frequent rainfall and minimize deadly landslides. Where geologists previously struggled to decipher aerial images to gauge deadly shifts in the earth's surface, they now receive the same data more quickly with the help of AI.<sup>12</sup>

<sup>7</sup> Ben Schiller, "5 Ways Artificial Intelligence Can Help Save The Planet," *Fast Company*, Feb. 12, 2018, <https://www.fastcompany.com/40528469/5-ways-artificial-intelligence-can-help-save-the-planet>

<sup>8</sup> Vijay Pande, "Artificial Intelligence's 'Black Box' Is Nothing to Fear," *The New York Times*, Jan. 25, 2018, <https://www.nytimes.com/2018/01/25/opinion/artificial-intelligence-black-box.html>

<sup>9</sup> Nicola Jones, "How Machine Learning Could Help to Improve Climate Forecasts," *Nature*, Aug. 23, 2017, <https://www.nature.com/news/how-machine-learning-could-help-to-improve-climate-forecasts-1.22503>

<sup>10</sup> "Extreme Weather and Climate Change," Center for Climate and Energy Solutions, <https://www.c2es.org/content/extreme-weather-and-climate-change/>

<sup>11</sup> Celine Herweijer, partner, PricewaterhouseCoopers, "Fourth Industrial Revolution for the Earth—Harnessing Artificial Intelligence for the Earth," January 2018, <https://www.pwc.com/gx/en/sustainability/assets/ai-for-the-earth-jan-2018.pdf>

<sup>12</sup> Medha Basu, "With Climate Change, Hong Kong Looks to Artificial Intelligence," *GovInsider*, March 22, 2018, <https://govinsider.asia/smart-gov/hong-kong-climate-change-disaster-ai/>

Similarly, as the speed and accuracy of technology improves, public officials and citizens are more likely to honor early evacuation warnings. The human toll from recent disasters like Hurricane Harvey could have been far worse if not for the millions of data points—fed by sources such as aircraft, satellites, ocean buoys, and ground stations—that were used to predict the event more than a week in advance. Future investments in AI can drive greater predictive capability, saving more lives.<sup>13</sup>

AI's ability to better foretell climate conditions also aids farming in ways other than more timely weather forecasts. If AI can't end drought or increase rainfall, it can help make scarce resources go further. That need will only grow. Global water demand will rise 55 percent by 2050; agricultural output must more than double before then to accommodate the world's growing population.<sup>14</sup>

### World Water Shortage in 2050

By 2050, the world's population will reach roughly 10 billion (compared to 7.7 billion today).

Of that number:

- Two in every three people will live in cities
- Between 4.8 and 5.7 billion people will live in a water-scarce area at least one month a year, compared with the 3.6 billion people who do so today

**Source:** U.N. World Water Development Report 2018<sup>15</sup>

AI is helping gather farm data, especially in areas where power is not available, as the technology is teamed up with low-cost sensors and unused radio frequency bandwidth to help lift agricultural productivity in less developed countries.<sup>16</sup> AI-driven analysis also is aiding pesticide regulation, through software that offers better-quantified herbicide application based on weed location and growth.<sup>17</sup>

## Connectivity for 'Smart' Cities, Faster Lanes

Rising populations, further migrating into urban areas, also strain energy use.<sup>18</sup> Retrofitting buildings with AI technologies can help reduce energy consumption. For example, internet of things sensors and connectivity devices linked to the cloud track performance and quickly flag the breakdown of essential equipment, such as HVAC systems, so a prompt response reduces unnecessary energy use.

"In the world today, 40 percent of the planet's electricity is consumed by buildings," Microsoft's Smith said. "If we can reduce the electrical consumption of buildings by 15 percent—the average that we [the Microsoft Redmond, Wash., campus] have gained—that will save the planet 4 percent of the world's electricity, or twice the electricity consumed by all the data centers in the world."

## Retrofitting buildings with AI technologies can help reduce energy consumption.

AI tools are being used to help assess building cooling systems and predict aberrations, such as unusual energy spikes, alerting property managers to enable a quick response.<sup>19</sup> Water and sewage management are equally essential to smart cities. AI sensors can deliver predictive data that monitors potential issues, such as leaks in underground water pipes.<sup>20</sup> Once again, this knowledge can help prioritize action, in the midst of strained budgets.

Air quality is another focus of smart cities. Tracking systems can pull data from sources like satellites and traffic cameras to reduce congestion and ultimately suggest alternate routes.<sup>21</sup> Meanwhile, autonomous vehicles, powered by AI software, can also foster cleaner air. Because of their potential for interconnectivity and for driving safely in close proximity to each other, they can avoid "phantom" traffic jams. This means less stop-and-go traffic and smog.<sup>22</sup>

<sup>13</sup> Todd Thibodeaux, "Lifesaving Technologies Front and Center in Disastrous Month," *SpaceNews*, Oct. 12, 2017, <http://spacenews.com/op-ed-lifesaving-technologies-front-and-center-in-disastrous-month/>

<sup>14</sup> Tim Smedley, "Is the World Running Out of Fresh Water?" *BBC Future Now*, April 12, 2017, <http://www.bbc.com/future/story/20170412-is-the-world-running-out-of-fresh-water>

<sup>15</sup> United Nations, "World Water Development Report 2018," March 19, 2018, <http://www.unwater.org/publications/world-water-development-report-2018/>

<sup>16</sup> "TV dinners," *The Economist*, Sep. 17, 2016, <https://www.economist.com/science-and-technology/2016/09/17/tv-dinners>

<sup>17</sup> Errol Barnett, Duncan McKenna Keener, "Farmers Look to Artificial Intelligence as Workforce Declines," *CBS News*, April 24, 2018, <https://www.cbsnews.com/news/artificial-intelligence-could-revolutionize-farming-industry/>

<sup>18</sup> David Roberts, "Want to Reduce the Energy Used by Buildings? Make Cities Denser," *Vox*, Nov. 26, 2017, <https://www.vox.com/science-and-health/2017/11/26/14388942/building-energy-use-density>

<sup>19</sup> Max Ernst, "The Potential of Machine Learning and AI for Smart Buildings," *IoT For All*, Feb. 15, 2018, <https://www.iotforall.com/machine-learning-ai-smart-buildings/>

<sup>20</sup> "Using AI to Trace Leaking Pipes," *The Economist*, April 26, 2018, <https://www.economist.com/science-and-technology/2018/04/26/using-ai-to-trace-leaking-pipes>

<sup>21</sup> Roger K. Lewis, "For a Truly 'Smart' City, You Need a 'Geographic Action System,'" *The Washington Post*, May 4, 2018,

[https://www.washingtonpost.com/realestate/for-a-truly-smart-city-you-need-a-geographic-action-system/2018/05/02/bccd231e-4a37-11e8-9072-f6d4bc32f223\\_story.html](https://www.washingtonpost.com/realestate/for-a-truly-smart-city-you-need-a-geographic-action-system/2018/05/02/bccd231e-4a37-11e8-9072-f6d4bc32f223_story.html)

<sup>22</sup> Jack Stewart, "It Takes a Single Autonomous Car to Prevent Phantom Traffic Jams," *Wired*, May 16, 2018, <https://www.wired.com/story/one-autonomous-car-prevent-traffic-jams/>

The complete integration of driverless technology, however, may still be decades away. Americans in 2016 averaged 100 million miles driven for each fatality. By contrast, autonomous vehicles hadn't driven nearly that number before the first fatality occurred.<sup>23</sup> Proponents say the ratio will eventually tilt in favor of self-driving cars and that evolving technology will better address limited visibility and bad road conditions and avoid the pitfall of human distractions altogether.<sup>24</sup> The technology's advance toward that level of capability will improve consumer trust and help larger sustainability goals through things like "blended" fleets.

"When we talk about autonomous, we need to talk about 'connected,' 'shared,' and 'electric,'" said Tom Alberg, cofounder and managing partner of Madrona Venture Group, a Seattle-based investment firm. "That combination produces great environmental benefits."

Las Vegas is a testing ground for this concept. At January's Consumer Electronics Show, the on-demand ride company Lyft ran a pilot program with Aptiv, an automotive technology company, to offer self-driving, on-demand transit to and from 20 city locations. More than 400 rides were driven in automatic mode. The pilot program, initially open to journalists, has since expanded to the public.

Today, 30 autonomous vehicles are available to and from high-demand locations across Las Vegas, with navigation aided by the city's installation of a vehicle-to-infrastructure technology, in partnership with Lyft<sup>25</sup> – signaling public-private partnership in AI-driven sustainability. As they would with regular rides, users flag a self-driving vehicle through the Lyft app. The vehicle always includes a driver, in the event the customer decides against the self-driving option.<sup>26</sup>

"User adoption of new behavior—and new technology—is [happening] much faster than people anticipate," said Jody Kelman, Lyft's self-driving platform product lead. She cites the rapid use of ride-sharing vehicles, unimaginable to the public even a few years ago.<sup>27</sup>

## AI's Journey of a Thousand Miles

Public awareness of AI's potential to improve this future starts with engagement. A key objective will be to maintain public confidence that the inevitable shifts that come with introducing a new technology will bring the promised improvements. AI leaders in both the public and private sectors might take a cue from the autonomous vehicle industry and its proponents on outreach.

"We can get over some of that consumer and user fear by introducing the technology in constrained environments," said Reema Griffith, executive director of the Washington State Transportation Commission. "People have to ease into it, in terms of having opportunities to experience it."<sup>28</sup>

This incremental, "things add up" approach moves sustainability and AI from mere buzzwords into everyday life, and that conversation is slowly beginning to happen.

AI won't eradicate climate change or ensure infinite resources, but it will shed light on how to prioritize action. "The world is in the early stages of a sustainability revolution that has the impact and scale of industrial revolution," said Al Gore, chairman of Generation Investment Management, which he co-founded in 2004 with former Goldman Sachs executive Dave Blood.<sup>29</sup>

Gore's comments reflect the incremental steps by which AI technology is advancing the aim of preserving the earth's resources and ensuring a better quality of life. That is the ultimate story of sustainability, told through everyday things that add up.

<sup>23</sup> Megan McArdle, "How Safe Are Driverless Cars? Unfortunately, It's Too Soon to Tell," *The Washington Post*, March 20, 2018,

[https://www.washingtonpost.com/opinions/no-driverless-cars-arent-far-safer-than-human-drivers/2018/03/20/5dc77f42-2ba9-11e8-8ad6-fbc50284fce8\\_story.html](https://www.washingtonpost.com/opinions/no-driverless-cars-arent-far-safer-than-human-drivers/2018/03/20/5dc77f42-2ba9-11e8-8ad6-fbc50284fce8_story.html)

<sup>24</sup> Chris Isidore, "Self-Driving Cars Are Already Really Safe," *CNN Tech*, March 21, 2018, <http://money.cnn.com/2018/03/21/technology/self-driving-car-safety/index.html>

<sup>25</sup> Jody Kelman, self-driving platform product lead, Lyft, "A Road Map for the Autonomous Age," *Bloomberg Sustainable Business Summit*: Seattle, May 17, 2018

<sup>26</sup> Stephen Edelstein, "Lyft and Aptiv Deploy 30 Self-Driving Cars for Las Vegas Public Trial," *The Drive*, May 7, 2018,

<http://www.thedrive.com/tech/20684/lyft-and-aptiv-deploy-30-self-driving-cars-for-las-vegas-public-trial>

<sup>27</sup> Jody Kelman, *Bloomberg Sustainable Business Summit*: Seattle

<sup>28</sup> Reema Griffith, executive director, Washington State Transportation Commission, "A Road Map for the Autonomous Age,"

*Bloomberg Sustainable Business Summit*: Seattle, May 17, 2018

<sup>29</sup> Emily Chasan and Dina Bass, "Al Gore Sees Bipartisanship Returning in Fight on Climate Change," *Bloomberg*, May 18, 2018,

<https://www.bloomberg.com/news/articles/2018-05-18/al-gore-sees-bipartisanship-returning-in-fight-on-climate-change>

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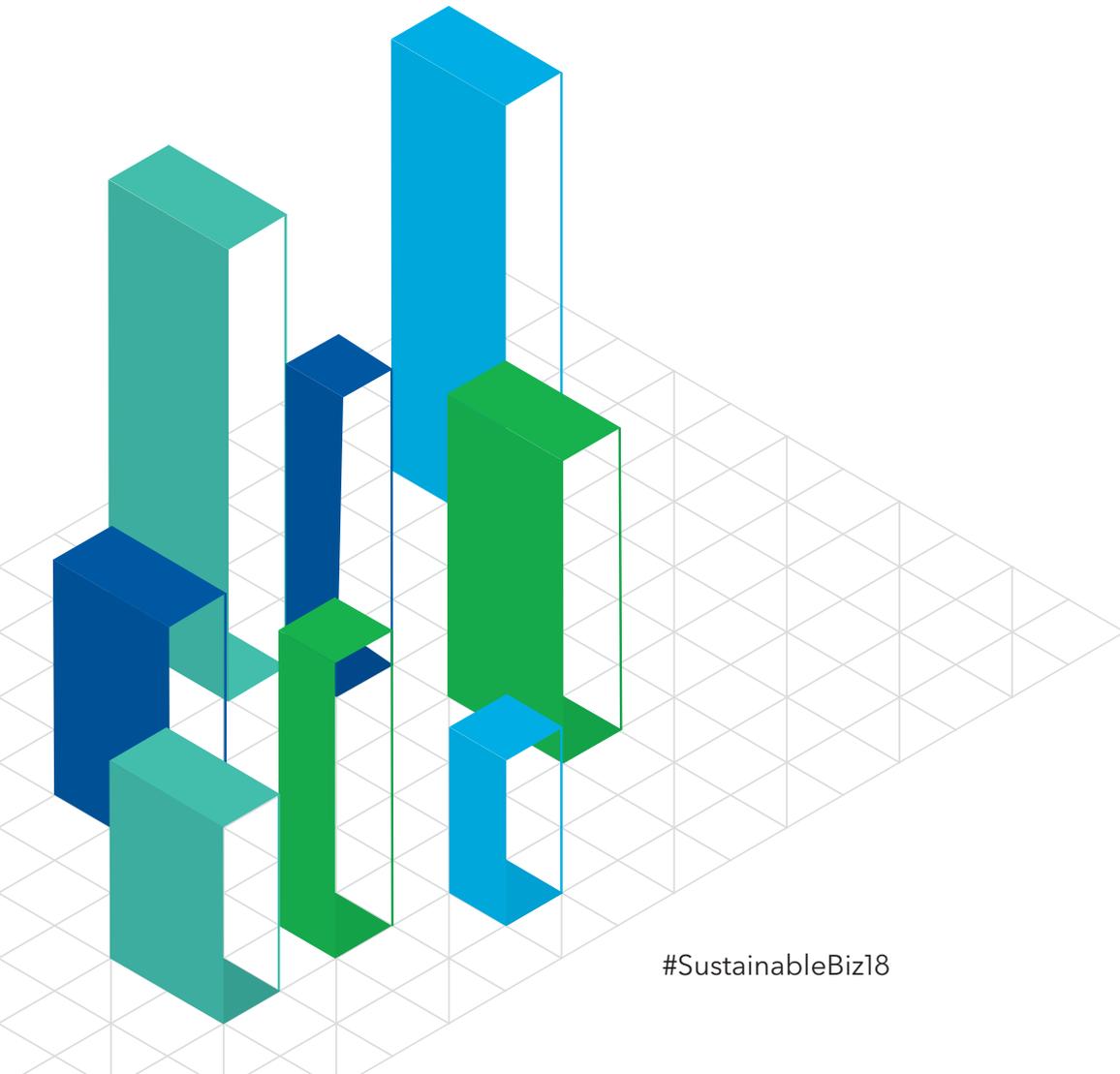
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