Honeywell

Smart Buildings Make Smart Cities

Honeywell Smart Building Score™

Green. Safe. Productive.

EY
Building a better working world

A white paper authored by Honeywell and Ernst & Young LLP

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White paper based on research conducted by IMRB International.

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Executive Summary

Smart Buildings Make Smarter Cities

The government of India has launched an ambitious and transformational scheme to develop 100 Smart Cities. These smart cities will be enabled by a number of smart solutions including those targeted to infrastructure, energy, transport, utilities, environmental sustainability, and communication. Government and civic authorities are key enablers for significant portions of civic and administrative infrastructure, utilities, and public amenities. However, individuals, private building owners, and businesses can also contribute by making private and public buildings smarter. After all, the smarter the buildings, the smarter the city will be.

In effect, smart buildings are a fundamental building block for a smarter city

People spend 80 to 90 percent of their lives in buildings, making buildings an integral part of their ecosystem. With the advent of new technologies, the role buildings play is being redefined from a static environment to a more dynamic and interactive space that impacts the lifestyles, wellbeing, and productivity of their occupants.

In our research on this subject, we came across multiple evaluation frameworks for buildings. However, there was no single framework that could be used by all stakeholders such as users, occupants, developers, and policymakers; across countries (most frameworks are driven by industry associations within a particular geography); and comprehensively across the three broad aspects of smart buildings – green, safe, and productive.

Green: The "green" aspect in buildings is well known, and for good reason. The economic and sustainability benefits of green buildings have been proven through extensive academic and applied research.

Safe: The "safe" aspect in buildings is not equally well researched or illustrated. The value of human life and property is critical and should be given the highest priority in any building.

Productive: The conversation around productive buildings is still nascent. However, this is the one area that is likely to see the fastest change in relevance and importance, driven by two major megatrends: connectivity and comfort.

Hence, the Honeywell Smart Building Score™ has been developed to be a universal framework for quick, comprehensive, and easy assessment of any building. It can be administered across countries with minimal adaptation. The framework of the Honeywell Smart Building Score™ is also flexible and adaptable for future enhancements as applications and solutions for smart buildings continue to evolve. Fifteen smart elements in each building are rated on their green, safe, and productive outcomes, based on pre-defined parameters of capability, coverage, and uptime. The Honeywell Smart Building Score™ is then arrived at as an average of these green, safe, and productive outcomes.

The Honeywell Smart Building Score™ was applied for the first time in more than 2,000 buildings across eight Indian cities to validate the tool, and assess building smartness. Key takeaways from the research are:

- Buildings score highest on green, lowest on safe features
- Focus of smart system investments is still on basic needs of electricity, ventilation, and communication
- Public and private buildings have similar scores, indicating that opportunities and needs exist for both sectors
- Scores across verticals vary significantly. Of the 10 building verticals researched, airports and hotels have the smartest buildings; the residential and education verticals have the least smart buildings

Finally, the white paper identifies a clear call to action for key stakeholders in the ecosystem:

- Government and policymakers: The Honeywell Smart Building Score™ could help add a valuable enabler to the smart cities strategy and guidelines. The incentives provided to green buildings should be extended to include safety and productivity in buildings as well. Public buildings could set for benchmarks for private participation in the drive towards smarter buildings
- Users, owners, developers: All three aspects – capability, coverage, and uptime – need to be focused on. The Honeywell Smart Building Score™ could be used to take purchase and leasehold decisions, and to drive vertical-specific strategies for smart buildings
- Industry associations, consultants, architects, and service providers: These influencers could create benchmarks, drive education, and demonstrate the economic argument for, and benefits of, smart buildings to build smarter cities

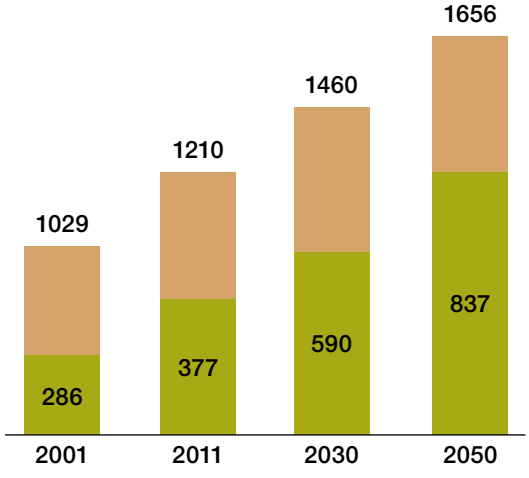
This research and white paper are the beginning of a comprehensive movement towards smarter buildings. The Honeywell Smart Building Score™ has been launched in India and will drive data, analytics, and action in smart buildings around the world.

Introduction

Rapid urbanization is among the biggest megatrends transforming the Indian economy. To accommodate this mammoth growth in urban population[1], India needs to develop new cities and re-engineer existing ones to improve the quality of life for residents.

To address the challenges of urbanization, the government of India has launched an ambitious and transformational scheme to develop 100 Smart Cities. Smart cities would be required to provide basic infrastructure that supports quality of life for residents, a clean and sustainable environment, and smart solutions for their citizens[2]. These cities would have reliable and uninterrupted energy and water supply, proper sanitation, efficient management of solid waste, decongested roads, last mile connectivity, and effective use of information and communications technology (ICT) to make physical infrastructure efficient[3].

India's Urban Population Growth



By 2030, the number of Indian cities with a population of more than 1 million will be 70, which is twice the number of cities in Europe with similar population today.

The population in these 70 Indian cities in 2030 will also be twice the prevailing population of the U.S.A.

Smart Buildings Make Smart Cities

Buildings are integral constituents of a city ecosystem. People spend 80 to 90 percent of their lives in buildings, be it in homes, offices, recreation, retail, transport, or public service facilities. As technology advances, buildings are no longer just physical structures providing shelter but are increasingly defining the quality of life of their users. Buildings are becoming complex entities with multiple interconnected systems such as lighting, ventilation and cooling, utilities, and security. The complexities increase with the size of buildings and the nature of their use. In most traditional buildings, these complex systems exist in silos, leading to inefficiencies in energy consumption, building usage, and lower quality of services. According to a study under the United Nations Environment Programme[4]:

- Buildings consume about 40 percent of global energy, 25 percent of global water, 40 percent of global resources, and emit approximately one-third of greenhouse gas emissions
- Residential and commercial buildings consume approximately 60 percent of the world's electricity

Large buildings are also vulnerable to adversities – manmade and natural – leading to potentially high losses to life and assets. Smart buildings can potentially reduce the effects of such adversities and may also enable proactive measures and intelligence to help prevent them from occurring.

Further, smart cities envisage efficiencies in urban infrastructure and utilities, smart communication and data networks, and comfortable environments for work and daily life. All of these will enable smart and productive users. Smart buildings are a critical enabler of such comfort and productivity.

Thus, developing smart buildings would go a long way in creating smart cities and enhancing overall quality of life.

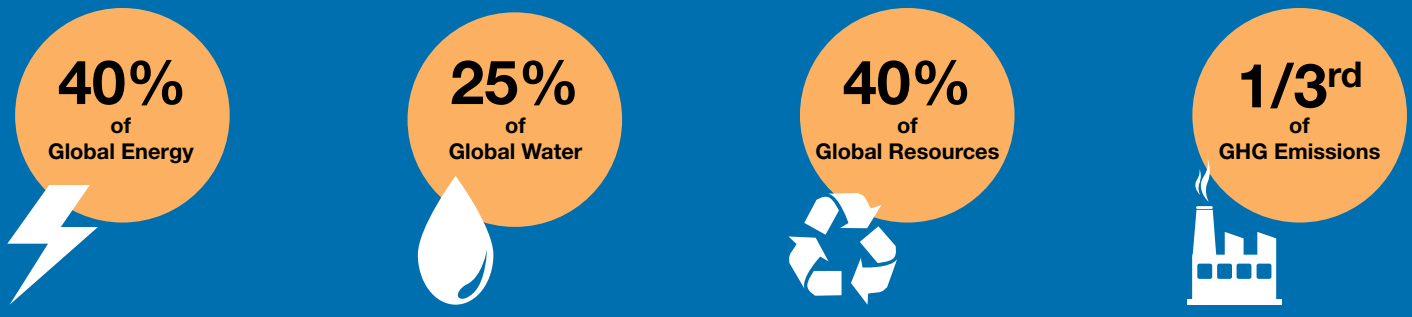
[1] Census of India (2011) and Mckinsey Global Institute (2010).India's Urban awakening: building inclusive cities, sustainable economic growth.

[2] Press Release by Ministry of Urban Development on 07-May-2015 at 14:51 IST.

[3] Keynote Address by Union Urban Minister at US – India Smart Cities Conclave on November 22, 2014.

[4] Buildings and Climate Change, UNEP Sustainable Buildings and Climate Initiative (2009).

According to a study under the United Nations Environment Programme, buildings consume:



Residential and commercial buildings consume approximately

60% **of the world's electricity**

Benefits of Smart Buildings

According to a PricewaterhouseCoopers report, India will be the third largest construction market in the world by 2020. According to an Ernst and Young estimate, around nine billion square meters of incremental building stocks are being added in this decade (2011-20). Implementing smart building solutions that make buildings green, safe, and productive will save up to 30 percent of water usage, up to 40 percent of energy usage, and reduce overall building maintenance costs by 10-30 percent[5].

The economic and sustainability benefits of green buildings have been proven through extensive academic and applied research. For example, The Energy and Resources Institute (TERI) carried out a study to assess the economic benefits of making buildings green. According to the study, green buildings outperform traditional buildings on three key economic indicators: discounted payback period, lifecycle cost analysis, and savings-to-investment ratio. The study identified that by making a building green, while the capital cost increased from 4 percent to 32 percent, the lifecycle cost was lower, payback period of this incremental capital cost was one to three years, and the ratio of savings-to-investment ranged from 1.9 to 15.3[6]. According to another study by U.S. Green Building Council, valuations of buildings increased by 8.5 percent to 25 percent for Leadership in Energy and Environmental Design (LEED) certified buildings, thereby generating higher value for building owners[7].

Safety and security in buildings is not as well researched or illustrated as green buildings. In 2013, Honeywell carried out a study in India, to identify critical issues related to safety in buildings. According to the study, fire, earthquakes, terrorist attacks, and floods are generally identified as the biggest threats by building users. Among all of these, fire safety is the most significant safety issue (63 percent of all respondents). For example, fire in a prominent hospital in Kolkata in 2011 left 89 people dead and 57 injured. This triggered safety audits across the country. One of these audits[8] revealed that more than 50 percent of hospitals and 60 percent of high-rise buildings lacked adequate fire safety measures or did not follow minimum compliance requirements in major cities across the country. It is not only human losses (lives lost, medical treatment of injuries, pain, and suffering) but also economic losses (property damage, business interruption, and loss of reputation) that make a compelling argument for safe buildings.

The productive buildings conversation is still nascent. Their benefits are not as well recognized or documented as compared to those for green and safe buildings. However, this is the one area that is likely to see the fastest change in its relevance and importance. This change is driven by two major megatrends: connectivity and comfort. As in the rest of the world, the Internet of Things (IoT) is rapidly transforming lives. In India, a relatively younger population, rapid growth of internet and smartphone users, improvements in coverage and speed of internet connectivity on wireless platforms, will only accelerate this trend. A majority of buildings today don't have proactive measures to manage rapidly transforming connectivity needs. Another completely different megatrend is the increased sensitivity and awareness of a comfortable environment. While a lot of factors will come into play for sustaining the general environment, the role of buildings will transform in ensuring acceptable indoor air quality and other basic comfort factors. All of these will go a long way in making buildings smarter by being more productive.

[5] Energy Ensemble (2015), Retrieved on June 8, 2015 from http://energyensemble.com/news_details.php? news_id=240.

[6] Shukla (2013). Green Building Making Financial Sense. National Conference on Green Design. Stein Auditorium, India Habitat Center, New Delhi, February 14-15, 2013.

[7] Green Building Market and Impact Report (2011), U.S. Green Building Council.

[8] Pal & Ghosh (2014). Fire Incident at AMRI Hospital, Kolkata (India): A Real Time Assessment for Urban Fire. Journal of Business Management & Social Sciences Research (JBM&SSR), 3 (1) pp 9-13.

Smart Building Evaluation Framework

In our research on this subject, we came across multiple evaluation frameworks for buildings: Asian Institute of Intelligent Building, Building Research Establishment, Continental Automated Building Association, Intelligent Building Society of Korea, Shanghai Intelligent Building Appraisal Specification, Shanghai Construction Council, Intelligent Building Assessment – Architecture and Building Research Institute, and Leadership in Energy and Environmental Design (LEED) green building rating system. However, there is no single framework that can be used by all stakeholders such as users, occupants, developers, and policymakers; across countries (most frameworks are driven by industry associations within a geography); and comprehensively across the three broad aspects of smart buildings: green, safe, and productive. The most popular and successful rating system is LEED certification by the U.S. Green Building Council.

LEED focuses on impact related to green and some aspects of comfort (productivity). Similar deliberation on each of these scales leads to the conclusion that it will be useful to have a comprehensive and simple framework to drive smart building assessment and improvement[9].

The Honeywell Smart Building Score™ has been developed as a universal framework for quick, comprehensive, and easy assessment of any building. It can be administered across countries with minimal adaptation. The framework of the Honeywell Smart Building Score™ is also flexible and adaptable for future enhancements as applications and solutions for smart buildings continue to evolve.

[9] Chen Z., Clements-Croome D., Hong J., Li H., Xu Q. (2006). A Review of Quantitative Approaches to Intelligent Building Assessment. Renewable Energy Resources and a Greener Future,VIII-6 (2).

Honeywell Smart Building Score™

In simple terms, the Honeywell Smart Building Score™ focuses on scoring assets that make buildings green (energy efficiency, reuse of resources, use of clean energy), safe and secure (detection and response to threats, controlling access to the facility, securing lives and assets), and comfortable and productive (illumination, thermal comfort, air quality, connectivity, energy availability).

The Honeywell Smart Building Score™ has been developed with three broad guidelines:

- Only active components (devices/equipment, or software referred to as "assets" hereafter) of a smart building have been considered for evaluation. The passive components (architectural design, building location, building materials) once constructed rarely change much, and hence have not been considered in scoring. This feature also makes the Honeywell Smart Building Score™ relevant for both new and existing buildings.
- The Honeywell Smart Building Score™ measures the following:
  - Capability of assets in the building
  - Coverage or spread of the assets within the building
  - Uptime of assets
- The Score is an average of three outcomes of a smart building:
  - Green
  - Safe
  - Productive

Honeywell Smart Building Score™

GREEN

- Flexible cooling and heating
- Power consumption monitoring and control
- Energy-efficient electrical appliances and plumbing fixtures
- Conservation and efficient use of natural resources

SAFE

- Surveillance and intrusion monitoring
- Fire detection and notification
- People and vehicle screening and access control
- Disaster response
- Gas and water leakage detection and notification
- Worker safety and personal protection

PRODUCTIVE

- Uninterrupted power supply
- Wired communication and data infrastructure
- People, vehicle, and cargo movement management
- Wireless communication and data infrastructure
- Indoor environment comfort, quality, and control

***Each of these 15 assets was assessed on asset capability, asset coverage, and asset uptime.**

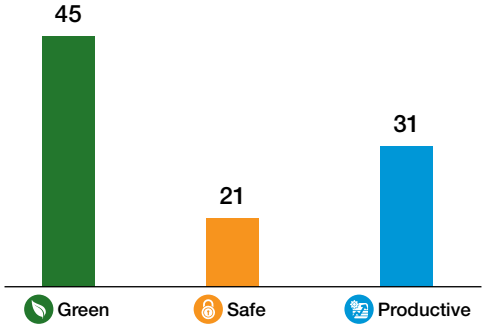
For the first time in India a survey was conducted to assess more than 2,000 buildings spread across eight cities: Ahmedabad, Bangalore, Chennai, Delhi, Hyderabad, Kolkata, Mumbai and Pune

National Survey using Honeywell Smart Building Score™

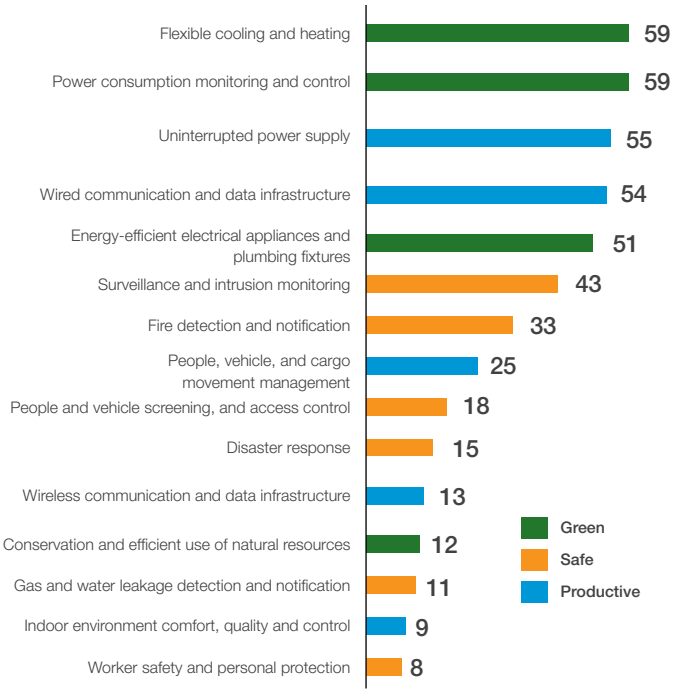
Key takeaways from the analysis of the Honeywell Smart Building Score™ survey include:

- **Buildings score highest on green, lowest on safe features:** Across building verticals, the scores on green attributes are much higher than on safe and productive. Discussions with multiple stakeholders reveal that the sustained focus on green buildings by institutions like Green Rating for Integrated Habitat Assessment (GRIHA) and Indian Green Building Council (LEED rating) is likely to have contributed to awareness and deployment of green technologies. Furthermore, the green building concept and its adoption have been catalysed by government support in the form of recognition by regulatory bodies and fiscal incentives provided by government and financial institutions. Scores on productive buildings rate second due to basic needs (backup power and basic connectivity), economic benefits in terms of attracting users (thereby better revenue), and reducing operating costs. Safe building scores are the lowest as most of the benefits of these investments show up in risk avoidance. Therefore, investments in assets making buildings safer are driven almost exclusively by compliance requirements. Both users and owners have not paid enough attention to safety aspects and the economics related to safety. The only vertical category where safe building scores are highest is airports.
- **Focus of smart system investments is still on basic needs of electricity, ventilation, and communication:** Five out of the fifteen asset groups drive the higher smart scores. Three of them (flexible cooling and heating, power consumption monitoring and control, and energy-efficient electrical appliances and plumbing fixtures) are related to energy indicating the scarcity, cost, and lack of reliability of this resource. It can be argued that all five relate to basic needs in a building and therefore the focus on them is not surprising. However, seven asset groups bring down the Honeywell Smart Building Score™ across all verticals. Four of these are in safe category, two in productive and one in green. This suggests that to make buildings smarter in India the focus should move from needs that ensure basic functioning of the building, to needs that enable and protect stakeholders better.

Honeywell Smart Building Score™



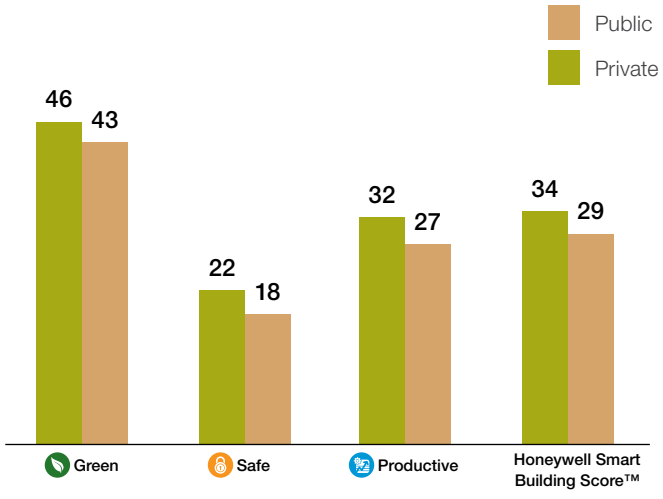
Overall Average 33



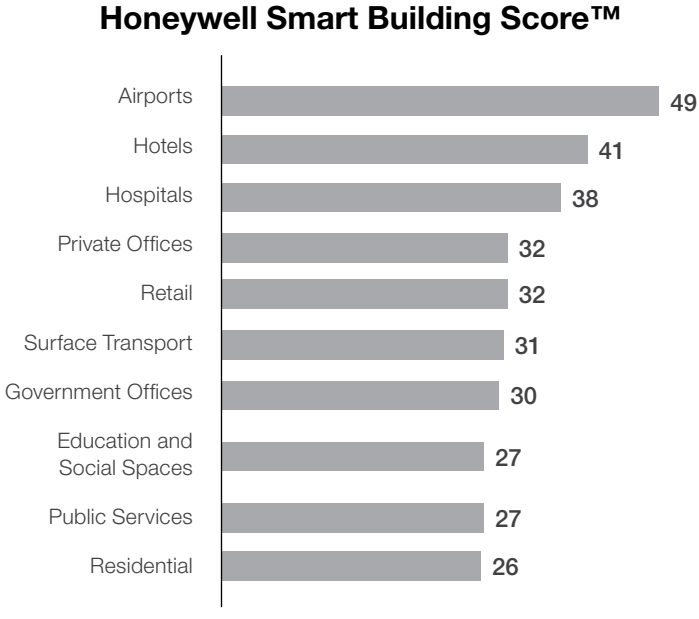
SURVEY ACROSS 10 VERTICALS

Airports
Hotels
Hospitals
Private Offices
Retail
Surface Transport
Government Offices
Education and Social Spaces
Public Services
Residential

- **Public and private buildings have similar scores:** The scores are not very different between private and public sector buildings both on the overall Honeywell Smart Building Score™, or green, safe, and productive scores. This shows that not only is there broad opportunity across building types for smart improvements, but both the public and private sectors play important roles in helping drive the actions necessary to make buildings smarter. Until now the task of making a city smart has been seen as primarily the government's prerogative. Our research concludes that the private sector will need to take equal ownership in making Indian buildings smart and, therefore, cities smarter.



- **Airports and hotels have the smartest buildings; residential and education building verticals have the least smart buildings:** The Honeywell Smart Building Score™ varies widely depending on building type. Airports score highest, while residential buildings score lowest. It is notable that critical infrastructure serving important segments of the public such as hospitals, schools, courts, and administrative buildings, have scored low. This makes a clear case for building owners, developers, and operators to do more to make these buildings smarter. It is also critical that the government and policymakers drive the movement towards smart buildings both as examples through public buildings (public services, government offices, surface transport, education and social spaces) and guidelines and incentives for private buildings (residential, retail, private offices). Detailed analysis and strategies for each of the 10 verticals studied is presented in the annexure to this white paper.



Conclusion: Need for Action for Smart Buildings

Results from this first national research to assess building smartness suggest a clear need for action from all stakeholders:

Government and Policymakers

- Use the score to measure building smartness to drive the larger smart cities vision. Make smart building measurement an integral component of smart city guidelines
- Widen the focus of incentives and guidelines for green buildings to include safe and productive buildings
- Drive a smart city experience for the public by focusing on making public buildings smarter
- Create guidelines and stronger policies for driving private sector participation in the 100 Smart Cities initiative by focusing on key private sector buildings

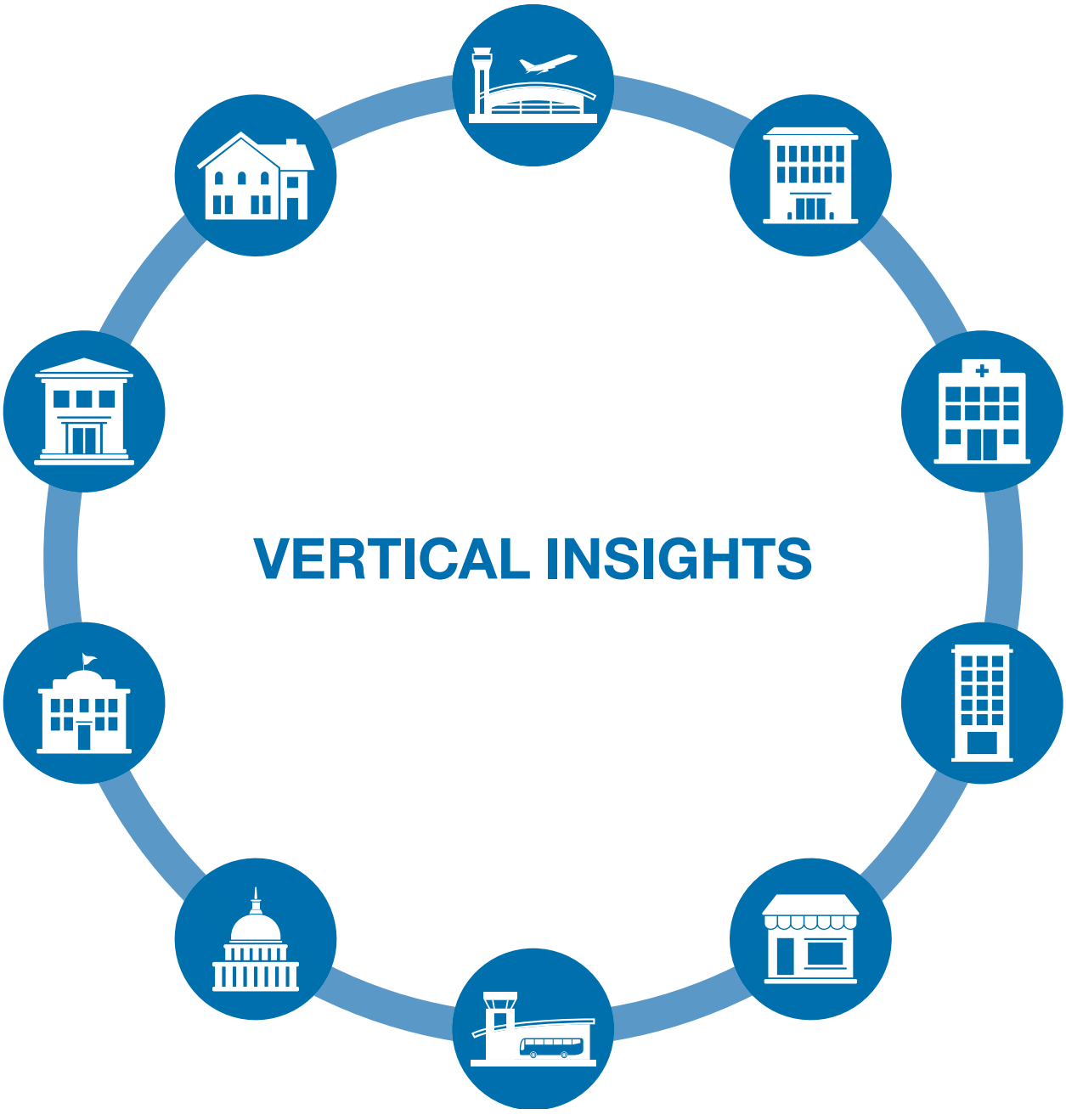
Users, Owners, and Developers

- Enhance building smartness by focusing on all three aspects: asset capability, asset coverage, and asset uptime
- Use the Honeywell Smart Building Score™ to make informed leasehold and purchase decisions
- Use vertical-specific strategies to drive building smartness effectively and efficiently

Industry Associations, Consultants, Architects, and Service Providers

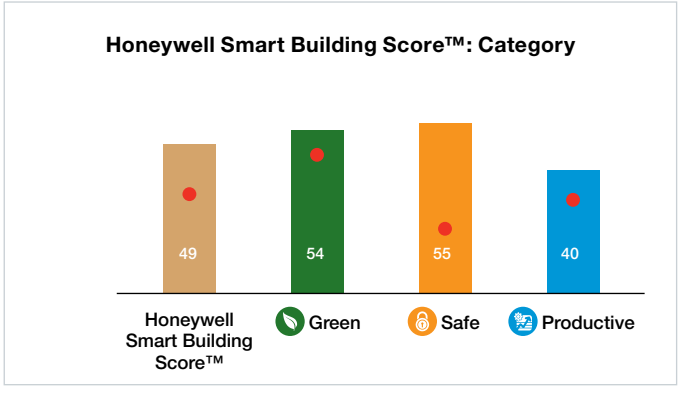
- Building on increased awareness and impact of the green building movement, push similar research on benefits of safe and productive buildings as well
- Deploy best practices and benchmarks identified in this white paper
- Educate users and owners, and advocate smart building benefits to policymakers
- Demonstrate the economic argument for smart buildings to make smarter cities

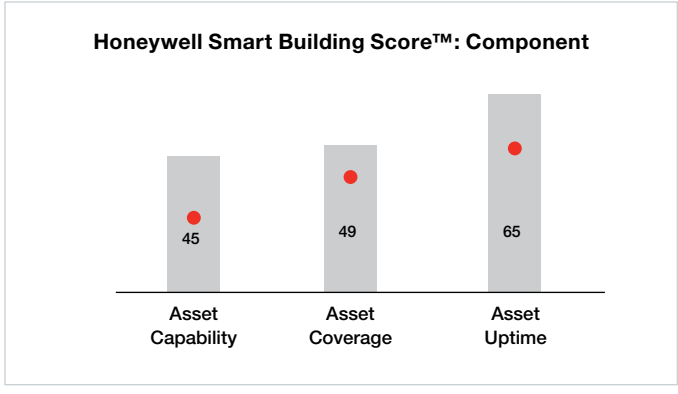
Annexure



AIRPORTS

The airports vertical comprises domestic and international passenger terminal buildings.





● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for airports:

Green	Safe	Productive
• Flexible cooling and heating • Energy-efficient electrical appliances and plumbing fixtures • Power consumption monitoring and control	• Surveillance and intrusion monitoring • Fire detection and notification • Disaster response • Worker safety and personal protection	• Uninterrupted power supply • Wired communication and data infrastructure

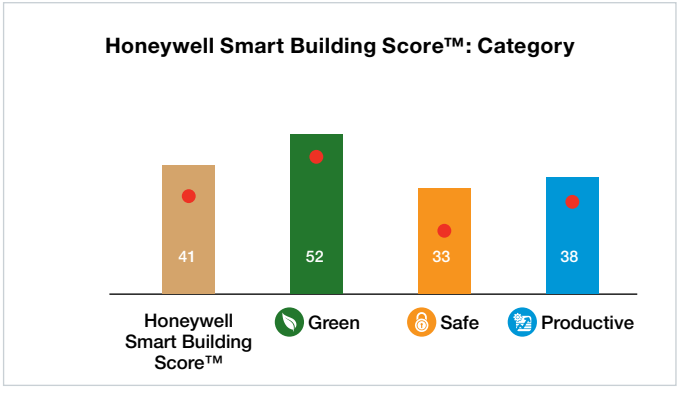
The data clearly indicates that this vertical has the smartest buildings in India. While this wasn't surprising, it is interesting that this is the only vertical where the safe scores are higher than green scores. Given how much energy is consumed in airports, it is a clear area for improving the Honeywell Smart Building Score™. Further, most of the assets in this vertical have relatively higher uptime and significant coverage compared to other building verticals.

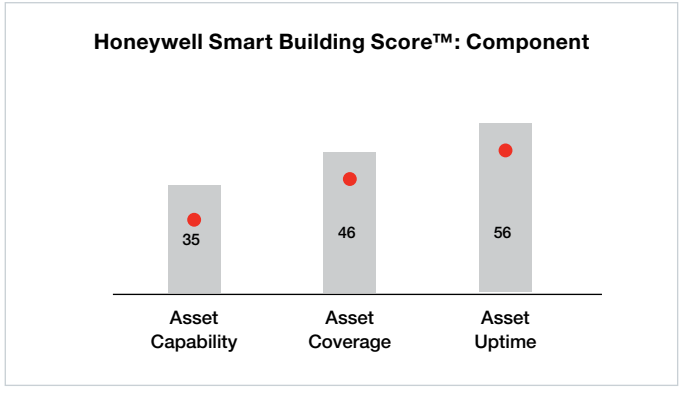
How can airports become smarter?

- **Green:** Conservation and efficient use of natural resources for such uses as solar panels for electricity generation and water heating, and solid waste and water recycling
- **Productive:** Improve productivity and user experience by making seamless wireless communication available across the terminal building. Ensure smooth circulation and movement of people and vehicles to reduce crowding or queuing. Focus on managing indoor environment comfort, quality, and control

HOTELS

The hotels vertical includes luxury, mid-segment, and budget hotels.





● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for hotels:

Green	Safe	Productive
• Flexible cooling and heating • Power consumption monitoring and control • Energy-efficient electrical appliances and plumbing fixtures	• Surveillance and intrusion monitoring • Fire detection and notification	• Uninterrupted power supply • Wired communication and data infrastructure

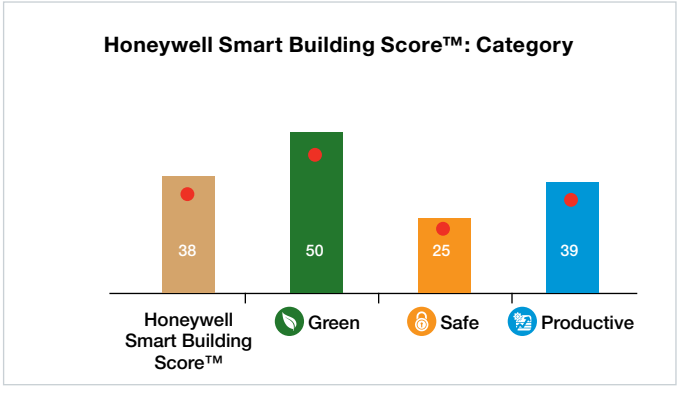
Among privately owned buildings, hotels stand out as the smartest. Hotels have smarter buildings than the national average in all three categories: green, safe and productive. Further, most assets in this vertical have relatively higher uptime and coverage compared to other building verticals. However, there is significant variation in scores between luxury and other hotel categories in terms of fire safety and systems for screening people, vehicles, and cargo.

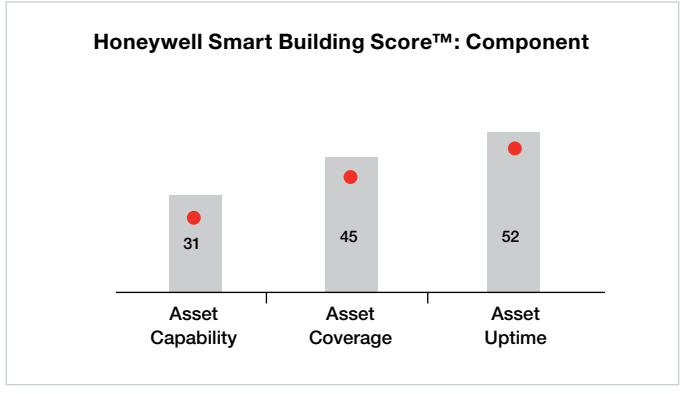
How can hotels become smarter?

- **Green:** Focus on conservation and efficient use of natural resources, such as use of solar water heaters to provide pre-heated water for boilers for laundry and kitchen applications
- **Safe:** Emulate airports, which score highest in surveillance and intrusion monitoring, and fire detection and notification systems. Provide better systems for water and gas leakage detection, disaster response, and health and worker safety and personal protection
- **Productive:** Improve systems for indoor environment comfort, quality, and control. Focus on improving productivity and user experience by making wireless communication and data infrastructure connectivity seamless and available across the building

HOSPITALS

The hospitals vertical includes super-specialty hospitals, secondary care hospitals, and other healthcare facilities.





● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for hospitals:

Green	Safe	Productive
• Flexible cooling and heating • Power consumption monitoring and control • Energy-efficient electrical appliances and plumbing fixtures	• Surveillance and intrusion monitoring	• Wired communication and data infrastructure • Uninterrupted power supply

The hospitals vertical ranks among the smartest buildings in India, after airports and hotels. Like hotels, in this vertical too, there is a significant dispersion in scores between the high-end hospitals and the rest. Further, most of the assets in this vertical have higher uptime and coverage compared to other building verticals, indicating the criticality of system performance in hospitals.

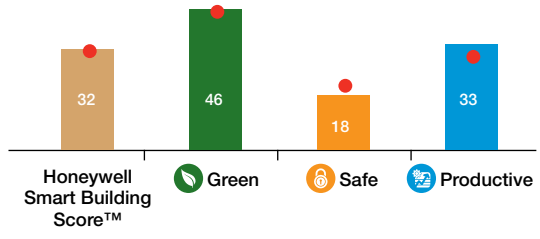
How can hospitals become smarter?

- **Green:** Focus on conservation and efficient use of natural resources
- **Safe:** Given the criticality of safety in hospitals, focus on fire detection and notification is essential. Improve access and screening systems for people, vehicles, and cargo. Improve disaster response, worker safety and personal protection, and gas and water leakage detection and notification systems
- **Productive:** Providing a comfortable environment is critical to hospitals. Healthcare facilities also have large transit populations of users and occupants. Focus on indoor environment comfort, quality, and control systems. Improve productivity and user experience by making wireless communication and data infrastructure seamless and available across the building. Also improve systems for people, vehicle and cargo movement management

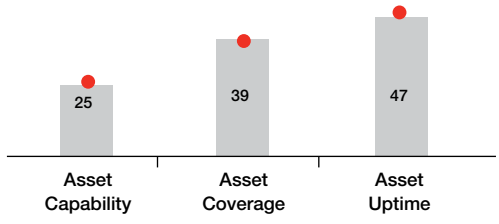
PRIVATE OFFICES

The private offices vertical includes high-end and mid-segment office spaces.

Honeywell Smart Building Score™: Category



Honeywell Smart Building Score™: Component



● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for private offices:

Green	Safe	Productive
• Flexible cooling and heating • Power consumption monitoring and control • Energy-efficient electrical appliances and plumbing fixtures	• Surveillance and intrusion monitoring	• Uninterrupted power supply • Wired communication and data infrastructure

The scores for private offices are only higher than the scores for government offices. However, it is surprising that the difference is very small. The scores are below national averages for two categories: safe and productive. Further, uptime and coverage for most assets are similar to the national average. Given the multitude of these buildings, it is important for policymakers to focus on this vertical as a driver for smart cities.

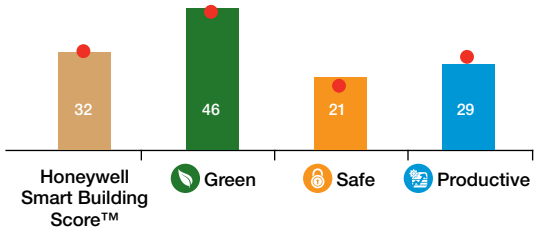
How can private offices become smarter?

- **Green:** Focus on conservation and efficient use of natural resources
- **Safe:** Improve people and vehicle screening and access control. Focus on fire detection and notification. Improve disaster response, worker safety and personal protection, and gas and water leakage detection and notification systems
- **Productive:** Focus on indoor environment comfort, quality and control systems. Improve productivity and user experience by making wireless communication and data infrastructure seamless and available across the building. Also improve systems for people, vehicle and cargo movement management

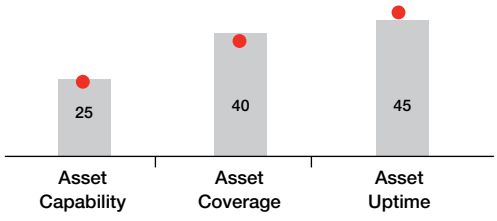
RETAIL

The retail vertical includes malls and shopping complexes.

Honeywell Smart Building Score™: Category



Honeywell Smart Building Score™: Component



● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for the retail vertical:

Green	Safe	Productive
• Flexible cooling and heating • Power consumption monitoring and control • Energy-efficient electrical appliances and plumbing fixtures	• Surveillance and intrusion monitoring	• Uninterrupted power supply • Wired communication and data infrastructure

The retail vertical has the most consistent correlation of scores with national averages across all assets and categories. Making this vertical smarter could have the maximum impact on the lives of a large number of people.

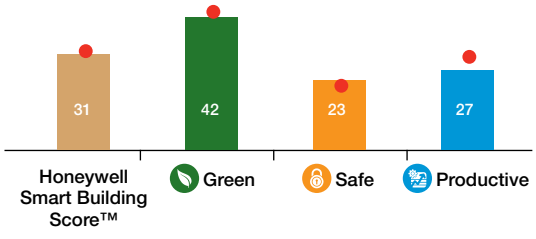
How can retail buildings become smarter?

- **Green:** Drive conservation and efficient use of natural resources
- **Safe:** Focus on fire detection and notification. While people access cannot be limited, improve access control and screening systems for people and vehicles. Improve disaster response, worker safety and personal protection, and gas and water leakage detection and notification systems
- **Productive:** Emulate airports in improving productivity and user experience by making wireless communication and data infrastructure seamless and available across the building. Improve systems for indoor environment comfort, quality and control. Focus on people, vehicle and cargo movement management, especially for the large transit user population

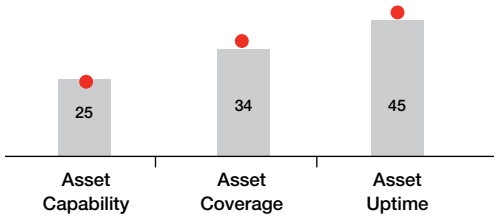
SURFACE TRANSPORT

The surface transport vertical includes metro stations, railway stations, and bus terminals.

Honeywell Smart Building Score™: Category



Honeywell Smart Building Score™: Component



● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for the surface transport vertical:

Green	Productive
• Flexible cooling and heating	• Uninterrupted power supply
• Power consumption monitoring and control	• Wired communication and data infrastructure
• Energy-efficient electrical appliances and plumbing fixtures	

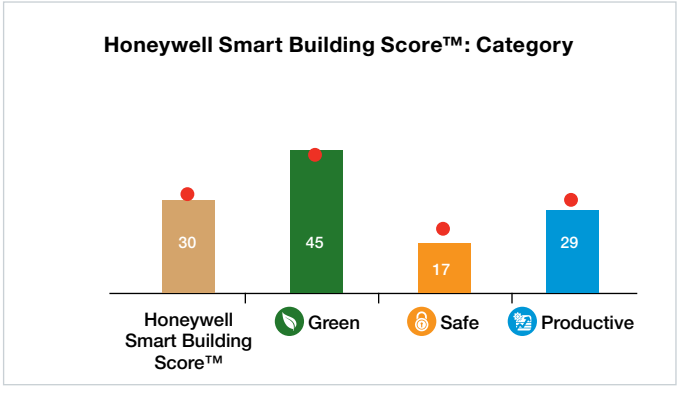
A large number of people pass through these buildings every day. The average citizen can truly experience the difference in moving to smarter cities if these buildings become smarter. However, most scores are close to national averages – this indicates a significant opportunity for improvement.

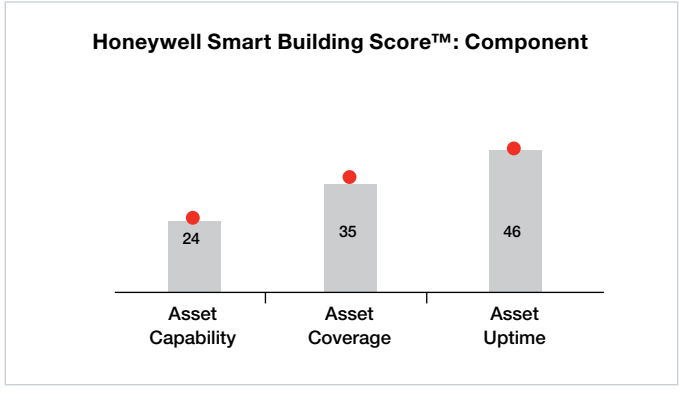
How can surface transport buildings become smarter?

- **Green:** Focus on conservation and efficient use of natural resources
- **Safe:** Emulate airports in people and vehicle screening and access control, disaster response, worker safety and personal protection, and gas and water leakage detection and notification systems
- **Productive:** Improve productivity and user experience by making wireless communication and data infrastructure seamless and available across the building. Improve indoor environment comfort, quality and control management, and people, vehicle and cargo movement management

GOVERNMENT OFFICES

The government offices vertical includes central and state government administrative buildings.





● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for government offices:

Green	Productive
• Flexible cooling and heating	• Wired communication and data infrastructure
• Power consumption monitoring and control	• Uninterrupted power supply
• Energy-efficient electrical appliances and plumbing fixtures	

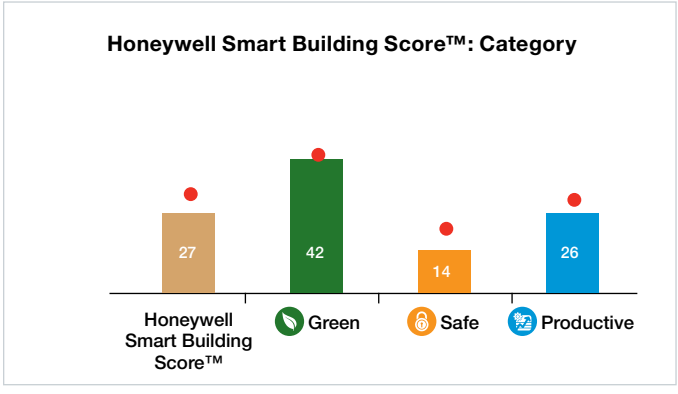
This vertical scores below the national averages in two categories: safe and productive. Further, uptime and coverage for most assets are similar to national average. Government offices must take the lead in driving building smartness benchmarks in the country.

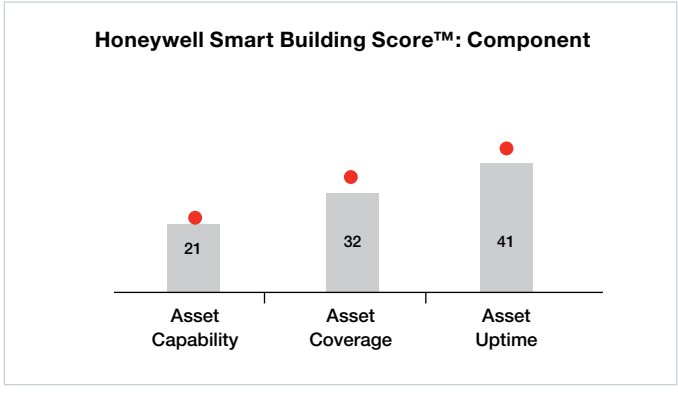
How can government office buildings become smarter?

- **Green:** Focus on conservation and efficient use of natural resources
- **Safe:** Focus on fire detection and notification. Given the need to manage access and information security in these offices, need to improve surveillance and intrusion monitoring. Improve access control and screening systems for people and vehicles. Improve disaster response, worker safety and personal protection, and gas and water leakage detection and notification systems
- **Productive:** Focus on indoor environment comfort, quality and control systems. Improve productivity and user experience by making wireless communication and data infrastructure seamless and available across the building. Improve people, vehicle, and cargo movement management systems

EDUCATION AND SOCIAL SPACES

The education and social spaces vertical includes schools, sports complexes, museums, and heritage buildings.





● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for education and social spaces:

Green	Productive
• Flexible cooling and heating	• Uninterrupted power supply
• Power consumption monitoring and control	• Wired communication and data infrastructure
• Energy-efficient electrical appliances and plumbing fixtures	

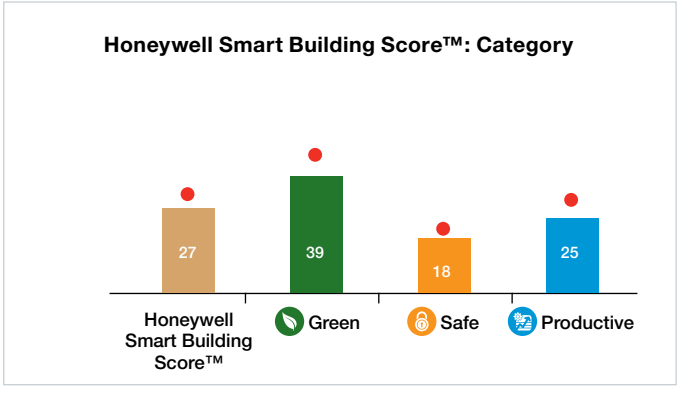
This vertical scores below the national averages in all three categories: green, safe and productive. Most assets have lower uptime and coverage compared to other building verticals. Safe scores are lowest in this vertical.

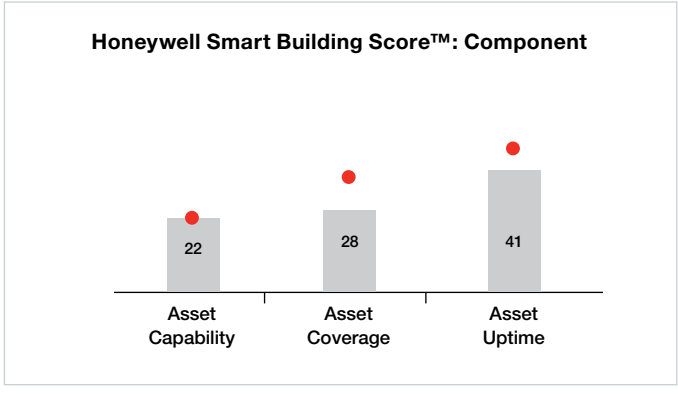
How can education and social space buildings become smarter?

- **Green:** Focus on conservation and efficient use of natural resources
- **Safe:** Focus on fire detection and notification. Improve access control and screening systems for people and vehicles. Improve disaster response, worker safety and personal protection, and gas and water leakage detection and notification. Focus on surveillance and intrusion monitoring especially because users include children and large masses of people
- **Productive:** Focus on indoor environment comfort, quality and control systems. Improve productivity and user experience by making wireless communication and data infrastructure seamless and available across the building. Improve people, vehicle and cargo movement management

PUBLIC SERVICES

The public services vertical includes police stations, fire stations, courts, passport offices, post offices, and prisons.





● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for the public services vertical:

Green	Productive
• Flexible cooling and heating	• Uninterrupted power supply
• Power consumption monitoring and control	• Wired communication and data infrastructure

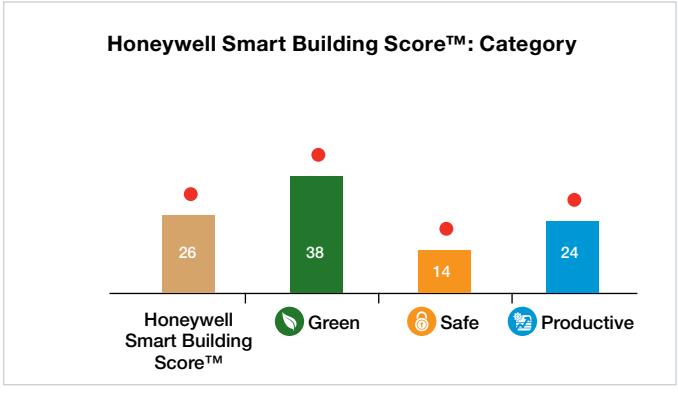
This vertical scores below national averages for all three categories: green, safe and productive. It ranks lowest on green scores. Uptime and coverage for most assets are below national average as compared to other building verticals.

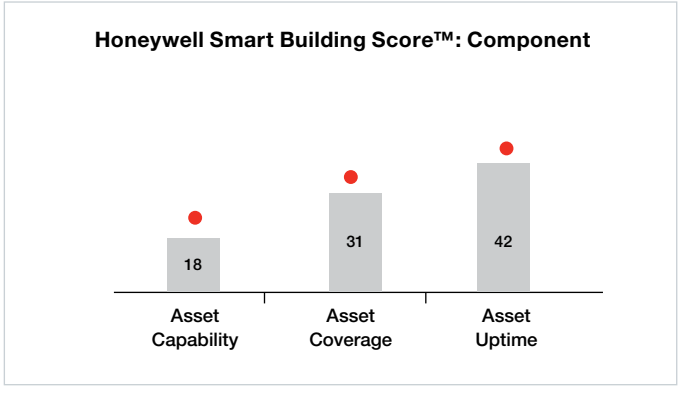
How can public service buildings become smarter?

- **Green:** Focus on conservation and efficient use of natural resources. Use energy-efficient electrical appliances and plumbing fixtures
- **Safe:** Focus on fire detection and notification, surveillance and intrusion monitoring. Improve access control and screening systems for people and vehicles. Improve disaster response, worker safety and personal protection, and gas and water leakage detection and notification systems
- **Productive:** Focus on indoor environment comfort, quality and control systems. Improve productivity and user experience by making wireless communication and data infrastructure seamless and available across the building. Improve people, vehicle and cargo movement management

RESIDENTIAL

The residential vertical includes high rise apartment units in both private and public sector housing complexes.





● Average across 2,000 buildings

Assets that significantly drive the Honeywell Smart Building Score™ for the residential vertical:

Green	Safe	Productive
• Power consumption monitoring and control • Use of energy-efficient electrical appliances and plumbing fixtures	• Surveillance and intrusion monitoring	• Uninterrupted power supply

The residential vertical scores below the national averages in two categories: green and safe. In fact, it has the lowest safety score across all verticals. Most assets have lower uptime and coverage compared to other building verticals. This vertical has poor wireless communication and data infrastructure.

How can residential buildings become smarter?

- **Green:** Focus on conservation and efficient use of natural resources
- **Safe:** Focus on fire detection and notification, and surveillance and intrusion monitoring. Improve disaster response, worker safety and personal protection, and gas and water leakage detection and notification systems
- **Productive:** Focus on indoor environment comfort, quality and control systems. Improve broadband infrastructure, and make wireless communication and data infrastructure seamless

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