Introduction

Carrier, its parent company, United Technologies Corporation, and Dodge Data & Analytics (then known as McGraw Hill Construction) first began collaborating on this research program in 2008 because both companies believed green building was poised to transform construction on a global scale. This 2018 edition of the research demonstrates that their vision has been fulfilled, more than either could have imagined.

This report compares data from the latest study (2018) to previous ones in the series (2012 and 2015), analyzing the level of green activity, the benefits of building green, the triggers most likely to spur further green market growth and the challenges that may impede it.

One of the most encouraging trends is the increasing percentage of respondents who expect to do the majority of their projects (more than 60%) green in most of the 20 countries/regions included in this study. The global average for this group is expected to increase from 27% to 47% between 2018 and 2021, and in about half of the locations, the percentage who expect they will be doing the majority of their projects green by 2021 is expected to double. This trend analysis clearly demonstrates increasing global commitments to building green.

This year’s study also features a deep look into the importance of healthier buildings as an element of green building. Findings validate its importance globally, with particular strength in diverse markets like China, Colombia, India, Ireland and South Africa, as well as the US. This is an emerging priority that can be expected to gain increasing traction in future studies.

Consistent with previous studies, the top challenges and triggers vary strongly by market, and thus, each market is analyzed in regional/country sections. Some of these sections compare the 2018 responses to those from 2015, providing a unique vantage point into the priorities and drivers in some of the top green markets in the world.

Among the most compelling elements of the data are the strong business benefits reported for both new green buildings and green renovations/retrofits of existing buildings. The findings since 2012 have clearly demonstrated the value of investing in green. For example, there has been a steady growth since 2012 in the number of owners who see a 10% or greater increase in asset value for new green buildings compared with traditional ones.

We would like to thank Carrier for their partnership on this research since 2008. We also thank the other organizations whose support made this SmartMarket Report possible, including the American Institute of Architects, Autodesk and the US Green Building Council, as well as the efforts of the World Green Building Council in advising on the study and promoting participation among its members.
Green building activity continues to grow across the globe, with dramatic increases expected in 20 countries across five continents between now and 2021. The latest in a series of studies, the findings show great consistency in the benefits derived from green with previous studies in 2012 and 2015, but they also demonstrate the increasing influence of social factors like creating a sense of community, encouraging sustainable business practices and especially improving occupant health and well-being.

**Green Building Activity Is Increasing, But Is Not Always Certified**

For the first time, global respondents were asked two questions about their level of green activity: the percentage of their projects considered green using a definition provided in the survey, and the percentage of their projects that are or will be certified under a recognized green building system. (See the Methodology on page 75 for the definition provided for green building.)

The chart at right reveals the total share of green projects reported by all global participants in the study currently, and the expected share in three years. It demonstrates that green building activity will increase, and, even more important, it shows that most of the increase comes from a large percentage of respondents (47%) who believe that they will build the majority of their projects (more than 60%) green by 2021.

The findings also reveal that some respondents who do the majority of their projects green are not certifying all of those projects. More important, the gap among those doing the majority of their projects green and those who are actually seeking green certification on the majority of their projects is expected to grow between 2018 and 2021. This indicates that green activity is expected to exceed certification activity and may suggest that those experienced with green are using certification more strategically.

**Growth in Green Driven by Ongoing Strong Business Benefits**

The table at right shows the significant operating cost savings, short payback periods and asset value increases achieved from investments in new green buildings and green retrofit projects reported by respondents in the current study and the two previous ones in 2012 and 2015. The savings achieved, the payback periods and the increased asset values are strikingly consistent, despite changes in the number of respondents, in geographies and in global economic conditions over those years. These business benefits form the foundation that helps promote the growth of further green building activity.

**Level of Green Building Activity**

(According to Global Respondents)

<table>
<thead>
<tr>
<th>Type of Green Building Activity</th>
<th>2018</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% to 15% Green Projects</td>
<td>21%</td>
<td>10%</td>
</tr>
<tr>
<td>Exploring (No Green Involvement)</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>16% to 30% Green Projects</td>
<td>22%</td>
<td>17%</td>
</tr>
<tr>
<td>31% to 60% Green Projects</td>
<td>27%</td>
<td>19%</td>
</tr>
<tr>
<td>More Than 60% Green Projects</td>
<td>47%</td>
<td>19%</td>
</tr>
</tbody>
</table>
Executive Summary

Client Demands and Environmental Regulations Remain the Top Triggers for Building Green
The current findings, represented in the chart at right, closely echo those of the previous 2015 study. The top triggers demonstrate that the market is pulled by client demand and pushed by environmental regulations globally. However, the importance of these and other triggers vary significantly by country.

Creating Healthier Buildings Is a Priority for Green Building
Creating healthier buildings is also an important trigger for green building globally, especially in Brazil, China, India, South Africa and the US. In addition, improving occupant health ranks first among the social reasons for building green, and the percentage selecting it has jumped 5 points from the 2012 study.

Social Reasons for Building Green Gain in Importance Over Time
Consistent with the 2012 and 2015 studies, respondents in 2018 were asked to rank several social reasons for building green on a one to five scale, from not important to very important. The chart at right shows the percentage who consider several of the reasons provided to be important/very important.

In addition to demonstrating the importance of healthier buildings, the chart shows a general trend of ascribing increased importance to the social reasons for building green over time, especially increasing worker productivity, creating a sense of community and supporting the domestic economy.

Obstacles to Building Green
Respondents citing higher first costs as a top obstacle has dropped from 76% in 2012 to only 49% in 2018. However, despite the drop, it still remains the top barrier in 2018.

Three additional barriers are selected by roughly one third of the respondents: lack of political support or incentives, affordability (green is for high-end projects only) and lack of public awareness. The degree to which each of these barriers is influential varies a great deal by country, suggesting different strategies are needed to promote green globally.
Respondents from China are divided into two groups for this analysis: those from Mainland China and those from Hong Kong. This is done to give a more specific portrait of these two very different markets. Also, the makeup of respondents in each of these groups is also different. Almost half (46%) of respondents from Hong Kong report that their company is a member of a green building council (GBC), while only 14% of respondents of Mainland China report that their companies are members. The low participation of members of green building councils may be reflected in the low share of green activity shown in the data from Mainland China.

**Green Building Market Activity**

The current levels of green activity in Hong Kong are much higher than those reported in Mainland China, with 53% of those in Hong Kong currently doing more than 30% of their projects green, compared with 35% in Mainland China.

Expectations about the level of green work by 2021 in Mainland China suggest the possibility of strong growth, with the percentage expecting to do more than 30% of their projects green almost doubling to 67%. However, the highest percentage fall in the moderate level of green building category between 31% and 60%.

In Hong Kong, the shift is less dramatic, in part due to the high level of green building already happening in this market. Those expecting to do more than 60% of their projects green by 2021 grows by 5 percentage points over the current figure, with a corresponding shift down among those doing fewer than 15% of their projects green. This steadier, moderate level of growth suggests that the Hong Kong green market is in a relatively mature state, while the explosive growth anticipated on the Mainland points to an emerging green market.

### SECTORS WITH EXPECTED GROWTH

Respondents from Mainland China expect to be engaged in green in multiple sectors, with relatively high percentages reported for several sectors, compared both to the global averages and to the percentages from Hong Kong. The percentages of Mainland China respondents are significantly higher than those in Hong Kong for two sectors (new institutional construction and commercial interiors) and directionally higher for three (new commercial construction, new low-rise residential construction and communities). Since the previous finding shows a higher level of green activity in Hong Kong than in Mainland China, this may suggest more specialization by sector-type for green projects among Hong Kong respondents than among those from the Mainland.

- **Mainland China**: The sectors reported by the highest percentage in Mainland China are new commercial construction (65%), new institutional construction (54%), new high-rise residential (49%) and commercial interiors (43%).

### Levels of Green Building Activity for Respondents in China (2018 and 2021 Expected)

<table>
<thead>
<tr>
<th>Sector</th>
<th>2018</th>
<th>2021</th>
<th>2018</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mainland China</strong></td>
<td>1%</td>
<td>9%</td>
<td>26%</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Hong Kong</strong></td>
<td>17%</td>
<td>5%</td>
<td>11%</td>
<td>3%</td>
</tr>
<tr>
<td><strong>1% to 15% Green Projects</strong></td>
<td>37%</td>
<td>37%</td>
<td>11%</td>
<td>12%</td>
</tr>
<tr>
<td><strong>Exploring (No Green Involvement)</strong></td>
<td>18%</td>
<td>18%</td>
<td>24%</td>
<td>11%</td>
</tr>
<tr>
<td><strong>More Than 60% Green Projects</strong></td>
<td>16%</td>
<td>16%</td>
<td>11%</td>
<td>3%</td>
</tr>
<tr>
<td><strong>31% to 60% Green Projects</strong></td>
<td>18%</td>
<td>18%</td>
<td>24%</td>
<td>11%</td>
</tr>
<tr>
<td><strong>16% to 30% Green Projects</strong></td>
<td>12%</td>
<td>12%</td>
<td>24%</td>
<td>11%</td>
</tr>
</tbody>
</table>
Hong Kong: New commercial construction also tops the sectors for Hong Kong at 59%, but close behind is new high-rise residential at 52%. The percentage expecting to do green high-rise residential work in Hong Kong is not only higher than that on Mainland China but is the second highest among the countries included in the study, with only Vietnam (61%) with a higher percentage expecting to work in this sector.

Influence Factors for Future Green Building Activity

TRIGGERS
The most important triggers for new green building activity vary widely between Mainland China and Hong Kong.

Mainland China: The top triggers are market demands and healthier buildings. Doing the right thing and branding/PR are also important drivers for this market.
- Mainland China has the highest percentage of respondents who consider branding/PR a top trigger of all the countries included in the study. This is likely because green building activity is still relatively low, which means that firms can still distinguish themselves through the efforts to build green, unlike in more mature green markets like Hong Kong.
- Doing the right thing also is more important on the Mainland than in Hong Kong. Again, this is often a bigger driver in emerging green markets than in more established ones.

Hong Kong: The top two triggers in Hong Kong are client demands and environmental regulations. Both factors that are not highly rated in Mainland China. In general, the top triggers in Hong Kong more closely mirror global averages than in Mainland China, with the exception of doing the right thing, which has less sway in Hong Kong than in most of the countries included in the study.

CHALLENGES
While the triggers for green projects differ, the top three challenges to more green building are the same for the Mainland China and Hong Kong respondents.

Higher First Costs: This challenge is selected by 49% of Mainland respondents and 43% of those from Hong Kong.

Affordability (perception that green is for higher-end projects only): 38% of Mainland respondents and 32% from Hong Kong select this challenge.

Lack of Political Support/Incentives: 30% of Mainland respondents and 39% of Hong Kong respondents select this one.

Social and Environmental Reasons for Building Green

SOCIAL REASONS
When asked to rate the importance of the six social reasons for building green included in the study, about three quarters of respondents from Mainland China rate five of the reasons as important: creates a sense of community (78%), supports the domestic economy (78%), improved occupant health and well-being (76%), promotes...
sustainable business practices (73%) and is aesthetically pleasing (70%). Respondents from Hong Kong are more tempered in their responses. The highest percentage from Hong Kong are the 68% who rate improved occupant health and well-being as an important reason, followed by 61% for sustainable business practices.

However, when those who rated several items as important were asked to select their top two reasons, there is much greater parity in the responses between Mainland China and Hong Kong.

- The top reason for both is also the one with the greatest disparity: 77% of respondents from Hong Kong select improved occupant health and well-being among their top two, compared with only 54% of those from Mainland China.
- The second most important social reason for both is creates a sense of community, with around half of the respondents from both locations placing it among their top two.
- The third most important social reason for building green, selected by 48% from Mainland China and 41% from Hong Kong, is promoting sustainable business practices.

**ENVIRONMENTAL REASONS**

As with the social reasons, the Mainland respondents tend to rate most of the environmental reasons for building green higher than those from Hong Kong.

- Both have a high percentage who consider reducing energy consumption important (89% in Mainland China and 80% in Hong Kong).
- The biggest gap falls in their estimation of the importance of improving indoor air quality, which is rated as important by 87% in Mainland China and 64% in Hong Kong.
- The only environmental reason rated as important by a higher percentage in Hong Kong (84%) than in Mainland China (73%) is lowering greenhouse gas emissions.

When those who rated several environmental reasons were asked to select their most important, 86% of those in Hong Kong who consider reducing energy consumption important selected it as one of the top two factors, compared with 70% of those from Mainland China.

A higher percentage of Hong Kong respondents (34%) also consider lowering greenhouse gas emissions a top environmental reason than those from Mainland China (19%).

Conversely, 48% of those in Mainland China who consider protecting natural resources important selected it as one of their top two reasons, compared to just 20% from Hong Kong. Mainland respondents also more frequently select improving indoor air quality (34%) as a top environmental reason for building green than do respondents from Hong Kong (21%).

**Business Benefits**

Respondents from Mainland China and Hong Kong are conservative about the percentage of operating cost savings they can expect for new green buildings. Both their one year (5%) and their five-year (9%) estimated savings are well below the global averages of 8% and 14%, respectively. However, respondents from Mainland China expect to see payback in five years, notably under the global average of seven years, while the average payback in Hong Kong is nine years.

The same holds true for green retrofits and renovations, which are also notably under the global averages of 9% savings in one year and 13% savings in five years. Payback time reported on Mainland China, though, matches the global average of six years, while payback in Hong Kong is expected to take nine years.

### Expected Business Benefits of Green Building in China

<table>
<thead>
<tr>
<th></th>
<th>New Green Building</th>
<th>Green Retrofit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mainland</td>
<td>Hong Kong</td>
</tr>
<tr>
<td>Decreased Operating Costs Over One Year</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Decreased Operating Costs Over Five Years</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Payback Time for Green Investments (Years)</td>
<td>5</td>
<td>9</td>
</tr>
</tbody>
</table>
Methodology:

World Green Building Trends Research

The World Green Building Trends Study was conducted to achieve the following objectives: 1) identify triggers, obstacles and reasons for adopting green building in the domestic marketplace; 2) measure past, current and future levels of activity in green building; 3) identify important construction sectors for growth in green building; 4) measure the impact of green building practices on business operations; 5) profile the use of green building products and/or methods; and 6) uncover trends in the industry through comparison with relevant findings from the 2012 and 2015 Global Trends in Green Building Studies.

The study was conducted between April and June 2018. It was fielded using panel providers, email blasts and association broadcast to members, or by forwarding the link to other groups as follows: 1) multiple Green Building Councils across the world sent email invitations to their members; 2) several associations (AIA, ACE, CIOB, IMEI and USGBC) sent the survey link to members; and 3) the survey was sent to a Dodge Data & Analytics database of industry professionals.

Study Participants
2,078 architects, engineers, contractors, owners, specialists/consultants and investors responded to the survey. All respondents were required to be employed construction professionals and to have non-building projects account for no more than 50% of their office’s revenue.

The distribution of respondent is as follows:
- Architect/Design Firm: 25%
- Contractor/Builder: 23%
- Specialist/Consultant: 21%
- Owner/Developer: 18%
- Engineering Firm: 12%
- Investor: 1%

Respondents were located in 86 countries, listed on page 76. Sufficient responses were provided for statistically significant analysis to be conducted for 19 countries, also listed on page 76.

COUNTRIES FEATURED
The percentage of respondents by the countries featured in report are as follows, along with the percentage of respondents from that country who are members of a green building council (GBC):
- Australia: 5% of total; 63% GBC respondents
- Brazil: 2% of total; 12% GBC
- Canada: 3% of total; 68% GBC
- China Mainland: 2% of total; 14% GBC
- China Hong Kong: 2% of total; 46% GBC
- Colombia: 6% of total; 32% GBC
- Germany: 2% of total; 8% GBC
- India: 19% of total; 51% GBC
- Ireland: 1% of total; 61% GBC
- Mexico: 3% of total; 20% GBC
- Norway: 4% of total; 73% GBC
- Poland: 3% of total; 39% GBC
- Saudi Arabia: 2% of total; 8% GBC
- Singapore: 3% to total; 28% GBC
- South Africa: 4% of total; 52% GBC
- Spain: 1% of total; 65% GBC
- UAE: 2% of total; 48% GBC
- UK: 4% of total; 13% GBC
- US: 16% of total; 53% GBC
- Vietnam: 3% of total; 39% GBC

Benchmark of Accuracy
The total sample size of 2,078 benchmarks at a high degree of accuracy: 95% confidence interval with a margin of error of 2%.

Definition of Green Building
Respondents were asked about their company’s level of green activity in two ways: by the share of green certified projects out of their overall work, and by the share of total green projects. For the determination of what qualified as a green building, the following definition was provided:

At a minimum, for a building project to be considered green, it must include the following:
- Efficient use of energy, water and other resources
- Pollution and waste reduction measures, and the enabling of reuse and recycling
- Good indoor environmental air quality
- Consideration of the environment in design, construction and operation

In addition, green building projects include as many of the following as possible:
- Use of renewable energy, such as solar energy
- Use of materials that are non-toxic, ethical and sustainable
- Consideration of the quality of life of occupants in design, construction and operation
- A design that enables adaptation to a changing environment
The results in this report are drawn from survey respondents from the following 86 countries, with statistically significant results on the highlighted 19 countries. See region/country-specific results on pages 46–74.
ACKNOWLEDGEMENTS:

The authors wish to thank Carrier, and its parent company United Technologies Corporation, whose vision and commitment have been essential to this research series since 2008.

We also thank our premier partners, the AIA and Autodesk, and our contributing partner, USGBC, without whose partnership and funding this report would not have been possible.

In addition, we thank World GBC for their active role as a research partner in helping the study be a success. We also appreciate the efforts of the GBCs globally who shared the survey with their members.

We also thank our other research partners, ACE, CIOB and IMEI, for their efforts to broaden the reach of our survey and variety of responses.

Finally, we thank all the individuals and organizations who contributed their experiences, data and images for publication in the case studies, along with those who agreed to provide their insights in our feature articles.
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