

BUILDING-TO-GRID

Industry Transformation for
Flexible, Integrated,
Value-Generating Resources

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NAVIGANT

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AUTHORS:

CASEY TALON
Research Director

MACKINNON LAWRENCE
Director

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ENERGY

BUILDING-TO-GRID

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1. INTRODUCTION: THE ROLE OF BUILDINGS IN A LOW CARBON FUTURE

Rapid demographic shifts like population growth, urbanization, and the rise of the middle class (140 million people annually) compound the interdependence of technology, regional economies, and government. Buildings offer enormous opportunity for value creation in this new era of globalization. According to Navigant Research's Global Building Stock Database, worldwide, an estimated 24 billion ft² of new commercial buildings is constructed annually — the equivalent of about 9,000 new Empire State Buildings. These new buildings amplify opportunities within the existing commercial stock, which is expected to represent almost 500 billion ft² in 2025. And while the climate crisis has magnified the challenges of globalization with unprecedented weather events, global population migration, and uncertainty over energy reliability and resiliency, it has also showcased the benefits of future-ready digital buildings.

The relationship between building energy supply and demand is evolving. Intelligent buildings use data analytics to direct automation and controls to optimize energy consumption, comfort, and experience. These digital, future-ready buildings use technology to coordinate building operations with other onsite distributed energy resources (DER) like solar, storage, or EV charging infrastructure. Building-to-Grid (B2G) is one of seven emerging energy platforms identified in Navigant's Energy Cloud 4.0 vision of a more sustainable, highly digitized, and dynamic energy system. Navigant predicts an increase in energy-related transactions that will be initiated within and delivered through customer-centric platforms like B2G made possible by digital, future-ready buildings.

The leap from intelligent buildings to B2G will require significant market shifts across five core industry dimensions — customers, policy and regulation, technology, business models, and operations — which raises several critical strategic questions:

- How can incumbent technology and service providers capitalize on the B2G platform?
- Where will new profit centers emerge across the evolving value chain?
- What business models should providers pursue to sustain shareholder returns while serving shifting public interests and the decarbonization imperative?
- How can the traditional regulatory construct for energy generators change to support new B2G grid interactions and enable revenue creation without penalizing non participants?

The following immediate priorities are critical next steps for B2G stakeholders:

- Invest in a B2G market entry strategy today — build, buy, or partner to bolster and expand legacy capabilities.
- Engage early adopters to demonstrate B2G potential with real life case studies that demonstrate the technical benefits and specific ROI tied to financial business models.
- Focus market education and outreach on the business benefits of B2G enabling technologies to create the business case customers need to begin the journey.

New synergies will emerge between utilities, technology and service providers, and building owners as traditional market roles give way to a more fluid competitive ecosystem. Ultimately — as an increasingly dynamic, flexible, and intelligent building stock achieves seamless interaction with an evolving grid infrastructure that prioritizes clean, distributed, mobile, and intelligent market systems — significant value creation opportunities will emerge.

This white paper expands on these priorities. **Section 2, Transforming Buildings into Flexible, Value Creating Resources**, details the foundation of B2G and the role of this new platform in the Energy Cloud. **Section 3, Positioning to Win Customers in the B2G Ecosystem**, explores the core market dynamics defining barriers and opportunities for customer engagement and B2G market development. **Section 4, Pathways to Success**, offers a roadmap to navigate the journey to tomorrow's B2G future. Finally, **Section 5, Conclusions and Recommendations**, summarizes specific actions B2G stakeholders can take to maximize their opportunity in the B2G transformation.

2. TRANSFORMING BUILDINGS INTO FLEXIBLE, VALUE-GENERATING RESOURCES

2.1 Setting the Stage for B2G

The intelligent buildings market has already initiated the market transformation toward B2G. Customers are realizing the benefits of digital technologies for optimizing their building system performance and are investing in these technologies today.

2.1.1 Unlocking B2G: Transforming Supply and Demand

B2G fundamentally redefines the relationship between energy supply and demand. This evolution will spawn new revenue streams across the stakeholder ecosystem, including owners, customers, and energy suppliers of residential, commercial, or industrial facilities already using data analytics to direct automation and controls to optimize energy consumption, comfort, and experience. B2G also describes the interaction of

building automation and controls with “bolt-on” infrastructure (DER such as solar, storage, or EV charging infrastructure) and coordinating these systems with third-party services like utilities.

Leveraging digital technology is not new in the building sector; even today, there are a multitude of solutions available for optimizing individual pieces of the puzzle — the building systems, DER such as efficiency and onsite renewables, or even energy reliability through traditional demand response (DR) programs. Robust markets for smart home and intelligent building technologies provide a foundation for building value across B2G platforms. In the residential sector, for example, smart thermostats, connected security systems, and smart home hubs are all part of the mainstream retail market, offering a foundation for deploying cohesive solutions that optimize multiple systems and enable aggregation of homes as energy and business resources. The same is true for the commercial and industrial (C&I) segments where automation and control of critical operational systems such as HVAC have been leveraged for decades.

While the blueprint for B2G success has yet to be written, step changes in the integration of digital systems within the building envelope and fleet approaches to building energy management enabled by digital infrastructure (such as virtual power plants [VPPs]) lay the groundwork for a rapidly evolving B2G ecosystem. Strategic partnerships will be critical to unifying domain and technology expertise, customer support, and advisory relationships. Building owners, managers, and occupants will benefit from improved economics, sustainability, and experience. Energy providers will showcase innovation to hedge customer attrition and declining market share. Manufacturers and technology providers will realize new business opportunities built around trusted partnerships with their customers. Service providers will deepen engagement and create new opportunities across adjacent markets.

2.1.2 Driving B2G Value: Partnerships and Stakeholder Engagement

B2G champions will successfully convene technology and service suppliers and other stakeholders, create and execute B2G strategy, and enjoy recurring revenue from sustained customer engagement. As such, B2G requires digital, automated, and integrated solutions that unify information technologies (IT) and operational technologies (OT). In commercial buildings, decision-making and management of IT and OT systems have long operated in isolation. B2G requires more dynamic interaction among key stakeholders. Each stakeholder group faces differentiated challenges on the journey to capitalizing on B2G:

- **Traditional building technology providers/manufacturers** will need to shore up IT skillsets or partnerships to offer digital extensions to their legacy OT systems (e.g. HVAC, lighting, security, and access controls).

- **Service providers** will need to develop domain expertise or partnerships to offer solutions aligned with the core business of real estate and facilities management.
- **Energy providers** will need to educate their trade allies on implementing digital technologies and invest in customer education and awareness to showcase capabilities outside traditional demand side management (DSM) offerings for value-added services.

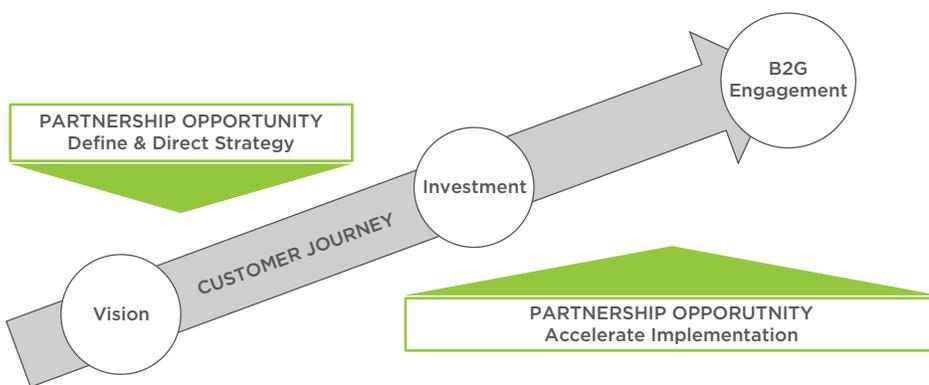
Ultimately, B2G advisory and managed services offer significant revenue potential for market stakeholders. Navigant expects continued interest in services to fuel substantial investment over the next 1-2 decades across a wide swath of energy, technology, and service providers. New revenue streams from advisory and managed services will represent a departure from traditional product-centric business models.

B2G's success relies on a recurring engagement model that supports customers through the journey of strategy development, technology deployment, and ongoing system, building, and asset management. Success is contingent on a holistic view of the B2G opportunity and clear definitions of partner goals — both on the supply side and demand side. Customers must understand their B2G investment supports building owners' core business strategy and suppliers must invest to deliver holistic, sustainable, and reliable solutions.

As illustrated in Figure 1.1, new partner relationships can help customers throughout the B2G journey in two important roles:

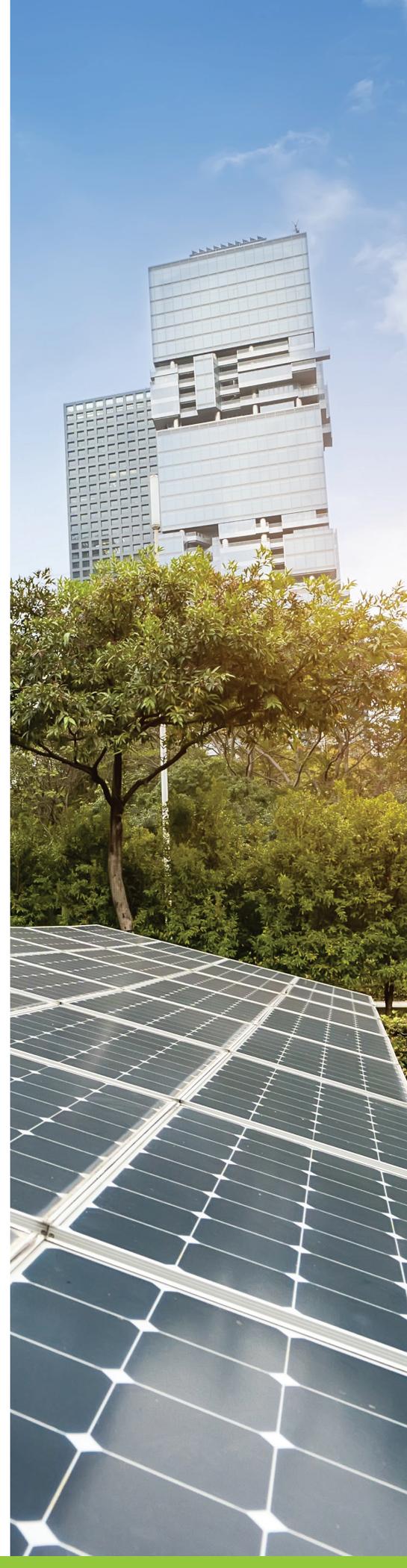
- **Define and Direct B2G Strategy:** Convene stakeholders, create marketing, education, and outreach collateral, and execute partner training programs on IT/OT convergence and DER and buildings integration.
- **Accelerate B2G Implementation:** Incentivize targeted investments, work with financial partners to educate and engage customers, promote grid service programs (e.g., automated DR [ADR]), and direct rate structure innovation. Explore new business models to overcome barriers to investment including leasing, or as a service offerings.

Figure 1.1: Partnering Through the Transition to B2G



(Source: Navigant)

The opportunity cost of inaction is huge — industry incumbents across the energy and building technology sectors who fail to innovate will lose out to new competition from adjacent markets, creative strategic partnerships, and flexible peers. The Paris Agreement target of 1.5°C will be missed and energy resiliency initiatives will become even more complex to deploy. Market leaders will emerge by focusing on change management to ensure that digital technologies become embedded in their business.



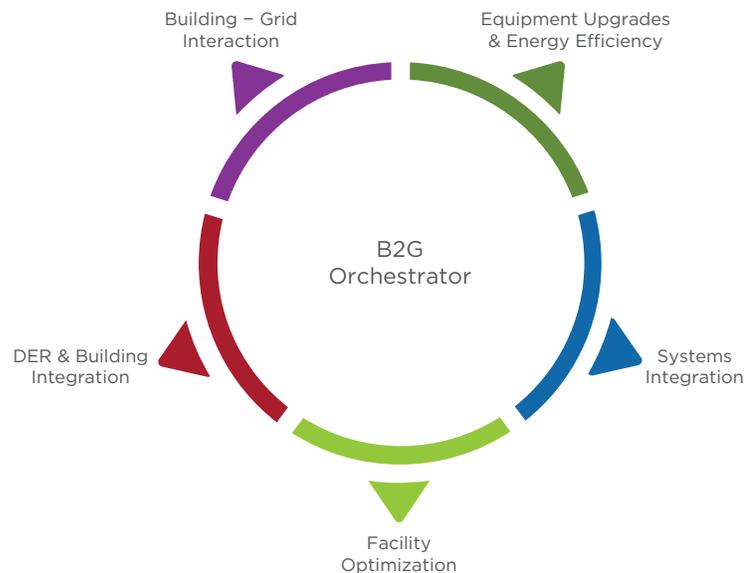


2.2 Initiating Market Transformation in the Built Environment

Building owners can reduce energy and OPEX and can improve the perceptions and experience in commercial buildings by maximizing the efficiency of a building and by layering automation and controls with data-enabled smart solutions. Technology, service, and energy providers can offer new managed services that improve the experience within the building and improve the bottom line for owners while generating recurring revenue all built around the data generated by smart solutions.

B2G is enabled by a continuous process of investment as equipment turnover and technology innovation unfolds. The returns are best measured with a strategic business lens that quantifies the hard numbers around energy cost savings, operational efficiencies, sustainability or carbon reduction targets as well as qualitative metrics around brand, satisfaction, and ultimately productivity. Technology, service, and energy providers are offering solutions that prepare facilities to be flexible, value-generating resources (defined as B2G). The supplier or partners that support customers through this ongoing process of improvement (characterized as a B2G orchestrator) will also benefit from competitive advantage as customers look for turnkey support throughout the journey.

Figure 2.1: Building-to-Grid: Creating a New Energy Asset Class



(Source: Navigant)

2.3 The State of Technology-Enabled Building Optimization and Grid Integration

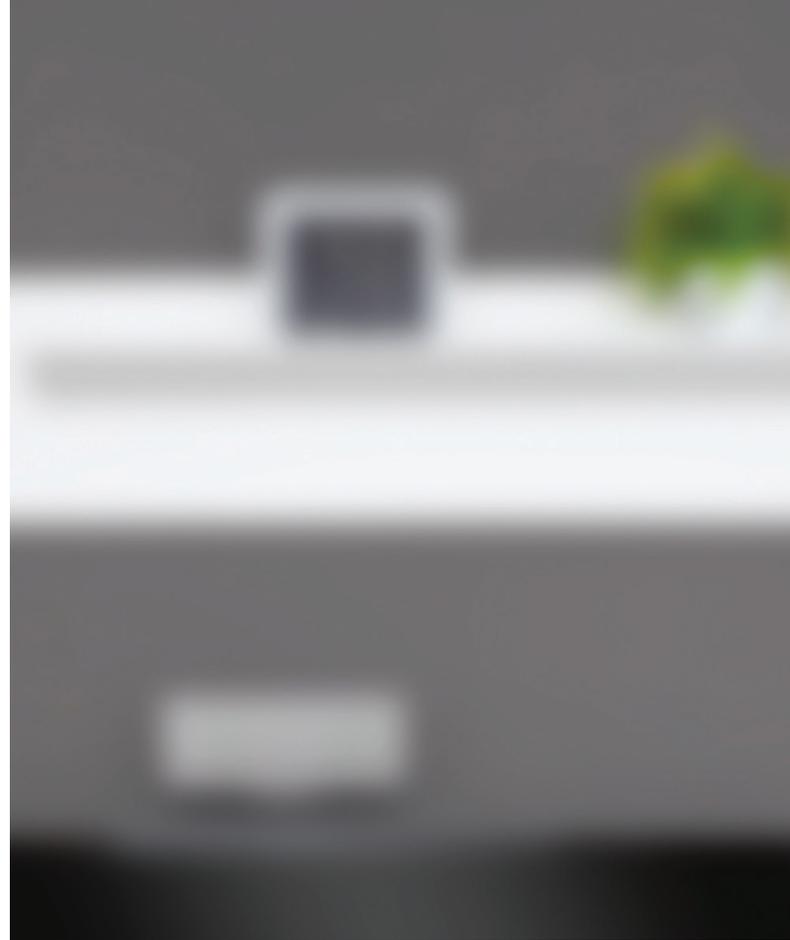
Data-driven technology has been deployed in buildings for decades. The advent of the smartphone redefined consumer demand for data-driven solutions in their personal lives, which has translated into an upward pressure across the buildings market for smart, connected solutions. The market transformation from intelligent buildings to B2G is about stacking the advanced technologies for automation and control to enable coordinated operations for energy flexibility, reliability, and decarbonization. In other words, B2G will be achieved when multiple solutions or services are delivered at the same time, rather than in a more traditional sequential approach. There is a compounding impact from the innovation of B2G as technologies and services are implemented in new ways, coordinated with existing systems, and leveraged for new business insight and occupant experience.

The following examples showcase the development of intelligent building solutions that have set the standard for the emerging B2G market:

- **Intelligent building software enables HVAC system optimization for energy and operational efficiency.** For more than 20 years, software vendors and building automation companies have offered facility operators the tools to monitor, report, and even direct automated improvement to HVAC operations. These solutions created the advent of the commercial intelligent buildings market. Energy cost savings associated with better HVAC performance (such as occupancy directed settings or pre-cooling) delivered straightforward ROI. The sensors, controls, and software also became the foundation for new analytics around space use, occupant preferences, and maintenance and repair strategies that deliver benefits to a broader set of building stakeholders than the operator-centric use cases for traditional HVAC operations and maintenance (O&M).
- **The smart home supersedes reactive home energy management strategies.** In 2011, Nest Labs introduced its first-generation learning thermostat, and the home energy management approach was transformed into a broader platform for achieving homeowner goals around technology-enabled convenience, sustainability, and comfort. Behavior modification programs, and other traditional energy efficiency measures retain a huge market for DSM, but behind-the-meter investment in smart technology is driving the smart home market.

2.4 B2G-Enabling Products and Services

There is an untold combination of winning B2G-enabling technologies, services, and business models, particularly when you consider the value stacking demonstrated in adjacent markets — the Uber effect on transportation, and supplementary services. However, there are technologies available today that enable the optimization of C&I facilities and DER, such as solar, storage, or EV charging infrastructure, which offer insight into potential revenue generation and stakeholder benefits. The delivery, deployment, and definitions of these technologies will evolve over time as they become bundled in ways that maximize value to the end users and revenue potential for solutions providers. The shift toward these bundled offerings is an extension of the evolution of technologies with the development of the intelligent buildings market. Legacy market leaders are threatened by new entrants that offer innovation in technologies and services, and they have been forced to pivot or evolve their business models and products.





Four categories of enabling technologies are key to generating value in the Energy Cloud through B2G that enhance building operations. These technologies overcome energy and operational efficiency, tap unused capacity, and deliver reliability and resiliency. A site with a complete technology stack of the B2G enabling technologies can respond in real-time through automation and controls to the grid and with other signals, which redefine how systems consume energy unlocking new value in residential, commercial, and industrial buildings:

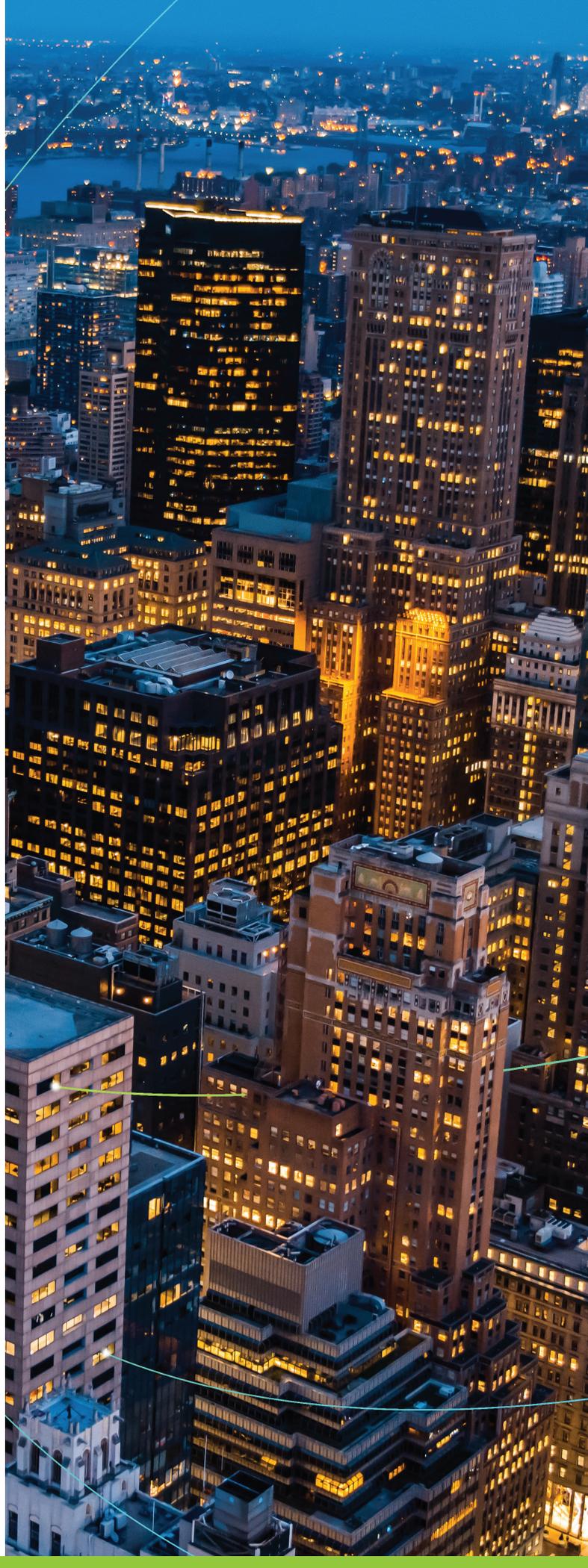
- **Digital infrastructure** is the foundation, building new revenue in the Energy Cloud as data becomes the critical ingredient to business insight and strategy. Digital transformation is also the foundation of the development of intelligent buildings — the building block for B2G. Internet of Things (IoT) is the framework for characterizing the deployment of sensors, gateways, and communications — the digital infrastructure in buildings. The result is a networked backbone that defines building use and operations as the critical input into the analytics engine.
- **Analytics** are the brains, which consist of the software algorithms and tools that translate data into information and direct action. Analytics enable streamlined operations of both the energy consuming building systems (i.e., HVAC and lighting) and DER. As B2G matures, the software interface presents the real-time information to building owners and asset operators, and ultimately to the network orchestrator. Analytics are also the tools on the utility side of the meter that provide insight into the demand profile for buildings and DER.
- **Automation and controls** represent the levers of optimization for buildings in the Energy Cloud. Both the systems inside the building and DER must be able to shift operations in real-time to be effective nodes in the Energy Cloud. Revenue will depend on buildings and assets that respond with the same sort of reliability and responsiveness as other energy assets and automation.
- **DER** becomes the bridge as the market transitions from the linear spoke and wheel model of today to the Energy Cloud. In the B2G context, revenue for DER is not associated with the asset itself but with the orchestration of energy consuming end uses, and the data generated by the analytics overlaying advanced automation and control technologies.

Today, the three main B2G constituent groups are making investments in technologies in each of the four categories to improve operations and business operations on both sides of the meter. While B2G is rooted in energy and sets the stage for energy-related revenue opportunities within the Energy Cloud, business opportunities for B2G are even broader. There are many value-added services that could create recurring revenue and ongoing customer-B2G vendor engagements. Early market entrants can initiate business via enabling technologies and expand into new bundled offerings for complete B2G solutions. The data of a B2G site becomes its own value stream — new business applications can be built around the insights from the data through software analytics.

2.4.1 B2G-Enabling Investments for Energy Providers

Energy providers deploy a host of technologies that support the energy transformation. These technologies not only deliver grid reliability and resiliency, but also offer a channel for two-way communications, energy flow, and system orchestration as the B2G market evolves. Key enabling technologies include:

- **Advanced distribution management systems (ADMSs)** encompass a suite of application software supporting electric distribution system operations. These may consist of real-time simulation and static engineering applications. ADMSs have been developed as an integrated, off-the-shelf grid management platform that integrate distribution operations with outage management and SCADA systems. They maintain a single as-operated model of the distribution network that is based off the as-built model (typically from GIS).
- **DR management systems (DRMSs)** have developed to help utilities manage DR programs and improve program ROI. At this point in the industry's evolution, there is no concise definition of a DRMS. In general, it is a system that has some level and combination of DR program enrollment, device tracking, forecasting, dispatch, data communications, and settlement capabilities. Some vendors offer comprehensive DRMS solutions while others have systems that focus on specific parts of the value chain, specific customer segments (residential or C&I), or specific utility user types (investor-owned utility, municipal/cooperative, or retailers). This report uses a broad definition to include many of the systems that offer partial solutions — and not just the full-service models.
- **DER management system (DERMS)** platforms allow grid operators to reliably operate systems with high penetrations of renewable energy, storage, EVs, and flexible loads. DERMSs may also enable new business models based on DER-based energy services, grid operation optimization, peak load management, grid decarbonization, and microgrid integration within distribution grids. DERMSs typically include DR but may also include resources like distributed generation (DG) and energy storage. While many of the actual system components may be the same, the applications may vary slightly. These tools are likely to converge and fall under one product category.
- **Demand side analytics** include applications for integrated DSM, which combines energy efficiency and DR, DER information, and load analysis. Solutions in this area lend themselves well to cloud-hosted models as most data is collected from the demand side of the meter and is not as sensitive as grid operations or billing data. Generally, these applications are not mission critical. Applications include DSM program management, load disaggregation, customer segmentation, pricing, and DER programs (for energy efficiency, DR, energy storage, and DG), geo-targeting for grid edge solutions, DER load forecasting, and demand analytics.





2.4.2 B2G-Enabling Investments for Customer

The intelligent building and smart home markets have largely developed independent of energy provider interventions. For many buildings and homeowners, the justification for investment may have started with energy cost savings as a straightforward measure of ROI, but as IoT has become mainstream, customers expect data-enabled technologies in their homes and buildings to deliver much more. Convenience, comfort, customization, and even productivity have become the cornerstones of investment justification. The following technology markets are growing rapidly, and the implementation reflects market readiness for B2G:

- **IoT** is shifting the facilities management paradigm in C&I buildings. Highly functional (yet lower cost) devices can be deployed with minimal business disruption. Broader acceptance of cloud-based software is supporting investment in intelligent building analytics and the growing understanding of the importance of cybersecurity for networked building systems. Smart home devices are proliferating at a similar rate. Smart thermostats and appliances, for example, offer homeowners convenience while enabling grid interaction through management programs such as DR. These three trends help IT departments add value to traditional operational and line of business problem solving.
- **Distributed natural gas (DNG)** is a class of DER investments that exemplify the opportunity for non-centralized use of natural gas to generate electricity, either on- or off-grid, supporting the flexibility and resiliency goals of B2G. When grid-tied, DNG connects at the voltage of the local distribution (not transmission) network. Individual prime movers, generally sized 10 MW or less, include generator sets, fuel cells, turbines, and microturbines. DNG holds specific promise when considering macro-level decarbonization goals.
- **VPP-enabling technologies** are a system that relies upon software and a smart grid to remotely and automatically dispatch retail DER services to a distribution or wholesale market via an aggregation and optimization platform. VPPs are built on a foundation of enabling technologies including metering and telemetry (or other technologies needed for measurement and verification), device controls (or other forms of IT communications so DER are aggregation friendly), software for optimization, and market interface with utility programs or organized markets for wholesale transmission operators.

3. POSITIONING TO WIN CUSTOMERS IN THE B2G ECOSYSTEM

3.1 Setting the Stage for B2G Success: Near-Term Market Dynamics

The digital transformation represents a fundamental set of changes in investment, business models, technology use, and experience for each of the platforms in the Energy Cloud. Billions of dollars of investment in intelligent building solutions, DER, and services are fueling the development of the B2G platform. When emerging technologies or products and services combine, second and third order effects emerge, such as new value streams. These expand the potential for new value creation. Energy Cloud platforms are not mutually exclusive; while each describes a node of technology innovation and value creation, they may overlap significantly.

Opportunities to tap new revenue streams are emerging quickly in the energy industry. For new entrants and third parties, bringing digital and platform experience from other industries will be an advantage, though certainly no guarantee of success. These actors may be able to afford to enter Energy Cloud platforms with more advanced business models; however, they will still require access to a diverse stack of physical assets. Partnering will be key to unlocking products and solutions as well as to creating lucrative synergies across emerging technologies.

The progression from command and control over siloed assets and linear value chains to Energy Cloud platforms entails a series of organizational changes for energy, technology, and service providers. B2G development requires expertise across building systems and DER, systems integration, and IT that extend beyond any traditional energy or technology suppliers' domain. To extend their offerings and skillsets in line with B2G, technology, energy, and service providers will need to determine their market entry strategy through acquisitions, organic growth, or partnership. There are pros and cons to each market entry strategy, which are outlined in Table 3.1.

Table 3.1: Market Entry Pathways for Revenue-Generating and Cost-Containing Services

ENTRY PATHWAY	PROS	CONS
Build	Sole ownership and revenue retention	Requires either investment in new human capital or training existing staff to tackle solutions development that is distinct from their core capabilities or experience
Buy	Accelerate market entry with established complementary offering	Change management requirements are significant to integrate a new organization within the incumbent's business — the clash between nimble startup strategy and legacy market leader business has been well-documented as product manufacturers looked to become digital/IoT market influencers
Partner	Negotiation provides flexibility that can enable solution development with lower capital investment	Negotiations around exclusivity can threaten future market entry possibilities as the market emerges and the ecosystem of potential partners expands

(Source: Navigant)





Energy, technology, and service providers aiming to engage in the digital building future with B2G will face a rapidly evolving competitive landscape regardless of the go-to-market strategy. A new architecture of IT, OT, and services must be seamlessly deployed to achieve the holistic and coordinated systems improvements and ultimately orchestration with onsite energy resources and the grid. The result is a new ecosystem of technology and service providers capitalizing on the opportunity to engage with B2G — from startups to adjacent markets to legacy building technologies, and innovators from manufacturing and energy. A few key capabilities are necessary to deliver turnkey B2G solutions, including:

- **Flexible systems integration:** Traditional mechanical and electrical contractors that once dominated the energy efficiency space are challenged to integrate smart solutions with IT backbones. At the same time, IT systems integrators that have long served enterprise customers are challenged to build expertise around building systems. There is a gap in the market and demand for a new breed of master systems integrators that can deploy smart solutions with robust IT architecture while translating the technical requirement to an executive customer base.
- **Cybersecurity expertise:** Increased connectivity of building and distributed energy systems requires convergence of IT/OT integration, which brings about a new set of challenges to building owners and property managers regarding cybersecurity. Cloud-hosted software as a service (SaaS) offerings, remote access to automation and controls, and data sharing across business and building systems bring fundamental changes to the close-looped nature of traditional building operations. Cybersecurity is an especially sensitive issue in commercial buildings. Organized crimes seeking to profit through illegitimate access to enterprise IT infrastructure or corporate and government espionage concerns are tangible threats to building occupants.
- **Scalable software applications:** The opportunity to introduce new software solutions that could deliver business insight from easily accessible sensor data (or even more sophisticated integration with building management systems or meter data) created a crowded and fragmented market. Many early adopters jumped on board with executives investing in new software applications, but without a mature intelligent building strategy the result was failed utilization or the dramatic burden of operators juggling up to 10 dashboards and reporting tools. The consequence has been a trickling skepticism and market confusion in defining best-in-class solutions. B2G could easily follow this path, so it will be critical that software offerings are open and can scale and address the core business challenges across an organization from engineer/operator to the C-suite.

3.2 Defining a Partnership Ecosystem

Orchestration of energy and building assets is the heart of the Energy Cloud. B2G success relies on a recurring engagement model that supports customers through the journey of strategy development, technology deployment, and ongoing system/building/asset management. Success is contingent on a holistic view of the B2G opportunity and clear definitions of partner goals — both on the supply side and demand side.

There is an evolving ecosystem of energy and service providers and technology vendors aiming to support customers through the B2G development process, which is focused on cultivating long-term relationships to guide investment and management. This kind of partnership requires domain expertise, customer service capabilities, and trust. Key industry players in the utility, facilities management, IT, engineering services, and manufacturing segments bring different strengths to the table, and acquisitions and strategic partnerships are aligning skillsets and offerings to support intelligent buildings customers. Table 3.2 illustrates key B2G activities and considerations for successful partnership.

Table 3.2: Mapping B2G Partner Opportunities

POTENTIAL B2G SERVICES AND INVESTMENTS	CHALLENGES	PARTNER REQUIREMENTS
Retrofit and upgrade the building envelope	The majority of homes and C&I buildings are aging and lack sufficient efficiency investment; in the US, the average commercial building is over 30 years old	Incentivize traditional energy efficiency measures beyond code, with stretch goals for super high efficiency Explore opportunities of energy efficiency measures alongside digital technologies and DER for portfolios, campuses, and neighborhoods to have a greater impact on greenhouse gas goals
Upgrade building systems (major energy end uses such as HVAC and lighting) and controls	Existing building stock is dominated by legacy systems that operate in isolation, and if controls and automation are present, they are often operated with closed/proprietary systems	Market reach and expertise for education and awareness Training partners for implementing integrated solutions
Deploy onsite energy resources such as storage and solar PV	Capital budgets, awareness/business justification with market-aligned use cases	Flexible financial options including emerging approaches such as anything as a service, or C-PACE
Integrate controls across building systems and DER	Gap in partner skillsets across IT/OT	Bridge gaps in expertise of systems integration, data integration, and systems coordination
Manage system performance	Willingness to outsource control, understanding and readiness to manage cybersecurity	Technology domain and customer business sector expertise
Grid services	Shortage of aligned rate structures, e.g., time of use (TOU), participation in existing programs	Influence and rate design expertise

(Source: Navigant)

The emergence of the B2G market brings a new competitive reality to incumbents that have owned customer relationships and majority share. If the technology delivers energy, it may no longer be offered by utilities. If the solution is a control system for building systems, it can now be offered by tech companies from adjacent markets. If the service is outsourced O&M, it can be offered by a niche startup taking opportunity away from legacy property management companies. There is already evidence of these shifts in customer-supplier relationships. The plethora of smart home devices at big box retailers, the small business optimization offerings of security companies, and the IoT platforms aggregating and optimizing campus building performance are all real-world illustrations of non-traditional providers gaining market share.

3.3 Opportunity Cost of Inaction

The economics of building ownership are changing in the era of digital transformation and climate change. Data is the new layer of value creation stemming from investment in digital technologies that appeal to the demands of occupants and executives – these bottom-up and top-down pressures are driving investment in B2G-enabling technologies. Market momentum is growing, and energy, technology, and service providers that fail to innovate face major disruption to their business because of the following converging factors:

- **Customer Attrition:** Rapidly expanding investment in digital technologies and DER represents a major shift away from the centralized, one-way electrical grid that has been the status quo for the past century. Customers are using onsite resources to generate their power supply or to offset their carbon footprint. Major project developers and technology and service providers are offering solutions direct to consumers and are offering a new set of customer choice that threatens legacy utility-customer relationships. The potential loss of customer base is a threat to the utility's bottom line and threatens customer equity as the rate base shrinks and large capital costs are distributed across fewer customers, which may have disproportionate impacts on the lower income scale.
- **Foregone Revenue:** Utility efforts have been largely reactive, focused on issues caused by renewables intermittency, shifting loads, capacity constraints, and bidirectional power flows. As utilities allow more time for the B2G marketplace to mature (namely the enabling technologies sub-markets), they are foregoing new revenue streams that would stem from new advisory and managed services supporting the distributed energy transition.

- **Degradation of Market Share:** Incumbency is threatened across the broader technology and services segments as horizontal digital technologies gain momentum. Large traditional market leaders may have developed their position over decades — or even over a century through large capital equipment products, for example. As their business evolved, they may have introduced new supplementary offerings, but many struggle to evolve with the advent of open, flexible, and cost-effective offerings. Adjacent market entrants are well positioned to steal customers in examples such as:
 - New IoT market entrants offer highly flexible, cost-effective product substitutes to traditional automation and control solutions
 - Renewable and distributed energy solutions providers offer turnkey solutions to replace traditional energy supply
- **Regulatory and Policy Mandates:** National climate policies drive the market in some regions, but in others leadership is found more regionally. As an example, in April 2019, New York City passed its Climate Mobilization Act, establishing specific limits on carbon emissions for buildings over 25,000 ft² beginning in 2024. This groundbreaking bill takes preliminary voluntary initiatives (which many cities have tried) into the realm of regulatory compliance, demonstrating the significant decarbonization potential in the built environment.
- **Climate change** presents universal risks to society and creates an imperative to address energy consumption and emissions from the building stock. Climate events threaten the market value of buildings from damage and destruction, but under this threat there are a series of risks to legacy business models that are separately emerging because of the impact of digital technologies and customer choice.

3.4 Illustrative Opportunities for B2G Services

Revenue-generating services are a significant source of value creation for innovative suppliers engaging in the B2G ecosystem. The transformation of customer engagement from point solutions and product sales to ongoing engagement models has a universal appeal by generating recurring revenue streams. B2G buildings will be characterized by ongoing improvements in energy efficiency, operational strategies driven by analytics, and comprehensive automation that enables actuating the facility as a grid or platform resource. Solutions providers can engage building owners and managers who are aligned with the concept of the B2G orchestrator in delivering turnkey offerings throughout the journey of digital transformation; the following services are examples of such opportunities:

- **Electrification and real-time demand management** solutions providers could offer a managed service in which they assess the electrification opportunities of the building or portfolio, finance the retrofits, and use the new equipment as levers

for articulating energy consumption in response to a next generation of grid stability programs (i.e., DR 2.0). Heat pump water heaters used as demand resources for residential customers offer a case study into this opportunity. There are significant opportunities in multifamily housing, campuses, and portfolios where awareness, capital burden, and managing staff skillsets have hindered electrification, but a B2G managed service offers a pathway to overcome these barriers.

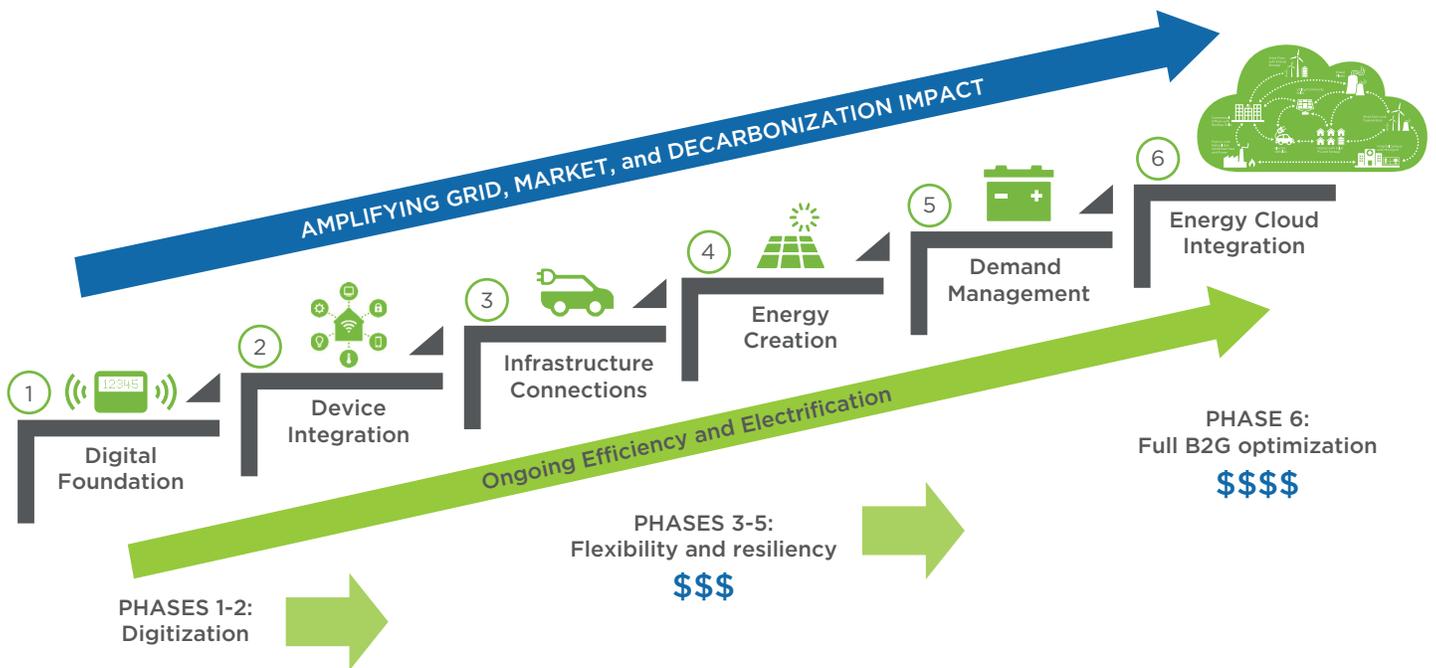
- **B2G analytics for traffic management and public safety** would marry the recurring revenue model for SaaS software and data as a commodity. Building owners would benefit from the insight of the low-cost SaaS analytics and potentially from a shared revenue stream, which the data their analytics offer to cities and other municipal stakeholders. Real-time occupancy data would become valuable population volume and velocity information for monitoring public safety and reacting to imminent or in-progress threats and public response.
- **New service opportunities for B2G assets** can also be compartmentalized into business segments. A few examples include:
 - **Energy Resilience Managed Service for Healthcare:** This segment could be an approach to support hospitals as they face new pressures to guarantee uptime with the increasing frequency of intense storms and climate-related events. The healthcare industry faces unprecedented pressure with the changing expectations for care and uncertainty of public policy. A B2G healthcare service could be a new way to outsource the energy monitoring, efficiency upgrades, equipment retrofits, and demand management.
 - **Commercial Real Estate Space as a Service:** Real estate managers must find new approaches to overcome the uncertainty of evolving tenant expectations for flexibility in leasing and space use. The convergence of coworking, short-term leasing, and density trends has created new challenges for traditional real estate business models. Solutions providers could help redefine office leases by leveraging space utilization analytics, automation and control technologies, and sustainability metrics that would garner premium rates.
 - **Health as a Service for Schools:** This segment would help administrators leverage innovative indoor air quality, lighting and climate control and automation, and analytics to deliver healthier classrooms for more successful students. This managed service approach could help administrators roll out initiatives in a timelier approach than traditional bond strategies and roll in energy efficiency measures and/or distributed renewables such as onsite solar to overcome the significant challenge of deferred maintenance.

4. PATHWAYS TO SUCCESS

4.1 From Intelligent Building to Energy Cloud Resource

The journey to B2G requires incremental investment and significant change management to transform the business of operating buildings and supplying energy and technologies. This evolution is made possible by technologies that enable integration and interoperability to optimize system performance and B2G use cases. One of the most dramatic opportunities for decarbonization in the built environment will be the extension of building systems from standalone applications focused on the operation of a single building to hubs within a wider network of energy and environmental monitoring systems. Energy, technology, and service providers will be incentivized to support this journey because of the magnified revenue potential as solutions become more sophisticated and aligned with the B2G concept, as presented in Figure 4.1.

Figure 4.1: B2G Development Journey



(Source: Navigant)

Ongoing Efficiency and Electrification: Investment in energy efficiency is a pragmatic first step toward tackling emissions from the built environment that contributes to climate change. Initial measures, such as retrofits in major energy consuming end uses (e.g., HVAC and lighting), set the stage for smart technology deployment to initiate the journey to B2G. A focus on energy efficiency is also the most cost-effective pathway to managing evolving energy demand when compared to the levelized cost of electricity resources, including fossil fuel resources and renewables. Once the journey begins, it is important for building owners and operators to retain a focus on efficiency and electrification as the process is timely and must be addressed on an ongoing basis. Electrification and heat pump retrofits offer a high impact example and will also support innovative B2G platform opportunities such as next-generation demand management.

Phase 1-2 — Digitization: Widespread discussion of technology trends — including IoT, cloud computing, and outsourcing through the as a service model — is driving momentum in investment of B2G-enabling solutions. The process of updating the infrastructure in the existing building stock and in the design and construction of new facilities is critical to creating spaces capable of building-to-grid integration. The rise of IoT is driving an overarching pressure to streamline integration with open, interoperable systems. The question comes down to whether market incumbents that have dominated business-selling-specific components can be nimble enough to ride the wave of change.

Phase 3-5 — Flexibility and Resiliency: Peak shaving is the most common grid service available today. DR programs have supported grid reliability for years, but in the B2G construct a new generation of DR will emerge that can support continuous and real-time equipment management to respond to localized grid pressures. Infrastructure connections are important in creating B2G assets because this is the point of investment and integration between systems optimizing performance within the facility to coordinate with onsite resources. Software analytics and controls are key enablers for this point of convergence between building assets and onsite property assets (e.g., battery storage). Energy creation is the set of investments supporting onsite renewables and storage. The definitions of ownership and management will evolve as the B2G orchestrator emerges. Finally, a new real-time, continuous demand management strategy can be deployed to deliver carbon, economic, and occupant benefits.

This new reality relies on utility investment in the grid edge, defined as the segment of the grid between (and including) the distribution substation and a DER network. The grid edge includes assets on both the supply (utility) and demand (customer) side of the meter, including distribution automation and microgrid equipment. The integration of distributed intelligence can help maximize the potential benefits of DSM and energy efficiency programs. The ability for meters and other distributed control devices to communicate with building equipment and behind-the-meter generation to manage capacity and load vastly improves the effectiveness of these types of programs. Further, utilities can invest in DERMS, which enables optimized control of the grid and DER (to the extent that a utility may be able to dispatch and control DER). To minimize disruptions and the presence of phantom loads, utilities need to manage the grid more proactively.

Phase 6 — B2G Optimization: This final stage in the B2G journey defines the transition from limited, short-term services of the traditional demand management to truly integrated grid assets responsive in real-time and even continuous in some scenarios. The result is a growing number of revenue-generating and cost-containing services, as highlighted in Table 4.1.

Table 4.1: Revenue-Generating and Cost-Containing Services

SERVICE CATEGORY	SOLUTION	SUPPLIER	POTENTIAL BENEFIT
Building Services	Power Management	Technology/Service Provider	A managed service model can be deployed to manage onsite DER including building systems management to minimize demand charges by orchestrating automation and controls on behalf of the building owner/manager for economic rather than grid reliability drivers
Building Services	Cybersecurity Management	Technology/Service Provider	Provide managed service for threat detection, vulnerability assessments, ongoing monitoring, and incident response
Building Services	Network Design and Management	Technology/Service Provider	Outsourcing network architecture design for future-proofing buildings with the most robust IT infrastructure for using the exponential rise in data associated with IoT and B2G applications
Grid Service	Generation Energy and Capacity	Electric Utility	Avoided costs for power plant fuel, O&M, startup and shutdown, capital for new generation facilities and associated fixed O&M

SERVICE CATEGORY	SOLUTION	SUPPLIER	POTENTIAL BENEFIT
Grid Services	Ancillary Contingency Reserves, Frequency Regulation, and Ramping	Electric Utility	Avoided costs for power plant fuel, O&M, startup and shutdown costs and opportunity costs associated with contingency services and frequency regulation
Grid Services	Non-Wires Alternatives	Electric Utility	Avoided capital cost for transmission and distribution equipment upgrades
City Services	Distributed Energy Procurement through Circular Economy	Municipality	Waste mitigation through reuse, recycle, repurpose (e.g., retired EV batteries as resiliency resource)

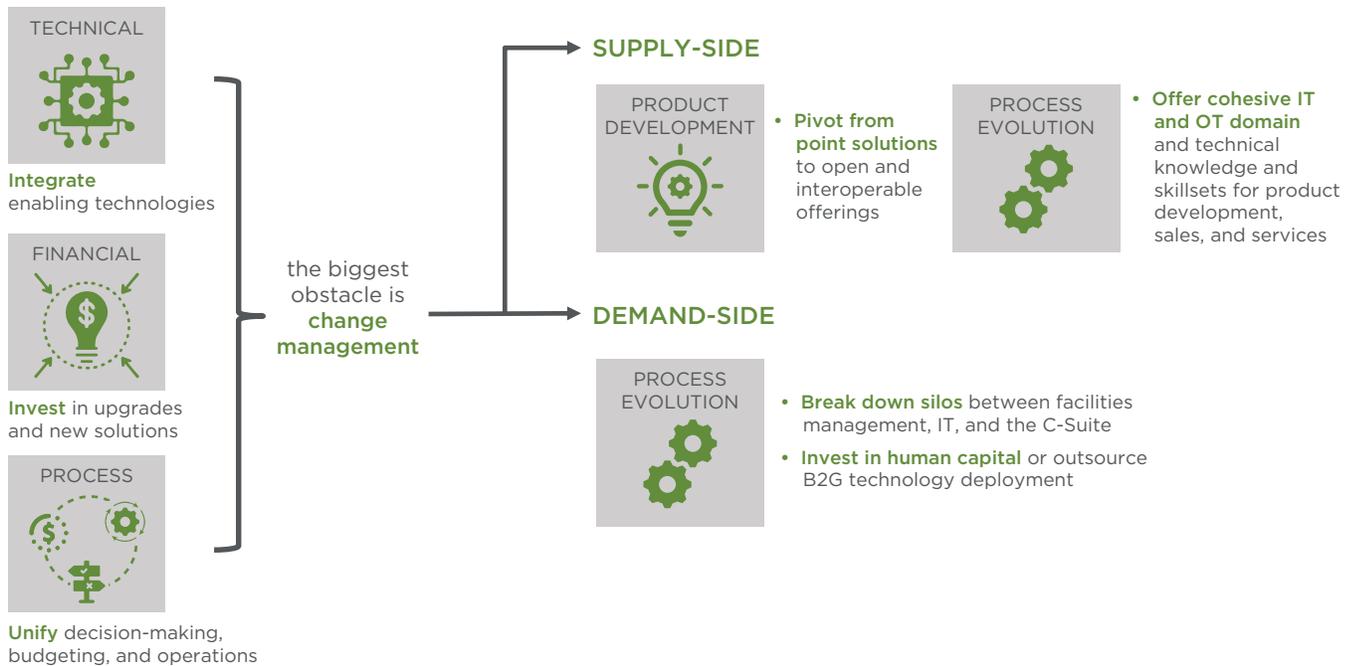
Source: (Navigant)

Aligning Technology Benefits and Customer Demand Profiles: The intelligent buildings market is breaking down silos between decision-making and systems operations within facilities, there is a leap to making orchestration between the facility, onsite energy and storage assets, and the grid a B2G reality. Energy, technology, and service providers are tackling pragmatic technical and financial hurdles, but the bigger challenge is change management. B2G orchestration is a transformation in facility operations, energy management, and investment strategy. New approaches to decision-making, ongoing management, and development strategy are necessary for both potential customers and B2G solutions providers. These challenges are highlighted in Figure 4.2 and demonstrate some specific near-term actions necessary to move the B2G market forward.

Figure 4.2: Aligning Technology Benefits and Customer Demand Profiles

Requirements for B2G Execution

Transitions in Business Approach



(Source: Navigant)



Supply Side Challenges: Several elements of the supplier business culture and organizational structure are obstacles to higher levels of B2G market penetration. The large incumbents (utilities, building equipment manufacturers) have risk averse cultures, operate in silos, and lack a specific B2G vision or comprehensive go-to-market strategies. Risk aversion can be a major disadvantage when competing in new markets because it limits innovative product development or aggressive product rollout. Many incumbents are organized with business units that operate in silos, which affects their ability to coordinate integrated planning efforts. This siloed organizational structure is not conducive to the level of collaboration required to initiate a wide-scale, cross-organizational effort. Furthermore, the legacy domain knowledge and skillsets that brought market dominance to existing incumbents may no longer align with the requirements for B2G solutions development. This issue is best illustrated when considering the required convergence between IT and OT systems to make B2G a reality. The challenge is to marry domain knowledge of energy and buildings with technical capabilities around IT networking and architecture.

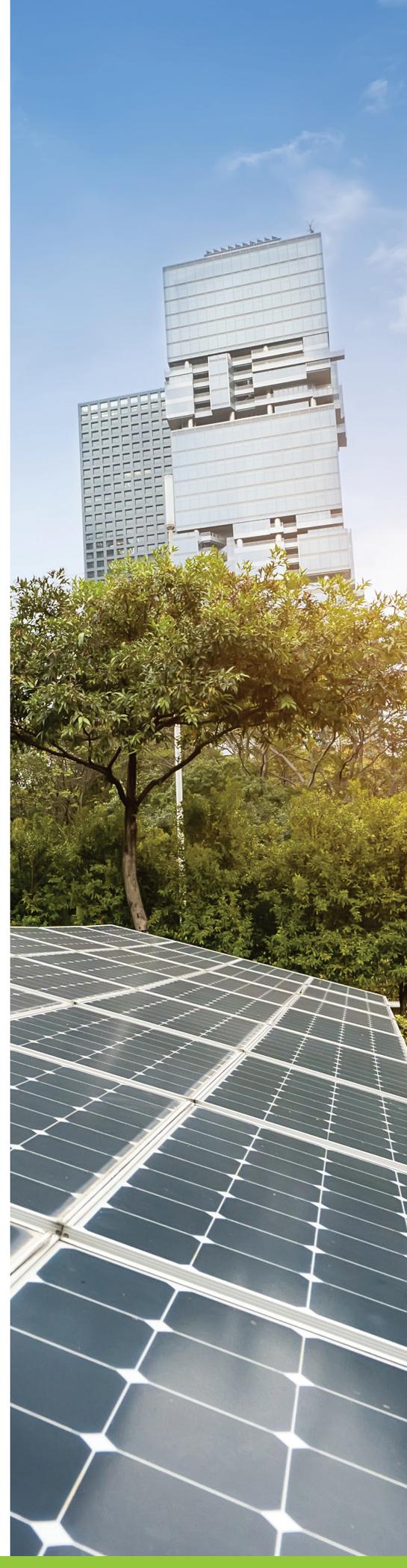
Demand Side Challenges: On the technical and operational side of B2G project development, building owners/managers can lack the skills to use the enabling technologies. Operational staff is highly trained for electrical and mechanical systems O&M, for example, but not for managing an IT network or a platform that controls the whole building in concert with onsite energy and storage resources. Having the in-house skills to interpret and extract value from data and analytics across new service areas is also something many customers lack. The challenge is compounded by the aging workforce in facilities management and challenges to attracting and retaining new talent as this career path evolves. As a result, customers need to add new staff, expand their technical skillset, or find partners with whom they can outsource their B2G strategy.

4.2 Other Key Drivers for B2G Market Development

The Energy Cloud transformation and the development of the B2G market are already having profound impacts across five core industry dimensions: customers, policy and regulation, technology, business models, and operations. The reality in the built environment plays out as follows:

- **Customers:** The perception of the home or commercial building has changed dramatically with the advent of digital technologies. IoT has become a household term, and the commercial building industry is facing new pressure to adopt technology to improve occupant experience. The result is a new and universal upward pressure on building owners to invest in new technologies, regardless of the business operating within. Owners perceive the built environment as a representation of their brand — technology is a way to showcase a commitment to sustainability, agility, and a commitment to greater mission-driven occupant expectations. This pressure is helping change the process of business justification, which supports greater adoption of next-generation technologies and prepares for B2G. Investment decision makers now recognize the most straightforward ROI metrics (which include energy savings) are just part of the buying rationale. Greater focus on comfort, convenience, productivity, and satisfaction help drive dollars to B2G-enabling technologies. For example, onsite solar PV and storage can not only position building owners to generate new revenue through grid services, but also to demonstrate their commitments to combatting climate change. As another example, intelligent building analytics enable system optimization for demand management and efficiency while generating data and reports for the C-suite for corporate sustainability reports used to attract and retain talent.

- **Policy, Regulations, and Corporate Initiatives:** Targeted climate policy and regulations for the built environment are complemented by equipment-specific codes and standards and broader energy policies. For example, local, regional, and even national building codes can mandate higher efficiency and even control technologies in new construction, as illustrated by Title 24 in California. Or air quality regulations can direct investment in specific types of DG by limiting allowances on emissions from diesel gensets. TOU rates and feed-in tariffs are also examples that have helped drive adoption of renewables such as distributed solar. Corporate initiatives around sustainability and climate change are also driving significant investment. LEED and ENERGY STAR represent the legacy opportunities for voluntary benchmarking and labeling of high performing buildings, while new opportunities (including Science Based Targets) will add momentum for investment in efficiency, DER, and supporting digital technologies.
- **Technology:** There is a major shift underway as nearly every traditional product supplier pivots to offer more comprehensive and digitally enabled solutions, fueled by the universal appeal of recurring revenue. Traditional building systems (e.g., HVAC and lighting) are being introduced with enhancements of sensing, controls, and analytics. The innovations are positioned as IoT platforms fueled by machine learning and other advancements in artificial intelligence. Major investments in the lighting industry offer one clear illustration of the potential value from these strategic moves. Major multinational incumbents have sold business units, acquired startups, and built completely new offerings that provide remote accessibility, are optimized with analytics, and are delivered with innovative business models such as lighting as a service. These transitions require executive commitment for the long term.
- **Business Models:** Building ownership and use is changing dramatically. Workplace changes are placing new demands on office building owners. Worker demands for flexibility are leading to a complete reset in space planning, resource use, and technology demand. WeWork is at the center of this market disruption and threatens legacy market leaders in the same way Airbnb threatens hoteling and Uber the taxi industry. This office segment example simply underscores the continued growth in the power of the occupant. The ecosystem of suppliers will be dynamic. Tech giants, telecoms, and security providers are already vying for ownership of the smart home. Oil & gas companies are beginning to explore new opportunities to offset the loss of market share coming from decarbonization and electrification initiatives. The B2G future will align with these new views on ownership and the growing shared economy. DER as a service, space as a service, HVAC as a service, lighting as a service — these are all constructs being tested to drive significant investment without the capital burden of traditional investment and position facilities to move along the B2G journey.
- **Operational Processes:** B2G facilities are a new class of asset — these homes and buildings will no longer be passive infrastructure demanding energy, but flexible resources for supplying energy and managing the energy flow. On one hand, the B2G asset offers a pathway for cost mitigation by managing changing energy demands without distribution investments. On the other hand, it challenges traditional energy providers to reimagine their customer relationships. The energy industry will be pressed to support the market development with complementary rate structures and regulatory guidance while maintaining reliable service for nonparticipants.



5. CONCLUSIONS AND RECOMMENDATIONS

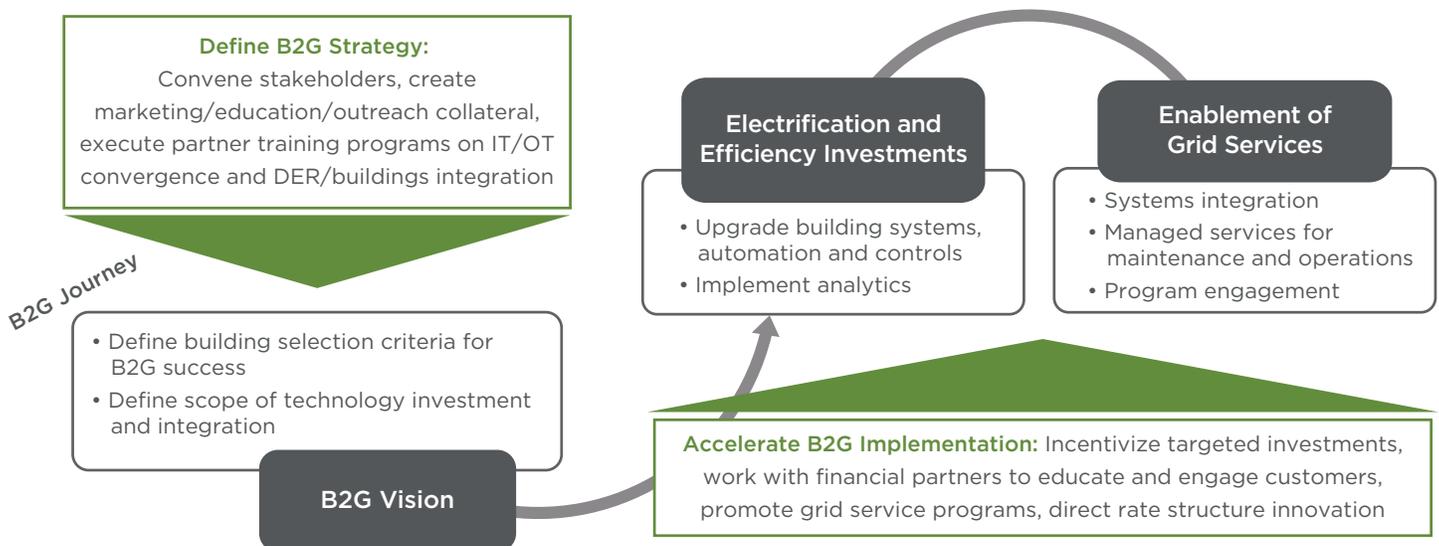
The B2G platform will lead to new revenue streams for energy, technology, and service providers willing to invest in strategy, product development, and market transformation efforts. Early adoption of key enabling technologies in the intelligent buildings and DER markets signifies a growing readiness for B2G development.

Ongoing investment in electrification and decarbonization will help garner customer engagement for B2G as measures improve the occupant experience in buildings — employees will be more comfortable, operations teams will improve repair and maintenance timelines, and executives will see stronger bottom lines through energy and operational efficiencies. The most impactful advancements, however, begin with digital transformation. Implementing and using data-driven tools to optimize building systems and coordinate operations will compound benefits for customers. For example, intelligent building solutions give executives insight into space use, asset tracking, and O&M processes to support changes that deliver more robust financial returns. As the journey continues, the efficient and sustainable buildings signify brand enhancement in terms of sustainability — an increasingly important metric for attracting and retaining employees, customers, and satisfying shareholders.

B2G development offers significant value to society at large. B2G enables energy flexibility that can support the utility grid integration of intermittent renewables and other DER. The ability to manage load in real-time helps counter grid pressures during peak or severe weather events, all of which are expected to increase over time with climate change. In addition, these flexible B2G energy assets can be community resources that can be leveraged during natural disasters — uninterrupted healthcare following hurricanes or fully powered backup shelters after floods.

The revenue potential from B2G advisory and managed services is enormous, driving interest in market entry across a wide swath of energy, technology, and service providers. Becoming the B2G orchestrator is the real jackpot. This new market actor will convene partners and stakeholders, create and execute B2G strategy, and enjoy recurring revenue from sustained customer engagement, as illustrated in Figure 5.1.

Figure 5.1: B2G Orchestration Partnership



(Source: Navigant)

The following recommendations offer utilities and technology and service providers the first steps to competing for customers in the emerging B2G marketplace.

Utilities:

- **Utilities should leverage their core advantages and strengths.** Utilities need to apply their capabilities and experience when defining their B2G strategy. They own and operate the electricity infrastructure, and, to a certain extent, the communication networks required for grid management. They have access to capital markets that could support financing enabling solutions for capital-constrained customers. Finally, and maybe most importantly, unlike other market entrants, utilities are positioned as trustworthy with data due to oversight and regulation. Utilities should use the well-established services business to enable market transformation through customer education and outreach and to enable trade ally skills development. Utilities should leverage existing customer relationships as a valuable channel to market for potential technology and service partners.
- **Invest in the Grid Edge:** Each B2G project will be unique with different network infrastructure requirements, as illustrated by common challenges caused by DER projects that include voltage instability, capacity restraints, bidirectional power, overutilization or damage to existing asset base, power quality, and load leveling and peak shifting. A network of strategically placed and fully equipped edge computing devices such as meters, inverters, voltage regulators, and distribution automation equipment can provide a distribution grid operator or utility with a solution to each of those challenges, which will then position them to successfully orchestrate the power interface of the B2G asset and the grid.
- **Collaborate with regulators to develop adequate compensation schemes to enable market transformation.** TOU pricing is one path to incentivize technology and service providers to introduce B2G-enabling solutions. TOU pricing also helps overcome the cost-benefits analysis limits to investment by offering low off-peak rates to encourage demand flexibility and load shifting through B2G solutions. This is particularly valuable from a climate change perspective in territories where the grid has highly variable emissions factors.

Technology and Service Providers:

- **Establish channel partnerships to break down legacy silos of customer engagement:** Where an equipment manufacturer's sales channels may be well-established (with facilities management decision makers, for example), new relationships with executives will be necessary to win business with evolved B2G-enabled digital solutions. Solutions providers need to develop the right partner networks, sales channels, end user customers, branding and marketing strategies, and product roadmaps to be successful in the B2G market. Most need to expand several, if not all, of these elements to pivot from their less comprehensive/integrated offering set.
- **Offer customers flexibility in pricing, technology roadmaps, and services.** Building owner requirements are unclear today because this is a nascent and rapidly evolving market. Even in the supporting technology markets such as the intelligent buildings market, customers are still getting comfortable with the solutions — gaining understanding of horizontal issues such as cybersecurity and data privacy — and may be cautious after failed pilots. New business models are emerging, but it is not apparent what will be successful in a world of massive IoT and big data. Commercial models (i.e., for data sharing) are being tested alongside models that





depend on softer metrics for success (and other funding sources). Suppliers need to balance the benefits of integrated, multiapplication platforms with the need to show short-term benefits against real-world building owner/manager challenges such as improvements in energy and operational efficiency, occupant experience, and ultimately productivity.

- **Focus on the B2G applications that are most relevant to core customer business objectives.** Consider the customer journey when introducing a B2G development strategy. Help customers use their existing technology and data to reduce upfront costs and redundancies. Energy management is only part of the value proposition for potential B2G customers, be conscious of the prevailing business challenges and how a unified B2G solution can tackle them in tandem. Recognize that customer expectations vary from one industry to another and tailor use cases to the core business and even less quantitative measures of ROI — e.g., interrupted power and reliability for healthcare, healthy buildings for education, or productivity for commercial office customers.
- **Develop robust analytics offerings as the foundation of B2G solutions.** Vendors must be cognizant to develop products that fit users' skillsets or partner requirements when outsourcing. Customers have been burned by investing in application after application and being left with a multitude of interfaces that create day-to-day burdens. It is critical to introduce an enterprisewide data strategy to ensure integration of data streams is both possible and scalable. Focus on data quality and analytics rigor to deliver business insight, not just more data to new customers.

B2G offers a huge opportunity for new revenue generation for innovative technology and service providers, enhanced customer-centric experience for building owners, and decarbonization and flexibility benefits for tackling the climate crisis. The opportunity cost of inaction is huge — industry incumbents across the energy and building technology sectors who fail to innovate will lose out to new competition from adjacent markets, creative strategic partnerships, and flexible peers. The target of 1.5°C will be missed and energy resiliency will become even more challenging. Market leaders are those that can rapidly iterate solutions around disruptive technologies and reach the broadest potential market as possible, as quickly as possible. Ultimately, B2G orchestrators will be those able to infuse innovation into their organization's DNA. They will break down existing silos and be willing to completely rethink every market assumption.

6. ACRONYMS AND ABBREVIATIONS

ADMS	Advanced Distribution Management System
C&I	Commercial and Industrial
DER.....	Distributed Energy Resources
DERMS	Distributed Energy Resources Management System
DG	Distributed Generation
DNG.....	Distributed Natural Gas
DR	Demand Response
DRMS	Demand Response Management System
DSM.....	Demand Side Management
EV.....	Electric Vehicle
GIS.....	Geographic Information System
HVAC.....	Heating, Ventilation, and Air Conditioning
IoT.....	Internet of Things
MW	Megawatt
O&M.....	Operations and Maintenance
PV.....	Photovoltaic
ROI.....	Return on Investment
SaaS.....	Software as a Service
SCADA	Supervisory Control and Data Acquisition
TOU.....	Time of Use
US.....	United States
VPP.....	Virtual Power Plant

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