



CABA Research Library – Members’ Area (Updated: March 2023)

The following reports are available to CABA members through the CABA Research Library:

(IS-2023-77) Welcome to Building X

This eBook was authored and published by Siemens in September of 2022. Several companies are bringing out AI-enabled programs to accelerate the digital transformation of buildings and to realize higher productivity, enhanced occupant well-being, and greater sustainability. This eBook describes how the Siemens Building X program accelerates the digital transformation of buildings to realize higher productivity, enhanced occupant well-being, and greater sustainability. Building X is a cloud-based, artificial intelligence-enabled connectivity platform for smart buildings. It unlocks the potential of linking disparate building data silos and combines them into one data lake, allowing users to control systems through a single source of truth and gain actionable insight previously unavailable. It discusses some of the Building X apps and the market-leading connectivity that will transform building operations from reactive or proactive to predictive and prescriptive.

(IS-2023-76) Unlocking Smarter Solutions for Managing the Built Environment

This report was authored by George Hawkinson, Richard Wendland, and Marc Petock and published by Burns & McDonnell in October 2022. The built environment is increasingly dependent on sophisticated, connected controls for heating and air conditioning, energy management, lighting, and many other systems. Unfortunately, many of these controls function in silos, with little interoperability and integration. A master systems integration strategy utilizing advanced controls platforms can give owners and operators the connectivity and access to the data they need to optimize operating costs, use energy more efficiently and address the pressing need to reduce carbon emissions. The report shows that technology is only half the story. The entire vision can be optimized further through the commissioning discipline. Commissioning provides the human insight and expertise needed to understand whether the data being gathered, compiled, and reported is accurate and consistent with the rules set by monitoring systems. This verification process also is important to be sure that applicable codes and standards are being met.

(IS-2023-75) The Sustainable Multi-Family Housing Opportunity

This report was published by Greenbuild in October 2022. A focus on sustainability and energy efficiency in the multifamily housing market can deliver benefits for a wide range of

stakeholders. Using green features and sustainable design achieves optimal results when all priorities, perspectives, and goals of stakeholders are in balance. The use of low-risk and proven technology and methods that have measurable value-add to the properties can be achieved with energy modeling and sustainable design at the earliest planning stages, ensuring every decision delivers a measurable benefit. This paper presents multifamily housing projects by teams of developers, architects, and engineers in Seattle. It details the necessary evolution of integrated design and energy strategies creatively implemented in three successive completed multifamily projects in Seattle. Multifamily housing, if designed and built responsibly, provides much-needed housing for a fraction of the cost of single-family construction. By design, dense urban housing creates a smaller carbon footprint, dramatically reducing per-person energy use and carbon emissions.

(IS-2023-74) The Economics of Electrifying Buildings - Medium-Size Commercial Retrofits

This report, published by RMI in September 2022, discusses the economic feasibility of electrifying medium-sized commercial buildings in the United States. It examines the upfront costs and long-term financial benefits of converting buildings from fossil fuel-based systems to electric heating, cooling, and hot water systems. The analysis concludes that while the upfront costs of electrification may be higher than traditional fossil fuel-based systems, the long-term operational and maintenance cost savings can result in a lower total cost of ownership over the life of the building. The paper also highlights the potential environmental benefits of electrification, including reduced greenhouse gas emissions and improved indoor air quality. Overall, it argues that electrifying buildings can be a financially and environmentally sound investment for building owners and operators.

(IS-2023-73) The CRE Tech Guide to Boosting NOI - Discover 5 quick steps to increasing NOI across your CRE buildings and portfolio

This eBook was authored and published by Building Engines, Inc. in October 2022 for property owners and operators who want to learn new ways to boost net operating income (NOI) with help from tech. Nearly half of commercial property teams are increasing CRE tech spend. They are streamlining with tech that can help NOI by reducing operating costs and driving additional revenue. Centralizing and connecting building data across teams and systems is essential to NOI growth. This tech and data can mobilize the property teams that are always on the go. Understanding the key data points, you can measure provides a fuller picture of tenant experience across portfolios and allows for the use of those insights to make the best business decisions.

(IS-2023-72) The Business Case for Sustainable Spaces

This report was compiled by Nancy A. Shenker and published by Greenbuild in October 2022. This report has industry experts sharing how their colleagues and the companies they serve can move more quickly to operate more sustainably. Employees are choosing companies that have a clear commitment to the environment. Public awareness of environmental issues rose because of the pandemic. Yet, many businesses may still be resistant to taking steps that promote

environmental health. Some companies merely pay lip service to sustainable building and practices. They balk at measures that will cut into their profits or delay or complicate development. They struggle with energy use reduction, social justice efforts, and new LEED construction. The many contributors discuss how they educate, incentivize, and compel companies to add environmentalism to their agendas. Making a case for sustainability requires companies to know their facts and be relentless and creative in advocacy.

(IS-2023-71) Start Breathing Easier - ABM is your guide to improved IAQ and healthier facilities

This report was authored and published by ABM Industries Inc in November 2022. Healthier buildings keep everyone healthier together. Safer spaces mean safer people. Keeping people safe now hinges on implementing a fact-based, expert-developed, and dynamic approach to occupant wellness. One that helps mitigate both air and surface-based viral transmission risks, while also increasing efficiencies and the financial health of the building operations. Using the Healthy Building Risk Assessment, a set of recommendations around air quality, surface disinfection, facility resiliency, and more are formed. After program implementation, ongoing results and data from repeated Healthy Building Risk Assessments are useful to recalculate risk and implement supplemental solutions moving forward. The report covers all areas of indoor air quality, energy efficiency and surface cleaning as well as communicating these programs to the occupants.

(IS-2023-70) Solving the Hybrid Work Puzzle

This report was published by JLL in October 2022. Hybrid is here to stay, and today's hybrid workplace needs to be a destination that attracts employees by making their time at the office "worth the commute." A dynamic approach to occupancy management provides benefits for workers and organizations across a range of hybrid models. JLL's Dynamic Occupancy Management does just that – allowing workers to schedule their time in the office, inform their colleagues and tailor their experience. The collective data generated by the workforce can help adapt the workspaces for the short-term, inform longer-term decision-making, and solve the hybrid work puzzle in a way that works for your organization.

(IS-2023-69) Smart Building Planning, Best Practices, and Network Design

This whitepaper was authored by Todd Harpel and published by Leviton Network Solutions in October 2022. Smart building growth is occurring as many companies have shifted to work-from-home or hybrid work policies over the past several years, leading to fewer occupants in commercial real estate buildings. Increasingly, building owners are evaluating smart building features to improve comfort in the workplace, reduce sick days, improve productivity to attract tenants, and remain competitive. Planning for the creation of a smart building must include a clear definition of the goals and desired outcomes of making the building intelligent. The stress and strain on the network caused by connecting so many new utility devices (IoT) can cause the network to become sluggish and adversely affect the user experience. To simplify management, improve security, and alleviate network stress in smart buildings, Leviton recommends that the network infrastructure connecting core LAN applications and utility applications become

physically separated in telecommunications rooms or closets. This creates a utility LAN, or what Leviton calls the uLAN™.

(IS-2023-68) Selling in Sustainability-Gaining Buy-in for Moving Sustainable Business Practices Forward

This report, published by Greenbuild in October 2022, discusses the importance of incorporating sustainability into the sales process, citing research that shows that consumers are increasingly interested in purchasing from environmentally responsible companies. It outlines several steps that sales professionals can take to align their approach with sustainable values, including highlighting eco-friendly product features and sharing information about the company's sustainability initiatives. The report also emphasizes the role of training and education in helping sales teams effectively communicate the value of sustainability to customers. Overall, the report argues that prioritizing sustainability in sales can help companies differentiate themselves from competitors, build customer loyalty, and drive revenue growth.

(IS-2023-67) Resilience at the Edge

This report was published by the Telecommunications Industry Association in October 2022. When planning an Edge Data Center (EDC) deployment, the need to address the availability of planned workloads to ensure resiliency is a top priority. The key characteristics of an EDC can be significantly different from those that top the list for larger enterprise or multi-tenant data centers. To help balance the costs and operational aspects of any EDC strategy, this paper outlines a number of critical questions that should be addressed to ensure resiliency at the edge.

(IS-2023-66) Regulating Embodied Emissions of Buildings

This report was published by The Atmospheric Fund (TAF) in November 2022. The building sector is now considering the embodied carbon in the net zero objectives. The vast majority of embodied emissions from new construction typically come from the procurement of a handful of key materials. These typically are concrete, steel, insulation, and timber. This primer has been created for policymakers and other decision-makers - including owners, designers, engineers, procurement officers, and other stakeholders who decide what we build as a society. The primer includes background information on embodied emissions (also called embodied carbon), benchmarks from 41 large buildings across Ontario, proposed reduction targets, and policy recommendations with sample language and reporting templates. It also notes several knowledge gaps and barriers the industry will need to overcome to effectively reduce embodied emissions in the years ahead - reductions needed to meet our climate targets. The topics covered can generally be applied to most buildings and/or infrastructure projects, however, the specific focus is related to large-scale "Part-3" buildings in Ontario.

(IS-2023-65) Redefining the Sustainable Workplace

This report was authored by Nancy A. Shenker and published by Greenbuild in October 2022. Business leaders are more focused than ever before on employee health and well-being --

especially as they create a new balance between physical space and remote working. Air, light, furniture, plants, food, meeting spaces, and even commute quality all have a significant impact on how people and customers feel about where they work. Schools, retailers, and municipal buildings are all tackling the complex issues around health, safety, and cost as they create and maintain sustainable workplaces. The report discusses the responses from the green building experts with their perspectives on the challenges facing businesses as they adjust to the sustainable -- and healthy -- new normal and their insights and predictions.

(IS-2023-64) Power Digitalization - Active Energy Management in Buildings

This report was authored by Tony Hunt, in 2021 and modified and published by Schneider Electric in October 2022. Most public, commercial, and industrial buildings are not energy efficient, representing an enormous untapped potential for decarbonization and sustainability efforts, as well as utility bill savings. Power digitalization plays a foundational role in active energy management and efficient facility operations. For existing buildings, this can be done by retrofitting electrical systems with smart devices and using energy and power management software that improves energy efficiency and reduces risk. This power digitalization investment helps facility management and maintenance personnel make better decisions, resolve issues more quickly, minimize downtime, and use less energy. In this paper, power digitalization for buildings is defined, and achieving power digitalization is based on connecting smart sensors and communicating devices to EPMS software and consists of three basic steps: Connect – Automate – Extend.

(IS-2023-63) Overcoming HVAC Challenges in Your Facility

This report was authored and published by Consulting-Specifying Engineer and ABB in October 2022. In commercial and industrial buildings, heating, ventilation, and air conditioning (HVAC) systems often need repair or replacement and the correct system must be specified and installed. To compound that challenge, HVAC systems can use about 35% of the energy load. That means selecting the right HVAC system is of high importance, both to consulting engineers and facility owners. This report discusses the 2022 research that showed HVAC systems within survey respondents' facilities are commonly challenged with aging equipment that needs updating or replacing (43%), meeting energy efficiency/sustainability goals (33%) and maintenance issues (29%). In looking at these challenges, engineers and facility personnel can address them by incorporating newer, more energy-efficient motors and drives into the HVAC system. The report discusses variable frequency drives (VFDs) and efficient motors and provides case studies that show significant energy and cost savings.

(IS-2023-62) Lessons From the Net Zero Challenge

This report was published by BOMA Canada in September 2022. This report shares insights and examples from the award program so that the industry can benefit from the lessons learned to help them achieve the similar levels of high performance on the path to net zero.

(IS-2023-61) Green-e Renewable Energy Standard for Canada and the United States

This report, authored and published by Center for Resource Solutions in September 2022, outlines the requirements and guidelines for renewable energy and carbon offset products to be certified by Green-e. The standard includes requirements for the eligibility of renewable energy sources, including specific environmental and social criteria that must be met, such as avoiding negative impacts on biodiversity and community engagement. The standard also outlines the requirements for the verification and tracking of renewable energy and carbon offset products, including the use of recognized third-party verification standards and regular reporting to Green-e. Overall, the Green-e Standard provides a comprehensive framework for ensuring the integrity and transparency of renewable energy and carbon offset products, and helps to build trust in the market for these products.

(IS-2023-60) Do More with Less - Moving Power and Building Management to the Cloud

This whitepaper, authored by Markus Hirschbold and Grant Reig in 2021 and modified and published by Schneider Electric in October 2022, discusses the potential benefits of cloud-based solutions for building and power management. The paper first describes the challenges faced by building and power managers in maintaining and optimizing their systems and the limitations of traditional management approaches. The paper then explains how cloud-based solutions can address these challenges by providing more efficient, cost-effective, and scalable management solutions. It highlights the benefits of cloud-based solutions, such as reduced hardware costs, simplified data management, improved data analysis, and remote access to data and systems. The paper also provides examples of how cloud-based solutions are already being used in building and power management, such as real-time energy management, predictive maintenance, and remote monitoring.

(IS-2023-59) Control the Network, Control the Costs - Solving the Wi-Fi Problem in Home Security

This whitepaper, by Parks Associates in partnership with Johnson Controls published in November 2022, focuses on the rise in demand for Wi-Fi devices integrated with security and smart home solutions, the impact of poor Wi-Fi network performance on the professional install channel, and the opportunity for dealers to own and manage the Wi-Fi network remotely, which would reduce their costs, limit truck rolls, and improve the user experience.

(IS-2023-58) Committing to Net Zero - How Businesses Are Meeting Their Carbon Pledge

This eBook, by Honeywell Building Technologies and published in October 2022, highlights the importance of committing to net-zero carbon emissions and provides insights into how businesses are achieving this goal. The eBook begins with an overview of the current state of carbon emissions and the urgent need to reduce them to limit the impacts of climate change. It then discusses the different ways that businesses can commit to net-zero carbon emissions, including setting science-based targets, adopting renewable energy sources, and implementing energy-efficient technologies. The eBook also provides case studies of several businesses that have successfully committed to net-zero carbon emissions, including Microsoft, IKEA, and

Schneider Electric. It highlights the strategies that these businesses have implemented to reduce their carbon footprint, including the use of energy-efficient technologies, renewable energy, and carbon offsetting.

(IS-2023-57) Carbon in Buildings - Material Embodied vs Operations Generated

This report was prepared by Greenbuild and GAF roofing and published in October 2022. In new construction, embodied carbon often takes center stage, as it is set by decisions made at the beginning of the building's life cycle and cannot later be altered. Embodied carbon represents emissions from building materials and construction and typically represents 28% of global building sector emissions. The need for resilience doesn't end with initial construction but also with operations. Using Passive Building Design is discussed. Investing in the Building Enclosure and the Impact of Building Codes as well as the cost savings and incentives for High-Performance Buildings are discussed. The challenges, opportunities, and strategies of building sustainability must be embraced as emissions continue to increase, regulatory requirements become increasingly stringent, and economic incentives continue to diversify.

(IS-2023-56) Toronto Part 3 Building Embodied Carbon Benchmarking Report

This report was jointly prepared by contributors at TAF, Mantle, University of Toronto, and the City of Toronto and published in November 2022. The building sector is now considering the embodied carbon in the net zero objectives. This report shows the results of the first attempt to collect and compare embodied carbon results as calculated using whole building life cycle assessments (WBLCA) for Part-3 buildings in Ontario for 41 separate buildings. Methodology differences make high-quality comparisons between projects difficult. Embodied carbon intensities increase with building height due to increased materials per area and greater subsurface works. Buildings with timber structures seem to have lower embodied carbon (~16% lower). Including sequestration makes this difference significant (~59% lower). Any future policy should provide clear guidance for required life cycle phases, objects of assessment, material quantity data sources, and treatment of carbon sequestration. While there is some 'noise' in the results due to variations in methodology, scope of assessment, and tools used by the teams these results are an important first step in understanding embodied carbon results in the City of Toronto and other Ontario municipalities.

(IS-2023-55) Building Back Better - Key Challenges In Reaching A Net Zero Built Environment

This whitepaper, by KPMG and Planon published in November 2022, informs real estate developers, investors, and occupiers, on what their businesses are up against in reaching their sustainability goals. It specifically outlines: why real estate organisations are central to tackling carbon emissions, the governmental policies in place to accelerate net-zero building initiatives, the challenges of designing and constructing net-zero buildings, the challenges of implementing net-zero principles across real estate investments, and the challenges of developing a net-zero corporate real estate portfolio and operations.

(IS-2023-54) Building Analytics Comparison Guide

This whitepaper, published by Clockwork Analytics in 2020 and modified in November 2022, describes the importance of FDD in HVAC systems and its potential benefits. The paper defines FDD as a process that uses software algorithms to identify faults and diagnose problems in HVAC systems. The paper discusses the challenges faced by building owners and operators in maintaining HVAC systems, and how FDD can help to address these challenges by detecting and diagnosing faults early, reducing energy consumption and costs, and improving the lifespan of the equipment. The paper also discusses the different types of FDD methods available, including rule-based methods and model-based methods, and the advantages and disadvantages of each. It highlights the importance of data collection and management in the FDD process, as well as the importance of working with qualified and experienced FDD service providers.

(IS-2023-53) Building A More Resilient America

This whitepaper was prepared by Tony Cho, CEO and Founder of Future of Cities and published by Greenbuild in October 2022. Solutions to today's sustainability issues must involve a collaborative worldwide community. We must build a country that will stand the test of time and lead the rest of the planet in making fundamental changes. This whitepaper defines how experts in the Greenbuild community on their take on the interconnection between sustainability and resiliency, the difference between sustainability and resiliency, how the U.S. government factors into sustainable development, and the challenges the U.S. faces in reaching a more resilient country

(IS-2023-52) Assuring Trustworthiness in Dynamic Systems Using Digital Twins and Trust Vectors

This paper was authored by A. Budiardjo, J. Geater, F. Hirsch, M. Pfeifer, D. Richter and published by the Digital Twin Consortium on October 25, 2022. The paper provides guidance to help organizations design digital twins securely and safely for digital transformation. It presents an understandable and interoperable model for digital twins' security and safety assurance that satisfies all stakeholders: technical, business, and regulatory.

(IS-2023-51) Accelerating Carbon Neutrality

This report, published by Enerbrain for AI4Cities on November 3, 2022, presents a comprehensive analysis of the potential of AI-based solutions to accelerate carbon neutrality in urban environments. The report first provides an overview of the AI4Cities project and its objectives. It then discusses the challenges faced by cities in achieving carbon neutrality and the role that AI can play in addressing these challenges. The report highlights several AI-based solutions that can contribute to reducing carbon emissions in cities. These include smart building systems, intelligent mobility solutions, and energy management systems. The report also discusses the potential of AI to optimize renewable energy generation and distribution, improve waste management processes, and enhance air quality monitoring

(IS-2023-50) A Guide to Measurement & Verification of Heat Pump Retrofits in Multi-Unit Res

Buildings

This report was prepared by Rushby Energy Solutions and published by The Atmospheric Fund on October 12, 2022. TAF commissioned this guide to support their Retrofit Accelerator program, which aims to increase the pace, scale, and ambition of retrofits that include heat pumps which require a large capital investment. This guide is intended for building owners, condo board members, and property managers to ensure heat pump installations are generating the expected energy savings, thus increasing heat pump adoption and encouraging electrification across the multifamily sector. It outlines M&V procedures and recommendations for heat pump retrofits, focusing on space heating retrofits in electrically heated MURBs. However, many of the principles can also be applied to heat pump retrofits in gas-heated buildings. IPMVP Option C is the recommended option for heat pump retrofits in MURBs. However, there are some scenarios when other IPMVP Options are recommended.

(IS-2023-49) The growing role of PPAs in corporate power purchasing

This report was prepared by the PV Magazine Group. The report deals with the growth of European corporate power purchase agreements (cPPAs) in solar, wind, renewables, and biomass. The growth is attributed to cPPA's renewable capacity online, channel private investment into new projects, and support EU climate and energy targets in a cost-effective manner. A case study from Spain is included. The main takeaway is that strong policy support is essential for long-term growth of cPPAs.

(IS-2023-48) Moving the Needle on Comprehensive Commercial Retrofits

This report was authored by Rohini Srivastava and Jasmine Mah from ACEEE and published on May 2, 2022. The report provides an assessment of programs that support and advance comprehensive retrofit projects. A literature review is presented along with interviews of experts in the field. Recommendations and resources are included to help increase the scale and scope of commercial retrofit programs. The main takeaway is that comprehensive retrofits achieve 15–40% energy savings.

(IS-2023-47) Leveraging AMI for the Low Voltage Landscape

This report was prepared by Itron and published on February 16, 2022. The report presents best practices for leveraging multi-purpose networks that support advanced metering infrastructure (AMI) to manage low-voltage applications. Insight is provided regarding plans for managing grid-edge devices as they are deployed at scale, along with the ways in which utilities are prioritizing grid management use cases. The main takeaway is that many utilities across the globe are planning to implement low-voltage applications and are finding opportunities for real-time data from EV charging programs.

(IS-2023-46) Industrial Heat Pumps - Electrifying Industry's Process Heat Supply

This report was authored by Ed Rightor, Paul Scheihing, Andrew Hoffmeister, Riyaz Papar from

ACEEE and published on April 13, 2022. The report examines the industrial heat pump (IHP) market, economics, industrial needs, and electrification potential to reduce energy and greenhouse gases. Also included are the enablers of research, development, and deployment of IHPs. The main takeaway is that IHPs can save up to 32% of the source energy for process heat generation.

(IS-2023-45) EnergySage Solar Marketplace Intel Report

This report was authored by Vikram Aggarwal from EnergySage and published in March 2022. The report provides a review of trends in pricing, equipment preference, and marketplace data for residential solar energy. Furthermore, it covers the new dynamics that have emerged in both the solar and storage industries throughout the second half of 2021, impacting solar pricing and consumer preferences for storage. The main takeaway is that financial savings are the main driver for consumers to pursue solar energy storage options.

(IS-2023-44) Progress & Pitfalls on the road to Net-Zero

This report was authored by Lance, Angel and published in February 2022 by National Public Utilities Council. It presents the results of a survey of 70 utility representatives in the US regarding climate change and net-zero plans. It is reported that global policy efforts to combat climate change are considered ineffective, and the new infrastructure law will predominantly drive investments in energy storage and renewables. Although it is expected that incremental change will be seen in an industry that is notoriously slow to change like electric utilities, the cost is seen as the main barrier to becoming net-zero utilities. It concludes that addressing the climate crisis will require investments in key technologies and stakeholder collaboration to overcome delays in deploying a cleaner electric grid.

(IS-2023-43) Office of the future revisited

The report "Office of the future revisited" by Cushman & Wakefield is a follow-up to their 2016 report on the future of the workplace. The report examines how trends in technology, sustainability, and wellness are impacting the design and use of office space. It argues that technology has transformed the way people work, with increased flexibility and mobility. Additionally, the report highlights the importance of sustainability, with companies using green buildings and renewable energy to meet their climate targets. Finally, the report emphasizes the importance of creating a workplace culture that prioritizes employee wellness, as it has become a key factor in attracting and retaining talent. Overall, the report provides insights into the evolving nature of workspaces and how companies can adapt to meet the changing needs of their employees.

(IS-2023-42) Building Decarbonization Solutions for the Affordable Housing Sector

This report, authored by York, Dan, et al. from ACEEE on April 2022, focuses on the need to decarbonize buildings in the affordable housing sector, which is a key component of achieving greenhouse gas emissions reduction targets. The report discusses the key barriers to

decarbonization in this sector, such as financing and lack of technical capacity, and provides a range of potential solutions, including leveraging incentives and financing programs, engaging with stakeholders, and advancing technology and innovation. The report also highlights successful examples of building decarbonization in the affordable housing sector and identifies opportunities for further action and collaboration to drive progress towards decarbonization goals.

(IS-2023-41) Using Software and Other Technologies to Make Renewable Energy a Cost-Effective Reality

This briefing paper, published by Harvard Business Review Analytics Services in January 2022, discusses how software and other technologies can be used to make renewable energy more cost-effective. The authors highlight the challenges of renewable energy project management and how technologies such as SiteTracker and Salesforce can help address these challenges. They also emphasize the importance of data analytics and machine learning in optimizing renewable energy production and reducing costs. The paper provides case studies and examples of companies that have successfully implemented these technologies to improve their renewable energy operations.

(IS-2023-40) Smart Buildings and the Battle for Sustainability

This whitepaper, published in March 2022, discusses the emergence of smart buildings, which are defined as buildings that use technology to enable efficient and economical use of resources while creating a safe and comfortable environment for occupants. The whitepaper explains how smart buildings offer advantages such as reduced costs, space optimization, and minimized environmental impact. However, concerns about privacy and security need to be addressed. The smart building ecosystem comprises building infrastructure management, security and access management, and energy management. Finally, the paper describes the key vertical markets of smart buildings, which are commercial and industrial buildings, healthcare buildings, and residential buildings.

(IS-2023-39) Empowering Green Hydrogen: Data's key role in sustainable energy generation

This whitepaper on green hydrogen was published by Aveva in May 2022. As the world transitions to sustainable energy sources, the hydrogen economy represents a significant opportunity for energy producers with the right tools and strategies to evolve alongside it. The green hydrogen value chain will be more complex and involve more stakeholders than those of conventional energy sources, and without solid digital tools, companies will find it difficult to take full advantage of all the hydrogen economy has to offer. This whitepaper details the market trends and pressures driving investment in hydrogen, the predicted scale and scope of future hydrogen applications, the benefits of, and challenges to, participating in the hydrogen economy and the tools and strategies companies will need to enter the hydrogen ecosystem.

(IS-2023-38) Smart Locks and Access Control Supply Chain: Scaling Innovation

This report, authored by Jennifer Kent from Parks Associates and published on May 24, 2022, discusses the results of a survey conducted by Parks Associates on the adoption of smart home technology and specifically focuses on the usage of smart locks. The survey found that only a small percentage of households currently have smart locks installed, with concerns over security and price being the main barriers to adoption. The paper suggests that manufacturers can increase adoption by addressing security concerns, improving ease of use, and offering lower-priced options. Additionally, the paper identifies the potential for smart locks to be integrated with other smart home devices, leading to increased convenience and security.

(IS-2023-37) Smart Cities World Trend Report 2022 - Governance and Citizen Engagement

This trend report, by SmartCitiesWorld and published on June 24, 2022, discusses the role of citizens in shaping smart city governance, including the importance of transparency, accountability, and participation in decision-making processes. The report also highlights several case studies from around the world, showcasing how cities are working to engage citizens in the development and implementation of smart city initiatives. The report concludes with recommendations for cities on how to build trust and foster collaboration with citizens, such as creating accessible channels for citizen engagement, utilizing data and technology to improve citizen services, and prioritizing inclusive and equitable outcomes.

(IS-2023-36) Indoor green wall affects health-associated commensal skin microbiota and enhances immune regulation: a randomized trial among urban office workers

This report was authored by L. Soininen, M. I. Roslund, N. Nurminen, R. Puhakka, O. H. Laitinen, H. Hyöty, and A. Sinkkonen from University of Helsinki, and the ADELE research group and published on April 20, 2022. Discussed in the report is the impact of air-circulating green walls on bacterial abundance and diversity on human skin, and on immune responses determined by blood cytokine measurements. Based on an experiment involving a control group (no exposure to green air-circulating walls) and experimental group (exposed to air-circulating green walls), the main takeaway is that air-circulating green walls may induce beneficial changes in a human microbiome.

(IS-2023-35) The [Connected] Home is Where the Heart is: User Interface Design for Smart Appliances

This report, prepared by The Qt Company and published on October 21, 2021, explores the design trends and considerations for creating user interfaces (UIs) for smart appliances. The paper discusses the importance of creating intuitive and user-friendly interfaces for smart appliances, which are becoming more prevalent in households. The authors also emphasize the need to provide a consistent and cohesive UI experience across all devices and platforms, including mobile and web applications. The whitepaper also covers various design trends and best practices, such as using natural language processing, gesture recognition, and voice control. Additionally, the paper highlights the significance of user testing and feedback in creating effective UI designs.

(IS-2023-34) Smart Home with Batteryless Wireless Technology

This report, prepared by EnOcean Alliance and published on November 19, 2021, provides a comprehensive summary of what constitutes a "Smart Home", with a focus on batteryless wireless technology. The advantages of EnOcean's wireless technology are presented and include product interoperability, flexibility, reduced installation cost, free maintenance, and no reliance on batteries. The main takeaway is that the smart home market is expected to grow significantly and will rely on the integration of open interfaces, different standards, and technologies to enable homeowners to create flexible solutions.

(IS-2023-33) Measurement of CO2 Concentrations in Temperature Changes

This report was prepared by the AsahiKasei Group and published on November 12, 2021. The report deals with a comparison of temperature characteristics between Senseair's CO2 sensor and the competitor's products, all which play an important role in monitoring buildings' air quality. A new evaluation system was constructed that keeps a stable CO2 concentration and constant CO2 temperature. The main takeaway is that only Sensair's CO2 sensor achieved the required accuracy of 75 parts per million as required by the Green Building Certification Program (LEED).

(IS-2023-32) LoRaWAN in building automation

This report was prepared by DEOS.AG and published on May 1, 2022. The report deals with the Long Range Wide Area Network (LoRaWan) energy-efficient wireless technology and how it can be applied for building automation. Key components of LoRaWan are examined from networking and device perspectives. A practical application of LoRaWan to smart buildings is presented, along with its comparison to Wi-Fi and Bluetooth technologies. The main takeaway is LoRaWan's wide scope of benefits that include long-distance range and deep building penetration, long battery life, low cost of infrastructure, and widespread use in cities and communities.

(IS-2023-31) How the Next Generation of Community Solar Can Unlock New Value Streams and Help Communities Pursue Holistic Decarbonization

This report was authored by Stephen Abbott, Amanda Farthing, Matthew Popkin, and Madeline Tyson from RMI and published on April 11, 2022. The first generation of community solar allowed for greater access to solar energy for residential customers, but equitable access to renewable energy requires deliberate policy and program design. The concept of Community Solar+ introduces the idea of strategically deploying community solar projects to maximize local value streams and advance community-wide sustainability and equity goals. Four core value streams are identified: accelerating investment in EV charging infrastructure, increasing energy resilience for critical assets and vulnerable communities, aligning evolving grid and customer needs for an electrified future, and creating a more equitable energy system. The report offers a hypothetical financial model and case studies demonstrating Community Solar+ strategies already under development in Denver, San Antonio, and Washington, D.C. The report concludes

with recommendations for local governments, states, utilities, and other key stakeholders seeking to embrace this emerging practice.

(IS-2023-30) The Truth About Corporate Real Estate Data and Insights

This report was prepared by JLL Technologies and published on September 6, 2022. When it comes to data and insights for corporate real estate (CRE), not all business intelligence (BI) solutions are created equal. Many CRE organizations face challenges that prevent them from effectively using their data to make more informed decisions. But they see the value in it, and research from Forrester Consulting reveals CRE leaders' plans to use data and insights from BI platforms to optimize their portfolios, operations, and workplaces. This white paper examines the challenges around leveraging portfolio data to optimize real estate investments, the challenges of addressing operational processes with data and insights and plans to invest in technology to improve building operations and efficiency.

(IS-2023-29) Why Wi-Fi 6 goes hand-in-hand with cellular to enable the hyper-connected enterprise future

This whitepaper, prepared by Quectel and published on February 16, 2022, discusses the new Wi-Fi 6 standard, which is designed to offer faster speeds, improved reliability, and increased capacity for wireless networks. It explains the key features of Wi-Fi 6, including improved modulation and coding techniques, MU-MIMO, and OFDMA, and how they improve the performance of Wi-Fi networks. The paper also compares Wi-Fi 6 to previous Wi-Fi standards and highlights its benefits for different industries, including healthcare, education, and transportation. Additionally, it provides information on the various applications and use cases of Wi-Fi 6 and discusses the challenges and solutions in implementing this new standard.

(IS-2023-28) Simplifying the IoT Edge - Smart Spaces Best Practices

This whitepaper, from Parks Associates, published on April 29, 2022, discusses the growing complexity of the Internet of Things (IoT) ecosystem and the challenges associated with deploying IoT devices at the network edge. It highlights the importance of simplifying the deployment and management of IoT devices to enable the full potential of the IoT ecosystem. The paper identifies key factors driving the complexity of IoT deployments, including device heterogeneity, data security, and network connectivity. It also proposes a new approach to simplifying IoT deployments, which involves the use of an IoT edge platform that provides a unified management and security framework for IoT devices. The paper discusses the benefits of this approach, including reduced deployment and management costs, improved security, and increased scalability. Finally, it provides recommendations for organizations looking to implement an IoT edge platform, including evaluating platform providers based on their security capabilities and interoperability with existing infrastructure.

(IS-2023-27) Is the Industry - And The World - Ready For 5G Advanced?

This report, by ABI Research, published on July 12, 2022, discusses the readiness of the industry

and the world for 5G advanced, the next generation of 5G technology. It highlights the various features and benefits of 5G advanced, including higher data rates, lower latency, and improved energy efficiency. The report also discusses the challenges associated with deploying 5G advanced, such as the need for new infrastructure and the potential impact on existing networks. It provides insights into the current state of the industry and the key trends driving the adoption of 5G advanced, including the growing demand for high-speed data and the increasing use of IoT devices. The report also includes case studies of companies that are leading the way in deploying 5G advanced, as well as recommendations for organizations looking to implement this new technology. Overall, the report suggests that while there are challenges associated with 5G advanced, the benefits it offers make it a promising technology for the future of wireless communications.

(IS-2023-26) Is subscription-based the future of physical security?

This whitepaper was prepared by Siemens and published on February 8, 2022. In the business world, Software as a Service, or SaaS, is nearly fully mature. Largely replacing the on-premises delivery model, SaaS has delivered enormous value to businesses, large and small, in the form of lower costs, faster commissioning, better quality of product, a smoother user experience and cost-efficient scalability. But what are the barriers to entry for Security as a Service? Why is it experiencing this surge in popularity? And what does the future hold for this relatively new offering? Will the trend continue or fade quickly into the technology memory hole? And how should companies evaluate whether to take advantage of this new business model? This whitepaper addresses the barriers to entry for Security as a Service and provides security decision-makers with insights into the risks and opportunities.

(IS-2023-25) Are utilities prepared to prevent and solve cyberattacks?

This whitepaper, by Ericsson published on April 1, 2022, discusses the growing threat of cyberattacks in the telecommunications industry and the potential impact on 5G networks. It highlights the various types of cyber threats that telecommunications companies face, including DDoS attacks, malware, and data breaches. The paper also discusses the unique security challenges associated with 5G networks, such as the increased number of connected devices and the need for real-time data processing. It provides recommendations for telecommunications companies to improve their cybersecurity posture, including implementing a layered security approach, conducting regular security assessments, and investing in security technologies such as AI and machine learning. The paper also highlights the importance of collaboration between industry stakeholders, such as service providers, vendors, and regulators, to address cybersecurity threats and improve overall network security.

(IS-2023-24) Technology Advances Are Changing the Facilities Management Role

This report was authored by Edward Wagoner from JLL Technologies and published on August 2, 2022. Innovative software technologies are automating, streamlining, and disrupting facilities management (FM). Discover the job skills necessary for keeping up with the technologies changing the FM world. This whitepaper addresses how FM job descriptions have changed over

the years in response to technological innovations and the knowledge gaps keeping FMs from higher job performance and greater career flexibility.

(IS-2023-23) Introduction to Smart Systems

This report, prepared by Harbor Research and published in May 2022, The article discusses the evolution of "smart systems," which are integrated and interconnected networks of sensors, devices, and applications that work together to collect and analyze data and provide intelligent insights and actions. The article highlights the growing importance of smart systems in various industries, including manufacturing, healthcare, and smart cities. It provides examples of how smart systems are being used to improve efficiency, reduce costs, and enhance customer experiences. The article also discusses the challenges associated with implementing smart systems, such as data privacy and security concerns and the need for skilled professionals to manage and maintain these systems. The article concludes by emphasizing the importance of a holistic approach to smart systems, including a focus on interoperability, scalability, and sustainability.

(IS-2023-22) Doing IoT Right: Top Practices for Multi-Dwelling Units

This whitepaper, authored by Kristen Hanich from Parks Associates and published on May 2, 2022, discusses the growth and potential of the "MDU IoT" market, which refers to smart home technologies and devices installed in multi-dwelling unit (MDU) buildings such as apartments and condominiums. The paper highlights the unique challenges associated with deploying smart home technologies in MDUs, such as limited space and the need to ensure privacy and security for residents. The paper also discusses the opportunities for companies in the MDU IoT market, including the potential for new revenue streams and improved resident satisfaction. The paper provides examples of successful MDU IoT deployments, such as energy management systems and connected security devices, and offers recommendations for companies looking to enter the MDU IoT market, such as developing scalable and interoperable solutions and building partnerships with MDU property owners and managers. The paper concludes by emphasizing the importance of a resident-centered approach to MDU IoT, with a focus on convenience, ease of use, and privacy and security for residents.

(IS-2023-21) The ROI of Construction Technology

The Procore ROI report, published on April 11, 2022, presents findings on the return on investment (ROI) of using Procore construction management software. The report includes data from interviews with Procore customers who shared their experiences with using the software and the benefits they have gained from it. The report presents several key findings, including that companies using Procore experience increased efficiency, cost savings, and improved collaboration among team members. The report provides specific examples of these benefits, such as reducing change orders and increasing project completion rates. The report also highlights the positive impact of Procore on employee satisfaction and retention. Finally, the report offers a tool for estimating the potential ROI of using Procore based on a company's size and type of construction projects. Overall, the report provides evidence to support the value of

using Procore for construction project management.

(IS-2023-20) A Cybersecurity Threat Profile for a Connected Lighting System

The report prepared by the U.S. Department of Energy's Building Technologies Office, in February '2022, provides a cybersecurity threat profile for networked building systems, which includes building automation systems, lighting systems, HVAC systems, and more. The report outlines the potential vulnerabilities and risks associated with such systems, which can lead to data breaches, property damage, and even physical harm to occupants. It also identifies the potential threat actors, such as nation-state actors, hacktivists, and cybercriminals, and their motivations for targeting building systems. The report offers recommendations for securing building systems, such as implementing strong passwords and user authentication processes, conducting regular security assessments, and training employees on cybersecurity best practices. The report also emphasizes the need for collaboration between building owners, manufacturers, and cybersecurity experts to address the evolving threat landscape and to ensure the security and resilience of building systems.

(IS-2023-19) Powering nodes of wireless sensor networks with energy harvesters for intelligent buildings: A review

This paper, published on February 23, 2022 in the Elsevier Energy Journal, discusses the role of intelligent buildings in efficient energy management but also highlights the challenges in their energy use, particularly in powering wireless sensor networks. The paper proposes energy harvesters (EHs) as a solution to power sensor nodes in buildings, complementing the use of batteries and extending their lifetimes. The study reviews various EH technologies currently under the experimental or development phase that can extract power from environmental sources such as mechanical motion, thermal, light, radio-frequency, and fluid flow. The potential sites and building systems for extracting power through EHs are presented, along with the challenges and opportunities for each technology. The research findings indicate that EHs can generate enough power to partially or completely supply the power demands of sensor nodes in intelligent buildings.

(IS-2023-18) What Are the Building Blocks for Designing Smart Buildings

This paper, published by CFE Media - Consulting-Specifying Engineer on September 8, 2022, discusses the implementation of artificial intelligence (AI) in smart building systems to enhance their efficiency, security, and sustainability. The paper highlights the benefits of AI, such as predictive maintenance, optimized energy consumption, and improved occupant comfort. The paper presents several use cases where AI is being utilized in smart buildings, including energy management, fault detection, and predictive maintenance. It also discusses the challenges of implementing AI in smart buildings, such as data privacy concerns and the need for advanced algorithms and computing infrastructure. The paper emphasizes the importance of integrating AI with other smart building technologies such as IoT sensors and cloud computing platforms to create an interconnected and intelligent building ecosystem. It also highlights the potential for AI to improve building resilience and support disaster response efforts. The paper concludes by

calling for further research and development in AI and smart building technology to create more sustainable, efficient, and secure buildings. It also emphasizes the importance of collaboration between industry stakeholders, policymakers, and researchers to address the challenges and opportunities presented by the adoption of AI in smart buildings.

(IS-2023-17) Smart Building Connectivity Network

This whitepaper, published by TIA on September 16, 2022, discusses the importance of connectivity in smart building design, operation, and maintenance. It highlights the benefits of a robust connectivity network, including increased energy efficiency, enhanced occupant comfort, improved safety and security, and reduced operating costs. The document presents several case studies demonstrating how advanced connectivity technologies such as Wi-Fi, 5G, and cellular networks are being used to create intelligent and connected building systems. The paper also identifies the challenges of implementing a reliable connectivity network, including the need for adequate bandwidth, proper network architecture, and security protocols. It emphasizes the importance of selecting the right connectivity technology for a specific building environment, based on factors such as building size, use case, and location. The paper concludes by emphasizing the need for collaboration between building owners, operators, and technology providers to ensure that smart building connectivity solutions meet the evolving needs of building occupants and the larger community.

(IS-2023-16) How to Improve Indoor Air Quality While Minimizing Energy Consumption

This whitepaper, published by Schneider Electric on August 9, 2021, focuses on how building owners and facility managers can meet the new expectations of building occupants by improving indoor air quality. It also outlines how to control energy use and costs while implementing these return-to-work solutions.

(IS-2023-15) How Does Thermal Comfort Differ in Smart vs Normal Buildings

This report, published by AZoM.com Limited T/A on September 8, 2022, explores how the adoption of smart building technology affects thermal comfort in comparison to traditional buildings. The study involves analyzing data collected from occupants in both types of buildings using thermal comfort surveys and measuring environmental variables such as air temperature, humidity, and air velocity. The results suggest that smart buildings provide more precise and comfortable indoor conditions due to advanced control systems that adjust the environment to suit the occupant's preferences. Additionally, smart building technology provides more flexibility in individualizing the thermal comfort settings for occupants, leading to improved satisfaction levels. However, the study also identifies challenges such as higher energy consumption and costs associated with implementing and maintaining smart building technology. The report concludes that while smart building technology offers benefits for thermal comfort, a balance between energy efficiency and occupant satisfaction should be achieved to ensure sustainable and comfortable indoor environments.

(IS-2023-14) Help Wanted - Tech-Savvy Talent to Lead Smart Buildings Into the Future

This article by Betsy Conroy, published by Smart Building Technologies on September 7, 2022, discusses the growing demand for skilled professionals in the smart building industry and the need for workforce development programs to train individuals for these positions. The article highlights the various job roles that are emerging in the smart building industry, such as building automation engineers, data analysts, and cybersecurity specialists. It also discusses the importance of developing a diverse and inclusive workforce to ensure that the industry can benefit from a range of perspectives and experiences. The article suggests that industry stakeholders should collaborate to create training programs and apprenticeships that can help individuals acquire the skills and knowledge needed to succeed in the smart building industry. Overall, the article emphasizes the importance of investing in workforce development to support the growth of the smart building industry and address the skills gap that currently exists.

(IS-2023-13) The CMMS Solution to Facilities Management

This report, published by JLL Technologies on June 29, 2022, discusses how Computerized Maintenance Management Systems (CMMS) can benefit facilities management by improving maintenance planning, asset management, and overall operational efficiency. The report highlights several key features of a CMMS, including work order management, asset tracking, and preventive maintenance scheduling. It also provides case studies to demonstrate the benefits of implementing a CMMS in various types of facilities, such as hospitals, universities, and commercial office buildings. Overall, the report suggests that a CMMS can help facilities management teams streamline their operations, reduce costs, and improve the overall performance of their assets.

(IS-2023-12) The Business Case for Intelligent Buildings

This report published by Arcadis on June 29, 2022, provides an overview of the benefits of intelligent buildings and how they can help organizations achieve their business goals. It discusses the various technologies and systems that can be integrated into intelligent buildings, such as building automation systems, energy management systems, and smart lighting systems. The report also highlights several case studies to demonstrate the financial benefits of implementing intelligent building solutions. Overall, the report suggests that investing in intelligent buildings can improve the operational efficiency, sustainability, and occupant experience of buildings while also delivering a strong return on investment for businesses.

(IS-2023-11) Comprehensive Approach for Physical and Digital Spaces

This whitepaper, authored by Siemens and published on February 8, 2022, discusses the integration of artificial intelligence (AI) and machine learning (ML) technologies into building automation systems (BAS) and how they can improve building performance, occupant comfort, and energy efficiency. The report emphasizes the importance of data collection and analytics in AI and ML models, which can lead to actionable insights and proactive maintenance, reducing energy waste, and improving indoor air quality. The document also provides examples of AI and

ML applications, including fault detection and diagnostics, predictive maintenance, and occupant behavior analysis. Additionally, the report mentions the challenges associated with AI and ML integration, such as data quality, privacy concerns, and the need for skilled personnel.

(IS-2023-10) Commercial Real Estate and Air Quality Safety

This whitepaper authored by Blueair and published on December 8, 2021, discusses the potential health risks of poor indoor air quality and the importance of monitoring and maintaining good air quality in buildings. It emphasizes that air quality can have a significant impact on the health, productivity, and comfort of building occupants. The document also explores various strategies and technologies for monitoring and improving air quality, such as ventilation systems, air filters, and air quality sensors. Overall, the document highlights the importance of prioritizing air quality safety in building design, construction, and maintenance to ensure the well-being of occupants.

(IS-2023-9) Clean Indoor Air - The Guide

The report discusses the impact of the COVID-19 pandemic on the building automation and control systems (BACS) industry. The pandemic has accelerated the adoption of new technologies and approaches, such as the increased use of remote monitoring and control systems, the integration of indoor air quality sensors, and the implementation of touchless systems. The report also highlights the need for building owners and managers to focus on sustainability, resiliency, and flexibility in their buildings to ensure occupant health and safety. Furthermore, the document stresses the importance of cybersecurity measures for BACS systems, given the increased reliance on digital technologies and the potential for cyberattacks.

(IS-2023-8) Zero Carbon Building - Performance Standard

Canada Green Building Council's Zero Carbon Building Standard (ZCB Standard) Version 2 - Performance was published on June 21, 2022. The ZCB Standard sets out the requirements for new and existing buildings to become zero-carbon by 2030. The Performance version of the standard provides a framework for designing and operating buildings to achieve zero carbon performance over time. The document includes requirements for energy efficiency, on-site renewable energy, and carbon offsets. It also provides guidelines for measuring and verifying building performance, as well as a scoring system to evaluate a building's performance against the standard.

(IS-2023-7) Zero Carbon Building - Design Standard

This is the third version of the Zero Carbon Building (ZCB) Design Standard developed by the Canada Green Building Council and published on June 20, 2022. The standard provides guidance on designing and constructing commercial, institutional, and multi-unit residential buildings to achieve zero carbon emissions, with an emphasis on energy efficiency and the use of renewable energy sources. The standard includes three pathways for achieving zero carbon: energy efficiency, on-site renewable energy, and off-site renewable energy. It also sets performance metrics for various building components, including envelope, lighting, HVAC systems, and

renewable energy systems, as well as requirements for monitoring and reporting energy consumption and carbon emissions. The standard also includes a section on carbon offsets and the use of renewable natural gas.

(IS-2023-6) The Canada Green Buildings Strategy

The Canada Green Building Strategy Discussion Paper, published by Natural Resources Canada in July 2022, presents a national framework for improving the environmental performance of buildings. The paper outlines the benefits of green buildings, identifies gaps and challenges in the current building industry, and proposes strategies to improve energy efficiency, reduce carbon emissions, and promote sustainable building practices across Canada. The proposed strategies include enhancing building codes, standards and rating systems, improving access to financing and incentives, and increasing education and training for industry professionals and the public. The paper also highlights the importance of collaboration and stakeholder engagement in achieving these goals.

(IS-2023-5) Fuel-Switching Hydronic Systems to Low-Carbon with Air-to-Water Heat Pumps

Mitsubishi Electric published a report on February 8, 2022, highlighting the benefits of using air-to-water heat pumps for year-round heating and cooling, which are extremely efficient and can minimize the need for natural gas. Intertek evaluated the performance of Mitsubishi Electric's air-to-water heat pumps in 3 typical buildings located in Toronto, Vancouver, and Montreal with different climates, and confirmed that energy savings and carbon emission reduction can be achieved with a heat pump in various cold climates. The report also noted that a natural gas boiler was needed to supplement the building's heating needs only on extremely cold days, and that having an electric heat pump with a supplementary natural gas boiler provides energy diversity and redundancy, ensuring a reliable heating source in case any system goes off grid.

(IS-2023-4) 2022 Migration Patterns - The Ripple Effect

This report, authored by Placer Labs, and published in August 2022 focuses on the ripple effect of recent migration trends. Placer Labs used foot traffic data to show how a small influx of residents can influence a city's office occupancy rates, create commercial opportunities, and impact how retailers serve their communities. The whitepaper answers the following questions:

Where is population growth driving a strong workplace recovery?

Why are national chains now looking to expand in smaller markets?

How does domestic migration impact local retail and dining preferences?

(IS-2023-3) 8 Trends That Will Shape Real Estate And Facility Management By 2027

This whitepaper, authored by Planon and published on June 28, 2022, explores 8 disruptive trends that are currently solidifying and explains the extent of their impact on the CRE & FM domain in the next 5 years. What is happening around the topic of sustainable FM? What

technology is there to support? What post-pandemic consequences should be considered?

(IS-2023-2) PoE lighting Benefits and Design Considerations

This whitepaper authored by Panduit Corp. and published on June 10, 2022 discusses the concept of a "digital building," which refers to the convergence of smart devices to manage the day-to-day operations of facilities. It notes that traditionally, buildings have separate networks for various systems, but new technologies are creating the possibility of a single converged digital building network. Power over Ethernet (PoE) lighting is identified as a core component of this digital building revolution, as it merges advances in LED lighting with PoE IP networking, creating a Building Internet of Things (BIoT) component.

(IS-2023-1) How to Achieve Sustainable Indoor Air Quality

A Roadmap to Simultaneously Improving Indoor Air Quality & Meeting Building Decarbonization and Climate Resiliency Goals published by EvVerid on August 5, 2022. The whitepaper discusses the importance of indoor air quality in commercial workspaces, particularly in the context of attracting employees back to the office amid concerns over COVID-19 variants. The whitepaper emphasizes the negative impact of poor indoor air quality on employee productivity and health, and the need for building owners and operators to prioritize improving indoor air quality while also meeting energy conservation and climate resiliency goals. It also presents a four-step Clean First framework for achieving sustainable indoor air quality, which includes defining IAQ goals, cleaning indoor air, optimizing ventilation, and monitoring and controlling IAQ.

(IS-2022-161) The Future of Work Survey 2022

This 2022 Future of Work Survey was authored by Dr. Marie Puybaraud and the JLL's Global research team and published on August 16, 2022. This survey reports on the unprecedented experience of the global public health pandemic. It shows the rapid acceleration of the large-scale adoption of dynamic and flexible working, the growth of workplace technologies to support CRE (corporate real estate) functions in managing these new workstyles, and increased investment to bolster environmental sustainability goals. The power has shifted from the employer to employees, forcing organizations to reimagine workplace and portfolio strategies; and the greater application of technology is becoming crucial to boosting performance levels on all fronts. JLL has surveyed 1,100 strategic decision-makers in businesses around the globe. Offering hybrid working options will be critical to attracting and retaining talent. Without sustained investment in technology and data, it will become more challenging to achieve performance and resilience goals.

(IS-2022-160) The 2022 Tenant Engagement Report

This 2022 Tenant Engagement Report was authored by HqO and published on Jan 14, 2022. The year 2021 was a formative, transitional period for owners and operators of commercial real estate (CRE) properties. Between growth, consolidation, and significant funding in the PropTech market and evolving workforce needs due to the pandemic, CRE leaders faced an array of new

challenges to overcome including how to add value to buildings in ways that support every person who spends time in and around the workplace. HqO surveyed over 100 of the world's leading companies and found that 54% of properties have staff dedicated to tenant experience; 86% of property teams use a building app to communicate with the people in their properties; the many kinds of investments leaders are making to differentiate their assets, attract and retain talent, and achieve financial success; and other critical factors shaping the future of the workplace.

(IS-2022-159) Smart Buildings Balance Efficiency and Tenant Experience

This White paper was authored by Julie Petrone, and published by ABB Building Solutions July 5, 2022. Intelligent buildings open up new possibilities in the building space. As network solutions improve and new IoT services are developed, the buildings industry is leveraging technologies to provide better solutions for energy efficiency and occupant wellness. Digitalization is the driving force behind modern building evolution. Data-driven intelligence and automation have transformed commercial buildings into efficient, sustainable, safe, and comfortable environments that intelligently adapt and respond to people's needs. The networking of a technical building system, which drives efficiency gains, in turn, supports the emergence of new services. The report shows that ABB offers a unified enterprise platform that adds intelligence to buildings and provides a holistic solution for building management, resulting in lower costs and improved ROI over a building's life span, optimized performance and functionality, automated monitoring and control, greater occupant comfort, and enhanced safety and security.

(IS-2022-158) Malls that are Rising to the Top

This White paper authored by Placer Labs, Inc. and published on August 30, 2022, shows how malls are reinventing themselves and staying relevant thanks to experiential offerings, omnichannel options, and strategic tenant selection. Many began to predict the demise and downfall of malls, and that narrative intensified as online shopping grew in popularity. The rise of big-box stores, a focus on "services, not things," and COVID-19 only accelerated these trends. And after two years of isolation and a new, pandemic-induced wave of suburban relocation, malls' potential to bring people together is more prized than ever. Some shopping centers are turning to entertainment to draw crowds into their doors. Others are focusing on offering a full visitor experience that extends beyond simply grabbing a new shirt or a burger at the food court. Top-tier malls are turning to innovative solutions to stay ahead of the game.

(IS-2022-157) Ebook HVAC Summer Edition

This eBook was authored by individual contributors for each topic and published by CFE media on June 30, 2022. The discussions cover the various new methods, technologies and specifications like Division 25 and Well V.2 to make the HVAC equipment perform better and also reap the benefits of the digitalization of the new equipment by bringing that data back to a decision-making platform. The topics cover chiller optimization, boilers, and their controls, pumping configurations, and the electrification of our building systems. Each topic covers the issues from the technical capabilities and also the costs and benefits achieved. In many cases,

the extra costs up front provide significant operating and energy savings that justify the procurement of better equipment.

(IS-2022-156) Driving Resiliency Through Your Organizations Energy Infrastructure

This report was authored by Ameresco and published on July 26, 2022. In recent years, major weather events, such as hurricanes and wildfires, have exposed vulnerabilities in our energy system that have left many without power for days or weeks, exacting a high cost in terms of lost productivity and quality of life. The price of many distributed energy technologies, such as solar photovoltaic (PV) and energy storage, has dropped precipitously over the last decade, placing them in price parity (or better) with grid-supplied energy. This white paper explores ways in which government agencies, companies, and other organizations can leverage their energy infrastructure to minimize the adverse impacts of major events – in other words, to become more resilient. To date, much of the interest in resiliency has been limited to a few key sectors; however, this white paper, shows that a wide range of organizations are using their energy infrastructure to become more resilient in budget-sensitive ways.

(IS-2022-155) Building Meets Artificial Intelligence

This report was authored by Paul Baumann and published by Siemens on June 20, 2022. The report introduces the many benefits of effective artificial intelligence (AI) in many applications and suggests there are challenges, particularly when connecting and mapping technology within buildings. The topic of AI often causes a split in opinion: making human life easier, and concerns about unethical decisions or the replacement of humans. The subsets of AI in machine learning (ML) using substantial amounts of data from the construction phase and building information modeling (BIM) are explained. Siemens reports on its Building X, a holistic, open platform of data-driven applications and connectivity solutions for buildings during the operations phase. The platform is based on extendable business services and a common data model that provides a single source of truth for a digital building.

(IS-2022-154) Accelerating Coordinated Utility Programs for Grid-Interactive Efficient Buildings

This report was authored by Kate Strickland & Becca Trietch and published by Smart Electric Power Alliance on July 8, 2022. Grid-interactive efficient buildings (GEBs) are energy- efficient buildings that use smart technologies and on-site distributed energy resources (DERs) to provide demand flexibility while co-optimizing for energy cost, grid services, and occupant needs and preferences in a continuous and integrated way. To help accelerate this GEBs future, building energy programs will need to transition to better integrate conservation and active management of electricity in buildings for the direct or indirect provision of grid services. This study examined the barriers and potential solutions to this building energy program transition with a literature review, survey, focus groups, and one-on-one interviews used to document the industry's current challenges and strategies for success. Solution strategy implementation details, where available, are presented in case studies. By documenting the barriers and key strategies for coordinated EE+DF(+DR) programs, this study aims to support all stakeholders looking to unlock a GEBs future.

(IS-2022-153) The Detailed 5-Step Guide to Ideate Building Performance and Sustainable Design Strategies

This report was authored by COVE.TOOL and published on July 22, 2021. Since each site is different, each project is different, and each client is different, the eBook suggests a consistent way of evaluating building performance across all projects. Developing a decision-making framework is critical for any endeavor and using data-driven design processes solves this problem by using simulations to guide decision-making. In this e-book, they outline 5 key steps design teams can use to simplify building performance and sustainable design analysis and help them implement a repeatable, data-driven process that can be used on hundreds of projects successfully. Site analysis, understanding energy benchmarks, and using a building performance analysis tool, the team can now run through a holistic cost vs energy optimization to test out all the possible combinations for different strategies and pick out the best one.

(IS-2022-152) The Agile and Efficient Digital Building

This report was authored by Panduit Corp and published on June 30, 2022. The report defines the Digital Building as showing the changes to space and amenities as employers are wooing a younger, more collaborative workforce that cares about things like the health and wellness of the workspace and flexible working conditions. The advantages of a digital building go well beyond energy savings and optimized building operations. The report discusses the significant IP network installed by Cisco and the true benefit of a highly connected building. Technology has the potential to transform the operation of buildings. Connecting disparate systems and devices to an IP network allows those systems to share data on occupancy, space usage, temperature, and more, which makes buildings more responsive and efficient. This also leads to higher employee satisfaction and productivity.

(IS-2022-151) Rethinking Workspaces - Hybrid Workspaces Solutions and Use Cases Outlook

This report was authored by and published by Kontakt.io on March 4, 2022. Occupancy monitoring has become critically important especially as the need for workplace flexibility and safety has grown due to COVID-19 precautions. The report discusses the need to know how many people are in their buildings at any given time, who has been through the building, and what contacts they may have had. It suggests managers rethink the way their space is planned based on utilization data. Accommodating the new trend of hybrid workspaces depends not only on instant access to occupancy levels but historical data on space utilization. The report shows many of the sensors and software applications that provide the data for better occupant usage of the space and additional security and wayfinding capabilities to improve productivity.

(IS-2022-150) Lighting and Lighting Controls - Summer Edition

This eBook was authored by individual contributors for each article from the suppliers and consulting specifying engineers and published by CFE media on June 5, 2022. Each article describes the various ways that lighting control systems contribute to flexible, future-proof

buildings. It includes suggestions on upgrading existing lighting systems, addressing cybersecurity, and contributing to energy efficiency. Design features for the health care and school buildings are provided. The eBook contributes to the education on the rapid advancements in lighting and controls from both the engineers' and suppliers' perspectives. Specifying the right system for each job starts with laying out all the design considerations — reliability, responsiveness, security and scalability — asking the right questions about integration, remote system access and system resilience and making sure the manufacturer you choose has a history of service and support that meets your client's needs now and into future.

(IS-2022-149) Lessons from a Heat Pump Retrofit at CityHousing Hamilton

This report was authored by Keith Burrows from The Atmospheric Fund and published on June 14, 2022. The Atmospheric Fund (TAF), working with CityHousing Hamilton (CHH), planned and implemented a pilot project at a three-story multi-family residential building with 40 units. They installed a heat recovery, variable refrigerant flow (VRF) air source heat pump (ASHP) system in three suites to test the performance of the technology under real-world conditions and to provide best practice recommendations. Results showed increased comfort with the addition of cooling and while the heating loads were met there were no significant electrical savings when compared to the electric baseboard heaters previously used. This case study provides results, lessons learned, and recommendations. It includes significant detailed information on the measurement and verification methods including the tenant survey results.

(IS-2022-148) IoT for Smart Buildings

The IoT for Smart Buildings authored by Multi-Tech Systems and published June 13, 2022 covers how wireless sensors, gateways, and analytics leverage the Internet of Things to enable real-time data collection and analysis. It addresses the shared needs of every building that include building security, temperature control, water leakage, and smart restrooms. In this new landscape, facilities managers must evolve to source products, connect devices, and implement processes, which in the past, had been siloed or watched over by a single operator. The report is a summary of key points for facility managers to address, as they look to leverage new advances in their planning and execution of a wide range of Smart Buildings technologies. It contains many case studies showing the benefits of the wireless approach and armed with these new technologies and a better awareness of how they work together, the possibilities are endless.

(IS-2022-147) Green Retrofit Economy Study

The Canadian Green Retrofit Economy Study is a collaboration between The Delphi Group and the Canada Green Building Council (CaGBC) published on June 10, 2022. This report is a summary of findings gained through primary and secondary research between March 2021 and June 2022, building on existing knowledge from thought leaders across Canada and globally. It shows the existing approach to retrofit projects will need to level up and transform into a more systematic ecosystem of aggregated project and investment opportunities. Building owners and managers will need expert support in developing and implementing transition plans to leverage building renewal cycles and market opportunities. It discusses the technologies available today and

innovation in training the workforce. Both financing options and policy issues are covered and the different amounts of retrofit potential are shown.

(IS-2022-146) Future-Proof Building Operations to Optimize the Tenant Experience

This eBook was authored by BuildingEngines and published on October 18, 2021. The new normal of tenant experience is very different from pre-pandemic times. Now tenant experience (TeX) is all about cleanliness, air quality, workplace distancing, accurate and consistent communications, information flow, and most importantly—safety. With the average office occupancy rate in the United States currently down to 30 percent, versus normal times at 70 percent occupancy, improving the tenant experience is now a vital component of bringing people back to the office. Property teams and owners can do a lot to make tenants more comfortable and productive once they are back in their building. Occupants need to see a building as a safe space. To achieve this, tenant experience must now be about maximizing the comfort and confidence of occupants' experience in a building. To encourage re-occupancy and lay the groundwork for a successful post-pandemic building, property teams must understand their tenants have changed forever. While flashy amenities, discounts, and events might have won tenant loyalty in the past, tenants now place more value on spaces that promote health, safety, and well-being. This report covers the areas that need improvement.

(IS-2022-145) Energy Efficiency and Savings for Commercial Buildings

This ultimate guide to Energy Efficiency and Savings for commercial buildings was authored by buildingIOT and published on October 14, 2021. The guide explains the significant amount of energy with businesses, government, and commercial sites spending \$190 billion every year on energy-related costs. The EPA suggests that an average of 30% of the energy used in commercial buildings is wasted. Looking at the rising costs and understanding the primary energy-use and waste factors will enable building managers to identify potential areas to target for cost savings. The guide covers many of the areas for improvement. HVAC systems, Lighting, and energy-consuming equipment and devices can have building automation and use fault detection and diagnostics with continuous and actionable analytics that helps to regulate high energy-consuming equipment and devices. Achieving optimal energy consumption requires the collection and organization of essential data for evaluating and addressing energy efficiency over time. With the right analytics partner, you can put in place an analytics system to fulfill this role, enabling you to project future energy usage patterns, and develop goal-oriented energy efficiency and cost savings tactics.

(IS-2022-144) The CRE Playbook for Maximizing ROI on Sustainability

Building Engines, a JLL company, authored this CRE Playbook and published it on May 16, 2022. There is no choice but to face the current and future climate change-induced sustainability challenges for the CRE industry. CRE leaders must begin to do things differently in their buildings. Energy usage must decrease, and efficiency must improve. Tenant demands for healthier and more sustainable workplaces must be met. This playbook for achieving these goals involves technology. Technologies enable property teams to: enhance energy management practices;

prioritize health, wellness, and air quality; perform proactive maintenance; prolong equipment lifetimes; measure and evaluate the effectiveness and efficiency of existing systems; plan for capital investments; and achieve key energy certifications.

(IS-2022-143) Smart Solutions - Boosting Revenue in Multifamily Properties

This Smart Solutions eBook was authored by Jennifer Kent at Parks Associates in partnership with SmartRent and published on May 23, 2022. The MDU market is unique for its multiple stakeholders, bulk deployments, and multiple locations for installations. End-user residents, MDU property managers, and building owners benefit directly from proptech. Other ecosystem players are also in a position to capitalize on new demand and value, including smart home solution vendors, ISPs, insurance agencies, security providers, and installers. This whitepaper addresses how connected devices benefit multifamily owners and property managers, from improving business efficiency to driving additional revenues, as well as opportunities in the emerging MDU market for product vendors and service operators. The research includes a snapshot of the current market for smart home solutions in MDUs and key considerations for both vendors and MDU owners and managers

(IS-2022-142) The Real Estate Leader's Guide to Decarbonizing Your Portfolio

This guide, authored by and published on May 2, 2022, by Jones Lang Lasalle (JLL), discusses the various trends from science-based targets to net-zero commitments, and how to start reducing carbon emissions to keep the commitment to climate action. It offers implementation strategies to help you measure carbon, track it on an ongoing basis, and decarbonize your buildings to achieve your ESG goals. Moving forward on climate goals remains a challenge and even with strong leadership support, moving targets are everywhere. Amid increased scrutiny and market pressure, real estate leaders face a crowded and fragmented ESG space and a confusing array of regulations, pathways, and metrics. What is missing is a common understanding of how to successfully measure and reduce carbon emissions within the built environment. That is the next critical step needed for organizations to truly reduce their carbon footprints and advance their overall sustainability efforts.

(IS-2022-141) The Fast-Changing Future of Systems Integrators

This white paper by J2 Innovations a Siemens Company and published on January 14, 2022 discusses the various trends that are changing and driving success in the smart buildings sector, highlights how businesses can utilize the new technology offered by FIN Stack to deliver easier-to-use building automation and integrated smart buildings solutions in faster, more efficient ways. How building controls are changing and where the market is going and some of the key factors determining the changing direction of the buildings control industry. They include IoT in packaged equipment, end-user dashboards, remote management, the need for data cybersecurity, and competitive costing. Outdated software applications that are complicated to configure will lose out to newer “next generation software” able to offer end users and those who install and commission systems a simpler and easier way to interact and manage buildings. The adoption of data standardization will enable the various building systems to become more

easily integrated than has been possible previously.

(IS-2022-139) Simplifying the IoT Edge-Smart spaces Best Practices

This white paper was authored by Kristen Hanich of Parks Associates in partnership with Technicolor and published on April 28, 2022. IoT adoption is growing across the world. This includes not just consumer smart home device adoption, but IoT deployments in industrial and business settings. IoT sensors and devices capture data and perform tasks, communicating over IP and other protocols with cloud or local systems to create intelligent systems and enable automation. This whitepaper addresses the demand and growth of IoT edge solutions in smart buildings and smart spaces. It investigates top verticals and use cases such as smart apartments and MDUs, retail and warehousing, and hospitality and building management. It looks at common challenges and best practices in deploying solutions into these environments and examines new open solutions compatible with many different networking technologies, such as the use of gateways with both Wi-Fi and new IoT radios, which can create, expand, and improve services in these new smart spaces.

(IS-2022-138) Lighting and Lighting Controls - Spring Edition

This eBook on Lighting and Lighting Controls was published by CFE Media on May 2, 2022. For non-residential buildings, lighting is controlled by smart networks of “internet of things” devices — relays, occupancy/vacancy sensors, photocells, button stations, touchscreens, etc. — that optimize lighting conditions and energy use dynamically according to performance-based design parameters. This eBook has articles and case studies from the contributors, on the issue of lighting sequence of operations, wireless controls, health care lighting, networking of lighting, code compliance, and energy-efficient lighting with daylighting. Lighting and its controls need to address the visual comfort and productivity of the occupants and the possible energy savings that can be achieved with smarter lighting and controls.

(IS-2022-137) HVAC Spring Edition

This HVAC eBook was authored by Brandon Andow, Yovanni Cataño, Jose Colon, Jeremy Crowley, Ishai Oliker and others from the Consulting -Specifying Engineers, Air Solutions Company, Grunfos, and Raypack. It was published by CFE Media on April 29, 2022. This eBook has articles and case studies from the contributors, on the issue of solar gain on the design of buildings and building envelope improvements, the use of filters to protect HVAC equipment, the various methods of pumping, and the various options for boilers and a case study on district heating from a combined heat and power plant. HVAC options need to address the indoor comfort and productivity of the occupants and the possible energy savings that can be achieved with smarter HVAC equipment and controls.

(IS-2022-136) Green Quadrant: Integrated Workplace Management Systems 2022

This report was commissioned by Planon and prepared by Joy Trinquet with Susan Clarke of Verdantix Ltd. and published in March 2022. Applying the proprietary Verdantix Green Quadrant

methodology, the analysis is based on two-hour live product demonstrations with pre-set usage scenarios and supplier responses to a 238-point questionnaire. To understand customer needs Verdantix reviewed the data from a survey of 285 real estate and facilities decision-makers. The in-depth benchmarking concludes that eight suppliers lead the market and they demonstrated an excellent breadth of functionality and strong market momentum. The analysis also reveals that other providers offer strong propositions in workplace management, space management, mobile solutions, and tenant-facing engagement.

(IS-2022-135) Global Insights IoT & The Future of Healthcare

This research report, commissioned by Schneider Electric, was prepared by Guidehouse Inc and published on April 28, 2022. It demonstrates how IoT-based, open, interoperable platforms enable hyper-efficient, people-centric, resilient, and sustainable healthcare facilities of the future. The report offers insights from 600 global healthcare facility executives into IoT investment priorities and a simple framework to help implement of an IoT-based platform in healthcare facilities. The report covers:

- The market drivers and barriers behind IoT platform adoption
- End-to-end system benefits of IoT-enabled platforms
- Practical use cases for IoT-based solutions in healthcare facilities

It describes the need for hospitals and clinics to consider benefits ranging from energy efficiency and sustainability to resilience and patient centricity.

(IS-2022-134) Cybersecurity for Building Automation Systems

Trane Technologies authored and published this paper on May 2, 2022. Building Automation Systems (BAS) offer significant operational advantages for commercial building owners and occupants. They provide the applications and interfaces that make it easier to effectively manage indoor environmental quality (IEQ) and optimize energy efficiency. As connected systems, they share many of the same cyber risks as traditional IT assets. The paper provides an introduction to the best practices in BAS cybersecurity. These best practices fall into three main categories. These include Isolation from other systems; Secure Access – both on-site and remote; Operation and Maintenance – establishing (and sticking to) set protocols and maintaining a regular system and software maintenance schedule to maintain security over the long term. With due diligence, the risks are manageable.

(IS-2022-133) Building Automation Guide - Factors to Consider When Selecting a Building Automation System

J2 Innovations, a Siemens company, authored and published this guide in June 2019. The Building Automation Systems for most new commercial buildings, have complex HVAC and other services-related equipment and require the coordination of the various installed equipment, while the demands of the maintenance function frequently require the site's systems to be remotely monitored. This guide sets out the various factors to consider, to help when specifying

or evaluating competing system solution proposals. There are two ways competing propositions should be evaluated: according to the benefits they deliver and the technology they use to do that. It is important to choose a technologically modern system so that it does not become out-of-date too quickly or unable to be adapted over time to the new requirements that will no doubt continue to emerge.

(IS-2022-132) The Evolving Importance of Effective HVAC

This report was authored and published by Building Engines on March 28, 2022. From heating and cooling units to keep tenants comfortable throughout office buildings, to ventilation and purification units to ensure all occupants are inhaling clean air as they shop in retail centers or work in large warehouses, HVAC technologies play an integral role in property operations, as underscored by the COVID-19 outbreak. With COVID-19 being an airborne virus, the pandemic has cemented air quality as the top of mind for property teams and tenants alike. Building Engines fielded a national survey of nearly 300 building managers and engineers working within CRE properties in late 2020. As we go through the re-occupancy phase, the survey results can show how you can leverage technology to meet heightened air quality standards while securing tenants' trust and your organization's success in the long term.

(IS-2022-131) Smart Buildings eBook Winter 2022

This Smart Buildings eBook was authored by Aaron Szalaj, Bob Swanger, Timothy Howe, Marcus Myers, and Jeri Pickett from the Consulting-Specifying Engineers, Stantec, and Reliable Controls. It was published by CFE Media on March 29, 2022. This eBook discusses; The five steps to BAS replacements; Engineering with automated fault detection and diagnostics; The Art of Building Sustainability; Deliver smart buildings using CSI Division 25, commissioning; Tap into a building automation system's data and maximize investment; a video link to Designing smart buildings. Today's available BAS connectivity just didn't exist when most commercial buildings were constructed. Antiquated systems typically used proprietary technology platforms available only through a stand-alone terminal with obscure terminology and simple graphics, which means, not much data from the facility was used to improve building performance. This paper shows how consulting engineers can help owners optimize their existing investments while taking advantage of new technology.

(IS-2022-130) Build it for Zero Carbon

This executive guide on achieving a zero-carbon future was authored by and published on March 30, 2022, by Schneider Electric SE. Buildings consume 30% of the world's energy and are responsible for 40% of CO2 emissions. If we can collectively work together toward net-zero 2030 targets, then the trajectory of the temperature rise will stay within 1.5%, helping us to avoid a host of climate-change-related impacts. There's also a growing recognition of the intersection between climate action and social justice. BIPOC (Black, Indigenous, and People of Color), low-income, and traditionally under-resourced and underrepresented communities have historically borne a greater burden from these impacts. This paper lays out Schneider Electric's holistic, replicable strategy for organizational decarbonization. With this proven roadmap, organizations

of all kinds can define, set, deploy, and sustain decarbonization programs.

(IS-2022-129) Building Operating System

A TIA team of Bob Allan, Jeff Carpenter, Bill Moten, Laura Polas, Frank Straka, and Steven Zielke authored this paper which was published on March 24, 2022. The paper shows how today's smart buildings are data-driven, leveraging sub-system integration and analytics that improve functionality making them an operational and productivity asset. Effectively achieving smart building objectives starts with reevaluating the way they are designed, procured, and operated. The paper explores how to design and deploy a smart building based on an operating system model that ensures flexibility, reduced construction and operational costs, improved return on investment, and a better and more productive occupant experience. It examines how technologies like power over Ethernet (PoE) enabled edge devices, Digital Twins, and Single-Pair Ethernet (SPE) are emerging to deliver additional benefits and the potential for greater asset value.

(IS-2022-128) Top CRE Trends 2022

The Jones Lang LaSalle IP. Inc. research team, Richa Walia, David Barnett, Amber Schiada, James Taylor, Flore Pradere, and Marie Puybaraud contribute to this paper published on February 10, 2022. Business success lies in staying ahead of the curve and predicting the right step to take next for people, the planet, and profit. This 7th edition of the Top 10 Global CRE Trends report explores how firms can reinvent their corporate real estate strategies in response to ever-changing business priorities, a challenging operating landscape, and a volatile economic environment. The global COVID-19 pandemic has proven to be an accelerant of change and transformation for many organizations. Some of the ensuing changes were a long-time coming, such as the increased push towards a more sustainable, tech-infused world. Other shifts, like evolving working habits, had been bubbling farther below the surface, accelerated by the ongoing pandemic. Hybrid and remote work, climate change, digital applications, and sustainability are all trends discussed. Leverage intelligence and best practices from the partnership ecosystem are needed to co-create innovative solutions and achieve organizational objectives.

(IS-2022-127) Thinking Smart - How the Foundations of the UK will be Defined by Smart Buildings

Johnson Controls commissioned Sapio Research to conduct an online survey to uncover how smart buildings helped the UK & Ireland through the COVID-19 pandemic and how smart technology would be used to help organizations and the country reach its goals in the future. The results of the survey were published on July 5, 2021. About 100 building decision-makers across the UK & Ireland covering central government, large-scale healthcare, pharmaceutical, higher education, and wider commercial real estate, such as retail and banking with 500+ employees were interviewed. 99% of respondents saw the advantages of smart buildings. Smart buildings can help senior leaders in operational efficiency, sustainability, and occupant experience. However, as the research reveals, there is still some way to go with getting senior leaders on board for the journey. Therefore, it is incumbent on technology providers to both educate the

market on the future of what can be achieved by smart buildings and demonstrate the tangible benefits their budget investment can yield along the way.

(IS-2022-126) The Way Forward for ESG - Firms are Adapting Business Strategy and Boosting Technology Investment

This research report was authored by Verdantix and published by Corty Software Inc on October 20, 2021. As Environmental, Social, and Governance (ESG) and sustainability are rising to the top of the priority list for many organizations, ESG performance continues to play a larger role in financial decisions and access to capital, and more organizations are actively aligning overall business strategy with ESG goals to remain competitive and resilient. Corty contracted research firm, Verdantix to investigate: 1) Where 50 executives across 5 industries fall on the ESG maturity scale; 2) The state of corporate sustainability culture; 3) How executives are using operational data to define overall ESG and sustainability strategies; 4) The role of Environmental, Health, and Safety (EHS) in supporting ESG performance; and 5) Which technologies firms are investing in to improve ESG performance. The results show that firms with ESG and sustainability strategies that pay attention to improving cultures, leverage data to improve performance and invest in developing technologies are best placed to benefit from sustainable growth.

(IS-2022-125) The Grid Interactive Building

This White paper was authored and published by Siemens on June 22, 2021. This whitepaper identifies the emergence of a new type of building, the 'grid-interactive building', at the grid edge. The energy system is changing. Driven by climate policy, enabled by the decentralization of energy generation and digitalization of buildings and systems. Decarbonization of energy use is more technically feasible than ever before. This paper outlines some key concepts around the changing low carbon and energy efficiency landscape, and how the grid and smart buildings are starting to work together in new, connected ways as the grid-interactive building at the grid edge. It looks at the technology benefits for commercial buildings' energy users in relation to the grid. Lastly, it outlines steps that users could take to realize these smart benefits.

(IS-2022-124) The Future of Hybrid Work in Government

This White paper was authored and published by Samsung Electronics America Inc. and published on November 22, 2021. The paper shows that given remote work is here to stay, the future of hybrid work in government needs to be compliant in end-to-end solutions that empower agencies to achieve their missions more effectively. Samsung, the global leader in mobile, audio, and visual technology is helping governments improve their digital technologies creating a more secure and productive environment for all. They quote a McKinsey report that details what technology investments will enable the federal government to sustain a secure, productive, and resilient hybrid work model. These include mobile hardware, enterprise collaboration software tools, cloud security, and physical technology. A hybrid model can only be effective if conference rooms are outfitted with audio and visual equipment and high-speed Wi-Fi to support seamless collaboration. Remote work is not only favorable from an employee satisfaction and productivity standpoint but for economic and environmental reasons, too.

Global Workplace Analytics estimates that making a government-wide shift to half-time telework could save taxpayers \$11 billion a year in real estate, improved productivity, disaster outage prevention, lowered absenteeism and decreased turnover.

(IS-2022-123) Why You Can't Afford Not to Invest in a Sustainable Built Environment

This report, authored by Catriona Brady, Victoria Burrows, Ahmad Al-Musa, Sara Kawamura, Carolina Montano Owen, Arianna Palmieri, and WSP consultants for the World Green Building Council and published in February 2022, draws from and embraces the rapidly growing sustainability agenda across the built environment: the evolving scope of sustainability; a broadening of what is called 'green'; closer alignment with the UN's Sustainable Development Goals; and finally the rise in social value as not just a consideration, but a business driver for developers and investors. The report demonstrates seven irrefutable co-benefits for investing in a sustainable built environment, across both the financial and social value case.

(IS-2022-122) The Hybrid Workplace - The Return to Work Report

This report, authored by William Cowell de Gruchy of Infogrid and published on February 9, 2022, is a follow-up to Infogrid's previous Healthy Buildings Report. The importance of a healthy workplace has never been more prevalent, with 63 percent of employees saying that they are more concerned about it today than they were before the pandemic. This report analyses the results of a survey of 2000 employees on their thoughts around hybrid working and returning to the office. Some of the themes addressed are: the impacts of different modes of work on employee mental health; how the workplace can increase employee productivity; what employees expect from their employers as they return to work; and how employers can increase employee retention and attraction.

(IS-2022-121) Smart Buildings 2022

This report was authored by Andrew Phipps from Cushman Wakefield & Tom Redmayne from WiredScore and published on March 8, 2022. IoT gives a building the ability to use a mass of different data points to inform and make decisions. Linking this to the operating model via cloud computing allows for on-demand management of the building from anywhere and at any time. We are now able to visualize data in a much more user-friendly manner to allow decision-making to be more informed and to offer more clarity. This report provides the WiredScore definition of a smart building as one that delivers outstanding outcomes for all users, through digital technology, to exceed their evolving expectations. These include an inspirational experience, a workplace that attracts and delights, with flexible and personalized services, and a sustainable building through a reduced whole-life carbon footprint by using technology to operate the building more efficiently. Cost efficiencies are created by optimizing the building's performance and using future-proof design to be able to adapt to new demands. To deliver user functionalities reliably, robustly, and consistently, a smart building needs firm technological foundation. This is a combination of infrastructure, technological architecture, governance, and policy. Technological foundations are critical to ensuring the success of any smart building through reliable technology, a strong governance framework. They mitigate the risks associated

with smart buildings while maximizing the outcomes.

(IS-2022-120) Power Digitalization - Understand and Achieve Active Energy Management in Buildings

This report was authored by Tony Hunt of Schneider Electric - Energy Management Research Center and published in February 2022. Most public, commercial, and industrial buildings are not energy efficient, representing an enormous untapped potential for decarbonization and sustainability efforts, as well as utility bill savings. Power digitalization plays a foundational role in active energy management and efficient facility operations. For existing buildings, this can be done by retrofitting electrical systems with smart devices and using energy and power management software that improves energy efficiency and reduces risk. This power digitalization investment helps facility management and maintenance personnel make better decisions, resolve issues more quickly, minimize downtime, and use less energy. In this paper, we define power digitalization for buildings and describe a 3-step process to achieve it. Power digitalization transforms organizations from being uninformed and reactive to those that are insightful and proactive. An investment in power digitalization ensures that building owners and investors get real-time carbon tracking and transparency about their building's energy usage and it is essential in avoiding obsolescence.

(IS-2022-119) Future Ready Broadband Ubiquitous Connectivity For MDUs

This report was authored by Jennifer Kent and Tam Williams of Parks Associates developed for Cox Communities and published in February 2022. Building on advanced connectivity services, MDU property managers and owners can leverage the benefits of smart home devices and smart property solutions to drive revenue and increase net operating income. This whitepaper addresses the growing demand for exceptional connectivity in MDUs. It evaluates the benefits of next-generation connectivity services for MDU property managers and residents, as well as the role of the service provider as a key partner in smart MDU living. 53% of consumers report they value technology more now than before COVID-19 and are willing to pay for those features applicable to their living conditions and objectives.

(IS-2022-118) Bringing Embodied Carbon Upfront

This report was authored by Matthew Adams, Victoria Burrows, Stephen Richardson, of the World Green Building Council with support from Ramboil and C40. and published in February 2022. Carbon emissions are released not only during operational life but also during the manufacturing, transportation, construction, and end-of-life phases of all built assets – buildings and infrastructure. These emissions, commonly referred to as embodied carbon, have largely been overlooked historically but contribute around 11% of all global as well as the embodied carbon of individual materials. Achieving net zero embodied carbon for the entire sector will require far greater collaboration along the whole value chain to support efforts to decarbonize industry and to develop and deploy more low embodied carbon alternatives. Such collaboration allows businesses and organizations to identify and have confidence in the environmental, social, and financial benefits of taking a leadership position in the transition to a decarbonized built

environment. This 3-phase report describes the literature review of the challenges and the possible pathways to overcome them with a final review by many experts and stakeholders in the value chain to improve the recommendations.

(IS-2022-117) 2022 Facility Management Predictions

This report was authored by Dan Weltin, Editor-in-Chief, of Facility Market with contributions from Kelly Spinola, John Hajduk, Paul Head, Stormy Friday, and Stephen Ashkin and published by fnPrime in February 2022. The authors look at the trends affecting facility managers in 2022, including the Internet of Things, COVID-19, hybrid workplaces, and sustainability. Health and wellness initiatives matter to occupants and smart technology allows facility managers to know and manage occupancy patterns. In addition, IoT technology can help FMs be more strategic in their energy use to help meet energy efficiency goals, including net zero energy. Hybrid workplaces are a direct result of the pandemic and are here to stay. The report shows that climate change creates the need to embrace environmental initiatives and sustainability efforts will continue to matter, but maybe now more than ever.

(IS-2022-116) The Work Ahead in IoT - The Gap Widens Between IoT 'Haves' and Have-nots'

This report was authored by Euan Davis and Manoj Mathew from Cognizant and published on September 2, 2021. The report discusses how the Internet of Things (IoT) has gained market momentum with the manufacturing sector being the top adopter. More effective IoT deployments include artificial intelligence (AI) and machine learning (ML) underpinnings. The main takeaway is that IoT drives organizational performance outcomes by combining it with other advanced technologies and gaining buy-in from the employees is essential to making digital initiatives possible.

(IS-2022-115) IoT Signal

This report was prepared by Microsoft and published in November 2021. The report provides insights into the current and future state of the Internet of Things (IoT). The main takeaway is that IoT, despite its technological complexity, continues to drive organizational productivity beyond the COVID-19 pandemic. To advance such growth, consideration needs to be given to several technologies and factors that underpin its success such as artificial intelligence (AI), Edge Computing, Digital Twins, and data security.

(IS-2022-114) Internet of Things - Societal Challenges & Scientific Research Fields for IoT

This report authored by Emmanuel Baccelli from Inria and published on October 26 2021 presents Inria's views on the main trends and challenges in the Internet of Things (IoT), and how Inria is actively conducting scientific research, software development, and technology transfer around these challenges. Furthermore, the report identifies key societal challenges in a world depending on IoT, ranging from ethical concerns to transparency, sovereignty, and education. Emphasis must be placed on substantial research, deep tech development, and the introduction of standards to ensure that IoT benefits society and the environment.

(IS-2022-113) Ericsson Mobility Report

This report was prepared by Ericsson and published on June 4, 2021. The report deals with the trends regarding the 5G communication standard, mobile devices and traffic, and the Internet of Things (IoT). The speed of 5G uptake, which is far higher than it was for the 4G communication standard, is driving innovation to bring new technologies to market. Other important trends include IoT applications will be largely supported by 4G/5G and smartphones and video will drive up mobile data traffic. As such, it is recommended that societies plan for and invest in high-quality digital infrastructure.

(IS-2022-112) The State of Energy Management

This report, developed by DEXMA and published in 2021, forecasts trends in the energy industry post-COVID. It illustrates survey results carried out on 400 energy management professionals worldwide. The content provides insights into the industry composition, priorities, challenges, and technologies they use. Results suggest that identifying cost-effective energy efficiency improvements quickly and budgetary restrictions are the core challenge while HVAC is the most energy-intensive component in their buildings. On the other hand, air quality has become a key issue for companies to monitor, and the use of Energy Management Software (EMS) is growing. In terms of technological trends, demand response as well as control and optimization solutions sit at the top of the spectrum.

(IS-2022-111) Rethinking Buildings Post COVID-19

This report published in 2021 by Honeywell Building Trends Series was prepared to measure the perception of the impacts on building strategies and practices after the pandemic with a greater focus on healthy buildings and indoor air quality (IAQ). It shows the result of a survey conducted among facility managers who operate buildings across different sectors in the United States, China, Germany, and Saudi Arabia. Findings suggest that as occupants are more aware of how buildings can affect their well-being, this results in buildings operators having to rethink their modes of operations and incorporate investments in smart solutions that drive efficiency or sustainability while improving occupant experience.

(IS-2022-110) Net Zero Buildings - Why Companies Need a Single Strategy for Sustainability and Digitalization

This report was developed by Alvin NG from Johnson Controls, and published in 2021. It was written to justify the synergy between sustainability and digitalization. It is known that while decarbonization has become the major theme of sustainability driven by emission reduction targets, digital technologies on their own use lower costs and maximize efficiency and productivity as a selling point. In this sense, platforms that rely on cutting-edge software are presented as the solution for buildings to monitor and control every key performance indicator of the operations from a single dashboard. It suggests that alignment of the two strategies, despite its evident benefits, can still be a challenging task; in particular, due to the variety of systems and

volume of data in today's buildings. Nonetheless, early adopters of this approach will be in a better position to face the demands of a low-carbon future.

(IS-2022-109) Energy Efficiency of Smart Buildings - Towards Zero Consumption and Beyond

This report, developed by ABB and published in 2021, illustrates the array of building technologies readily available for energy and water consumption. The report argues that in smart buildings, savings depend upon the adjustability and controllability of systems. It exemplifies how variable speed drive (VSD) technology is instrumental to solve energy loss problems in buildings. It shows how high-efficiency motors, that allow partial load performance and integrated speed controls, offer excellent energy potential. Lastly, it suggests that Building Management Systems (BMS) coupled with digital services can take efficiency to new heights of performance and shorten returns on investments (ROI).

(IS-2022-108) Rate Designs Harnessing Vehicle Grid Integration Technology

This report was authored by Energy+Environmental Economics (E3) and published in May 2021. This report explores novel tariff designs that leverage active vehicle-grid integrations and electric vehicle charging aggregators to provide enhanced charging profiles that would benefit utilities, ratepayers, and drivers. The report presents a simulation for California that indicates moving from basic flat rates to time-of-use (TOU) would provide a 116% increase in net savings for drivers but may present other complications with the introduction of a secondary peak load. The report continues on to explore the inclusion of aggregators who can actively manage the charging for several thousand chargers, ensuring the best price for the drivers, better utilization of the grid, and more flexible tariff schemes along with the utility to better match the operating costs.

(IS-2022-107) Adaptive Lighting in Outdoor Security Applications

This report was authored by Nicole Hathaway and Manual Lopez from California Lighting Technology Center at UC Davis and published in November 2021. The report explores the different types of technologies used for detecting motion in security applications and explains that adaptive lighting has not been widely adopted within these environments. A case study is provided to demonstrate the effects of adaptive lighting adoption in security applications and the results indicate that 36 - 44% of energy was saved, with 90% of participants suggesting that the lighting was equivalent to or better than the preexisting system.

(IS-2022-106) White Paper on Unified Glare Rating (UGR)

This report was prepared by Ian Ashdown, Steve Fotios, Matt Hartley, Glenn Heinmiller, and Nathaniel Jones, in collaboration with the National Electrical Manufacturers Association, and published on October 2021. The report provides insight into the proper use of the Unified Glare Rating (UGR) for lighting design to meet application and task visual needs. Consideration is given to the historical background of UGR, literature review, and standards to clarify the intended use, embedded assumptions, and correct lighting design use. The information provided will help

organizations and individuals to create better lighting designs.

(IS-2022-105) Office Sublease Space at a Glance: North America Q4 2021

This report, authored by Cushman & Wakefield and published in February 2022, provides key themes and trends regarding office sublease space in the United States and Canada. Key themes include a decline in the U.S. sublease inventory, an increase in leasing activity, and the negative impact of the pandemic on the sublease space in Central Business Districts (CBDs). In Canada, sublease space declined in two of the four major Canadian markets, including Toronto and Calgary. There remains a sign of recovery for the sublease market in North America based on a decline in vacant sublease inventory in several major cities.

(IS-2022-104) Global Hotel Investment Outlook

This report, prepared by Jones Lang LaSalle (JLL) and published in January 2022, provides a forward outlook on the global lodging industry. Consideration is given to the impact of several factors on the industry including Covid19 pandemic, labor shortages, supply chain delays, operational costs, sustainability, and consumer demand. There is an overall favorable outlook for the industry based on an observed increase in global transaction volume, potential interest by investors, the industry's commitment to sustainability, and evolution in the physical use of available space.

(IS-2022-103) State Energy Efficiency Policy in a New Era, A Toolkit for Governors

This report was authored by Matthew Rogotzke, Jessica Rackley, and Dan Lauf from the National Governors Association and published in October 2021. The report provides insight for U.S. state governors on how to improve the energy efficiency policy for their states as efforts to decarbonize continue to grow. Recommendations are made to lead by example and capture cost savings, create jobs, reduce energy consumption, prevent pollution, and strengthen grid security. It is also suggested for states to engage utilities to provide affordable rates and increase access to energy efficiency projects.

(IS-2022-102) Reaching Today's Video Audiences - Platform Diversity and ROI

This report was authored by Paul Erickson and Tam Williams from Parks Associates and published in January 2022. The report discusses the growth in streaming video adoption and the expanding use of the "over-the-top" (OTT) video services. Device platforms used inside and outside the home to view video are considered. Information is provided regarding potential tradeoffs, complexities, and return-on-investment challenges presented when deploying broad platform support. Adoption of streaming video services is at an all-time high and video service providers need to ensure multi-platform device support.

(IS-2022-101) Energy Efficiency in Real Estate and Facility Management

This report was prepared by Dexma and published in September 2021. The report deals with an energy management strategy that real estate and facilities management companies can use to effectively manage multiple locations. A strategy is suggested that relies on data analytics and artificial intelligence to detect, analyze, and optimize the potential energy savings. Dexma's energy intelligence solution is proposed as a viable solution to achieving such savings. The reports find that efficient energy analysis and management of a portfolio, consisting of many buildings, requires a centralized energy analytics platform.

(IS-2022-100) Breath of Fresh of Air - How Clean Air Technology Can Give Your Building a New Lease on Life

This report, prepared by Johnson Controls and published in July 2021 presents survey results from 826 business leaders in Europe, the Middle East, Asia, and Latin America and presents the extent to which businesses have implemented clean air technology solutions. Key takeaways include air purification was implemented by 73% of the respondents and health care organizations and hotels are among the top leaders in implementing clean air technology. The report also offers a practical six-step strategy for achieving clean air in the workplace by considering ventilation, filtration, disinfection, isolation, monitoring, and maintenance.

(IS-2022-99) 70 Technology Trends That Will and Will Not Shape 2022

This report, authored by Stuart Carlaw of ABI Research and published in December 2021, presents key critical trends that will likely materialize in 2022 and those that will not. Main takeaways include supply chain issues and a prediction that 5G will continue to struggle in the enterprise sector. Furthermore, Ultra-Wideband (UWB) will accelerate precise location technologies to the mainstream, and the Chinese vendor community will retain its stranglehold on the Internet of Things (IoT) module market. Overall, 2022 will be promising and full of opportunities.

(IS-2022-98) New Criteria for a New, Smart Building Era

This report, published in July 2021, discusses the key criteria for designing and constructing new smart buildings which include cybersecurity, modeling capability using digital twins, and the use of smart technologies for building monitoring and control. To ensure buildings remain future-proofed, the new technology that is installed must interact easily with other devices/control systems. Siemens Smart Infrastructure unit is proposed as a source of expertise for organizations intending to design and construct new buildings.

(IS-2022-97) Energy Market Outlook What to Expect in 2022 and Beyond

Enel X's 2022 Energy Market Outlook, published in January 2022, provides energy summaries of the biggest US regional and national stories that may affect end users and pairs them with 2022 forecasts and discussions of energy products. Suggestions are provided on energy strategy which can serve as a resource to help organizations with their energy roadmap. The main trends discussed include growth in renewable energy sources, electric vehicle investment, natural gas pricing, zero-emission commitments, and a decline in energy storage (battery) costs. The main

takeaway is that organizations need to consider the main trends when setting their business goals.

(IS-2022-96) Home Security - A Redefined Market

This whitepaper authored by Amanda Kung from Parks Associates and published June 7, 2021 centers on the factors affecting the steady growth of the adoption of home security systems and professional monitoring services. Key trends include growth in self-installation of newly acquired security systems, strong new-start home sales with higher-than-average adoption of security, a rise in home renovations with more time spent at home, and increased second home sales in vacation areas. The main takeaway is that security dealers need to continue to seek unified solutions, have low support costs, and provide value for the customer.

(IS-2022-95) Adaptive, Sensor-Based Lighting for Security Applications

This report was prepared by California Lighting Technology Center & Hawaii Natural Energy Institute and published in November 2021. The report addresses adaptive lighting strategies, that include energy-efficient light sources and lighting controls, to reduce energy consumption and light pollution. The report provides in-depth coverage of available lighting technologies taking into consideration security guidelines. Results of field research and laboratory evaluation of lighting systems are included. Recommendations are provided for both general and high-security exterior lighting applications.

(IS-2022-94) 2021 Connecticut Public Utilities Annual Cybersecurity Report

This report was authored by Marissa P. Gillett from the State of Connecticut Public Utilities Regulatory Authority and published on January 7, 2022. The report deals with the growth of cybersecurity threats facing Connecticut's public utilities and the development of cybersecurity programs to mitigate such threats. Following the framework established by the Cybersecurity Action Plan, the key elements considered for the development of cybersecurity programs were corporate culture, threats, and the cybersecurity capability maturity model (C2M2). The main takeaway is that the success of a cybersecurity program relies on the commitment of all employees in an organization, as demonstrated by utility decision makers and support staff in Connecticut's utilities.

(IS-2022-93) Three Ways to Reduce Operating Costs of Power Generators with Remote Management

This report was prepared by HMS Industrial Networks and published April 2021. The report describes three ways in which remote management can be used in power generation to reduce the operating costs and improve control for a generator and engine combination (genset) fleet. They include predictive service of equipment based on usage, remote testing to avoid startup problems, and reduced fuel theft or leakage through remote sensor monitoring. Industrial examples of a communication gateway and a central management survey are provided. Benefits of remote monitoring include reduced operating costs, extended lifetime of equipment, and

improved planning of service visits and refueling.

(IS-2022-92) Value Beyond Home Security: Expanding Product Ecosystems

This report was authored by Jennifer Kent from Parks Associates and published on March 8, 2022. The report discusses how the market growth of connected devices and new technology has led to an expansion of professional services beyond home security. Anticipated growth is expected in residential broadband, video analytics, AI capabilities, smart lighting, smart sensors, smart sirens, vehicle smart tags, and perimeter monitoring. The main takeaway is that market growth will create further opportunities for professionals to integrate new monitoring services into the home.

(IS-2022-91) Smart Home Market Dynamics Report – 2021

This report was authored by Blake Kozak from Omdia and published November 2021. The report assesses numerous smart home industry scenarios and presents alternate paths that the smart industry may take toward 2030 based on device and industry trends. Long term growth potential for the smart home industry is also presented. Included in the report are historical costs for device imports and exports such as thermostats and door locks. The main takeaway is that the adoption of Matter, a new home automation connectivity standard, will be the catalyst for smart home growth.

(IS-2022-90) Global Guide to CRE Investing in 2022

This report was published by Cushman & Wakefield, March 2022. The report presents a well-researched perspective for investing globally in the 2022 commercial real estate market. An overview of the commercial real estate market is provided across Asia, North America, Latin America, and Europe along with market drivers, capital markets, and investment recommendations. The main takeaway is that the global property market recovery will gain momentum in 2022-23 creating global opportunities for investors.

(IS-2022-89) 2022 Canadian Construction Forecast

This report was authored by Andrew Snook and Mary Van Buren from On-Site and published December 2021. The report presents a promising 2022 outlook for Canada's construction sector but underscores that labour and supply chain challenges will persist. Other key trends include the importance of apprenticeship programs, data sharing, collaboration, cybersecurity, and new delivery models. The report is useful for businesses to identify specific market signals to successfully navigate the changing construction landscape. The Procor construction management platform is promoted as a way for construction companies to digitally transform their business.

(IS-2022-88) Green Quadrant: IoT Platforms for Smart Buildings 2022

This report was authored by Dayann Charles Jeyamohan and Susan Clarke from Verdantix and published January 2022. The report includes a detailed comparison of the 17 most prominent

Internet of Things (IoT) platforms for smart buildings available on the market. The market leaders include: JCI, Schneider Electric, Siemens and Spacewell. The majority of the platforms have evolved to include asset monitoring and maintenance, energy management, space monitoring, and building security. The report provides real estate owners and technology buyers insight to the leading offerings in the market and the vendors that will best meet their needs.

(IS-2022-87) Creating secure IoT device identities

This report was prepared by Intertrust and published February 2022. The report describes how to create secure Internet of Things (IoT) device and sensor identities, fostering data access and interaction across devices in a trusted ecosystem. Details are provided on how device and sensor identities function and the importance that public key cryptography plays in securing the identities. Consideration is also given to the provisioning process by which devices are provided an identity. A comprehensive, cost-effective, and a scalable solution developed by Intertrust is presented for the provisioning process.

(IS-2022-86) The 2022 Buyer's Guide for CRE Building Operations Technology

This report was prepared by Building Engines and published January 2022. The report provides commercial real estate owners and operators with a framework for selecting a building operations platform. The framework consists of the following five key elements: maximization of net operating income, effective and mobile friendly communication with tenants and operations team, thoroughness in deployment and support, interoperability and connectivity, and enterprise capability. The Prism building operations platform is proposed as a viable solution.

(IS-2022-85) Blended learning without limits

This report was authored by Samsung and published January 2022. The report deals with Samsung's digital education platform that can empower educators to help their students succeed while improving their mental well-being and the end-to-end education experience. The platform includes vibrant interactive digital whiteboards and advanced classroom management software. The benefits of the platform include scalability, cross-device compatibility, reduced preparation time for teachers, improved student engagement and interaction, and better connectedness between students and teachers.

(IS-2022-84) PRASH: A Framework for Privacy Risk Analysis of Smart Homes

This report was authored by Joseph Bugeja, Andreas Jacobsson, and Paul Davidsson and published in the Sensors Journal September 2021. The report deals with a security framework, PRASH, for modeling and analyzing the privacy risks of smart homes. Its three modules (system model, threat model, privacy metrics) enable privacy risk assessment of a smart home system. PRASH capability enables early threat identification, improved risk management scenario planning, and attack mitigation. Overall, PRASH will help to preserve privacy rights of residents.

(IS-2022-83) Private Networks Vol.1 - Transforming Private Networks with Samsung 5G

This report was prepared by Samsung and published October 2021. The report deals with private networks and proposes Samsung's 5G network solution as a superior strategy as compared to existing Wi-Fi based networks. The advantages of 5G networks include reduced latency, improved mobility, security, reliability, flexibility, coverage, and capacity. The application uses cases considered include smart factories, transportation, logistics, smart cities, and medical devices. The details of Samsung's private 5G solution are also presented in detail and cover radio, core, and transport network, along with the network management system.

(IS-2022-82) How AI Edge Platforms Can Transform Smart Spaces

This report was prepared by Mobile World Live and published April 2021. The report explores how artificial intelligence (AI)-enabled edge computing platforms are reshaping the way cities, enterprises, and venues operate. The role of mobile operators is also examined since they provide the underlying connectivity and bring together the various stakeholders necessary to make this transformation. Furthermore, the importance of video data in smart space applications is examined and NVIDIA Metropolis is proposed as a video analytics platform that applies deep learning AI to video streams. Supermicro's servers are featured as a viable solution for edge computing.

(IS-2022-81) Global Security Insights Report

This report was authored by Rick McElroy from WMW are and published April 2021. Based on a survey of 3,542 information technology executives, the report deals with the challenges and issues facing businesses worldwide when it comes to escalating cyberattacks. It identifies trends in hacking and malicious attacks, and the impact of security breaches on organizations' finances and reputation. Insights are provided on organizations' plans for securing new technology, adopting a cloud-first security strategy, and dealing with the complexity of the current cybersecurity management environment.

(IS-2022-80) 5 Steps to Delivering Smart Buildings

This report was prepared by Johnson Controls and published September 2021. The report outlines the key steps required to successfully create smart buildings. Since each building is unique, each approach needs to be tailored to ensure that smart solutions work together to get the desired results. The key steps included identifying building's weaknesses, creating a strategy to meet business objectives, assessing the smart technology currently in the building, creating a plan to integrate existing and new smart technologies, and communicating with stakeholders while delivering on the plan.

(IS-2022-79) OTT Streaming Trends to Watch in 2022

This report was authored by Eric Sorensen and Paul Erickson from Parks Associates and published February 2022. Important trends in the evolution of streaming services (TV via the Internet) are

reviewed. Key among these is the smart TV as a platform for accessing streaming stations, ad-supported streaming services (rather than pay-TV), and frequent churn as customers change streaming service providers. Streaming media players such as Roku are losing ground to smart TVs with built-in stream handling. The report recommends that providers focus on customer retention to overcome churn. The likelihood of mergers among streaming providers and the emergence of streams produced outside of the established distribution channels are discussed.

(IS-2022-78) How will offshore wind developments affect the U.S. power grid?

This report was authored by Maria Scheller, Thomas Rostad, Akanksha Goyal, and Ameya Ghodke of ICF and published in January 2022. The potential impact of large scale (28 GW) power generation by wind turbines offshore from the US Northeast and Mid-Atlantic states is analyzed. Offshore winds are more consistent than on land. Based on the model developed, local power prices should decrease as these wind-power sources increase. In some regions, transmission costs may increase to carry this power from the locations of the wind turbines. If the transmission grid cannot handle this power, the turbines may need to be curtailed. An alternative is to locate hydrogen production plants nearby to utilize this wind power.

(IS-2022-77) Health at Home: New Era of Healthcare

This report was authored by Jennifer Kent of Parks Associates and published in January 2022. The growth in the use of telehealth services by customers has accelerated from about 15% in 2019 to 60% in 2021 as a result of the pandemic in 2020. This growth is facilitated by changes in reimbursement, regulations, funding, staffing shortages, device innovation, and customer demand. Telehealth encompasses virtual visits, remote diagnostics, chronic condition management, post-discharge monitoring, and hospital at home. Remote care can be enhanced with remote diagnostic tools. Issues with such technologies are presented. Sensors for passive monitoring are discussed.

(IS-2022-76) Extreme Weather and Regional Grid Resilience; Lessons Learned from Texas Winter Storm Uri

This report was authored by Bruce Rising and 13 others and published by Siemens Energy, Inc. in January 2022. System failures in the regional management of electricity generation and distribution that led to massive power disruptions in Texas in February 2021 are analyzed. Cold weather is noted as a greater threat to supplies than hot weather. Suggestions for improvement include coordinating wind power with gas turbines, increasing gas storage, and preparing equipment for operation in cold weather. Improvements are recommended for each part of the electric grid starting with generation. Recommendations for the Texas grid to interconnect with other multi-state grids on a limited basis are included.

(IS-2022-75) Decarbonization | Addressing decarbonization at the grid edge

This report was authored by Delta-EE, a research and consultancy company, for Siemens Industry, Inc. and published in October 2020. Decarbonization can reduce energy-related costs and can

benefit the reputation of the company brand. Decentralization and digitization are facilitating decarbonization. Countries are deciding between emissions trading and a carbon tax. Energy generation is moving to the edge of the grid at the customer site with sources such as wind, solar, and storage, the electrification of heat and transportation, and generation of hydrogen from excess renewable energy. Use cases are presented for microgrids, virtual power plants, and e-mobility. Business strategies for achieving decarbonization are presented.

(IS-2022-74) Parks Associates 2022 Top Tech Trends

This report was authored by Jennifer Kent and others from Parks Associates and published in 2022. Five researchers at Parks Associates offer predictions for trends in the home systems market. Among the notable trends are the predicted mergers of media companies even as customers have more choices in video streams. "Personal Emergency Response Systems" and remote monitoring will increase for older consumers. Some customers expect health care providers to support remote monitoring. Product interoperability will continue to be challenging unless competitors agree to cooperate (such as the Matter initiative). Builders of multi-family units will be increasing the adoption of smart home technology. Solar panels, storage batteries, and smart thermostat adoption will depend on government and utility incentives. Internet providers will be offering smart Wi-Fi applications.

(IS-2022-73) The Disruptive Potential of Managed Wi-Fi

This report by Parks Associates, published in 2021 discusses what constitutes broadband Internet speeds and how there are differences among US government minimum standards for broadband (25 Mbps download and 3 Mbps upload) and minimum speed requirements for various streaming video services. There are further variations according to desired resolution (typically 3 Mbps for standard definition TV, 5 Mbps for high definition TV, 25 Mbps for 4K definition TV) and latency (delays that affect online gaming). 13 million US homes have no high-speed Internet access. As more people work from home, managed Wi-Fi service is growing in popularity to maintain connectivity and segregate work data from family data.

(IS-2022-72) Smart Products: Building the Modern Home

This report was authored by Patrice Samuels from Parks Associates and published in 2021. It provides an overview of the market growth in smart home devices. Such devices cover a large variety such as computers, smartphones, smart TVs, smart speakers, heart rate monitors, and sleep monitors. By 2025, US broadband households with broadband Internet service are predicted to have an average of 20 connected devices. Smart home controls applications include access control, lighting, energy management, safety systems, and water management. Some smart product features include a refrigerator that adapts to minimize energy usage, indoor air-quality monitoring, a package delivery portal to the house, and energy storage batteries for home power.

(IS-2022-71) Future-Ready Broadband: Ubiquitous Connectivity for MDUs

This report was authored by Jennifer Kent and Tam Williams from Parks Associates and published in 2021. The market for broadband connections in multi-dwelling units (MDUs) grew during the pandemic that started in 2020 as about 60% of occupants were working or learning from home. Property managers may offer better services at lower rates than if the tenant purchased service directly from an Internet service provider. 40% would like Internet access to be included in their rent payment; 77% are willing to pay higher rent for Internet access. This report explains how MDU managers could benefit from networked devices that monitor energy usage, water leakage, and control building services such as lighting.

(IS-2022-70) Home Security: Choice is the Ultimate Value Proposition

This report was authored by Jennifer Kent and Tam Williams from Parks Associates and published in 2021. The home security market grew about 10% in 2021 to reach 33% of households with broadband services (compared to 19% in 2016). 56% of new installations were self-installed. Most consumers want a unified application (app) experience as they add devices. Consumers have more choices of contracts, installation, and service at lower prices. Broadband service providers are adding home security to complement network security offerings. Some offerings are for monitoring security and other devices chosen by the customer. The market leaders among purchasers are parents and those forming new households.

(IS-2022-69) Home Energy Management: Driving Consumer Engagement and New Revenue

Effective energy management in a house requires timely information about solutions that are easy to use. Consumers are responding through "mindful actions" such as adjusting lights and thermostats, home improvements, and "extreme measures" such as installing solar panels. Consumers show a "lack of enthusiasm" for data about energy usage. Saving money is an incentive for energy management. Messages from utilities should be personalized for the customer. Connected devices in a home can offer opportunities for energy management especially if automated in smart devices. Consumers prefer energy management through automation with very little manual input. This report was written by Parks Associates and published in 2021.

(IS-2022-68) AI-enabled Data: Key to Video Service Optimization In Partnership

This report by Parks Associates, published in 2021, explores applications of artificial intelligence (AI) and machine learning (ML) to help providers and customers optimize the delivery of streaming TV services. 82% of those households with high-speed Internet access subscribe to at least one streaming service; the average is 5.6 streaming services. There is frequent churn in subscriptions except for Netflix (subscribed for 48 months), Amazon Prime (38 months), and Hulu (28 months). The churn rate is 44% especially among one-quarter of customers. Options for providers to retain customers are discussed using AI and ML tools. These tools can help with enhancing revenue, customer experience, content, churn detection and prediction, subscriber retention, audience analysis, and improving returns-on-investment.

(IS-2022-67) The Changing Landscape for EPCs in Canada - An Industry Perspective

This White Paper by MCW and KWM Consulting, provides a multi-faceted overview of the current state of Energy Performance Contract (EPC) services delivery in Canada, an industry MCW has supported for 30 years through MCW Custom Energy Solutions Ltd., our dedicated performance contracting division. The White Paper aims to provide unbiased evidence of historical success and recommendations regarding EPC project structures to policy-makers, regulatory organizations, and prospective EPC clients in the Canadian public sector. MCW looks forward to the future of the EPC model in Canada, which we believe remains a key solution to enacting important energy conservation, cost saving and de-carbonization solutions in existing building stock – a critical component of our collective ongoing climate change mitigation efforts.

(IS-2022-66) Using Data to Drive Workplace Innovation and Sustainability

In the facility management (FM) industry, both sustainability and workplace optimization have shifted from long-term goals to urgent, short-term priorities. With buildings currently accounting for around 40% of global carbon emissions, the need to improve the environmental performance of our buildings has never been greater. This white paper by Frost & Sullivan reveals the benefits of integrating building management solutions on a single technology platform, actionable data and tangible solutions to improve the management of buildings, how to leverage data to improve efficiency and tackle the sustainability challenges of the future and how to use integrated data insights to improve the way we design, build and operate buildings; comply with regulations; report our emissions; eliminate waste; and reduce operating costs and minimize risk.

(IS-2022-65) The Sustainable Real Estate Program Handbook

The 33-page handbook, by Stok LLC, covers critical factors in both developing and managing a Sustainable Real Estate Program. Each section provides a clear, step-by-step approach that seeks to codify and simplify what is, for most companies, a complex exercise in change. The handbook also uncovers insights behind key success factors: leadership, data, stakeholder buy-in, communication, and strategic approach.

(IS-2022-64) The Plumbing of Internet of Things

Today's device builders are scrambling to create feature-rich connected devices with digital experiences around them. But developers face challenges when adopting technology for an IoT implementation. This whitepaper by Siemens Digital Industries Software reviews ways to help manage potential risk factors.

(IS-2022-63) HVAC Winter 2022

This eBook was authored by Consulting-Specifying Engineer, Air Solutions Company and, Grundfos and published by CFEMedia on January 26, 2022. The eBook covers topics on the use of louvers to prevent snow intake, filters for HVAC, specifying roof top units, pumping systems, integrating BAS in designs and improving indoor air quality. Each topic explains the challenges and opportunities

in these HVAC applications with case studies and AHSAE standards and other regulations that could apply. New controls and building automation capabilities are shown to provide better control, monitoring, and reporting to improve performance and avoid breakdowns.

(IS-2022-62) How Tech is Helping Companies Optimize a Hybrid Future

As more and more companies invest substantial time and money into the ideal hybrid workplace, it is becoming ever more critical to have a crystal clear understanding of what occupiers really want out of their new flexible, hybrid spaces. In this report by Smarten Spaces published February 2022, the author explores the hybrid workplace priorities for enterprise office occupiers, and discuss a range of strategies which firms in a range of industries can use to provide these workplaces cost effectively, from technology to layouts and beyond.

(IS-2022-61) Combining OpenADR and EEBUS for Energy Control

In this whitepaper, by OpenADR and EEBUS, published January 2022 explains how these two established industry standards provide a solution available today to handle rapidly growing power demands. The paper details how secure capacity & tariff management and building control provided by both OpenADR and EEBUS together can enhance energy management and the smart grid. The paper examines the two standards often considered for energy management and smart grid applications. It helps to identify the key criteria that decision makers should be evaluating when designing a solution in terms of performance, reliability, scalability, interoperability, and security.

(IS-2022-60) Building a Better Hybrid Workplace

Hybrid work is the future. But how do we improve and adapt our spaces to operate successful hybrid models? Learn how companies use data to build better workplaces that are safe, efficient and empower people to do their best work. This report covers: where employees prefer to work using heatmaps of floorplans, creating safer spaces using occupancy data and displays, and building better workplace experiences by protecting employee privacy.

(IS-2022-59) Beyond IR Thermography How Continuous Thermal Monitoring Improves Performance and Equipment Protection

For many years, scheduled infrared thermography inspections have been the accepted method for reducing the risk of fire by identifying faulty or loose connections in electrical distribution systems. Continuous thermal monitoring offers a safer, more effective way to detect thermal risks on a system-wide, 24/7 basis before they occur. This report, by Schneider Electric, discusses how thermal monitoring reduces risk of fire more effectively than IR thermography.

(IS-2022-58) Accelerating the Path to Design Buildings that Satisfy Performance and Comfort

This report, authored by Ruben Cabanillas Ramosf at Skidmore, Owings & Merrill (SOM) and

published on January 14, 2022 by Cove.tool reviews a case study and describes the process and methodology, required climate data and various tools to bring moisture, temperature and air into the proper comfort zone. By adding cove.tool to their existing workflow, the designers at SOM found value in the way cove.tool helped them organize their data and reduce the number of steps and approvals in their original workflow. It also helped teams save countless hours through a simplified workflow that increased collaboration.

(IS-2022-57) A New Way to Work Requires a Novel Approach to Technology Investments

This report was authored by contributors to and staff at Frost and Sullivan and published in December 2021. The report is a compilation of 4 Chapters that describe the way business is adopting digital technologies and cloud services to enhance the work environment and increase productivity. The hybrid work environment, where employees, regardless of their location, have high-quality access to the tools and information they need to carry on their work, connect and collaborate with other team members, in a seamless, fully secure, uninterrupted way, is here to stay. API and integration unlock the full potential of Cloud communications and collaboration.

(IS-2022-56) The State of Commercial Real Estate Building Operations for 2022

This report was authored and published by Building Engines in January 2022. They partnered with BOMA (Building Owners and Managers Association International) to survey commercial property professionals about the state of CRE (commercial real estate) today, and their intentions and expectations for 2022. The survey results suggest an optimistic outlook for the commercial real estate industry in the year ahead. 93 percent of the CRE professionals we surveyed said their property portfolio had stayed the same or gotten bigger in 2021. And 98 percent of them expected their investment in CRE software to stay the same or increase in 2022. Property teams are increasingly aware of the carbon footprint of commercial buildings. They are taking action to address this, with 71 percent of survey respondents prioritizing energy efficiency for 2022. And they are conscious of a change in tenant expectations, with 63 percent of respondents looking to address health, wellness, and air quality in their buildings.

(IS-2022-55) The Growing Demand for Resiliency Solutions as Extreme Weather Increases

This report was authored and published by Bloom Energy and Wood Mackenzie Power and Renewables in January 2022. The Department of Energy (DOE) estimates that power outages cost the U.S. economy \$150 billion annually. Both the proliferation of more extreme weather events and America's aging power grid due that has much of the transmission and distribution built in the 1950s and 1960s. This aging grid is more vulnerable to outages caused by extreme weather. And utility initiatives to harden the grid against extreme weather are expensive, costs that will ultimately be passed down to ratepayers. In this report, Bloom Energy compares the various options for backup power with regards to costs, response time and environmental impacts.

(IS-2022-54) State of the Hybrid Workplace Report

This report authored and published by VergeSense in January 2022 analyzes workplace utilization

data drawn from over 40M square feet from across the world, covering various industries and enterprises. Averaging utilization across company working hours it was found that office utilization has increased by 135% since the start of the pandemic. New space planning ratio is one collaboration space for every two desks vs. the previous one collaboration space for every six desks pre-pandemic. Since the start of the year (Q1 2021) the average number of collaborative spaces per floor has increased by 35%. The average number of individual spaces per floor has stayed the same. Utilization of collaborative spaces has increased by 50%. In Q3 2021, the most frequented work-from-office days were Tuesdays and Wednesdays with 46% of total office utilization happening on those days. This report underscores that the future of the office is highly collaborative and agile, and the following data will help equip business leaders to make informed decisions regarding their real estate portfolios and office spaces.

(IS-2022-53) Smart Building Connectivity Shaping the Always-on Business of Tomorrow

In this December 2021 CommScope discusses three consistent needs emerging as enterprises embrace the efficiencies of intelligent buildings: The need for mobile connectivity within the enterprise, as fewer employees are bound to desks but need ubiquitous wireless coverage. The need to lay a future-ready infrastructure foundation for the still-evolving, ever-growing internet of things (IoT). The need to converge many disparate or proprietary networks onto a single, unified IP over Ethernet physical network layer. Each chapter includes specific recommendations you can put to work in your enterprise network to create a more intelligent, more efficient building that better serves the needs of your growing business.

(IS-2022-52) Intelligent Buildings - A Technical Overview

This July 2021 report released by the Center for Energy and Environment, based in Minneapolis, provides an overview of the state of intelligent building technologies. The authors look at what can be currently deployed to increase the efficiency of building operations, promote greater occupant comfort and productivity, and serve as an energy resource to the electrical utility grid. Details are provided on what it means for a commercial building to be intelligent and opportunities that can bring to building owners, operators, and occupants, as well as the grid.

(IS-2022-51) Intelligent Buildings Literature Review

This report by the Center for Energy and Environment came out in September 2021. In highlighting the areas that impact intelligent building energy use, this report focuses on the importance of ensuring that potential strategies are aligned with current design trends, market structure, building operation/maintenance, and work practices. Energy efficiency opportunities that intelligent buildings can provide are discussed along with their market potential.

(IS-2022-50) Smart Home Ecosystem Growth Opportunities

This report by Harbor Research (August 2021) highlights that smart home market is fragmented with competing networking standards, a myriad of multi-purpose hubs, and legacy-entrenched technology that tend to focus on single applications (e.g., home security, energy, entertainment).

Further challenges include incomplete platforms, narrow point-solutions, and software incompatibility. Technical recommendations are proposed for greater industry collaboration to remove barriers to adoption, improve the overall user experience and lower cost.

(IS-2022-49) What Gets Measured Gets Managed - The Role of Real-Time Insights in Construction Project Success

This report from Procore Technologies (May 2021) explains how construction managers can improve product quality, overall efficiency, and productivity by having better visibility into project performance. Various strategies for gaining those real-time insights into projects are discussed, including performance monitoring systems (construction-specific platforms and point solutions) and artificial intelligence (AI) or machine learning technologies. The research suggests that companies can still improve their performance by shifting away from manual data collection and reporting tools and adopting integrated platforms that deliver real-time performance metrics.

(IS-2022-48) Grid-Edge DERMS - An Enterprise Platform Built to Manage DERS at Scale

This 2021 report from New York-based EnergyHub focuses on how electricity grid operators can manage distributed energy resources (DER) on both sides of the meter - at the grid-edge - using a combination of DER Management Strategies (DERMS). Following discussion of key challenges in managing grid-edge DERs, the authors examine five key capabilities required, including customer-centric aggregation, grid-edge situational awareness and a robust infrastructure. Illustrations of operating models and examples of successful deployments are provided including one focusing on electrical utility Arizona Public Service.

(IS-2022-47) Draft Heat in Buildings Strategy - Achieving Net Zero Emissions in Scotland's Buildings

This draft strategy by the government of Scotland (February 2021) sets out actions and proposals for transforming the country's buildings and the systems that supply their heat, ensuring all buildings reach zero emissions by 2045. A framework for the country's long term local heat and energy efficiency, dubbed LHEES, is outlined. Strategic priorities include supporting those least able to pay; strategic investments in technology; showcasing net zero Leadership; and investing in Innovation and demonstration to drive forward competitive advantage. Under the £1.6-billion LHEES program, over two million homes and 100,000 non-domestic properties will transition from fossil fuel powered heating to non-fossil fuel energy efficient systems, by 2034, and, to zero emissions heating and cooling systems by 2045.

(IS-2022-46) Equipment Reliability - Basics Matter Now More Than Ever

This 2021 branded content report by GE Digital and Utility Dive produced by studio is subtitled "How changing operations and market dynamics put a renewed focus on cost-efficient plant-wide reliability." Power plant owners and operators are expected to continue to face greater reliability challenges. This report highlights that combining the workflows and fundamentals –

that have always been essential to reliability – with advanced software and analytics that monitor all of the components of a power plant, traditional power generators can become more reliable even as their operations change.

(IS-2022-45) PoE Lighting Improves Firefighting Preparedness and Response

This 2021 report by the Siemon Company examines the ability to integrate a digital lighting system with an existing emergency alert system. A case study focusing on the Evendale Fire Department located in Cincinnati, Ohio, is provided. In the case study, it was possible to program the lights in the bunk room to gradually illuminate and wake the firefighters more gently when calls came. The benefits included more efficient response times and improved cognitive functioning, a more aesthetically-pleasing environment, and cost savings from less energy consumption and maintenance. The report suggests that PoE lighting is rapidly gaining traction in the commercial construction industry and the market is expected to continue growing in the years to come.

(IS-2022-44) Optimal Installation - The Key To A Successful HVLS Investment

This 2021 report from Hunter Fans proposes simplified framework for users to select a high-volume, low-speed (HVLS) fan for a facility. Outlining that temperature control and air quality are the primary reasons of fan installation, the report explores the technicalities and installation considerations to ensure that it is installed in the most cost- and time-efficient manner. Factors such as square footage of the space envisaged, ceiling height, the type of structure where the fans will be mounted to, electrical requirements, and fan control options are explained.

(IS-2022-43) Energy Efficiency and Demand Response - Tools to Address Texas' Reliability Challenges

In this report for October 2021, ACEEE examines seven residential energy efficiency retrofit measures that could be adopted in Texas in light of the state's electricity reliability problems. Power shutoffs over the winter (February 2021) and the tight summer supply situation during the same year illustrated that Texas lags behind other states in deploying energy efficiency and demand response programs. The authors provide a preliminary analysis intended to offer ballpark estimates for what energy efficiency and demand response could accomplish quickly in Texas. An estimation of benefits (peak demand reduction, lower energy bills, reduced need for utility capital expenditures) to Texas consumers and power generation utilities is also carried out.

(IS-2022-42) Community Choice Aggregation and Energy Efficiency - Opportunities, Challenges, and Lessons Learned

This 2021 report by ACEEE examines the opportunity presented by Community Choice Aggregation (CCA) energy efficiency initiatives in the United States. It identifies the key obstacles, contextual regulatory and legislative factors that influence program opportunities, and offers a set of improvement opportunities for the CCA role in supporting energy efficiency in

their local context. The analysis shows that a majority of CCAs operating nationwide are not currently offering energy efficiency programs. Findings suggest that communities pursuing energy aggregation can be more successful at realizing the benefits of energy efficiency programs by addressing resource funding, developing partnerships, and leveraging community support.

(IS-2022-41) Lighting for Health - Human-Centric Lighting

This 2021 report by Luminus Devices, Inc. from 2021 examines human-centric lighting (HCL), a decades-old concept that now through scientific and LED technology advancements is supported by more sophisticated approaches not previously seen. The analysis highlights that creating basic HCL schemes requires selecting fixtures with the appropriate color temperature and brightness that reach circadian standard targets while optimizing for human productivity, comfort, and rest. The report outlines what “healthful light” means and discusses the role of existing standards such as the WELL Building Standard, which provides an evidence-based system for calculating healthful light.

(IS-2022-40) Landlords Must Adopt and Refine Flex Strategies to Survive a Rapidly Changing Real Estate Market

In 2021, Essensy undertook to understand current trends in real estate related to flex spaces — and user and landlord expectations and strategies in a post-pandemic world. The findings reported here reflect data collected through an interview format across the UK, North America, and Europe. Building occupant expectations highlighted the importance of technology in buildings, remote working, interior environments that support employee productivity. From the landlord perspective, the most common strategies cited were flexible meeting spaces, premium serviced offices and short lease office spaces. The analysis concludes that demand for flex space will become more common in the market and that a digital ecosystem can unlock new revenue generation opportunities to monetize more building services.

(IS-2022-39) Bringing Clean Energy Home

This October 2021 report from RMI, an independent nonprofit, is subtitled “Unlocking Innovation and Policy to Align US Household Energy Use with Ambitious Climate Targets.” It describes the challenges, opportunities, barriers, and emerging solutions associated with aligning household energy decisions with ambitious climate policy targets. The authors conclude with recommendations for solutions providers, policymakers, regulators, and utilities, and an assessment of an example household energy service that could help unlock clean energy for U.S. households. The latter item involves in-depth look at the energy savings potential that can be realized through solutions like Nest Renew, providing customers with features that enable demand response and energy efficiency.

(IS-2022-38) Home Unbound - Transitioning Back to the Office After COVID

This 2021 report was by Brivo, a provider of cloud-based access control and video surveillance, and

WhosOnLocation, a people presence management software company. The analysis showcases the results of an online survey of five hundred thirty-eight respondents in all U.S. states. The aim is to gauge people's willingness and main concerns regarding to the office. Human interaction with clients and colleagues was cited the main reason for returning to the workplace. Nonetheless, 59% of survey respondents expressed concern about returning to an office and worker proximity was identified as a major worry for all sectors. The report concludes that one-third of workers will eagerly return to the office, one-third will stay at home, and a final third will take a hybrid approach.

(IS-2022-37) U.S. & Canada Office Fit Out Guide

This 2021 report from JLL provides a useful tool to compare office construction fit-out costs across U.S. and Canadian markets relying on robust data collected by the company from several projects in the region. The analysis uses three different offices fit out styles and space configurations to assist the user to make better and more informed real estate decisions at the planning stage of the project. It suggests that while National average costs could increase by 3.5 to 5.5 percent over the course of 2021, salaries are forecast to keep rising at a steady pace in the range of 2 to 5 percent. The trends about how designs are adapting to the post pandemic world, are similar in both, Canada and the United States.

(IS-2022-36) Smart Home Light Based Service Oriented Architecture and IoT

This academic article was published by IOP Publishing in February 2021. The report presents an application of Service Oriented Architecture (SOA) and Internet of Things (IoT) to build a control lighting system for smart homes. Based on the Raspberry Pi microcontroller, the system includes security features and can be deployed remotely using an Android smartphone.

(IS-2022-35) Machine Learning in Wireless Sensor Networks for Smart Cities - A Survey

This academic article appeared in MDPI's *Electronics* journal in April 2021. The report presents an in-depth literature survey of machine learning methods as an optimization tool for regular wireless sensor networks and Internet of Things (WSN-IoT) nodes deployed in smart city applications. The survey results indicate that the supervised learning algorithms have been most widely used (61%) as compared to reinforcement learning (27%) and unsupervised learning (12%) for smart city applications.

(IS-2022-33) How using smart buildings technology can improve indoor environmental quality in educational buildings

This report was published by EDP Sciences in April 2021. The report presents a case study of an architectural project for an elementary and junior high school academic campus in the state of Nuevo León, Mexico. The project takes into account extreme climate conditions, while applying the best alternative and bioclimatic strategies through the implementation of inmotics, a responsive architectural skin, sustainable construction systems, and native vegetation. The result of the project is a comprehensive environmentally friendly building that is based on the latest

environmentally oriented systems and technologies.

(IS-2022-32) Artificial Intelligence Evolution in Smart Buildings for Energy Efficiency

This academic article that appeared in the MDPI journal *Applied Sciences* in January 2021. The report provides an in-depth review of recent studies on the application of artificial intelligence (AI) technologies in smart buildings through the concept of a building management system (BMS) and demand response programs (DRPs).

(IS-2022-31) An Automatic Aggregator of Power Flexibility in Smart Buildings Using Software Based Orchestration

This academic article appeared in the MDPI journals *Sensors* in January 2021. The report presents a software-based modular and hierarchical building energy management system (BEMS) to control the power consumption in sensor-equipped buildings. This system is able to aggregate the controls of the all-controllable resources in building to realize its flexible power capacity. The main novelty of this system is that it can handle the heterogeneity of the installed hardware system along with time bound changes in the load device network and its scalability; resulting in low maintenance requirements after deployment.

(IS-2022-30) The Guide to Smart Building Technologies

This October 2021 report by Cisco discusses how the COVID-19 pandemic accelerated the need to create “smart and intuitive” buildings. By providing a sense of health and well-being for users, these buildings also maximize space utilization around social distancing and other mandates. Architects, developers, and building operators have opportunities to leverage technology to add value to planned or existing structures. Through design with technology, they can build “trusted workplaces” featuring improved health and safety, more intuitive spaces, and reduced costs and resource usage, all while increasing sustainability.

(IS-2022-29) Advanced Supervision of Smart Buildings Using a Novel Open-Source Control Platform

This article which appeared in the MDPI journal *Sensors* deals with an advanced supervision model for continuous online monitoring and analysis of process behaviour in smart buildings or other industrial control systems. The model is developed using open-source tools and includes an artificial operator to autonomously supervise the process. The model has been successfully tested in a simulation and a practical case study of a two-storey family house.

(IS-2022-28) A Unified Methodology to Predict Wi-Fi Network Usage in Smart Buildings

This report was published in the journal *IEEE Access* in January 2021. The report looks at the use of Wi-Fi network association information as a basis for the design of intelligent systems for smart buildings. The proposed methodology enables the user to evaluate and to create machine

learning models for energy efficient smart building management systems. The authors report that the model can be used to predict occupancy with an 87% accuracy.

(IS-2022-27) Emerging Trends in Wireless Infrastructure

This report by Rohde & Schwarz was released in August 2021. The report describes the emerging infrastructure trends of wireless networks for 4G, 5G, and beyond 5G. These trends provide more opportunities to service providers for network deployments, network customization, and network optimization. The analysis provides commentary on some of the key drivers, including spectrum, densification and coverage extension methods, virtualization and cloudification, and network customization and intelligence. These trends, which are presented in detail, are expected to continue in the coming years with the advance of 6G deployments.

(IS-2022-26) Consumer Systems and Home Automation - A Disruptive End to Silo Thinking

This report appeared in *Euromonitor International* in August 2021. The analysis focuses on the importance of consumer systems, rather than product silos, to reap new incremental profit opportunities with new business models. Key elements to creating new business models include holistic thinking, improving user experience, and creating partnerships. Business case studies are presented regarding pay-per-wash and Internet of clothing (IoC) initiatives.

(IS-2022-25) Demand Flexibility in New York City Buildings - Benefits Beyond Carbon

This report by RMI (May 2021) focuses on how electrical power demand flexibility provides benefits to New York City. Community level benefits include improved air quality, reduced pollution, and reduced operating costs. Buildings need to be incentivized to combine the electrification of heating with controls that allow their demand to be flexible. Compliance with Local Law 97 (LL97) will be supported with system wide decarbonization, combined with efficiency, demand flexibility, and electrification.

(IS-2022-24) BIPV Solutions in Europe - Competitiveness Status & Roadmap Towards 2030

This report from the Becquerel Institute, a research institute focusing on solar PV, was released in May 2021. The authors examine the “competitiveness” level of various building integrated photovoltaics (BIPV) solutions in key Western European markets. Competitiveness is assessed using a method of total costs and revenues of ownership to clearly identify the intrinsic economic attractiveness of BIPV as a building envelope solution. The methodology includes an “extra cost” assessment to consider the role of building components fulfilled by BIPV elements and consequently the avoided expenses for the façades or roof claddings. Findings highlight that as electricity generating units, BIPV systems can be competitive and an attractive investment.

(IS-2022-22) State of the Electric Utility Survey Report 2021

This report from Utility Drive was released in March 2021. Findings from a national survey of

hundreds of utility leaders across the United States are presented. Survey results indicate that COVID-19 has impacted an increase in remote working and loss of revenue. The main drivers on the electrical load changes were the shifts that took place during the pandemic, and energy efficiency programs. Utilities expect an increase in use of grid-scale solar energy, distributed energy resources, grid-scale battery storage, and wind. Top priorities for utilities going forward are renewables, sustainability, and the environment.

(IS-2022-21) Utilizing Existing Copper Infrastructure for Deployment of Fiber-grade Services

This report from the Broadband Forum was released in January 2021. The report deals with fiber access extension as an alternative to existing copper infrastructure, one that provides service providers an architecture to deploy fiber services cost effectively. This architecture consists of a network where the fiber is extended by using a copper medium without causing significant degradation in quality of user experience as compared to the fiber to the home topology.

(IS-2022-20) Powering Forward to Net-Zero - AEP's Climate Impact Analysis

This 2021 report was authored AEP, a large power producing company in the Mid- Atlantic Region. The analysis focuses on the progress and direction of the company to achieve Net-Zero by 2050. The challenges to get to all renewables is complex and difficult. Nicholas addresses employment, technology, corporate responsibility, and technical obstacles that must be tackled to be successful. Having a large coal generation base requires much investment, training, tremendous building projects.

(IS-2022-19) Getting Control of Comfort and Energy: The Benefits of Upgrading to Automated Shades and Advanced Lighting in Commercial Buildings

This report by Denver Net Zero from May 2021 describes how upgrades in terms of automated shades and advanced lighting will help the energy effectiveness of building lighting systems as well as healthy working environments. Five key steps are outlined: 1. Focus on occupant improvements, what needs are not being met by the building; 2. Engage a single entity to provide turnkey design, installation, commissioning, and long- term system support for the system; 3. Get stakeholders at the table early, including the IT department, facilities managers, and key occupants and staff. Communicate the benefits of the new systems to generate buy-in from occupants; 4. When conducting a cost-benefit analysis of system upgrades include occupant health benefits such as improved comfort, well-being, and productivity. Pursue energy efficiency incentives to support the project; 5. Maximize your savings by bundling HVAC retro-commissioning, lighting upgrades, advanced lighting controls, and other advanced technology solutions.

(IS-2022-18) Denver's Net Zero Energy (NZE) New Buildings & Homes Implementation Plan

Denver's "NZE" plan was set out in this 168-page document prepared by the New Building Institute and Denver Climate Action, Sustainability & Resiliency (released in January 2021). The stated objectives focus on clean energy job growth, economic recovery, and improved energy

equity through enhancements to the Denver Building and Fire Code with the goal of all new buildings achieving net zero energy by 2030. The plan envisages, in particular:

- Net zero energy, all-electric new homes in the 2024 Building Code
- Net zero energy, all-electric new buildings in the 2027 Building Code
- New buildings performing as designed with performance verification in the 2030 Building Code

(IS-2022-17) Seeds of Opportunity - How Rural America is Reaping Economic Development Benefits from the Growth of Renewables

This report by RMI was published in January of 2021. This report sets out to quantify the scale of the economic development opportunity from the growth of onshore wind and utility-scale solar projects in rural areas, and demonstrates what that means for communities through case studies of existing projects from three different regions. The report offers recommendations for local, state, and federal leaders to unlock this opportunity. In total, the analysis suggests that the approximately 600 GW of new wind and solar projected to be built between 2020 and 2030 would generate \$220 billion in lifetime value across rural America.

(IS-2022-16) Renewables in Cities 2021 Global Status Report

This article by REN21, a renewable energy policy think tank, was published in May 2021. The article provides insight to the progress that has made over the last 20 years and that current challenges and opportunities in relation to future progress. City governments in more than 830 cities in 72 countries had set renewable energy targets in at least one sector (power, heating and cooling, and/or transport), the analysis shows. Over 610 of these cities had set 100% renewable energy targets.

(IS-2022-15) From Traditional to Smart Building Materials in Architecture

This report was published by IOP Publishing in June 2021. A comparison between intelligent materials and traditional building materials for building efficiency is provided. The authors include an overview of the types of materials that can be used in construction and architecture, thus offering a new perspective on innovative techniques that will be available, or are already available, paving the way for improvements in both disciplines. Consideration is given to smart and sustainable design with emphasis on maintaining thermal, visual and acoustic comfort.

(IS-2022-14) Smart Materials in Architecture for Actuator and Sensor Applications A review

This academic article published by SAGE in August 2021 reviews smart materials-based technologies which are currently applied or developed for application in civil structures, focusing on smart material applications for actuation or sensing. Applications of the investigated materials are discussed, including shape memory materials, electro- and magnetostrictive materials, piezoelectric materials, ionic polymer-metal composites, dielectrical elastomers, polyelectrolyte gels as well as magneto- and electrorheological fluids, are presented for the

fields of architecture and civil engineering.

(IS-2022-13) Smart Home Modification Design Strategies for Ageing in Place - A Systematic Review

This report was published in the *Journal of Housing and the Built Environment* in August 4 2021. It presents findings from a literature review of 34 scholarly articles regarding the current strategies and approaches directed to integrate innovative technologies in the home modification process to support independent living and ageing. The findings indicate that both home modification and smart technologies can support older adults' independent living, especially with fall prevention and indoor accessibility. The fundamental requirements in smart home modification phases are customization, minimum life interference, and extensible technologies to cope with the ageing process.

(IS-2022-12) Live, Work, Connect

This November 2021 report by WiredScore reports on the results of a survey of those who transitioned to home working or studying throughout Europe during the pandemic. The findings and analysis show that productivity levels when working from home have increased across Europe during the COVID-19 pandemic. As well, the desire to remain constantly connected has brought to light the need for the best digital connectivity, no matter the location. The authors highlight that while digital solutions are being implemented within buildings, a significant knowledge gap exists, leaving many unable to use the technology to its full potential.

(IS-2022-11) Smart Buildings - Our Future is Smart

This April 2021 report was released by SmartScore. With little agreement in the industry on fundamental questions for the smart building — how to create one, how to work with the supply chain, or even what 'smart' means – this report sets out to sharpen the meaning of the smart building with a user-centric, outcome-orientated approach. The report argues that smart buildings must above all use digital technology to deliver “outstanding outcomes” for users and exceed their expectations. The outcomes that users care most about, according to the authors, are an inspirational experience, a sustainable building, cost efficiencies, and a “future-proof by design” building.

(IS-2022-10) The Untapped 87% - Simplifying Controls Technology for Small Buildings

This December 2021 report was authored by James Dice and published by Keyframe Capital Partners, L.P. BAS are generally only installed in larger buildings—those above 75,000 square feet. But solving the climate crisis and maintaining a resilient electric grid depends on reducing complexity for ALL buildings, including the 5.5 million buildings under 50,000 square feet. This report delves into, among other aspects: the value of controls technology to small building owners and other stakeholders; how layers of complexity stack upon each other, and how to remove them; and innovative trends in small building controls. The analysis shows that scaling controls solutions to all buildings is a vital next step. Scalability will be enabled when the whole

complexity stack comes together and is fit to each exact subset of this heterogeneous market.

(IS-2022-9) Decarbonizing Canada's Large Buildings - Summary Report

This report by RDH Building Science in collaboration with Dunskey Energy + Climate Advisors was released by Canada Green Building Council (CaGBC) in December 2021. The report evaluates the potential pathways to decarbonized building operations, including the estimated deep carbon retrofit costs for Large Buildings. Nearly all office building archetypes can reach net zero carbon operations, while at the same time achieving a positive net present value. The authors highlight that large building retrofits can reduce building-sector emissions by up to 51 per cent (21.2 million tons), the report notes.

(IS-2022-8) Net-Zero Energy & Net-Zero Carbon — Design Strategies to Reach Building Performance Goals

This report by cove tool was published on October 12, 2021. The reports highlights that architects, engineers, and all parties involved in the building design process must begin implementing sustainable strategies into their workflows to make a significant impact in the fight against climate change. In this e-book, the differences between net-zero energy and net-zero carbon are illustrated, along with key design strategies to help architects and engineers meet performance targets.

(IS-2022-7) The Financial Impact of Healthy Buildings

This report from the MIT Real Estate Innovation Lab appeared in October 2021. Using the commercial real estate data platform CompStak and healthy building public databases from Fitwel and WELL, a real estate hedonic model was created in order to ascertain the value of healthy spaces on the effective rent of offices spaces in ten U.S. cities. Findings show healthy building rents transacting between 4.4 and 7.7% more per square foot than their nearby non-certified and non-registered peers. This “premium” for healthy spaces exists independently of all other factors such as LEED certification, building age, renovation, lease duration, and submarket. These results indicate that healthy buildings are seen as an asset that correlates with employee or tenant well-being and productivity.

(IS-2022-6) SMART BUILDINGS Fall 2021 | Consulting-Specifying Engineer Ebook

This ebook by *Consulting - Specifying Engineer* produced in collaboration with Siemens focuses on chiller energy optimization systems versus building automation systems, highlighting four demand factors beyond COVID-19 prevention for smart buildings. The report explains that a chiller energy optimization system continuously looks at all of the operating equipment and seeks to minimize the overall chiller plant electric demand.

The technology has the ability to monitor and adjust setpoints and equipment speeds, and it's this flexible readjusting of established control loops that makes the device "smart" — a system working in conjunction with the BAS to optimize the operation of the chiller plant without human

intervention.

(IS-2022-5) Build Up 2030 Framework for the Transformation of Real Estate

This September 2021 report was authored by the Institute for Market Transformation (IMT). Along with the changes resulting from the COVID-19 global pandemic, the real estate industry is also transforming its understanding of and approaches to how buildings contribute to the economy and to healthy communities. IMT's "Framework for Transformation" comprises 10 principles it recommends real estate professionals and companies to use to actively transform their business practices and communities. Drawing on discussion with a coalition of 20 real estate industry leaders from across the U.S, IMT proposes vision that was informed by the "realities and potential seen by professionals" in terms of industry transformation.

(IS-2022-4) Modular Software Architecture for Local Smart Building Servers

This academic article was published in MDPI's *Sensors Journal* in August 2021. It presents the architecture and construction of a novel plug-and-play system for optimal monitoring and control of energy and water consumption in smart buildings. Based on the Raspberry Pi microcontroller, the system is cloud-based and includes nine modules that inter-communicate. The system was tested on fifteen social housing units was able to detect abnormal energy consumption.

(IS-2022-3) A Smart Home Architecture for Smart Energy Consumption in a Residence With Multiple Users

This academic article published in the journal IEEE Access presents an evaluation of a Smart Energy Control Systems (SECS) architecture called SmartCom. The system provides an accurate identification of electrical equipment through near field communication (NFC) between smart outlets (SO) and appliances. The results indicate that the system can achieve a rebalanced residential energy consumption 87.3% of the time with minimal disruption to users' comfort.

(IS-2022-2) Luminaire Level Lighting Controls and the Future of Healthy Buildings

In this report from May 2021, researchers with the Energy Studies in Building Lab at the University of Oregon describe ways to improve utilization of the presently disparate LLLC and BAS data streams to support energy efficiency and improve human comfort and human health outcomes. Published by BetterBricks, a commercial resource produced by NEEA (Northwest Energy Efficiency Alliance), the report outlines key potential benefits that include: improved ventilation management to support improved cognitive function; improved vertical field lighting scene management to reduce glare and improve circadian exposure; and data integration and situational awareness to support building operations that will reduce pathogen transmission risk. There are, however, notable obstacles to delivering on that vision, ranging from poor hardware and software interoperability and privacy/security concerns to the (complex) need to optimize the number and types of sensors in a network.

(IS-2022-1) Grid-Interactive Efficient Buildings Made Easy

This June 2021 report by RMI recommends actionable steps for GSA building managers to implement low- and no-cost measures that result in utility cost savings and greenhouse gas emissions reductions. The best candidates for grid-interactivity adjustments are buildings that are subject to time-of use utility pricing, are all-electric or have future electrification planned, or have existing energy storage and renewable energy capabilities, the authors note. Upcoming renovations or equipment replacement projects present ideal opportunities to add GEB measures. Moreover, building managers should consider “GEB-ready” measures, such as requiring smart controls on lighting, HVAC equipment, and other electric fixtures and equipment and integrating all new equipment into a central EMIS.

(IS-2021-266) Taking the Pandemic Pulse of Healthcare Real Estate

This BOMA International “Deep Dive” from August 2021 highlights that nowhere have COVID’s transformational effects been more apparent than in healthcare; namely, the medical office building (MOB) sector. A key factor in MOB growth has been the move to take healthcare off the hospital campus and bring it out to patients. Competition between health systems, cost management and containment and insurance pressures are all drivers of this trend.

(IS-2021-265) The Future of Commercial Facility Management

This September 2021 report by Propmodo Research for Microshare looks at the tools and tech platforms that facility managers can enlist to make their jobs easier. The analysis identifies key challenges facing practitioners in the space and explores facility manager training requirements, providing a closer look at competencies and skill sets modern FM professionals should come to the table with.

(IS-2021-264) Raising Awareness Around IoT Strategy, A Mobile Network Operators Perspective on Approaches and Challenges

This report was prepared by Forrester Research and published in April 2020. The authors provide insight to organizations on how to integrate Internet of Things (IoT) solutions into their business. Fundamentally a customer-centric opportunity, the development of IoT solutions demands a long-term approach during which organizations focus on preparing for the competition ahead and learning the best techniques and processes to achieve full deployment, the authors highlight.

(IS-2021-263) Commercial Office – 7 Keys to a Successful Post-COVID Workplace

In a report from April 2021, Building Engines highlights that while COVID-19 upended the CRE industry, many keys to the property managers success pre-pandemic have been essential in navigating the current moment and will be crucial during what comes next. Timely communications, strong team collaboration and flexible thinking are key to any building

portfolio's success. Moreover, as property teams know, many challenges lie ahead, including the fact that buildings now need to provide what home offices can't, including flexible coworking spaces and attractive amenities.

(IS-2021-262) Low Carbon Multifamily Retrofits: Garden Style 1-3 Stories

This report focusing on a distinct *garden style, 1-3 stories* building segment is part of a series authored by NYSERDA & Steven Winter Associates for Building Energy Exchange and published in March 2021. The report emphasizes retrofit strategies that maximize occupant comfort and energy savings through a transition from fuel to electricity-based heating, cooling and hot water systems. Aligned with typical capital improvement cycles, the recommendations will prepare buildings for increasingly stringent efficiency and carbon emissions targets through careful phasing of work across all major building components, including upgrades to exterior walls, windows, and ventilation systems. The report describes the primary benefits of a low carbon retrofit with details on the major system upgrades needed to access those benefits.

(IS-2021-261) Low Carbon Multifamily Retrofits: Post 1980 8+ Stories

This report focusing on the “post 1980s, 8+ stories” segment is part of a series authored by NYSERDA & Steven Winter Associates for Building Energy Exchange and published in March 2021. The report emphasizes retrofit strategies that maximize occupant comfort and energy savings through a transition from fuel to electricity-based heating, cooling and hot water systems. Aligned with typical capital improvement cycles, the recommendations will prepare buildings for increasingly stringent efficiency and carbon emissions targets through careful phasing of work across all major building components, including upgrades to exterior walls, windows, and ventilation systems. The report describes the primary benefits of a low carbon retrofit with details on the major system upgrades needed to access those benefits.

(IS-2021-260) Low Carbon Multifamily Retrofits: Post-War 8+ Stories

This report focusing on a segment of buildings — 8+ stories — constructed in the post war period is part of a series authored by NYSERDA & Steven Winter Associates for Building Energy Exchange and published in March 2021. The report emphasizes retrofit strategies that maximize occupant comfort and energy savings through a transition from fuel to electricity-based heating, cooling and hot water systems. Aligned with typical capital improvement cycles, the recommendations will prepare buildings for increasingly stringent efficiency and carbon emissions targets through careful phasing of work across all major building components, including upgrades to exterior walls, windows, and ventilation systems. The report describes the primary benefits of a low carbon retrofit with details on the major system upgrades needed to access those benefits.

(IS-2021-259) Low Carbon Multifamily Retrofits: Post-War 4-7 Stories

This report focusing on a segment of buildings (4-7 stories) constructed in the post war period is part of a series authored by NYSERDA & Steven Winter Associates for Building Energy Exchange

and published in March 2021. The post-war building selected by the authors for study is a 7-story, market-rate residential building in Brooklyn, New York. The building has masonry exterior walls enclosing 83 apartments across 76,113 gross square feet. Typical of a large swath of buildings in New York City (as well as many other regions), the building is thought to be representative of the most common challenges that will be encountered by anyone looking to perform a deep retrofit of an occupied multifamily building.

(IS-2021-258) Low Carbon Multifamily Retrofits: Prewar 4-7 Stories

This report focusing on “prewar, 3-7 story” building was authored by NYSERDA & Steven Winter Associates for Building Energy Exchange and published in March 2021. The report emphasizes retrofit strategies that maximize occupant comfort and energy savings through a transition from fuel to electricity-based heating, cooling and hot water systems. Aligned with typical capital improvement cycles, the recommendations will prepare buildings for increasingly stringent efficiency and carbon emissions targets through careful phasing of work across all major building components, including upgrades to exterior walls, windows, and ventilation systems. The report describes the primary benefits of a low carbon retrofit with details on the major system upgrades needed to access those benefits.

(IS-2021-257) Smart Buildings - A Framework for Assessing the Openness of a Building Management System (BMS)

This April 2021 report from Schneider Electric’s Buildings Research Center emphasizes three layers which the authors contend need to be understood in the context of “open” building management systems. These include (1) Data acquisition/sharing, (2) System integration, and (3) Building orchestration. The report proposes a framework, clarifies terminology, and outlines key criteria associated with being “open” — including how these criteria influence the complexity and performance of the BMS. Example use cases for each are presented.

(IS-2021-256) Why Sustainability Should be Your Competitive Edge

This March 2021 report is by Honeywell International. “Executives are increasingly turning to sustainability as a force multiplier for competitive advantage,” the authors write. In the past, this was typically not a competitive focus – simply a means of demonstrating responsible corporate citizenship – and so sustainability initiatives often became silo,” within the enterprise. Today, with the recognition deep ties between “sustainability” and “profitability, sustainably managed companies have become increasingly attractive to investors and customers. This report provides insight into the right “sustainability path” and how industry stakeholders can begin to identify the strategy that best fits their company by answering three critical questions: *What’s my objective?; What are my opportunities?; And What will be my approach?*

(IS-2021-255) A Guide to Building Automation Systems and CMMS Integration

This March 2021 from Eagle Technology looks at how customers can win by integrating their building automation systems (BAS) with their computerized maintenance management system

(CMMS). Maintaining a comfortable and efficient work environment is an important factor for any business, and with BAS integrated with the asset maintenance software, one system environment can be used to control the indoor environment and ensure that building equipment is running efficiently. “Whether they are monitoring the building’s temperature or analyzing how efficiently the air conditioner is running, it can all be done by using the same software,” the authors write. Because everything is completed using the same system, the faster it is to train and bring employees up to speed efficiently.

(IS-2021-254) Transform with Technology - Shaping the Future of Real Estate

This August 2021 report by JLL Research and MIT sets out to identify which real estate technology investments are the most impactful, and how stakeholders can use them to increase the employee health and wellness, maximize value of a property, and drive business forward. The digital transformation underway as the technology ecosystem around the built environment matures and consolidates is examined. The technologies available now or currently in development will radically reshape how people interact with and use buildings, with the potential to delivery much more “human-centric, resilient and responsible built environments.”

(IS-2021-252) Energy Management in the Ontario Mid-Tier Commercial Real Estate Sector

This December 2020 report was authored by CIET and Knowenergy with input from a steering committee and published by the Independent Electric System Operator (IESO) in the province of Ontario. Focusing in particular on organizations that manage mid-tier commercial real estate (CRE) buildings, the report proposes a strategy to engage them in the energy transition. The analysis was based on a survey conducted among 77 building owners and property managers, supplemented by site visits at eight mid- tier buildings. The research indicates that many respondents are lacking in their understanding of metering and lease mechanisms to monetize the value of investments in energy efficiency. The outcomes also highlight the need for education and capacity building in this market, focusing on how building owners can create value from energy efficiency.

(IS-2021-251) Flexible Buildings - Five elements to create buildings ready for the new world of work

This June 2021 report by Schneider Electric in partnership with WORKTECH Academy sets out to define “flexible buildings.” With more flexible work patterns, flexible teams and flexible organizations, the market will naturally come to demand “flexible buildings” more and more as well. How should the term *flexible building* be defined? How should its key attributes be understood? This report provides practical considerations on how to specify and procure a flexible building. Designing for change, developing data science skills within the CRE team and treating flexibility as an office amenity are among the key issues raised.

(IS-2021-249) Corporate sustainability goal setting and measurement

GreenBiz Group presented the results of a survey of sustainability leaders at Fortune 500

companies as the starting point for a discussion around sustainability targets and evaluation criteria. The analysis argues that sustainability targets demand that companies consider operational planning horizons that can extend for decades. It shows that 80% of companies have emissions reduction targets and some of them have started to include “Scope 3” emissions to influence emissions of other companies and activities in their value chains.

(IS-2021-248) LEED building design and construction guidelines

This 2021 report by Gordian was designed to help architects, engineers, construction professionals and facility owners more easily grasp LEED sustainability principles. The resource reviews the highlights from each of the nine LEED guidelines and points out where they might prove valuable. The goal is to bring the main objective of each criterion to the forefront – adding practical recommendations where applicable.

(IS-2021-247) Low Carbon Strategies for Utility End-Use Sectors

This 2021 report by global consulting services company ICF examines the impact of electric infrastructure decarbonization on utilities. It analyzes challenges and opportunities linked to transportation electrification and argues that utilities can play a major role in shaping the uptake of electric vehicles. At the same time, EV charging will impact utilities as it increases the need to consider resilience upgrades and further grid hardening.

(IS-2021-246) Next-Generation Lighting Strategies

This 2020 ebook was prepared by I+S in collaboration with the industry outlet BUILDINGS is a compilation of articles by lighting industry experts. Keeping with the theme that good lighting must be about more than just illuminating a space, the authors provide overviews of technologies and strategies to carry out lighting retrofits in buildings and they explore an array of technical considerations associated with light quality, including lighting controls systems, energy efficiency, and quality metrics. Key Words: Light systems/controls, property management, system monitoring equipment, energy efficiency

(IS-2021-245) 10 Predictions for Smart Building Technology in 2021 and Beyond

Verdantix analyzed the major trends that expected to influence the smart building technology market over the next 12 months and beyond in this report from December 2020. What will be the key objectives of building managers? Which technology areas will see strong levels of investment? How will integrated platform solutions fare? The analysis cover topic such as building electrification, smart controls and new applications to facilitate integrated solutions, digital twin applications and other “occupant centric” features.

(IS-2021-243) Automated Demand Response Non-Residential Incentive Structure

This report by Energy Solutions and Lawrence Berkeley National Laboratory, from August 2020,

examines factors affecting the calculation of control incentives in the automated demand response (ADR) program within California's investor-owned utilities. The analysis highlights growing customer and industry interest in the program, the importance of incentives, trade ally networks and vendor engagement for program success, and the importance of cloud technologies to lower cost.

(IS-2021-241) iISBE Frameworks for Performance Targeting and Assessment

This December 2020 report from the International Initiative for a Sustainable Built Environment focuses on development tools for the establishment of sustainability performance targets, with the goal of assessing predicted or actual performance for small urban areas and buildings. Consideration is also given to integrated design process and post-occupancy performance evaluation. With the proposed tools, users have the opportunity insert local context values, performance benchmarks and targets to suit certain building types, leading to a calibrated system that provides meaningful results.

(IS-2021-240) Unlocking Value Across the UK's Digital Twin Ecosystem

TechUK outlines how digital twins can be adopted effectively to cope with unprecedented levels of risk and uncertainty in this report from February 2021. Targeted support for the UK's digital twin ecosystem will unlock value for people, economy, society, and planet, TechUK argues in this report from February 2021. A series of ESG recommendations to level up digital twin innovation and investment to take advantage of UK expertise in this area are proposed for government and innovation bodies. Accelerated adoption of digital twins will drive decarbonization, trigger the reduction of social inequalities, and drive sustainable R&D-led growth, the authors contend.

(IS-2021-239) Work Smarter to Live Better – Understanding the New Expectations of the UK Workforce When it Comes to Hybrid Working

This report by Microsoft, published in February 2021, presents the results of a survey of 4000 UK office workers carried out to understand the habits and new expectations of the UK workforce when it comes to hybrid working. Successful implementation of hybrid working will require people support through good management, ongoing fairness of opportunity, and prioritizing employees' health and wellbeing. Important takeaways include addressing employee resilience and workplace culture, mindfulness and ability to disconnect, and providing high flexibility with devices that can seamlessly integrate from the desktop to a mobile platform.

(IS-2021-238) A Scalable approach to residential EV management

This January 2021 report from EnergyHub presents a three phase EV management strategy that will ensure a safe and reliable grid. It is predicted that by 2030 more than 80% of the charging infrastructure will be residential and the strategy outlined here relies on smart charging stations that have the ability to capture charging behavior and provide load management capabilities. The components of the strategy include time-of-use (TOU) rates, an active event-based peak management, and automated managed charging that takes into account real-time grid and

market constraints.

(IS-2021-237) New Era of Workplace Data & Analytics

This report was prepared by Comfy and published in February 18. The report provides insights to business owners for informed decision-making in a time of workplace transformation. Flexible working models, data and analytics for effective space utilization, workplace design, and strategies to maximize real estate savings are discussed. Through analysis of key metrics, businesses can better understand workspace usage patterns to support business continuity while reducing overall costs.

(IS-2021-236) A Feature Selection-Based Predictive-Learning Framework for Optimal Actuator Control in Smart Homes

This report appeared in the academic journal *Actuators* (April 2021). The authors propose a predictive-learning framework based on contextual feature selection and an optimal actuator control mechanism, with the goal of minimizing energy consumption in smart homes. The analysis also addresses how optimal control can reduce energy cost and improve performance resulting from lesser learning cycles and decreased error rates.

(IS-2021-235) A Novel Robust Smart Energy Management and Demand Reduction for Smart Homes Based on Internet of Energy

This academic paper published in the *Sensors Journal* (July 2021) presents a residential energy management (REM) technique capable of monitoring and controlling residential loads within a smart home. A new distributed multi-agent framework, which is based on the cloud layer computing architecture, is developed for real-time microgrid economic dispatch and monitoring. A system based on the Raspberry Pi microcontroller is implemented to test the proposed framework, which is shown to be capable of effectively tracking load (demand) changes.

(IS-2021-234) Latency-Optimal Computational Offloading Strategy for Sensitive Tasks in Smart Homes

This March 2021 report in *Sensors Journal* discusses a computational offloading strategy for processing large amounts of data generated by smart devices. The technique focuses on minimizing delay by applying the back-pressure algorithm (BMDCO) to determine an offloading decision and the number of tasks that can be offloaded. Simulation results show that BMDCO is stable and can reduce computational delay.

(IS-2021-233) LSTM Networks Using Smartphone Data for Sensor-Based Human Activity Recognition in Smart Homes

This February 2021 report in the *Sensors Journal* deals with human activity recognition (HAR) using smartphone sensor data. To explore this strategy, a generic framework is proposed based

Convolutional Neural Network (CNN) and Long Short-Term Memory (LSTM) networks. The experimental results indicate that the proposed CNN-LSTM network performs well in activity recognition, enhancing the average accuracy by up to 2.24% as compared to prior state-of-the-art approaches.

(IS-2021-232) Multimodal Approaches for Indoor Localization for Ambient Assisted Living in Smart Homes

This report appeared in the *Information Journal*, a scholarly publication, in March 2021. The report deals with indoor localization for ambient-assisted living in smart homes. The localization strategy relies on Bluetooth low energy (BLE) beacons, BLE scanners, activity zones, and accelerometer and gyroscope data gathered from diverse behavioral patterns. Experimental results show system accuracy of 81% to track user's indoor position.

(IS-2021-231) Being Blind to Water Use

This July 2021 report by HydroPoint found that the biggest obstacle to eliminating water waste wasn't broken pipes — it was people and “institutional water blindness.” The report covers many of the areas in buildings and outside that are wasting water and can be improved.

(IS-2021-230) Energy Management Information Systems Technical Resources Report

This technical resource report from July 2021 provides information and best practices for understanding, designing, and implementing Energy Management Information Systems (EMIS). Its authors are with the U.S. Department of Energy, Energy Efficiency Renewable Energy Office and the National Renewable Energy Laboratory. An EMIS can help agencies improve energy performance, reduce operational cost, and for federal staff, can serve as a valuable component of an agency's portfolio-level energy and water metering strategy, the author highlight. EMIS functions and capabilities are discussed along with their applicability and benefits to federal agencies. These include information that can be used throughout the EMIS life cycle, ranging from system design to implementation and ongoing maintenance.

(IS-2021-229) HVAC Summer Edition

This Consulting-Specifying Engineer eBook was published by CFE Media in June 2021. The lead article covers four steps for designing a VRF system and how variable refrigerant flow offers an alternative HVAC solution, and it is followed by a case study focused on designing VRF for an office. This issue also has articles on what ASHRAE 90.4 does for data center energy efficiency; delivery and maintaining modular pumping systems for HVAC; and pumping controls methods and their impact on system efficiency.

(IS-2021-228) Improving Building Design with Division 25 Specifications

This e-book from Schneider Electric (first published in August 2020 and modified in February

2021) was designed to provide consulting engineers with the key trends driving smart building specifications. One of the biggest smart building hurdles for engineers is the fact that key “controls” conversations are not taking place among electrical, mechanical, IT, OT, and other divisions before design. As a result, engineers are forced to integrate systems that haven’t been vetted in an iBMS atmosphere. This, in turn, causes data integration roadblocks, endangering the entire smart building project. Division 25 specifications help building owners and managers get what they want in terms of increased value and a platform that can be expanded with future technology.

(IS-2021-227) Smart Products - Building the Modern Home

This June 2021 white paper was developed for GE Appliances by Parks Associates. The authors describe new smart home applications and their market penetration. As consumers become familiar with market offerings, new smart product categories emerge, offering added benefits that address different pain points. New categories include solutions that monitor indoor air quality and facilitate independent living, safe package delivery, and energy resilience in the home.

(IS-2021-226) A Research Paper on Internet of Things Based Upon Smart Homes with Security Risk Assessment Using OCTAVE Allegro

This paper appeared in the International Journal of Engineering Research & Technology in June 2020. The paper provides an overview of the Frugal Labs IoT Platform (FLIP), based on the Raspberry Pi, for building an IoT-enabled smart home. OCTAVE Allegro methodology is applied to the system to assess security risks and reveals that the system is vulnerable to both internal and external security threats.

(IS-2021-225) 67 An IoT-Based Smart Home Automation System

This paper appeared in MDPI's Sensors Journal in May 2021. The authors present Toggle, a system for interconnecting sensors, actuators, and other data sources for multiple home automation. The approach leverages application programming interface (API) for communication. A smartphone application is also introduced that allows users to control various home appliances and sensors.

(IS-2021-224) The Future of Smart Home Design

This report was published by Silicon Labs in June 2020. It examines what Original Equipment Manufacturers (OEMs) should know about the future of smart home design to develop compelling smart devices. By considering the ways that smart devices will improve ease of use, the report describes the role that artificial intelligence and machine learning will have in enabling new capabilities, and the security that will be needed to be implemented to protect users, devices, and OEMs.

(IS-2021-223) Stepping Up Europe's 2030 Climate Ambition

Subtitled “Investing in a Climate-Neutral Future for the Benefit of our People,” this September 2020 report by the European Commission deals with the EU economy-wide 2030 greenhouse gas emissions reduction target. Actions that will be required across all sectors of the economy are discussed. Consideration is also given to launching revisions of the key legislative instruments to support this goal, as well as hosting a public debate to increase the EU’s contribution to the Paris Agreement.

(IS-2021-222) An Economic Approach to Neutral Host Network Deployments

This report was prepared by Microlab and published in June 2021. The report describes Neutral Host Networks (NHNs), as a solution for addressing a demand for more capacity and connectivity in wireless networks, and provides a brief comparison between NHN ownership models. Benefits and challenges that affect the Total Cost of Ownership (TCO) for NHNs are outlined. The analysis provides insights into how NHN owners can lower the TCO by minimizing the deployment complexity while providing an “economical” path to leverage future spectrum allocations to improve capacity per user or monetize new use cases.

(IS-2021-221) High-Impact Programs Targeting Regional Multifamily Energy Savings

Opportunities This July report was prepared by ACEEE reviews four multifamily utility efficiency programs and their

success in achieving high savings in regions throughout the U.S. Criteria considered in the review include spending, savings, and participation data. The programs address regional energy-saving opportunities and include strategies to reach deeper savings by encouraging more-comprehensive energy-saving measures. Providing free or low-cost energy assessments and offering performance-based incentives or higher rebates for whole-building approaches are some of the most successful tactics.

(IS-2021-220) ICS Cybersecurity Year in Review 2020

This February 2021 report is the latest installment in a yearly analysis of cyber threats, vulnerabilities, assessments, and incident response insights pertaining to Industrial Control System (ICS) / Operational Technology (OT) by Dracos. The recommendations offered to improve ICS/OT cybersecurity include increased network monitoring, prioritization of assets, improved incidence response capability, continuous monitoring of network segmentation, and securing management of credentials.

(IS-2021-219) Lighting the Patient Room of the Future

Subtitled “Evaluating Different Lighting Conditions for Performing Typical Nursing Tasks,” this study was published in the academic journal Health Environments Research & Design in November 2020. The paper explains how aspects of lighting in patient rooms are experienced and evaluated by nurses while performing simulated work under various lighting conditions.

Insights are provided regarding lighting to support circadian synchronization, lighting at night, the distribution of light in the patient room, use of multiple lighting zones, and the use of colored lighting.

(IS-2021-218) SmartCitiesWorld City Profile – London

This report by SmartCitiesWorld (March 2021) explores how the London, U.K. uses technology and smarter approaches to deliver better services and improve citizens' quality of life. In 2010, the city created the London Data Store, an open data platform, to inform its infrastructure growth. In 2018, London launched the smart city roadmap (Smarter London Together) and the Emerging Technology Charter regarding use 5G and artificial intelligence (AI) to support the needs of Londoners. By demonstrating an ability to listen, adapt, evolve, and crucially collaborate, London has positioning itself well to continue evolving as a smart city.

(IS-2021-217) How Network Testing Ensures High-Quality In-Building LTE and 5G Deployments

This report was by the technology group Rohde & Schwarz and published in May 2021. The analysis deals with the entire indoor deployment cycle of mobile networks, such as distributed antenna systems (DAS) and small cells. It highlights the characteristics of these systems, the planning phase, installation and verification of the deployed system. Mobile network testing solutions to verify successful mobile network deployments indoors are discussed.

(IS-2021-216) OPC UA Users and Experts Conveying Knowledge and Experience

This report was published by the OPC Foundation in December 2020. Expert content from market leaders in communication, automation and industrial IT is brought together in an analysis highlighting the benefits and the potential of the Open Platform Communications Unified Architecture (OPC UA) technology for end users, system integrators, operators in the world of industrial IoT. Key areas covered include open process automation, a deep dive into OPC UA, field level communication, insights to the mechanical engineering industry association (VDMA), open serialization communication, Microsoft's role in OPC, and the smart factory web.

(IS-2021-215) SmartCitiesWorld City Profile – Sydney

This report was authored by Jon Glasco from SmartCitiesWorld and published in January 2021. The report profiles the city of Sydney, Australia as a smart city. With a global ranking of 14 in the Digital Capitals Index, and 18 out of 109 in the Smart City Index, Sydney boasts a high level of resiliency and particular strengths in areas like finance, education, manufacturing, technology, trading and tourism. To improve its current smart-city standing, Sydney focused on post-COVID economic recovery planning, investment in digital technology and infrastructure, recalibration of jobs, community wellbeing, remote work, and investment in transport and public spaces. Emerging technologies, combined with strategic use of digital technology to connect remote and disadvantaged communities, will be influential in ensuring Sydney's continued "smart city" growth.

(IS-2021-214) 2021 Industry Insights

This report was prepared by Electrical Construction & Maintenance (EC&M) and published in April 2021. The authors present an “inside look” at key technologies markets, technologies, and trends expected to shape electrical construction and building activity in 2021. The construction industry will face a hiring boom. Growth is expected in residential, commercial, and industrial projects, as well as economically charged regions and tech hubs. Material shortages in the electrical industry are likely to occur. Alternative materials are proposed, such as fiberglass, for conduits traditionally made from polyvinyl chloride or galvanized rigid steel. Maximizing revenues and increasing process efficiencies will be important keys to success this year.

(IS-2021-213) Profitably Decarbonizing Heavy Transport and Industrial Heat

This July 2021 report was authored by RMI, a non-profit organization focused on accelerating the clean energy transformation. The paper discusses how to transform by 2030 heavy transport such as trucking, aviation, and shipping to decrease impact on greenhouse emissions. Furthermore, consideration is also given to reducing industrial heat from production of materials such as steel, aluminum, cement, and plastics to lower the impact on climate change. Emphasis is placed on clean electricity as the key enabler for transformation hoped for.

(IS-2021-212) Brave New World - Leveraging the Private Networking Opportunity

This report was prepared by Sierra Wireless and published in May 2021. It examines why private Long Term Evolution (LTE) and 5th Generation mobile (5G) networks have emerged as an option for many organizations. Operational basics for each network are presented, along with discussion of the differences between these options and Wi-Fi networks, public LTE and 5G networks. Use cases are featured to assist professionals to determine if a private LTE or 5G network might help organizations create more value for customers, employees, and other stakeholders.

(IS-2021-211) The Built Environment Investment Thesis

This report was prepared by Shadow Ventures, an Atlanta-based venture capital investment firm, and published in March 2021. It provides an assessment of the built world markets, challenges and technology solutions, and investment opportunities. Markets considered include real estate, architecture, engineering, construction, infrastructure and capital projects, security, utilities an energy, logistics, transportation, and distribution. Key challenges highlighted are labor shortage, fragmented communication, environment concerns, thinning profit margins, and climate change. Technology based remedies proposed include robotics, automation software, collaborative project management software, interoperable data models, and innovative building methods and materials. Significant opportunities exist for venture capital firms to invest in startups to bring those innovations to the built environment.

(IS-2021-210) ESG, SRI, and Building Energy - An Economic Imperative for Chief Executives

This report was prepared by ENTOUCH Controls and published in late 2020. The authors focus on Environmental, Social, and Governance (ESG) and Socially Responsible Investing (SRI) as it relates to the building sector. Market trends indicate that they have gradually become a standard for investing in real estate due to the multiple benefits in terms of costs savings, productivity, profitability and regulatory risk minimization. The report illustrates how commercial buildings can be a potential solution to the unsustainable buildup of atmospheric carbon by implementing energy efficiency measures and energy management systems to reduce consumption. It explains a seven-step process for smart retrofits developed by the sponsor of this report.

(IS-2021-209) America's Zero Carbon Action Plan

This report was prepared by the Sustainable Development Solutions Network (SDSN) and published in late 2020. This 347-page paper examines many aspects of moving to a zero-carbon economy. There is a chapter dedicated to the decarbonization of buildings, underlining how this sector accounts for almost half of the country's greenhouse gas (GHG) emissions.

(IS-2021-207) Demand Response with Variable-Capacity Light Commercial HVAC Systems

This report was prepared by the Electric Power Research Institute (ERPI) and published in September 2020. The authors evaluate of the electrical demand response (DR) potential of variable capacity (VC) heating, ventilation, and air conditioning (HVAC) equipment in light commercial building applications through demonstrations at two field sites in Southern California. Variable refrigerant flow (VRF) systems and packaged rooftop units (RTUs) were considered. The findings for the VRF system suggest that capacity limit control can reduce electrical demand with minimal impact on indoor temperatures. For the RTU system, it was not possible to implement advanced demand-response controls.

(IS-2021-206) Demand-Side Solutions to Winter Peaks and Constraints

This report from the American Council for an Energy-Efficient Economy came out in April 2021. The report describes the opportunity for electrical demand-side resources to address potential winter peaks and constraints. Examples of remedial strategies for utilities and market participants are provided. Some of the key strategies: using existing programs that target winter peak demand reductions through energy efficiency and demand response; applying demand-side measures that reduce heating load; residential weatherization measures; applying intelligent operation of heating equipment through residential smart devices; and energy storage and managed electric vehicle charging.

(IS-2021-205) Assessment of Occupational and Skills Needs for Energy Efficient Buildings

This report by ECO Canada was released in February 2021. The authors outline the capacity and challenges of today's building sector workforce in Canada to achieve energy efficiency within new and existing commercial, institutional, and multi-unit residential buildings. The key finding is

that Canada's building sector workforce does not have the widespread experience or skills required to perform their roles in a manner that achieves energy efficiency goals. Seven recommendations are made regarding how stakeholders can address such skills gaps.

(IS-2021-204) Energy Smart Buildings Readiness Guide - How to Make a Building Energy Ready

This report from Iconics published in September 2020 describes building operational data can be used to optimize its performance. The key components considered include networking technology, protocols, system interoperability standards, documentation, and key performance indicators. A detailed example is provided summarizing typical properties monitored for HVAC equipment.

(IS-2021-203) Engineering Net Zero - Canadian Technical Report

This report by SNC Lavalin from March 2021 recommends key actions necessary for Canada to achieve a "net zero" greenhouse gas (GHG) emissions by 2050. Emphasis is placed on design, engineering, construction, operations, and maintenance, combined with a fundamental transformation of societal behaviours and lifestyles, to reduce carbon emissions. An overview of emerging technologies to achieve the "net zero" goal is presented.

(IS-2021-202) Future Energy Scenarios

This July 2020 report comes from Britain's National Grid Electricity System Operator (ESO). The analysis explores the assumptions and conclusions from the extensive modelling, research, and stakeholder engagement undertaken by the National Grid ESO on how energy system must evolve while safely and reliably delivering low carbon energy to end consumers to meet the net zero goal by 2050. Taking into consumer and energy system perspectives, the key requirements include availability of open accessible data, consumer incentives, use of hydrogen and carbon capture and storage, immediate action across all key technologies and policies, and full engagement across society and end-consumers.

(IS-2021-201) Green and Equitable Economic Recovery

This April 2021 report was prepared by Climate Mayors. It highlights key policy priorities and local success stories contributing to a green and equitable recovery and demonstrating job creation and resilience. The areas to watch include sustainable infrastructure, a better coordinated government role (city, state, federal), emphasis on electric transit and citizen mobility, zero carbon buildings, transition to renewable energy, urban greening, and the necessity for federal funding.

(IS-2021-200) Improving the Customer Experience in the Utilities Industry

This report by Harvard Business Review from February 2021 offers a snapshot of the customer experience (CX) evolution in the electric, gas, and water utility industries. Key takeaways include

that CX will be utilities' top business priority and that the existing siloed operating structure within utilities will need to change to align with demands of digital age. The customer experience overall will shape utilities' brand and determine whether customers see it as the provider of choice.

(IS-2021-199) Keeping the Lights On - How to Ensure Connected Lighting Systems are and Remain Secure Throughout Their Lifecycle

This report produced by SmartCitiesWorld in association with Signify was published in April 2021. The report describes how to ensure robust, end-to-end cybersecurity in connected lighting deployments. It contends that a model of "shared responsibility" is the best approach and highlights why cloud-based systems are better suited to the demands and rigors of today's connected world when compared to on-premise IT infrastructure. Best practices are presented and myths are discussed that can cloud an organization's decision-making.

(IS-2021-198) Net Zero by 2050 - A Roadmap for the Global Energy Sector

This report from International Energy Agency (May 2021) maps out the energy sector's path to global energy sector by 2050. Milestones to achieve the goal are provided spanning all sectors and technologies – for what needs to happen, and when, to transform the global economy from one dominated by fossil fuels into one powered predominantly by renewable energy sources. Emphasis is placed on investment, innovation, fairness, inclusivity, skillful policy, design and implementation, technology deployment, infrastructure building, and international co-operation.

(IS-2021-195) Proving the Business Case for Building Analytics

This October 2020 report by the Lawrence Berkeley National Laboratory presents the results of the Smart Energy Analytics Campaign. From 2016-2020, the public-private sector partnership assessed the costs, benefits, and common practices of Energy Management Information Systems (EMIS). With support for 104 organizations and 6,500 buildings covering over a half a billion square feet of combined floor space, the initiative produced the largest-ever dataset on EMIS costs and benefits and revealed a 2-year simple payback. Key outcomes included median annual energy savings of 3% (energy information systems) and 9% (fault detection and diagnosis). The report discusses, among other aspects, monitoring-based commissioning practices (MBCx) that use EMIS tools.

(IS-2021-194) U.S. Department of Energy Progress Report 2021 - Partnering for the Future - Leadership, Innovation, and Proven Solutions

U.S. Better Buildings Initiative partners have been contributing energy, water, and waste solutions designed to support an accelerated transition towards clean energy. This progress report from May 2021 underlines that building owners and plant managers faced significant new barriers to energy efficiency caused by the COVID-19 pandemic: lower occupancy levels, the need to upgrade ventilation systems quickly, budget shortfalls, and layoffs/staffing disruptions. Despite these difficulties, new strategies and solutions have moved forward in four key areas

essential to building a more efficient and cost-effective energy future.

(IS-2021-193) Buildings of the Future - Creating Safer, Healthier and more Responsive Environments This 2020 report from Schneider Electric sets out a vision to create “resilient, sustainable, hyper- efficient and human-centric buildings” — transforming today’s buildings to meet tomorrow’s needs. The importance of these foundational aspects has come to the forefront in the year of the pandemic, the author highlight. The report focuses on the potential for (1) Maximizing space efficiency (2) Enhancing occupant well-being (3) Improved employee experience, and (4) Reducing operating costs.

(IS-2021-192) Creating Truly Open Cities - The Importance of Building Interoperable Smart Cities from the Ground Up

This report by Smart Cities for Paradox Engineering came out in September 2020. It discussed 6LoWPAN’s value in creating “open and interoperable smart cities” and Paradox Engineering’s platform that uses 6LoWPAN. The Swiss company’s PE Smart Urban Network is a connectivity platform and applications ecosystem that allows cities to manage a range of urban services. The authors also examine other developments in the open standards movement that will be “key to helping city authorities ensure future smart projects reach full maturity.”

(IS-2021-191) The Evolving Importance of Effective HVAC Management

To understand how tenant expectations for HVAC systems have changed during COVID-19, Building Engines conducted a national survey of nearly 300 CRE building managers and engineers. Reporting on the results in late 2020, the company highlighted the increased importance property managers give to HVAC systems — their capabilities as well as maintenance issues — and discussed how HVAC management should be handled to meet new air quality standards while maintaining tenants’ trust throughout re-occupancy. The report focuses on the company’s new Prism solution, designed to provide “transparent HVAC management” for buildings owners/tenants. The solution tracks, among other aspects, routine (and important) tasks such as filter changes demonstrating proficiency and responsibility.

(IS-2021-190) 2021 Multifamily Amenities Survey, Multifamily Design and Construction Magazine

Multifamily Design+Construction magazine surveyed respondents on how their amenities were affected by the pandemic and presented the results in June 2021. There were, not surprisingly, numerous examples of property managers closing fitness centers, pools, playgrounds, and game rooms, at least temporarily; other respondents removed amenities, pushed activities outdoors, or made modifications, such as using plexiglass separators in fitness areas. However, more than half said they had not made changes, either because a given construction/installation project was already far along, or because they believed the best course of action was to “weather the storm.” The pandemic era will continue to raise difficult questions about how multifamily housing—including the amenities—should be designed in ways that best support occupant health and wellness.

(IS-2021-189) 2020 Luminaire Level Lighting Controls Incremental Cost Study

This NEEA report by Energy Solutions (January 2021) estimates the incremental cost of Luminaire Level Lighting Controls (LLLC). The analysis grouped these products/systems into “smart” and “clever” based on their differing features and price points. It showed that the average price for more complex, smart systems has oscillated but shows an overall decrease in costs over time. The variation was thought to be due to the continued addition of incremental feature packages and capabilities that the smart systems can enable. Smart systems remain more expensive than their clever-hybrid counterparts, and their value proposition tends to be linked to increasing value from nonenergy benefits.

(IS-2021-188) 048 Atlas of Energy Efficiency - Brazil 2020 Indicators Report

This February 2021 report was authored by members of the International Energy Agency technical team and the *Empresa de Pesquisa Energetica* (Brazil’s federal public agency focused on energy sector research). The research explores the impacts of the COVID-19 pandemic crisis and measures related to energy consumption and efficiency in different economic sectors in Brazil.

(IS-2021-187) Broadband Insights Report - 4th Quarter, 2020

This February 2021 report by OpenVault breaks new ground by exploring the cumulative impact of pandemic growth on broadband networks. Broadband service providers have experienced across-the-board growth in consumption and speeds, testing networks as never before due to COVID-19, the analysis shows. Data on two distinct categories is provided: subscribers on flat-rate billing (FRB) plans that offer unlimited data usage and those on usage-based billing (UBB) plans, which bill subscribers based on their broadband consumption. The average monthly bandwidth usage at the end of 2020 approached one-half of a terabyte (TB) of data, or close to 483 GB. Subscribers on unlimited usage plans, or FRB plans, were closer to 497 GB.

(IS-2021-186) Maintenance Key Performance Indicators

This report from Eagle Technology (November 2020) discusses Key Performance Indicators (KPI’s), their benefits and key examples for maintenance managers. Computerized Maintenance Management System (CMMS) KPIs are used to track performance in several areas over time and indicate when an organization is operating inside or outside of acceptable levels. An enhanced KPI reporting would include analysis of data collected by assets, work orders, labour and material history, and costs. Details on major maintenance KPIs are provided.

(IS-2021-185) NLPIP Lighting Answers UV Disinfection Products

This report by the Lighting Research Center from December 2020 was published by Lighting Answers. Guidance on use of ultraviolet (UV) light for disinfection of surfaces and air in buildings is provided; the authors report on the results of a recent survey and testing that was undertaken

to look at issues of effectiveness, safety and energy expenditure. While there are no clear UV specific regulations, the report references the many associations and organizations that have articles and books on the topic of UV lighting applications.

(IS-2021-184) 5 Ways to Lower Energy Use Intensity on Your Building Project

This report by Cove.tool (June 2021) discusses why engineers should be calculating the EUI of buildings, to better predict their projects' yearly utility costs — useful in understanding the impact of each design decision. EUI or Energy Use Intensity is a building's annual energy consumption relative to its gross area and broadly, it can be divided into heating, cooling, lighting, equipment, fans, pumps, and hot water. Building design that responds sensitively to the local climate conditions can improve occupant comfort and significantly reduce energy consumption, the report highlights. As an example, "solar heat radiation can work against or in favor of whole-building energy consumption, depending on the building location."

(IS-2021-183) 7 Must-Have Capabilities for Your Next Building Operations Platform

This March 2021 report from Building Engines underlines that in a competitive CRE climate, having an outdated building operations platform makes it much harder to become more efficient, generate more revenue, and provide a top-notch tenant experience. Armed with the right building operations software, build owners can complete all their tasks more efficiently, and this e-book sets out 7 "must-have" capabilities in a modern building operations platform. They include, among other aspects: 1. Scalable cloud infrastructure, 2. Automation of slow workflows, 3. Mobile capabilities, 4. Tenant experience functionality, 5. Robust analytics and reporting, 6. Ability to capture all revenue.

(IS-2021-182) 2020 - Our Air in Review

This January 2021 report was by AirRated, which provides a certification for Indoor Air Quality (IAQ). Just 22% of customers stated that they are knowledgeable about air quality and only 40% and 45% of customers said they understood the sources of indoor and outdoor air quality respectively, in a recent AirRated survey. Furthermore, 62% of business owners said that the reason why they hadn't made changes to the air quality in their buildings was due to a lack of information. When building, renovating and occupying spaces, it is important to prioritize the need for to establish standards that outline improvements for ventilation, filtration and air cleaning for new offices and commercial properties, while maintaining a sustainable approach to building design, the report argues.

(IS-2021-181) Best Practices Guide - Predictive Maintenance Using Automatic Fault Detection and Diagnostics

This October 2020 guide from the International Institute for Sustainable Laboratories was authored by Cimetrics. The report examines the opportunity represented by predictive maintenance to save money and increase facility reliability. The risk of equipment failure can be reduced by continuous, automated analysis of equipment performance to identify faults before

they become critical. A successful predictive maintenance program requires investment in a data-rich building automation system, configuration of that system to perform analytics, development of a process and workflow to manage the automatic fault detection and diagnostics (AFDD) results, and training of facilities personnel on the program. The result is a leaner, more efficient lab facility operation, helping to eliminate energy-wasting faults while freeing up funds and labor for other types of sustainability improvements.

(IS-2021-180) Connected & Protected - The Vulnerabilities and Opportunities of IoT Security

ABI Research identifies three distinct IoT markets based on low, moderate, and high security requirements in this report from April 2021. The “low security” requirements category included buildings, home appliances, home monitoring, home security & automation. The “moderate” category included commercial building automation, condition-based monitoring, gas meters, video surveillance, smart meters, and water meters. “High security” category in buildings could include Automated Teller Machines (ATMs), healthcare equipment monitoring, patient monitoring, OEM telematics, and usage-based insurance. The amount of IoT security revenue available does not always correlate with the amount of IoT connections, and “disproportional” allocations of revenue can be seen in some markets.

(IS-2021-178) The State of Demand-Side Energy Management in North America

The third volume of CPower's State of Demand-Side Energy Management in North America (June 2021) provides a breakdown of the most important issues, trends, and regulations designed to help commercial and industrial organizations make better decisions about their energy use and spend. The report takes up questions such as: FERC 2222 is poised to usher DERs into the wholesale energy markets in the US. How are the markets responding? How will California rebound after suffering its first blackouts in nearly 20 years?; What has Texas learned from the devastating grid failure this past February?; What will New England and PJM do to appease states that are angered at the policies they feel affect their desired fuel mixes?; and How is New York tracking toward its climate goals and what market designs might it employ to help achieve them?

(IS-2021-177) Decarbonizing the Built Environment

This JLL Global Research report was released in June 2021. A survey of senior executives representing 647 occupiers and investors was conducted in the first quarter of 2021, with results showing a clearer, stronger understanding of how organizations across the globe are progressing in their journey toward net zero carbon via their investment in more responsible real estate, and to what level sustainability ambitions are being translated into actions. “Occupiers, investors and city leaders each have a role to play in meeting demand for greener, more sustainable spaces.”

(IS-2021-176) How to Make Smart Buildings Even Smarter

This report from Siemens Industry was published in April 2021. Buildings and facilities could still benefit from even greater measures of openness to ease integration challenges, some quite

costly. The authors report that 82 percent of decision-makers confirm that building automation is important or very important, and 64 percent plan investments in integration solutions in the next year. But 30 percent of system integrators estimate they lose up to \$1 million a year due to integration-related issues, resulting in them turning to open-source data-integration tools. This report describes the Desigo Optic program for better optimization of a structure's performance without making its operation too complex to manage. The program also helps in the management of the data that must be stored in a BMS and most importantly, in deriving insights that can drive greater operational efficiencies.

(IS-2021-175) The 2021 Buyer's Guide to CRE Building Operations Technology

This report was published by Building Engines (July 2021). CRE tenant expectations are rising, budgets have tightened, and competition is increasing. "Amid this change, one theme is clear: Assembling the right technology stack can be the difference between cementing your portfolio's long-term growth or falling behind competitor buildings". Modern software platforms and point solutions hit the market each day and can help a team work smarter, faster, and more cost effectively. But choosing the right solutions—and avoiding clunky, overpriced, and difficult-to-deploy options—takes research. The authors list "must-have capabilities" and support features for choosing a building operations platform.

(IS-2021-174) The Future of Building Design, Construction and Operations

This eHandbook from the Global Wellness Institute was published by Buildings in November 2020. COVID-19 has impacted the design and operation of commercial buildings in myriad ways— from shutting facilities down for months on end at the start of the pandemic to rethinking the way we view physical space and how it can help keep occupants safe as businesses reopen. Given the challenges, this resource sets out to highlight opportunities that can be found in best practices that support health and wellness efforts. It provides a breakdown of different building components that can have a positive impact on occupants; guidelines for incorporating wellness strategies in commercial facilities; as well as case studies.

(IS-2021-173) 2021 Pandemic Guide

BOMA Canada sets out a blueprint to manage pandemic-specific challenges for employees, tenants, and other stakeholders in this guidebook from July 2021.

(IS-2021-172) Engineering an Intelligent Building

This report by Newcomb & Boyd (July 2021) discusses the state of the market for Intelligent Building Technologies, the market forces driving strategies, and the implications for operations and occupants. Highlighting that engineering an intelligent building requires "putting people at the center," the authors provide case examples from the operations and user experience realms and shows the paramountcy of having a dedicated strategic planning process & team.

(IS-2021-171) Smart Buildings: Spring Edition

This e-book was produced by Consulting-Specifying Engineer magazine and ABB (April 2021). Among other topics, this e-book discussed: integrating buildings systems through controls; selecting a building automation system, getting started in designing a smart building; and smart building consulting: integrating people and systems.

(IS-2021-170) The City of Toronto's Net Zero Existing Building Strategy

The City of Toronto has set a goal of reducing city-wide emissions to net zero emissions by 2050 or sooner, relative to 1990 levels. Achieving this goal requires a significant reduction in the emissions derived from energy use in buildings, as they represent over half (55%) of Toronto's GHG emissions, highlights this report by the city's energy and environment division from May 2021. The authors discuss the bigger challenge of achieving the net zero goal with the large number of existing buildings. It reports on a concerted and coordinated market shift involving multiple actors, including federal, provincial and municipal governments, as well as industry associations, financial institutions, trade unions, the real estate sector, and of course – home and building owners.

(IS-2021-169) IoT at the Edge - How AI will Transform IoT Architecture

This report by wireless provider Kajeet (April 2021) underlines that the vast amounts of information gathered by IoT devices can be a serious challenge. But thanks to advancements in AI and machine learning, the authors argue, AI can be used to lower costs and improve productivity through data-driven decision-making and smart automation. Smart devices and sensors are rapidly changing the ways in which all industries and buildings operate – from healthcare and telecommunications to industrial maintenance and utilities management. Sensors and devices that can automatically generate or capture real-world data for analysis are now available, making it possible to shorten product and service delivery times, better understand the consumer, track assets, plan resource allocations, predict machine breakdowns, lower costs, and streamline production and service delivery processes.

(IS-2021-168) Canada's Climate Retrofit Mission

This report by think tank Efficiency Canada (June 2021) defines the contours of a climate retrofit mission for Canada. It quantifies the retrofit potential and demonstrates the scale required to confront the climate emergency. The authors set out a “mission-oriented” policy framework to the building retrofit challenge and then proposes a way to organize the public sector to achieve it.

(IS-2021-167) DroneDeploy Deep Dive - Transforming Facility & Property Inspections with Drone Solutions

This eBook by DroneDeploy came out in May 2021. It discusses the benefits of drone technology for inspections and takes a closer look at how drone software transforms facilities and property

management inspections. Through drone inspections, decision makers become more strategic: managing more effectively, lowering costs, determining measurable outcomes, optimizing assets, and driving unparalleled ROI, the authors argue. To start, drone solutions help companies collect an accurate baseline view of their assets. Creating a pavement condition index (PCI) empowers users to see pavement conditions down to the foot-by-foot level. Low-cost drone flights over roofs and walls provide thermal imaging and empowers clients to understand where problem areas are and can often detect leaks or water erosion invisible to the naked eye. More importantly, customers save time for their employees, take preventative action before problems get more costly, and spend millions less on annual maintenance.

(IS-2021-166) Unlocking the Queue with Grid-Enhancing Technologies

This February 2021 report by the Brattle Group was prepared for the WATT (Working for Advanced Transmission Technologies) Coalition. The analysis discusses how Grid-Enhancing Technologies (GETs) can resolve the transmission issue hindering the deployment of renewable generation and the analysis focuses on three GETs, in particular: Advanced Power Flow Control, Dynamic Line Ratings, and Topology Optimization. The authors provide a case study illustrating how the Southwest Power Pool use of 3 GETs enabled more than twice the amount of additional new renewables or 2,600 MW to be integrated for annual cost savings of \$175 million and annual carbon emission reductions of over 3 million tons.

(IS-2021-165) Planning for the Future - FERC's Opportunity to Spur More Cost-Effective Transmission Infrastructure

This January 2021 report by Americans for a Clean Energy Grid describes the need to update and replace a now 50-year-old electricity transmission infrastructure with a more regionally connected one to better accommodate shifting demand and a changing resource mix. The report calls on FERC (Federal Energy Regulatory Commission) to establish guidelines to ensure proactive planning for future needs; require planners to employ the best available data and forecasting methodologies; require planning authorities to consider the diverse benefits of transmission holistically; require planners to evaluate all available solutions, including new physical infrastructure options and grid-enhancing technologies; and direct planners to select a portfolio of solutions that is likely to maximize aggregate net benefits.

(IS-2021-164) Unrealized Potential - Expanding Energy Efficiency Opportunities for Utility Customers in Florida

This report was authored from ACEEE and published in January 2021. The authors take the measure of Florida's underperformance in energy-efficiency programs and provide the following recommendations: setting utility energy saving targets; requiring EE programs for underserved customers; moving from "ratepayer impact measure" approaches to better utility cost test measurement approaches; and eliminating the two-year payback screen. Such measures would incentivize utilities to invest in cost-effective energy efficiency programs, the report argues.

(IS-2021-163) A Case Study on Integrating Customer DER - Moving the Needle on Utility DERMS Innovation in Australia

This report by Peter Asmus and Michael Kelly from Guidehouse Insights was published in January 2021. The authors discuss a successful Distributed Energy Resources Management System in Onslow, Western Australia. Utilizing a single DERM platform and behind the meter applications, a standalone microgrid was optimized to successfully integrate and instantaneously manage solar PV/diesel/natural gas generation, storage batteries and energy demand. An advanced DERMS algorithm combines real-time data with historical patterns to make real-time decisions. The combined microgrid helped reduce costs and the carbon footprint while providing sustainable energy.

(IS-2021-162) Accelerating Decarbonization of the U.S. Energy System

This February 2021 report from the National Academies of Sciences, Engineering and Medicine and provides a technical blueprint and policy manual for the U.S. energy system over the first critical 10 years of a 30-year effort to transform to net-zero GHG emissions. The report identifies federal policies to advance five technological and four socioeconomic goals and to how to achieve quantitative milestones along this path. Upwards of \$2 trillion in costs would be funded through federal appropriations and carbon pricing. The benefits would be significant, including a more competitive and inclusive U.S. economy. Extensive policy summary tables with cost benefit analysis are provided.

(IS-2021-161) Annual Energy Outlook 2021 with Projections to 2050

This report was authored by the U.S. Energy Information Administration and published in February 2021. Utilizing the National Energy Modeling System, various energy projections to 2050 are provided. Energy consumption fell faster than GDP in 2020 and “will take years” to return to 2019 levels, the analysis concludes. Demand for transportation fuels will return to 2019 levels in 2025. Petroleum will remain the most consumed fuel, while coal and nuclear generating capacity will gradually be replaced by natural gas and renewable technologies. High natural gas production will support exports and industrial use. The report sets out a variety of projections related to energy consumption, GDP, carbon dioxide emissions by fuel type, and electricity use by end-use sector projections based on different assumptions.

(IS-2021-160) Blueprint for State Action: NARUC-NASEO Task Force on Comprehensive Electricity Planning

A joint task force involving NARUC (National Association of Regulatory Utility commissioners) and NASEO (National Association of Energy Service Companies) set out two years ago to examine how electricity system planning processes can achieve greater alignment “after being siloed for decades.” The result report, from February 2021 summarizes the work and offers practical ways to accelerate state actions in aligning electricity system planning approaches, building upon the experience of the 15 Task Force member states. The recommendations were driven by a desire to: improve grid reliability and resilience; optimize use of new and existing resources; avoid

unnecessary costs to rate papers; support state policy priorities; and increase the transparency of grid-related investment decisions.

(IS-2021-159) AMI Survey January 2021

This report was authored by Maravedis and published in January 2021. A smart metering survey, conducted in the fourth quarter of 2020, reviewed: meter and WAN requirements, top use cases for Automated Metering Infrastructure (AMI), and key challenges requiring resolution. The top identified AMI use cases include measuring, detecting leaks and improving operational efficiency, and the authors underscore that AMI must incorporate data security and network availability. LoRaWAN and LPWAN options are compared, including applicability for Smart Cities and Home Energy Management Systems. Private networks are preferred 2:1 over public networks. Challenges with AMI include interoperability issues and validation of business models.

(IS-2021-158) Determining Utility System Value of Demand Flexibility from Grid-Interactive Efficient Buildings

This report was authored by Johanna Zetterberg and Monica Neukomm from SEE Action and published in April 2020. The authors focus on methods and practices for determining the economic value of grid-interactive buildings, and how to design market-based programs to optimize demand flexibility, costs and efficiency of the energy network. Data requirements for the economic valuation modeling of demand flexibility grid services are outlined. The analysis includes a summary of valuation enhancements and an extensive list of implementation resources and offers illustrative utility examples.

(IS-2021-157) Powering Our Net Zero Future

This report from the UK Secretary of State for Business, Energy and Industrial Strategy focuses on initiatives under way to drive the country toward net zero. This white paper presents a vision of how the UK makes the transition to clean energy by 2050 and what this will mean for consumers of energy in homes and places of work, and for how businesses use energy to produce goods and services. The way energy is produced and used will rest on a decisive shift away from fossil fuels to using clean energy for heat and industrial processes, as much as for electricity generation.

(IS-2021-156) The Intelligent Automation Global Market Report

This January 2021 report by Shared Services & Outsourcing Network (SSON) presents 5 case studies by 5 authors illustrating where intelligent automation can impact performance and aims to help readers better understand the ROI. Intelligent automation has proven its efficacy when it comes to improving customer experience, driving new revenue opportunities, supporting digitization across an enterprise, improving data's value add, and finally, offering greater transparency.

(IS-2021-155) Demand Side Energy Management in the Time of COVID

This report by CPower published in January 2021 focuses on the energy challenges major industries faced in 2020 and continue to face in 2021. The analysis presents demand-side energy strategies each industry should consider to offset pandemic year losses and/ or to optimize energy use and expenditure by monetizing existing energy assets in U.S. energy markets. The authors also provide an explanation of the deregulated U.S. energy markets and discuss demand-side energy management opportunities available in each market for commercial organizations.

(IS-2021-154) How smart is your office?

This report from SmartCitiesWorld (February 2021) examines the current state of the smart office movement and identify not only the most in-demand applications and technologies, but what approaches organizations are taking and what the main barriers are to creating more intelligent workspaces. A smart office benefits from being built on a common connected infrastructure capable of accommodating different applications and devices and gathering data from these applications and devices. Responses show that most companies are not taking this integrated approach. Moreover, in practice, a connected lighting infrastructure often serves as an ideal entry point for businesses who want to distribute IoT capabilities throughout their workspaces. However, as the survey revealed, many are not maximizing the use of connected lighting as a cost-effective starting point for smarter indoor spaces.

(IS-2021-153) How the Smart Office Acts as a Team Player in Crisis Management

This report from Siemens Industry was published in May 2020. The role of the smart office in contributing to a crisis management response is examined, with discussion of some of the digital technologies available and how they support the operation of office buildings while keeping the occupants healthy and safe. With the use of workplace applications, it is possible to deliver timely and local communication, showing how density management can be facilitated through sensors and booking software and how risk mitigation can be achieved with data and access control. “The lines are becoming increasingly blurred between buildings, technology and community as new workplace solutions are introduced based on intelligent building infrastructure.” The analysis concludes that it is crucial to acknowledge the different layers within an office building which generate data points – from infrastructure to spaces to people – and the ability to connect them. The building itself has an ever- increasing role to play throughout the lifecycle of the crisis – and beyond.

(IS-2021-152) Building Better Places

This report was from SmartCitiesWorld was published in March 2019. Smart, connected technologies are helping to make buildings more efficient, productive, healthy, comfortable and personalized for the people who work in them. And because commercial buildings make up a significant percentage of the built environment, smart buildings have a significant role to play in creating a sustainable future for cities and the planet.

(IS-2021-151) Air Conditioning and COVID-19: Slowing the Spread

This report from Carrier (May 2020) explains the various systems for indoor air quality and the ways to improve and monitor them. A generation of research and experience has proven that when properly maintained and operated, heating, ventilation, and air-conditioning systems (HVAC) can reduce the spread of viruses. HVAC systems work in a built environment to supply comfortable, clean, recaptured air, mix in healthy levels of fresh air, and contain or exhaust contaminants. Air delivery systems can reduce the transmission of viruses through inline filtration and are also critical in maintaining healthy humidity levels between 40% and 60% indoors which may help to limit the spread and survival of SARS- CoV-2 within the building, while minimizing the risk of mold growth and maintaining hydrated and intact mucosal barriers of human occupants.

(IS-2021-150) Leading Better than Normal

This January 2021 report from JLL highlights that COVID-19 exposed the social and economic inequities and vulnerabilities across healthcare, education and social systems. As a result, the importance of environmental, social and governance (ESG) goals has increased, and it is with this momentum that stakeholders can increase these commitments for a better future. The report provides specific recommendations from JLL’s leaders on the improvements that can be made—across industries, property types and regions—in the year ahead. In 2021, the real estate industry has the opportunity for transformative change in the areas of emissions, climate change, social justice and equality. Smart building technology, machine learning and predictive analytics can be powerful tools to enable greater building efficiency, predict maintenance needs and optimize performance for a reduced environmental impact, a healthier human experience and reduced operating expenses.

(IS-2021-149) Buildings are Getting Smarter - Are They Also Getting Healthier

This report was published by SmartCitiesWorld in June 2020. This report examines how connected lighting can lead to a more efficient workplace and healthier workforce. A flexible approach to managing the indoor environment and workspace is vital because each building is unique, and each building occupant has unique preferences. Research confirms that indoor air quality (IAQ) affects the well-being of building occupants and that poor IAQ is linked to lower productivity levels and “sick building syndrome.” A connected lighting system can serve as a platform to host sensors and enable facility managers to leverage the value of a building’s lighting infrastructure by monitoring workspace parameters such as occupancy, temperature, light, noise, air quality, relative humidity, volatile organic compounds, CO2 levels, dust and pollution.

(IS-2021-148) Smart Buildings and Carbon Neutrality – A Race Against Time

This report was authored by Jon Glasco for SmartCitiesWorld was published in June 2020. This report examines the potential for policy interventions and innovative technologies to mitigate building emissions, support carbon neutrality measures and facilitate green initiatives. Examples of innovation in energy efficiency include energy-saving retrofits and upgrades (reducing energy loss and emissions by modernizing the building envelope); and microgrids combined with

renewable energy sources, providing capabilities to achieve a more balanced energy supply. Other types of innovations include energy storage solutions combined with on-site renewables; use of intelligent platforms, sensors and user-centric communications to support energy-efficient behavior and reduce energy use; and AI and machine learning to provide notification about energy waste or loss.

(IS-2021-147) Impact of Glazing Properties on Energy Use Intensity and Daylight Quality

This report from building performance platform COVE.TOOL was published in March 2021. The analysis focuses on the energy and daylight impact of selecting different types of glass products based on their performance properties. The author highlights the impact of changes in glass properties on the energy use intensity and daylight quality of this office project. With energy regulations becoming stringent around the world, and glazing leading to a significant impact on performance, using iterative testing can be a cost-effective way to design a higher-performing building.

(IS-2021-146) Microgrids Find Their Business Case with Climate Resilient Internet

This December 2021 report by David Theodore of Climate Resilient Internet (CRi) highlights that microgrids remain the future for resilient, sustainable energy, but cost is a stumbling block. This paper confronts that challenge with a stronger value proposition; one that taps a new revenue stream and maximizes client resilience. In this new vision, microgrids extend resilience to mission critical Internet and cloud data, where extreme weather is causing blackouts so consequential, they must be avoided at all cost. Internet resilience isn't so simple, because data—even from a user's Wi-Fi or their smartphone—relies on untold miles of fiber optic infrastructure, all of which is vulnerable to weather, and dependent on the electric grid. However, a new solution has emerged, called "Climate Resilient Internet"—based on a new certification for climate change and operating on the same "resilience is local" principle as the microgrid. One of the compelling facts put forward is that the savings from a single prolonged internet outage could fund an entire microgrid deployment (typically \$2-\$4 million/MW).

(IS-2021-145) Charting a Path to the Future of the Office

This report published by BOMA International Deep Dive was published in March 2021. This report provides a reflection on the how the COVID-19 has changed commercial real estate. In "stage one," tenants and property managers established hastily constructed work-from-home (WFH) protocols and the placement of plexiglass and hand sanitizer stations. The office space industry "normalized" under new—but often changing—rules of engagement in "stage two," as employees grew accustomed to wearing masks and adjusted to working in a more solitary context. "Stage three" centered on planning for a return to work, albeit in fits and starts and in numbers still greatly reduced from the days of full occupancy. Stage four is still taking shape, and it will require decisions on how the office of the mid-term future looks both in physical appearance and in the protocols that will ensure tenant confidence.

(IS-2021-144) Architects vs Contractors vs Owners - Who Can Most Impact Climate Change in the Built Environment?

This report was authored by building performance platform Cove.tool and published in April 2021. The challenges of reducing carbon emissions in the building industry requires a multi-pronged effort on the part of owners to drive demand, architects to design for the demand, and contractors to execute design in a climate-conscious manner. But today data-driven workflows and analytical tools make it easier for buildings to account for sustainability concerns, with powerful digital tools that provide in-depth analyses of a project for its entire lifecycle, and tools that provide quick metrics and graphical representations of information to drive client discussions and design decision-making. External stakeholders like global organizations, advocacy groups, and governments can push for greater efforts and collaboration between owners, contractors and architects to create a sustainable and carbon-conscious building industry in the future.

(IS-2021-143) Designing Electricity Rates for An Equitable Energy Transition

This February 2021 report was produced by California non-profit Next 10 in collaboration with the Energy Institute at UC Berkeley's Haas School of Business. The groundwork for the transition to renewable energy has been laid, but changes to how the California and its residents pay for electricity will be needed to ensure equitable outcomes as the state pursues a carbon-neutral path, the report concludes. In particular, the current system of recovering system costs through high volumetric prices is not only inefficient; it imposes a relatively large burden on lower- and average-income households while it recovers a shrinking fraction of system costs from higher-income households because of the diffusion of rooftop solar. A variety of potential approaches to ensure utility revenues can be kept stable without relying on the current rate model are described.

(IS-2021-142) 2020 Construction Technology Report

JBKnowledge reviewed construction industry technology trends in this report from December 2020. Challenges faced by construction companies — and their adaptation strategies — are presented. The analysis covers top software and mobile apps for the construction industry with innovation forecasts and budget benchmarking. A comparative analysis is provided between current and prior year data to highlight important trends.

(IS-2021-141) 2020 Year-End Data Center Trends

JLL Research focused on data center trends and projections for 2021 in this January 2021 report. Demand for data centers, and creation of new capacity, continued to increase with millions of people working from home, attending online schooling, shopping online, and gaming. That growth is likely to continue based on strong investment, demand for 5G, and need for sustainability.

(IS-2021-140) Building Digital Twins

This report by Ken Dooley and José Carlos Camposano from Granlund was published in December 2020. The report explores digital twins through a user-centric approach to determine user needs and the benefits that could be created by connecting data to a digital twin. Different digital twin categories exist, with varying degrees of complexity and timelines for adoption, and less complex solutions are likely to achieve a better balance between the customer value and the resources needed for their implementation and maintenance.

(IS-2021-139) The Advent of Private LTE and 5G

This April 2020 report by Harbor Research offers recommendations for organizations to develop new business opportunities by leveraging smart systems and the Internet of Things. The key enabler includes high performance networks such as Long-Term Evolution (LTE/4G) and next generation 5G. Use of private network services is proposed to act as an abstraction and orchestration layer to link existing networks and optimize data flow and operational efficiency. Successful deployment of new technologies will strongly depend on organizations being able to engage different channels and deploy new technical and business models.

(IS-2021-138) Global Economic Value of Wi-Fi

This February 2021 report from the Wi-Fi Alliance forecasts that the value of Wi-Fi globally will rise from \$3.3 trillion in 2021 to \$4.9 trillion in 2025 and highlights the importance of ensuring sufficient spectrum for Wi-Fi use to continue the benefits of this technology. Updating results from an earlier study (2018), the analysis presents economic value results for 14 countries and the EU that were developed by economists at Telecom Advisory Services. The data on Wi-Fi's economic value was developed by assessing several key factors and global developments impacting the Wi-Fi industry that contribute to the value of Wi-Fi for 2021 and beyond.

(IS-2021-137) Momenta Prediction Report | 2021: A Look Ahead

This report was authored by digital industry venture capital firm Momenta and published in January 2021. The report discusses how evolving technologies will impact consumers' lives and transform how they communicate, collaborate and do business. Technologies discussed include artificial intelligence, the Internet of Things, cloud computing, 5G, and blockchain. Factors impacting how people work are presented and include social responsibility, wellness, distributed work, and automation. The report also highlights advances in clean energy, electric vehicles, and space technology as indicators of where the market is heading.

(IS-2021-136) Foundations for a Science-Based Net-Zero Target Setting in the Corporate Sector

This report by CDP, the global environmental reporting non-profit, was published in September 2020. The paper describes how companies can apply a science-based targets initiative to achieve net-zero global CO2 emissions by mid-century. Key items discussed include the importance of public awareness regarding CO2 emissions, common understanding on what net-zero means for companies, and the development of a science-based framework for the formulation and assessment of net-zero targets.

(IS-2021-135) COVID-19 and the Economic Value of Wi-Fi

This report by Telecom Advisory Services, from December 2020, demonstrates the economic importance of Wi-Fi under pandemic conditions. “Critical contributions” of Wi-Fi include provision of Internet through free access points, efficient and concurrent access to the Internet by multiple devices, reduction in wireless expenditure, support of unserved communities through wireless Internet service providers (WISPs), and virtualization of business processes.

(IS-2021-134) Broadband Myths - Are High Broadband Prices Holding Back Adoption?

This report from the Information Technology & Innovation Foundation published in February 2021 deals with factors impacting broadband accessibility in the U.S. Key takeaways are that while U.S. broadband prices are competitive with other nations, wider broadband access can be achieved through government subsidies for low-income users, improved user literacy and device cost, and user access to private ISP providers.

(IS-2021-133) The Future of Enterprise Networking and Security - Are You Ready for the Next Leap?

CATO Networks presents the results of a global survey that polled 2,376 IT executives on the impact of the COVID pandemic and secure access service edge (SASE) technology on IT purchasing and strategies. The key findings in this January 2021 report reveal that IT enterprise budgets and priorities will focus on remote access performance and security. SASE presents important benefits to organizations such as increased security, time savings in management and maintenance, overall cost savings, and greater agility in adapting to new challenges. CATO's SASE solution is promoted as the first SASE platform to help organizations reap such benefits.

(IS-2021-132) A National Roadmap for Grid-Interactivity Efficient Buildings

This report from the Office of Energy Efficiency & Renewable Energy was released in May 2021. The Building Technologies Office, with industry support, put together a roadmap that outlined how to achieve, by 2030, triple the deployment of Grid-interactive Efficient Buildings (GEBs) over 2020 levels. A GEBs are defined as industrial, commercial or residential facilities which can provide both energy efficiency and optimization of grid services through control and automation. Grid services include resource adequacy, capacity firming, frequency and voltage regulation, ramping reserves, resiliency, black start, etc. The paper highlights both the barriers preventing — and pillars that support — GEB adoption.

(IS-2021-131) The State Transportation Electrification Scorecard

This report from the American Council for an Energy-Efficient Economy (ACEEE) was published in February 2021. This comprehensive report evaluates and provides a scorecard of states' policy activities and efforts to electrify transportation. While transportation accounts for 28% of GHG, EVs currently represent only 2% of the American vehicle market. California led in five of six

categories, including: planning & goal setting; incentives; efficiency; grid optimization; and equity. Recommendations pertaining to benchmarking, data collection, investment and establishing clear policy direction are provided, with policy guidelines for transportation electrification.

(IS-2021-130) Anatomy of a Healthy Building

This September 2020 report by Honeywell provides a technical guide to improving air quality and health safety with regards to COVID, with detailed references. Specific information is provided for: temperature & relative humidity; air filtration; cleaning & disinfection; ventilation; pressurization; and surface cleaning & disinfection. Information on the effectiveness of various air-filtration devices is provided.

(IS-2021-129) The Building Electrification Technology Roadmap (BETR)

This report from the New Buildings Institute was published in January 2021 and provides a guide to developing, implementing and supporting electrification programs. Extensive qualitative research drawing from California efficiency programs of 38 technologies across four end-use areas (Space Heating, Water Heating, Cooking and Clothes Drying & Laundry) is provided. A Technology Assessment Graphic Tool is provided. As an example, heat pumps use 36% less energy, produce 71% less GHG and are 300% - 400% efficient compared with high-efficiency condensing gas furnaces. Electrifying the four main gas-using technologies of space and water heating, cooking and clothes drying cuts energy use by over 40% and GHG emissions by over 75%. The analysis discusses key roadblocks and recommendations.

(IS-2021-128) Building a Successful Smart Home Strategy

This report was authored by Plume Design and published in December 2020. Consumers will require fast, ubiquitous and reliable connectivity from their communications service providers (CSPs) as smart home ecosystems evolve. By 2023, the consumer segment will be three times as large as the business segment, with the global smart home market reaching \$317 billion by 2026. This report discusses the current market state, business models, challenges and solutions. Plume's integrated CSP solution is said to reduce customer churn by 30%, truck roll rates and service deployment timelines by 67% and support calls by 50%, resulting in net promoter scores increasing by 60 points.

(IS-2021-127) Building Automation Opportunities to Meet NYC Emission Laws in Existing Buildings

This 2021 paper from EnOcean Alliance highlights that New York City now requires that large (over 25,000 square feet) existing buildings (residential and non-residential) reduce their carbon emissions by 40% by 2030 and by 80% by 2050. As an ambitious climate regulation for buildings, the new law invites discussion about the opportunities available for carbon reduction for buildings which involve building automation, intelligent control Systems and widespread sensor implementation and provides examples of projects where EnOcean-based systems have been

installed. The authors provide real-world cases where the EnOcean's resource-saving energy harvesting technology has been adopted in NYC to enable buildings there to be sustainably digitalized for a reduced carbon footprint.

(IS-2021-126) Better than Normal

JLL explores long-term opportunities for improvement in residential, commercial and industrial real estate in the wake of COVID-19 in this 2021 report. Demand for more space and flexibility and use of technology solutions for operations and maintenance have become essential for residential users. Given the shift, trends involving the distribution of office spaces in urban and suburban areas and the continuity of working from home model are discussed. The implications of the new focus on wellness and sustainability in many sectors like work offices, industrial and hotels are also examined. The authors conclude that the real estate industry has the opportunity for transformative change in the areas of emissions, climate change, social justice and equality — and grounds for optimism about large cities' long-term resiliency.

(IS-2021-125) Energy Efficiency Snapshot 2020

This report was prepared by Northeast Energy Efficiency Partnerships (NEEP) and published in 2020. It provides an overview and jurisdictional scan regarding public policy advancements in energy efficiency policies and performance metrics for twelve U.S. states located in the Northeast and Mid-Atlantic region. Figures indicate that energy efficiency is the fastest-growing jobs sector in the energy industry and most of the investments are directed towards electric programs followed by natural gas efficiency programs. A correlation to the reduction of regional carbon emissions in the region for the period 2014- 2018 is also given.

(IS-2021-123) Energy Storage - Impacts of Electrochemical Utility-Scale Battery Energy Storage Systems on the Bulk Power System

This report was authored by the North American Electric Reliability Corporation and published on February 2021. This report confirms Battery Energy Storage Systems (BESS) will grow exponentially with utility-scale storage increasing from 899 MW in 2019 to 3,500 MW by 2023. BESS provides system reliability through frequency regulation, voltage support, and peaking capacity. However battery storage is an emerging technology and lags in integration with renewable resources. North American market development information is provided. California leads with 1,300 facilities in operation or under construction. Lithium-ion and flow battery applications and market potentials are discussed. Recommendations for modifications of NERC standards to address specific issues are provided.

(IS-2021-122) Property Owners Guide to Private Networks

This report was authored by the Connectivity Wireless Solutions and published in April 2020. This report provides an understanding of Citizens Broadband Radio Systems (CBRS) designed to enhance mobile broadband, open connectivity to cable operators, and extend broadband service through a private network. Real-use cases discussed include airports, stadiums, hospitals,

convention centres, universities and commercial buildings. Results of a successful Times Square NYC pilot included enhanced Wi-Fi, mobile and monitoring device connectivity in one of the most densely populated tourist spots in the world.

(IS-2021-121) Leading by Example - How Multifamily Real Estate Companies Approach Energy Management and Savings

This report from the American Council for an Energy-Efficient Economy (February 2021) reports on the results of a comparative study of energy and carbon emission reduction programs for three multi-family real estate companies. An Urban American initiative in NYC achieved a 30% reduction in energy consumption through equipment upgrades and additional weather sealing. A 439-unit apartment in Union City, California achieved an ROI of 42% with a simple payback of 2.4 years on a \$1.44 million project. The third program was a Joint Ownership Equity NYC project involving 386 units and \$14.3 million in upgrades. Over all, energy efficiency is prioritized in capital planning and ongoing operations in each of these programs, leading to tangible energy savings and better energy management.

(IS-2021-120) The Modern Energy Minimum - The Case for a New Global Electricity Consumption Threshold

This report by the Energy For Growth Hub was published in January 2021. The authors link energy poverty with economic poverty. The sectors that account for energy consumption include industrial (44%), residential (28%), commercial (23%), agriculture (3%) and transportation (2%). The energy poverty line is assessed at 100 kWh, corresponding to an annual income of \$208 per year. By comparison, the median for high-income countries is 6,270 kWh and \$20,000 per year. The authors propose establishing a two-threshold global energy minimum consumption of 1,000 kWh per person per year (300 kWh residential, 700 kWh non-residential), which would correlate to an average income of \$2,500 per year.

(IS-2021-119) State of Construction Tech

JLL looks at the current state and key trends in construction technology in this report from December 2020. The analysis proposes a “construction technology hierarchy,” growth trends, and the data on current venture capital investment. The technology hierarchy includes details on different construction tech categories which are ranked as foundational tools, a “primary impact” technologies, or “secondary impact” technologies. Most of growth due to the pandemic have been digital collaboration platforms, virtual scanning tools, and safety focused wearables. Venture funding was on par with prior years and with new funding being concentrated in categories that have grown because of the pandemic.

(IS-2021-118) Connected Complexity | The Padi Platform: Open-Source Tools For Open Data

This white paper by Harbor Research and published in March 2021. The paper deals with a software tool, Padi, that enables simple, durable and context-sensitive integration between complex systems without wasteful custom development. It is argued that by using open-source

connection profile mechanism, Padi addresses integration issues and enables system developers work more collaboratively by integrating data flows in a reusable way with generalized and extensible concepts.

(IS-2021-117) The Dematerialization Path to Profitability and Sustainability

This report was prepared by Ericsson Consumer & Industry Lab and published in February 2021. Based on a survey involving 5,059 online respondents, the report examines the future of enterprises, white-collar work, and the role of ICT in the next 10 years. Key findings focus on the importance of dematerialization for increased profitability, the remote-work trend for white-collar jobs, the growing adoption of extended reality (XR) and the increased use of renewable electricity for enterprises.

(IS-2021-116) The global economic impact of 5G

This report was authored by Wilson Chow from PWC and published in January 2021. By considering use-cases in health care, smart utilities, consumer and media, industrial manufacturing, and financial services, the analysis highlights that the adoption of 5G will add US\$1.3 trillion to global GDP by 2030. To achieve such gains, companies will need to factor 5G into their technology road maps and strategically apply use-cases that will deliver the greatest value. Policy makers and governments, for their part, will need to regard 5G as fundamental component of societal infrastructure.

(IS-2021-115) The Future Telco-Connected Home

This report by Omdia Research for the Broadband Forum was published in January 2021. Opportunities for broadband providers to differentiate their products by offering new services and deriving additional revenue from the connected home are explored. Standards are needed to avoid fragmentation, for open platforms to encourage third-party developers, and "to maintain customer trust," the analysis shows. The security of the router and home network, and customer privacy, remain top challenges.

(IS-2021-114) The 2020 State Energy Efficiency Scorecard

The 14th edition of the American Council for an Energy-Efficient Economy's ranking of U.S. states on their policy and program efforts to save energy; and their progress in pursuing efficiency as a cost-effective tool to achieve state clean energy goals. Score cards covering utility policy, transportation, building energy efficiency policies, state initiatives, and appliance efficiency standards are provided in this report, from December 2020. California leads and sets standards which are adopted by other states, particularly regarding low-emission and zero-emission vehicle programs. Regionally, the northeast leads the way.

(IS-2021-113) Sustainable Recovery - World Energy Outlook Special Report

This report from the International Energy Agency (July 2020) provides a three-year sustainable recovery plan for the electricity, transport, industry, building, fuel and emerging low-carbon technology sectors. A \$USD1 trillion investment would yield a 1.1% increase in global GDP, create 9 million jobs, and reduce GHG emissions by 4.5 billion tonnes. New policies and regulatory frameworks would be required to support this plan, which would help achieve the long-term climate goals of the Paris Agreement.

(IS-2021-112) Side Effects: How Renewable Energy Policies Drive Innovation in Complementary Grid Technologies

This January 2021 report from the Information Technology & Innovation Foundation evaluates the impact of seven renewable policies in OECD countries on patenting rates of technologies that complement renewable energy; in particular, solar and wind. Modeling shows the impact that strong renewable policies, market-based demand policies and R&D investment have on innovation. Renewable policy scores by country (Denmark leads) are provided. The analysis shows how the U.S. compares against the global mean over the past 20 years, across 7 metrics.

(IS-2021-111) Responding to Automation Technology Adoption in Canadian Industries

This report Conference Board of Canada report, which came out in January 2021, covers industry- specific trends and attitudes that shape how Canadian organizations adopt automation, using surveys and interviews of managers and frontline workers. Key findings indicate the importance of integrating digital applications and mobile devices, workforce preparedness, understanding the pressure placed on employees to ‘up-skill,’ and compatibility of automation with existing systems. Barriers to embracing automation are also discussed and include labor shortages, reactive response by employees, insufficient system testing, and inconsistent regulations.

(IS-2021-110) IoT Spotlight Report 2020

This report was authored by Erik Brenneis from Vodaphone and published in September 2020. Based on a survey of 1,639 businesses globally, the report describes how business leaders are using IoT, how the technology is helping them become ‘future ready,’ and the next steps forecast for IoT. Business adoption of IoT remains strong, with IoT at the core of digitalization enabling business to seize new business opportunities. Many businesses are also turning to it to help them grow stronger and adapt in the face of unforeseen events such as COVID-19.

(IS-2021-109) Canada Real Estate Market Outlook 2021

This 2021 report by CBRE Limited takes a closer look impacts of the COVID-19 pandemic on the commercial real estate market across Canada. It explains how different market sectors (e.g., industrial, logistics) will continue growing as e-commerce demand remains strong, while the rebound in other sectors (e.g., office, retail, hotel) will depend on how vaccination roll-out evolves. The authors go on to provide a long-term outlook linked to demographic trends and the evolving digital economy. They provide a regional market analysis of Canadian urban centers

using statistical information and underline that it is probably too soon to say exactly how remote working will impact demand for office space until workers return safely to office.

(IS-2021-108) Meeting the dual challenges of Covid-19 and climate change

This report was authored by Nils Larsson from ISSBE and published in November 2020. It aims to establish a business case for responding to the dual challenge of climate change and COVID-19 impacts. The analysis explores actions needed in buildings to comply with anticipated health requirements for the post-pandemic period, as well to tackle climate related impacts. It is argued that an integrated action framework that incorporates a variety of strategies for the building industry is urgently needed. As examples, decision-makers should prioritize measures such as focusing on building renovations and retrofits, improving ventilation rates and strengthening energy performance and housing programs for low income populations.

(IS-2021-107) IoT Signals

This October 2020 report by the Hypothesis Group was commissioned by Microsoft. Part of a series of reports on the Internet of Things (IoT), the analysis offers "new learning and insights around the current and future state of IoT." A survey was undertaken involving decision makers in large companies (1000+ employees), where 91% of these companies worldwide (94% in Germany) are involved in IoT adoption in some form. Most projects have moved from "learning" and "trial" to "purchase" and "use" stages. Adoption is highest in retail and energy. IoT is being adopted to enhance productivity and security. Barriers to IoT adoption include complexity and cost. Companies adopting IoT are also developing their familiarity with artificial intelligence (AI) and edge computing, and 70% are using digital twins for simulation with IoT.

(IS-2021-106) Functional Requirements for Broadband Residential Gateway Devices

This technical report by the Broadband Forum, titled "TR-124," was published in December 2020. It contains requirements for a residential gateway between a broadband network such as DSL (digital data over analog telephone wires) or GPON (gigabit passive optical network using fiber optics) and a home network. Applications include voice, data, broadcast video, video-on-demand and two-way video using broadband networks. Among the requirements is support for IPv6 (Internet Protocol version 6), which extends the address space of IPv4 from 32 bits to 128 bits, in that way making it possible to accommodate billions more devices.

(IS-2021-105) Artificial Intelligence: The Future of Coworking

This report was prepared by Yardi company and published in October 2020. The ways in which artificial intelligence (AI) and the Internet of Things (IoT) impact the shared workspace industry today—and how they will shape coworking as a whole in the near future—are the focus of the report. The authors argue that growth and adoption of AI will be influenced primarily by user trust. As AI and IoT become more powerful, refined, and accepted, operators will ultimately free up more time from manual tasks, gaining the ability to focus on the community-driven aspects of coworking.

(IS-2021-104) A U.S. Grand Strategy for the Global Digital Economy

This report was authored by Robert D. Atkinson from the Information Technology & Innovation Foundation and published January 2021. This paper presents a stark view of world competition in information technology: "Today's era is one of nationalization, mercantilism, increased authoritarianism, and tension." The author urges the U.S. to focus on developing hardware and networks to support communications necessary for "the digital economy." Moreover, the U.S. faces a risk where much of the world, including the EU, could align against U.S. IT and digital interests, leading to a many-against-one environment, with detrimental consequences. Various scenarios are present for how the U.S. might ally with countries outside of China and Russia or might be thwarted by these allies.

(IS-2021-103) 2021 State of Disruptions

Avant Communications released this report in January 2021. The results of a survey of 500 U.S. executives in IT, security and finance were presented, pointing to business transformation as a key business driver that enterprises need to understand well in to stay ahead of the competition and sustain growth. The main trends and takeaways include the use of software-defined networks, multi-protocol label switching, growth in as-a-service models (contact centers, infrastructure, unified communication), co-location, inclusion of trusted advisors, and cybersecurity preparedness.

(IS-2021-102) Intelligent Buildings and COVID-19 | Executive Summary & Module 1

In this CABA Landmark Research project, Frost & Sullivan evaluated the key issues and challenges presented by the pandemic for the intelligent buildings industry, assessed the implications for current and future technology evolution, and outlined measures that will help build future resiliency for the sector. The Executive Summary report and Module 1 of 3 are available as a free download.

(IS-2021-101) Energy Technology Perspectives 2020

This International Energy Agency report from January 2021 offers detailed analysis and advice on the clean energy technologies the world needs to meet net-zero emissions objectives. The analysis maps out the technologies that will be required to tackle emissions in all parts of the energy sector, including areas where technology progress is still lacking, such as long-distance transport and heavy industries. The authors show the amount of emissions reductions that are required from electrification, hydrogen, bioenergy and carbon capture, utilization and storage. An assessment of emissions from existing infrastructure and the recommended countermeasures is also provided.

(IS-2021-100) Dissecting IoT for the Rural Broadband Ecosystem

Finley Engineering released this report (December 2020) focusing on six to ten-year planning for

the potential growth of connected devices, informally called Internet of Things (IoT). The estimated 30 billion connected devices in 2020 are expected to reach 50 billion by 2025. Business and industrial applications are expected to outpace home applications. Use cases in rural America are described for agriculture, healthcare, town operations, and education. The role of fiber optics and fixed wireless networks for a data infrastructure is presented in summary form. Public funding programs are discussed.

(IS-2021-99) Automation 2020: OT/ICS Cybersecurity

This December 2020 eBook was published by Automation.com, a subsidiary of the International Society of Automation. It examines emerging cyberthreats—in particular, the misuse of DNS protocols—and sets out a "zero-trust" cybersecurity approach that should work within Operational Technology (OT), industrial control systems (ICS), and supervisory control and data acquisition (SCADA). There are key takeaways on the value of open and secure SCADA systems, safety best practices for improving OT cybersecurity, and how to strategically communicate cybersecurity information to corporate board members.

(IS-2021-98) 5G Standalone Architecture

This January 2021 report by Samsung examines the advantages of 5G networks over 4G networks (LTE) in terms of throughput, latency and reliability. 5G allows operators to provide unprecedented communication services for end-users and to explore innovative business use-cases that can generate new revenue streams by using 5G-specific services. Migration strategies from 4G to 5G are presented, including standalone (SA) and non-standalone (NSA). Over all, NSA can be an attractive option for customers who have interest in quickly deploying 5G by utilizing legacy network and minimizing upfront investments. "However, the SA architecture is the best choice for operators that want to tap new 5G opportunities, as 5G-specific services are available only in SA architecture."

(IS-2021-97) Zero Carbon London

This November 2020 report by New London Architecture in the UK reports on a survey of challenges and solutions to help industry support the path to carbon neutrality in the city of London. Over 100 businesses involved in the whole-building industry were surveyed. According to the respondents, lack of policies and green funding are the two major obstacles to achieve zero carbon emissions. The resulting proposals emphasize the importance of retrofits of existing buildings, the adoption of a circular economy approach for design and construction as well as a complete transition to clean sources of energy. Lastly, the annex provides a list of existing projects in London that set the bar for environmental design.

(IS-2021-96) Energy Efficiency 2020

This December 2020 report from the International Energy Agency (IEA) reviews energy efficiency (EE) trends with a special emphasis on the impact of the COVID-19 crisis on EE technology adoption and global energy markets. Facts showing how the pandemic influences the energy

demand and energy intensity in the building sector, appliances, manufacturing industry as well as transportation (urban and long distance) are illustrated and discussed in depth. In light of government funding on energy efficiency and COVID-19- related stimulus measures, the report provides analysis of the role of the energy efficiency industry as a driver for economic recovery and job creation.

(IS-2021-95) Global Renewables Outlook: Energy Transformation 2050

This 2020 report published by International Renewable Energy Agency (IRENA) examines energy transformation with closer a look at needs and impacts at the regional level, in both energy and socio-economic terms. This study also outlines a vision of transformative energy policies as the path to decarbonization. On the innovation and technology side, carbon dioxide (CO₂) emission reductions in shipping, aviation and heavy industry remains the most difficult obstacle. Addressing such challenges soon will be crucial to achieve net-zero emissions in the second half of the century.

(IS-2021-94) Canada's Net Zero Future: Finding Our Way in the Global Transition

This February 2021 report from The Canadian Institute for Climate Choices proposes credible pathways for Canada to reach its goal of net zero greenhouse gas (GHG) emissions by 2050. Policy options across sections are evaluated and discussed as “safe bets” and “wild cards.” The report highlights the need for government action to implement and enforce strong policy, manage the risk linked to "wild-card" solutions, implement an accountability framework, and ensure the transition to a net zero economy is fair and inclusive. References to supporting studies are provided.

(IS-2021-93) Building the 22nd-Century Utility

This January 2021 report by Val Jensen of consulting giant ICF is subtitled “How a utility CEO remakes her business to survive—and even thrive—into the future.” Instead of providing a future model based on incremental improvement of past practices, this paper provides a fresh approach based on what the future consumer is likely to need in the coming years—and how these needs could be monetized. A two-tier structure involving network capabilities and energy-as-a-service provides a utility with a more responsive, resilient and consumer-friendly business model, one better structured to respond to changing future demands. Illustrations of how this model would work in practice are provided.

(IS-2021-92) Automated Facial Recognition - A Guide to Ethical and Legal Use

This January 2021 report from the British Security Industry Association proposes terms of reference and frameworks for governance and compliance for the legal and ethical use of AFR. The report provides verification and identification decision trees and discusses how AFR storage and data privacy should be approached. This report helps frame the discussion around AFR, and the inherent rights individuals should retain as the technology continues to progress.

(IS-2021-91) 2021 Strategic Directions: Megatrends Report

This February 2021 report from Black and Veatch looks to inform the 2021 decision-making process that will drive capital spending and help utilities position for the future. Supported by survey results from 1,000+ power, water, telecommunication and natural gas professionals, the report identifies three significant trends: Customers Driving Sustainability in the C-Suite; Next-Level Reliability Through Resilience; and Turning Data into Action. Results suggest that 83% of utilities are pushing capital towards clean energy with 70% leading innovation in this area; 73% are focused on improving reliability; 85% have a water/drought management plan; and 60% identify regulatory changes as a risk.

(IS-2021-90) Affordability and Resilience: The Challenge of Tower Renewal in Private Rental Apartment Buildings

This December 2020 report by the Urban Land Institute presented the conclusions of a special panel tasked with proposing creative renovation and redevelopment solutions for tower clusters in the Greater Toronto Area (GTA). Based on analysis of the challenges facing these sites, the panel developed recommendations on selected sites that could be applied more broadly. The panel underscored that Toronto's apartment towers remain critical landing points for new immigrants and housing strivers constrained by the "missing middle." Refocusing on tower renewal is crucial, as no alternative housing currently exists for much of the city's residents.

(IS-2021-89) Combined Heat and Power and a Changing Climate: Reducing Emissions and Improving Resilience

This January 2021 report by the Combined Heat and Power Alliance looked back on the national three-day summit it held in the fall on the role of combined heat and power in a low-carbon future. This report is based on the presentations and discussion by those who attended the event, as well as on previous research and analysis undertaken by the alliance. Key benefits of combined heat and power systems are examined. CHP is a climate change solution because it can both reduce emissions and be a resilient energy resource, reliably providing electric and thermal energy even during severe weather events, the authors write.

(IS-2021-88) Data Automation is the New Battleground in the Mortgage Industry

This report by Barbara Hodge, Principal Analyst and Global Digital Editor, Shared Services and Outsourcing Network (SSON) was released in September 2020. It is argued that the mortgage industry is in desperate need of a "digital overhaul." Automating data ingestion will underpin operational resilience, reduce costs and deliver new revenue streams as mortgage providers tap into customer and property data currently trapped in applications, contracts and valuations. The author predicts that swift, seamless workflows combined with reliable data analytics will become "game-changing" for the mortgage industry, and the extent to which the opportunity is taken up will greatly influence the success of different industry players.

(IS-2021-87) Guide to Building a Connected Workplace with a Remote Workforce

This COVEO report released in April 2020 discusses the need for today's employees to be equipped with up-to-date tools and information resources in order to work effectively from any location. There are currently several organizational challenges preventing a unified digital workforce, including siloed and disconnected systems which lead to inaccurate and inconsistent data, the authors write. The report describes the key measures companies can undertake to build an intelligent and connected digital workplace—one that creates trust and confidence among employees, while allowing them to adjust to the new realities of remote work.

(IS-2021-86) OpenBlue Healthy Buildings | Pulse Survey

Johnson Controls surveyed more than 400 firms in the U.S. and Canada on their approach to supporting healthier buildings and a successful return to work in 2021. The resulting report, published in January 2021, revealed a keen interest in healthy buildings initiatives and valuable insights on what that means to companies today. A universal spending pattern across industries also became clear. In particular, while some industries spend slightly more on clean air initiatives (commercial real estate) and others on disaster response and healthy workspace (healthcare), overall, the need and desire for healthy buildings and safe workspaces transcends vertical markets.

(IS-2021-85) Lessons from a Heat Pump Retrofit at Walpole Ave: A TAF Case Study

This report prepared by The Atmospheric Fund (TAF) was released in November 2020. To advance climate action and reduce carbon emissions in the Greater Toronto and Hamilton Area (GTHA), The Atmospheric Fund (TAF) is focused on scaling up the adoption of deep energy retrofits (defined here as savings of 40 per cent or more) in multi-family buildings. Deep retrofits offer multiple benefits to communities including carbon reduction, cost savings, and health and comfort improvements. The report describes the results of installing heat pumps at a nine townhouse blocks having 120 suites in total, ranging in size from one- to three-bedrooms. To demonstrate the viability of retrofits focused on electric heat pumps, TAF installed and monitored eight cold climate air-source heat pumps (CC- ASHPs) as a pilot project. The results and lessons of the pilot project are summarized here. The heat pump pilot demonstrated that the multi-split systems can effectively maintain comfortable conditions through a cold Toronto winter.

(IS-2021-84) Most Innovative Projects of 2020

This report by Enel X (January 2021) shows how some of its leading commercial, industrial, institutional, and utility clients meet their energy challenges. While 2020 will be remembered as a pandemic year, it also marked a major, positive shift in the way energy is consumed, the authors write. Fossil fuel companies continued to lose market share as deployments of renewable energy projects accelerated. Even in oil- and gas-rich Texas, solar, wind, and energy storage projects dominated the queue to connect with the grid. The report highlights the effectiveness of: 1) Highly coordinated demand-response programs that protect the grid and

local communities in hours of need; 2) Innovative solar-plus-storage initiatives that are replacing grid instability with energy resiliency, while also reducing GHG emissions; and 3) Ingenious fleet and infrastructure electrification efforts that are making carbon-free travel possible.

(IS-2021-83) Adoption of Light-Emitting Diodes in Common Lighting Applications

This report by the U.S. Department of Energy (August 2020) examined the effects of LED for lighting in terms of energy saved for markets where non-LED technologies were traditionally installed (incandescent, halogen, etc.). Estimates for energy savings if there were 100% penetration of LEDs are presented. As of 2018, indoor penetration of LEDs was about 30% and outdoors was 51%. Indoor penetration was slower than outdoors because of LED light quality aesthetics. About 4 quadrillion BTUs could be saved with 100% LED installation, the analysis projected.

(IS-2021-82) Why Local Solar for All Costs Less: A New Roadmap for the Lowest Cost Grid

This report was authored by Vibrant Clean Energy, LLC and published in December 2020. Using software modeling, the researchers analyze the potential impact of local solar power generation on total emissions of carbon dioxide. Fossil fuel generation accounts for 32% of all energy-related carbon dioxide emissions, the report notes. The current mix of fuels is about 20% coal and almost 50% natural gas. Coal for electricity generation is expected to end by 2040. The modeling compared business-as-usual with government mandates to reduce emissions. With clean energy mandates in the U.S., potential savings of \$473 billion by 2050 are projected.

(IS-2021-81) Sector Coupling: Creating an Interconnected Decarbonized Energy System Benefiting Industry, the Power Sector and Society

This December 2020 report from DNV GL investigates the relationship between power sources for various industries as they move toward electricity and hydrogen as the primary fuel source. The analysis describes coupling between different economic sectors (e.g., industry, services, households and transport) as they transition towards the use of electricity and hydrogen as the dominant energy carriers. Traditionally, economic sectors have been tied to specific energy carriers and energy carriers are tied to specific uses. Electrification is a main enabler of the energy transition and a main aspect of sector coupling. Sectors that previously used various energy carriers will now compete for the same source: electricity. Sector coupling will lead to “market coupling”, meaning that prices of energy will depend on its use in different markets. Market coupling may well have a positive effect on the business case for renewable electricity generation and lead to promising new opportunities for industry.

(IS-2021-80) How Technology Can Save Traditional Retail

This report was authored by Juniper Research Ltd and published in September 2020. A review of technologies to improve the operations of a retail store to be more competitive with online sales was undertaken. The technologies included: smart checkout (faster checkout), smart mirrors [not explained], beacons using Bluetooth (to help the customer find a specific product in the

store), RFID (electronic tags with product data read wirelessly at a short range for inventory management), and robotics. The use of AI (artificial intelligence) is discussed for improving the customer experience. Smart checkout technology was a \$2-billion market in 2020 and is expected to reach \$387 billion by 2025.

(IS-2021-79) Vision for Driving a Clean Energy Transformation

This November 2020 report was authored by the American Wind Energy Association. The authors set out recommendations for driving renewable energy to meet climate and economic-expansion targets, delivering renewables to consumers at the least cost, expediting federal permitting for renewables, and removing competitive barriers for renewable energy to reduce the costs of decarbonization. Recommendations for specific executive orders, laws, regulations, and tax policies are listed.

(IS-2021-78) The Italian Superbonus 110 Percent Economic Recovery Program - A Golden Opportunity for Energy Efficient Technology

This November 2020 report is by EnOcean Alliance. A new Italian law aims to boost the economy by providing financial incentives promoting sustainability and improving energy efficiency, especially in older residential properties. COVID-19 economic recovery programs will strongly support a shift towards energy-efficient solutions by allowing for the tax deduction of up to 110% of the costs incurred over several years. Italian law already provides an “ecobonus” that has made it possible for building owners to offset the cost of installing remote monitoring/control systems for heating, air conditioning and hot water supply in a property. Enhanced legislation that took effect in July 2020 extends fiscal deduction to 110% when building automation systems are installed in conjunction with other, more extensive works aiming to reduce energy consumption within the same building.

(IS-2021-77) The Smart Home Opportunity: Room-by-Room

Parks Associates prepared this June 2020 report for ESA Research, with support from Resideo. The authors examine the challenge of marketing professionally-installed home automation equipment, especially security and safety systems, versus selling do-it-yourself (DIY) equipment. The analysis provides three choices around DIY: DIY as a fallback if the customer refuses professional installation, DIY as an alternative to professional installation, and DIY as the only option built around voice recognition. Companies are advised to tailor their product offerings to specific rooms in the house according to customer needs. Moreover, security companies should position their offerings in smart home devices as appropriate for specific locations in the house. These companies should be sensitive to consumer's privacy concerns.

(IS-2021-76) Advancing Deep Retrofits in the UAE

This report was authored by Majd Fayyad and Jason John from the Emirates Green Building Council and published in October 2020. The analysis aims to help industry and government explore solutions, approaches and incentives to retrofitting buildings—measures that must go

beyond current renovation programs to achieve greater energy and financial savings. Moreover, this study presents the views of key stakeholders in the UAE retrofit market and seeks to establish roadmaps for deep retrofits and decarbonization of the existing building stock.

(IS-2021-75) A Powerful Priority: How Appliance Standards Can Help Meet U.S. Climate Goals and Save Consumers Money

This paper published in the last quarter of 2020 by the American Council for Energy Efficiency Economy shows how updates to national appliance standards could mean significant carbon reductions, utility-bill savings, and better management of peak electricity demand. Estimates are provided to quantify the savings if 47 products are subject to upgraded efficiency standards. Water heaters, commercial and industrial fans, and furnaces for space heating and lighting offer the greatest carbon reductions opportunities, the analysis shows. Improving test procedures can also help ensure that standards deliver the expected savings.

(IS-2021-74) Decarbonizing Public Sector Buildings

This NEEP report (November 2020) is an update to a 2012 report entitled *Greening the Public Sector, Maximizing Energy Efficiency*. The original report provided recommendations and exemplars for how public sector buildings could achieve higher levels of energy efficiency. Some of the recommendations that remain relevant include reducing cost barriers for constructing energy-efficient buildings and schools, increasing workforce training and education, and establishing the goal of zero energy for all public buildings. However, while zero energy was considered a long-term goal for public sector buildings in 2012, it is now a proven performance target for many buildings today, the authors write. Their analysis sets out updated recommendations to help states implement strategies to rapidly decarbonize public sector buildings and demonstrate how building decarbonization can drive market transformations in the overall building sector.

(IS-2021-73) Smart Home, Healthy Home

This report published in 2020 by Park Associates provides an overview of how the healthy home concept was developed as an extension of the green building movement and the type of goods and services found in the market. “Healthy home” is a powerful new value proposition for builders. Second, the report illustrates the results of a recent consumer study which found that interest in health-related use cases increased due to COVID-19 concerns. Topics such as safety, clean air, clean water, energy management and senior care technology have emerged as top concerns in consumers’ minds. The report also analyzes the implications for dealers in the security industry as potential suppliers of integrated solutions linked to their security platforms.

(IS-2021-72) State of Operations and Maintenance Software

James Dice, Founder, Nexus Labs, and Raj Subramanian, Co-Founder and CPO, Facilio analyze the current state of software in building O&M and the barriers for technology adoption. They examine the possibilities that can be unlocked with modern software and suggest a viable

strategy for real estate owners and operators to unlock that potential. The paper presents insights and observations based on the changing real estate technology landscape and backed by learnings from working closely with the industry.

(IS-2021-71) Energy Efficiency Program Financing: Size of the Markets

This ACEEE policy brief from November 2020 estimates the volume of residential and commercial energy efficiency financing from five programmatic sources. Energy-efficiency financing programs typically aim to increase the scale of investment in energy efficiency, as grants, rebates, and other incentives alone will not be enough to reach efficiency goals and targets, the authors. Due to the decentralized nature of energy efficiency financing programs and the dearth of publicly available data, there has been a lack of sufficient information on the volume of recent annual lending to energy efficiency from programmatic sources. This brief aims to fill this knowledge gap and provide a baseline for future research.

(IS-2021-70) Energy Impact of Human Health and Wellness Lighting Recommendations for Office and Classroom Applications

Researchers from the Pacific Northwest National Laboratory evaluated the potential energy impacts of circadian lighting designs. Specifically, this research from August 2020 investigated the potential energy impacts of circadian lighting design recommendations that are gaining attention in a variety of common applications such as offices and classrooms. Within the two applications considered, parameters like surface reflectance distribution and desk orientation were also evaluated to explore the magnitude of potential effects. Using results from 45 unique simulation conditions, the analysis estimates that energy use may increase between 10% and 100% because of increased luminaire light levels used to meet circadian lighting design recommendations listed in current building standards (WELL v2 Q2 2019, UL Design Guideline 24480, and CHPS Core Criteria 3.0.)

(IS-2021-69) WBA Annual Industry Report 2021

This November 2020 report by the Wireless Broadband Alliance examines how new levels of Wi-Fi speed, security and reliability have become available through innovations such as multi-access point mesh, Wi-Fi 6, very high throughput, and ultra-low latency. As industry turns to enhanced Wi-Fi, the latest Wi-Fi standards (Wi-Fi 6 and 6E, based on IEEE 802.11ax standards) will deliver a sea change in Wi-Fi capabilities and performance on 1200 MHz of additional spectrum. The Wi-Fi community has worked to turn an impressive core standard into a fully deployable, monetizable platform, the authors, write. With publications like the Wi-Fi 6 Deployment Guidelines and Scenarios, the WBA seeks to aid service providers in deploying networks that are optimized for many different markets and applications, and that consequently have far greater commercial potential than previous platforms.

(IS-2021-68) Fire Safety Challenges of Green Buildings and Attributes

This October 2020 report was published by the Fire Protection Research Foundation. Specifically,

the goal was to examine fire events involving green / sustainable building materials, features and technologies, and to assess the current state of research, regulatory changes, engineering approaches, risk mitigation strategies, and firefighting tactics associated with fire challenges with green / sustainable building materials, features and technologies, which have emerged since 2012, when the group previously examined this issue. The analysis recommends integration of sustainable buildings attributes into fire incident reporting systems. It calls for more robust and appropriate test methods for assessment of materials, components, and systems performance. The importance of having better tools for holistic design and performance assessment, taking advantage of BIM and other technologies that are defining the future of the construction market, is also discussed.

(IS-2021-67) Fit For Future: The Impact of COVID-19 on Workplace and Portfolio Strategies

This December 2020 survey was conducted by Fit for Future with support from the Royal Institution of Chartered Surveyors. The pandemic brought a radical transformation to the world of work. Supply chains are being reconfigured, consumer preferences have changed and working practices and expectations have adapted, influenced by technology use. There will also be longer-term impacts that greatly affect the way workplaces and real estate strategies are planned and managed. Looking ahead to those changes, collaborative research team sought to canvas opinions from those at the forefront of the decision-making process. A questionnaire survey was conducted with the support of more than 100 organizations spanning governmental bodies and private sector companies. Approximately 20% of the survey participants were interviewed and their views are captured in this report, which is aimed at real estate occupiers, the supply chain and policymakers.

(IS-2021-66) Lead-Free Perovskite-Inspired Absorbers for Indoor Photovoltaics

This report from October 2020 highlights the potential to use indoor photovoltaics (IPV) to power autonomous devices. Lead-free perovskite-inspired materials (PIMs) have recently attracted significant attention in photovoltaics research, due to the similarity of their electronic structure to high-performance lead-halide perovskites, but without the same toxicity limitations. The capability of PIMs for indoor light harvesting has not yet been considered, however. Calculations around low- toxicity PIMs reveal their considerable potential for IPV, thus encouraging future efforts for their potential to power IoT devices.

(IS-2021-65) Prediction of an OT Attack

This Tenable white paper, published in December 2020, discusses the need to update the current operational technology (OT) security paradigm. Some organizations wanting to be more efficient and cost-conscious buy into IT-OT convergence, while others deploy Industry 4.0 or IoT technology. These two initiatives yield massive benefits but can also open the door to new risks. A newer form of security takes both the network and both IT & OT devices—together—into account. This is called attack vectoring, which redefines how one can address attacks by identifying the high-risk pathways an attack may take if it were introduced to the OT environment. An important aspect to attack vectoring is running simulations that can best

determine weak points and where security interventions will be needed before an attack is launched.

(IS-2021-64) Canadian Provincial Energy Efficiency Scorecard

This 2020 report from Efficiency Canada, housed at Carleton University's Sustainable Energy Research Centre, assessed provincial energy efficiency policies and outcomes introduced or implemented between January 2019 and June 2020. Provincial scorecards are provided, covering five policy areas: Energy Efficiency Programs; Enabling Policies; Buildings; Transportation; and Industry. British Columbia and Québec retained the top two spots in the overall rankings. British Columbia continues to lead in both Enabling Policies and Buildings, and Québec again places first in Transportation. Overall, energy efficiency improvement was less than 2% and also less than the 3% target for Canada. The energy efficiency methodology, data on program spend, and recommendations provide helpful reference material for policymakers and energy efficiency sector professionals.

(IS-2021-63) Identified & Authorized: Sneaking Past Edge-Based Access Control Devices

This September 2020 paper from Trend Micro Research September 2020 examines the capabilities and security of new access-control devices based on edge computing architecture. Many popular access control solutions based on biometric technology are more secure and less prone to issues such as credential theft and fraud than traditional security solutions. However, biometric authenticators are usually computationally heavy. Offering an alternative approach is edge computing, a distributed architecture design that places computing nodes at the edge of the network. This brings them much closer to information-gathering sensors and devices, thereby eliminating the need to send large amounts of data to computational services in distant locations. The analysis concludes that many edge-based access-control devices are fully capable of controlling access through facial recognition, but they lack basic security features. Manufacturers should apply the necessary guidelines and measures to make sure that these devices are as secured and protected as possible.

(IS-2021-62) the Time is Now for a Holistic Approach to Assessing Smart Buildings

This April 2020 position paper from TIA discusses the need to define smart buildings, identify gaps in existing measurement methods, and develop preliminary assessment criteria. Those criteria, to support the objective of holistically measuring building technology and performance, should encompass six primary smart building operational categories, the authors write: connectivity, health and wellbeing, life and property safety, power and energy, cybersecurity and sustainability. Buildings are to be scored on a sliding scale and their operators provided with the information and guidance they need to improve scores all building lifecycle stages. The TIA launched the new SPIRE program for smart buildings recently, and are currently running SPIRE pilot buildings.

(IS-2021-61) Transparency, Digitization, Decarbonization: The Imperative for Transparent,

Sustainable and Resilient Real Estate

The 11th edition of the Global Real Estate Transparency Index (GRETl), produced jointly by JLL and LaSalle Investment Management, was released in July 2020. With data from 163 cities in 99 countries and territories, the report provides a comprehensive survey of the availability and quality of performance benchmarks and market data, governance structures, regulatory and legal environments, transaction processes and sustainability metrics. GRETl is intended to guide cross-border investors, developers and occupiers of real estate—as well as government and industry bodies looking for international benchmarks. This year’s edition was extended to quantify 210 separate elements of “transparency,” with additional coverage on sustainability and resilience, health and wellness, proptech and alternatives sectors.

(IS-2021-60) Addressing Subscriber Security Challenges with Comprehensive Gateway Security Controls

This Calix white paper published in May 2020 looks at current and emerging options for home Wi-Fi network security. The analysis describes various security solutions that subscribers can purchase, such as endpoint security software and standalone cybersecurity hubs. These options, however, come with significant limitations, the white paper notes. Given those drawbacks, service providers can integrate best-in-class technologies like PUF, WPA3 and software-based security controls in the residential gateway, it is argued. This approach ensures “complete protection at the network perimeter” while minimizing the impact on performance and maximizing the subscriber experience, the authors write.

(IS-2021-59) Changes in SSL Device Efficiency and Optical Performance Under Accelerated Aging Conditions

This report for the U.S. Department of Energy’s solid state lighting technology division came out in June 2020. Lighting application efficiency (LAE) describes the efficient delivery of light from the light source to the lighted task and is viewed as a new frontier—increasing energy savings with solid-state lighting (SSL) technologies. A LAE framework that takes into account light source efficiency, optical delivery efficiency, spectral efficiency, and intensity effectiveness is discussed. This research focuses on a sampling of the available SSL products that can be broadly defined as having modified spectral output; the method of spectra modification has a significant impact on light source efficiency and long-term optical delivery and spectral efficiencies. Enhanced optical performance came at the cost of reduced light source efficiency for the lamps and light engines examined in this study.

(IS-2021-58) Multi-Tenant Datacenters and Sustainability

This September 2020 study by 451 Research based on primary-research survey data assesses the market dynamics of a key enterprise technology segment. In the coming years, major technology players and their datacenter providers will need to demonstrate they are working aggressively to improve their sustainability practices. IT vendors and cloud service providers are instrumental in achieving a smaller environment footprint by improving efficiencies across industry, including

enterprise IT. To gauge how this segment views the importance of sustainability measures in datacenter operations, 451 Research was commissioned by Schneider Electric survey MTDC operators. The resulting study is based on more than 800 datacenter service providers globally.

(IS-2021-57) Data Center Outlook | Outperforming Other Sectors Amid the Pandemic

This September 2020 report by JLL combines forecasts from analysts across the company's regions. According to Nareit, data center REITs outperformed other sectors amid the pandemic in total returns, due to immediate demand for e-commerce and virtual connectivity. While they have challenges with manned operations and increased demand, the report projects that data center REITs will continue to outperform other sectors throughout the year. Operators with diverse tenancy have been largely unscathed from direct COVID-19 impacts. Other operators, such as QTS and CyrusOne, have set record revenue backlogs.

(IS-2021-56) Energy End-Use Data Collection Methodologies and the Emerging Role of Digital Technologies

This publication is authored by the Energy Data Centre (EDC) of the International Energy Agency (IEA) and released in October 2020. The paper explores the role of new and digital technologies for energy end-use data collection. It reviews applications, strengths, and weaknesses of the major existing technologies, dividing them into three broader categories based on whether the purpose is data collection, data management, or data analysis. The case studies and analysis provided may serve as a starting point for energy statisticians and energy efficiency experts in guiding the design, and/or informing the implementation of new technologies for data collection.

(IS-2021-55) Building Analytics Comparison Guide

This December 2020 report by Dennis Krieger of Clockworks Analytics and James Dice of Nexus Labs examines and compares the range of tools available to O&M teams, from building automation system (BAS) alarms to fault detection and diagnostics (FDD). This paper tells the story of that second "D" and why it is so important. To illustrate, the example of a large air handling unit experiencing several issues is examined. The paper concludes by issuing a challenge to the industry: building owners need FDD, not just FD.

(IS-2021-54) The Post-COVID Recovery: An agenda for resilience, development and equality This 2020 report was published by the International Renewable Energy Agency (IRENA). It

makes the case that action on clean energy can be instrumental in the post-pandemic period to strengthen the economic recovery, bolster sustainable development and ensure carbon emission reductions. This report provides practical insights, options and recommendations for governments to consider. It is intended to support informed policy-making as countries devise recovery measures specific to their circumstances.

(IS-2021-53) Sharing Knowledge on Electrical Energy Industry's First Response to COVID-19

This 2020 report from IEEE's PES Industry Technical Support Leadership Committee (ITSLC) examines how the electrical power and energy industry has been dealing with emerging challenges resulting from the pandemic. It compiles the results of a survey carried out to identify the type of mitigation measures and practices implemented by some electric utility operators around the globe to keep workforces safe and mitigate technical issues that might occur.

IS-2021-52) Framework Document on a Transformational Plan for the Built Environment

This November 2020 report by Holger Wallbaum and Colin Fudge was presented at the World Sustainable Built Environment online conference Beyond 2020. Its main purpose was to provide clear guidance to the global built environment and interconnected sectors such as urban planning, urban design, urban landscape and green infrastructure to achieve the UN's Sustainable Development Goals by 2030. All these sectors are critical in capturing life-cycle assessment at the neighbourhood, city and regional level, the analysis show. Specific initiatives with measurable activities and outcomes in nine areas are provided.

(IS-2021-51) Transforming Data into Action

This October 2020 report from Northeast Energy Efficiency Partnerships (NEEP) is subtitled "A report on how benchmarking data can be used to achieve deep energy savings." It highlights the importance of energy benchmarking to understand energy usage across city and state jurisdictions, which is helpful in developing strategies to achieve climate goals. Interactive energy dashboards and maps, home energy scores, building performance standards, and policy guidelines are discussed.

(IS-2021-50) Interpreting Global Energy Scenarios for Emissions Planning at the Utility Scale

Researchers at the University of Wisconsin-Madison were asked by the primary utility company in Madison to evaluate IPCC scenarios relevant to its operation (Intergovernmental Panel on Climate Change). The resulting report published in November 2020 focuses on the application of IPCC scenarios to the Madison Gas and Electric Company's planning to reduce carbon emissions. The analysis makes clear that when applied to specific goals at the organizational level, electricity demand and carbon intensity of generation affect carbon emissions.

(IS-2021-49) The New Era of Energy Management - How to Reduce you OpEx While Achieving Sustainability

This report by ABB was published in March 2020. It outlines the need to measure and monitor electrical systems to obtain real-time data which, when coupled with robust energy modelling reveals patterns and opportunities to better manage energy waste. The authors discuss energy bill verification; multi-utility validation; load profiling; multi-site comparison; and optimized equipment performance. Implications for the integration of SaaS, AI and machine learning are discussed.

(IS-2021-48) IoT Connectivity Buyer's Guide

This report was released by Aeris in October 2020. The analysis is intended to help organizations to evaluate cellular IoT connectivity providers against the critical dimensions of coverage, support, cost control, and security. The authors focus on the specific capabilities that “make or break” IoT deployment success at scale and their analysis could be of interest to engineers, technologists, system integrators, wireless carriers, and business owners/directors deploying IoT devices and systems.

(IS-2021-47) Lighting Control in Patient Rooms - Understanding Nurses' Perceptions of Hospital Lighting Using Qualitative Methods

This article from Health Environments Research & Design Journal (August 2020) is by Lindsay McCunn from McCunn & Associates Consulting. Findings underlined that controllability was among the “best” lighting attributes—although more refinement is necessary for optimal staff productivity and patient satisfaction—and daylighting was also considered to be among the best attributes. The study also found that “trespassing” of light is an issue. more attention can be paid to the ways in which window shades, and light sources outside of rooms, penetrate spaces and affect users. Qualitative analysis of four hospitals with results on lighting control is provided.

(IS-2021-46) State of the Ecosystem Report

This July 2020 report by the Z-Wave Alliance focuses on smart home and connected technologies both inside and outside of the home. The authors discuss the current state of smart home technology, current and future trends, opportunities, and the developing role of Z- Wave in smart homes. The report will be of interest to smart home technology distributors and installers, companies providing home accessibility solutions, and system integrators.

(IS-2021-45) Macro Grids in the Mainstream - An International Survey of Plans and Progress

This November 2020 report is by James McCalley and Qian Zhang from Ohio State University. Their analysis identifies the value of developing inter-regional transmission and macro grids in the U.S. An extensive global comparison is presented, along with a cost-benefits analysis, engineering design options/requirements and a discussion of three characteristics said to be essential for successful implementation. The authors lay out a 21st-century vision of macro grids with various possible scenarios.

(IS-2021-44) Smart IoT Applications and Environments: Key Antenna Considerations in Designing Your Smart Ecosystem

This report was prepared by TE Connectivity and published in September 2020. It covers technological challenges, explores specific demands, and shares considerations for selecting the optimal antenna for IoT applications. Highlights of the discussion center on how the growing use

cases of IoT are posing challenges for wireless connectivity and insights on smart building and smart tracking applications trends and challenges. The report will be of interest to wireless operators, antenna manufacturers, engineers, technologists, and system integrators.

(IS-2021-43) Facility Services Now: Results from the 2020 CMM In-House Facility Management Benchmarking Survey

This report was authored by Amy Richardson from Cleaning & Maintenance Management and released in March 2020. Results of a survey of in-house service providers and facility managers conducted prior to the pandemic are presented. Top concerns included health and safety; improving facility image; security; improving productivity/efficiency; and staff training. Additional detailed survey information regarding cleaning and maintaining facilities is provided.

(IS-2021-42) Foundational Cybersecurity Activities for IoT Device Manufacturers

This May 2020 report was released by the National Institute of Standards and Technology (NIST). The report describes recommended activities related to cybersecurity that manufacturers should consider performing before their IoT devices are sold to customers. These “foundational cybersecurity activities” can help lessen the cybersecurity-related efforts needed by customers, which in turn can reduce IoT device compromises and attacks carried out using compromised devices. The topics include assessment of customer needs and goals, communication with customers, and device support issues. The report will be useful to manufacturers of IoT devices, engineers, technologists, and IoT system integrators.

(IS-2021-41) Why Digital Twins Are Critical to the Industrial IoT

This June 2020 report from Juniper Research centers on the application of virtual models in Industrial Internet of Things (IIoT) applications to detect issues, advance both learning and understanding, as well as to test and simulate scenarios in the physical model counterpart. The topics include key drivers, values, and challenges associated with implementation of digital twins (virtual and physical models). The target audience for the report includes engineers, technologists, IT professionals, and system integrators.

(IS-2021-40) Luminaire Level Lighting Controls Replacement vs. Redesign Comparison Study

This September 2020 study by University of Oregon researchers summarizes the results of a field study which compared Luminaire Level Lighting Controls (LLLC) to Networked Lighting Controls (NLC). Specifically, the research set out to determine if LLLC systems, applied as one-for-one (1:1) replacement retrofit solutions, can provide lighting energy savings and lighting quality comparable to more comprehensive networked lighting control (NLC) redesign solutions. The latter also require significant cost investment in design, specification, and install. Cost data indicates LLLC savings of one-third to one-half the cost of more comprehensive NLC solutions. Methodology and detailed analysis are provided.

(IS-2021-39) 2020 Energy Efficiency Indicator Survey

Johnson Controls released the results of its annual Energy Efficiency Survey in December 2020. Half of organizations plan to increase investment in energy efficiency, renewable energy and smart building technology in 2021, the analysis showed. Surprisingly, facility energy usage in 2020 dropped little despite lower occupancy rates. 79% indicate data analytics and machine learning will have a very significant impact on buildings. 70% will have one or more net-zero facilities in the next ten years. The authors provide a discussion of current funding mechanisms.

(IS-2021-38) Enable Operational Agility with a Digitally Connected Workforce

This report authored by Peter Bussey, Matthew Littlefield and Vivek Murugesan from LNS Research was released in December 2020. This research focuses on how industrial organizations are implementing “connected worker” initiatives as a core pillar of their industrial transformation programs. Results point to a new focus on increased operational agility; improved safety, productivity; and improved performance and profitability. Actionable recommendations and a solution architecture are provided.

(IS-2021-37) DERMS Fact Versus Fiction - Debunking Six Myths About DER and DERMS

This report by Peter Asmus of Guidehouse Insights was released in December 2020. Distributed energy resource management systems (DERMS) run algorithms frequently and quickly to keep the distribution grid in balance. This report defines six key aspects of enterprise DERMS, and their relationship to Advance Distribution Management Systems (ADMS), Virtual Power Plants (VPP) and Distributed Energy Resources (DER).

(IS-2021-36) Crisis-Tested IT Teams Accelerate Digital Agility Plans

This report from IDG Communications was released in September 2020. A survey of 100 IT decision-makers revealed that those who were already engaged in some stages of digital transformation believed that their investments left them better prepared and able to cope with widespread disruptions of normal business operations. 74% of companies have elevated IT leadership to the executive team recently. The analysis also projects that nearly half of knowledge workers will work from home after this crisis. 45% will change both their IT priorities and investment levels. Survey results of future infrastructure-oriented technology initiatives are also provided.

(IS-2021-35) Transactive Energy Market for Energy Management in Microgrids

This April 2020 article in the academic journal *Energies*, by researchers from Monash University in Australia presents a transactive energy market (TEM) framework for implementation within microgrids. The TEM facilitates the integration of distributed energy resources (DER) into existing electricity networks and orchestrates energy management and energy trading through appropriate market mechanisms. An efficient solution is required to ensure DER owners are incentivized to participate, especially in countries such as Australia, where there is 21.6%

installed grid capacity of roof-top PV systems. The report discusses pricing mechanisms and market scenarios and concludes with a case study for the TEM as it would apply in a real-world example - the Monash University microgrid.

(IS-2021-34) OpenVault Broadband Insights Report

This report from OpenVault was released in September 2020. This report highlights continued growth among “power users” who consume 1 TB or more of data, the steady migration of subscribers to faster speed tiers, and revenue implications for broadband service providers. Average monthly data consumed at 384GB was up 40 percent in the third quarter of 2020 vs. over the same period in 2019. Although flat since the second quarter of 2020, 8.8 percent of subscribers consumed more than 1TB, compared to just 4.2 percent in the third quarter of 2019. Comparisons between flat rate billing and usage base billing, and between North American and European data usage are provided.

(IS-2021-33) Building the Case for Net Zero

This report was authored by Karl Desai, Richard Twinn, and Alexandra Jonca from the UK Green Building Council and published in September 2020. The report presents the findings of a feasibility study that highlights real-world implications for achieving new net zero buildings. It illustrates how new buildings can be designed to reach net zero performance targets and the effect this has on cost. The report is useful to builders, building owners, engineers, architects, and designers.

(IS-2021-32) Network Convergence

This August 2020 report by CommScope, subtitled “Building a smart, simple infrastructure with advanced network capabilities,” sets out a strategic approach for planned and building network convergence. By embracing such an approach, operators can solve issues of network complexity with “one smart, simple network architecture which provides a common network to handle today’s demand.” Topics include enhanced mobile broadband and the path to convergence, planning and building for convergency, and the many ways convergence transforms an operator’s network. The report will be of interest to engineers, technologists, IT professionals, wireless operators, and network service providers.

(IS-2021-31) Rural Broadband Valuations Remain High as Investors Move Down Market for New Opportunities

This report by economist Jeff Johnston of CoBank ACB was released in September 2020. With the accelerated need due to COVID to improve broadband access to under and unserved rural markets, investor interest is growing. The \$80B government commitment to infrastructure spending will contribute to the market support for high valuations of fiber-based operators. Low earth orbiting satellites are not anticipated to have a significant impact on these valuations in the near future. Overall, the abrupt shift in 2020 to working from home and remote learning has significantly increased high-speed data subscriptions, representing a new catalyst for the

broadband market.

(IS-2021-30) Rural Broadband – 8 Actions to Ensure Fiber Deployment Success

This report from Black & Veatch was released in November 2020. Twenty three percent of rural Americans do not have access to fixed high-speed broadband. To help close this gap, the U.S. is prioritizing rural broadband, enabled by fiber, to connect rural citizens and foster much-needed innovation across rural services, businesses, and industries such as healthcare, education, and agriculture. Rural electric co-ops can take a leading role in fiber deployment. The authors list eight recommendations designed to remove hurdles, accelerate implementation, and minimize costs. Case studies are provided.

(IS-2021-29) Performance Incentive Mechanisms for Strategic Demand Reduction

This February 2020 report from ACEEE defines performance incentive mechanisms (PIMs) for strategic demand reduction (SDR) as “megawatt reductions comprised of energy efficiency and demand response that aim to minimize system costs by displacing the need for services traditionally provided by the supply side.” A new generation of SDR PIMs is on the rise, driven by a need for flexibility at times of peak demand and a shift toward more variable generation. Thirteen states have an SDR PIM in place for at least one utility. A review of case studies demonstrates that PIMs can be an effective strategy for incentivizing SDR. Key remedies are proposed to unlock SDR, which the analysis indicates is largely untapped, reaching nowhere near the potential cost-effective load flexibility.

(IS-2021-28) Impacts of the E-QUIP Tax Proposal

This report authored by Lowell Ungar, James Barret and Chris Perry from ACEEE was released in December 2020. This report estimates the cumulative impacts from the Energy Efficient Qualified Improvement Property (E-QUIP) proposal would be: 130,000 net additional job-years; \$15B in energy-bill savings (NPV); \$11B additional business and federal investment; and 100M tons of CO2 emissions avoided. Detailed analysis including assumptions is provided.

(IS-2021-27) Building Opportunities for the New COVID-19 Reality

This July 2020 report by Impact Infrastructure, Inc. explores HVAC systems and their role in reducing the airborne transmission of COVID-19. Best practices for HVAC usage within the built environment set out by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) and REHVA (Federation of European Heating, Ventilation and Air Conditioning Association) are discussed. It also discusses Cost Benefit Analysis (CBA) and provides a case study to showcase how to evaluate investments into recommended HVAC strategies.

(IS-2021-26) Tomorrow's Smart Connect Products Require Smarter Connectivity Services Today

This report by James Moss from ABI Research was published in November 2020. It examines the role of Connectivity Management Platforms (CMPs) and global connectivity coverage solutions. The evolving needs of—and challenges faced by—operators and enterprises are discussed. Recommendations, with a case study, for next generation CMPs are provided.

(IS-2021-25) The Smart Home Floor Plan - Three Key Device Strategies

This report authored by Steven Jones and James Moar from Juniper Research was released in November 2020. It provides an overview of the smart home market and discusses aspects such as device forms; smart home value chain and product strategies; disruptive technologies; and portfolio diversification options. The number of global installed smart home devices is forecast to rise to 13.5 billion by 2025. Additional research is available, including related to market trends; five-year forecasts; strategic analysis; and vendor strategies.

(IS-2021-24) Tech Giants Collaborate to Create Digital-Native Smart Building

This report from Microsoft was prepared in July 2020. The discussion outlines the value of creating a digital twin of a building's physical space and operations on a modern platform that allows a safer and more secure integration of sensors and devices as technologies evolve. Energy and maintenance costs are reduced, design is improved, space is optimized and the overall user experience is enhanced. A user case study is provided.

(IS-2021-23) Residential Security Market Trends

This November 2020 Park Associates research report was commissioned by the Electronic Security Association (ESA) and sponsored by Resideo. It provides an analysis of residential security trends related to competition, attach rates and the market impact of COVID-19. Findings include: home ownership (34%) and professionally monitored security systems (31%) continue to increase; 76% of security system purchasers want interactive services while 63% want a self-installed system; and 35% of broadband households are extremely concerned about their household's safety and security. Resideo and Parks Associates are CABA members.

(IS-2021-22) IoT - The Internet of Transformation 2020

This report was authored by Markus Rothmuller and Sam Barker from Juniper Networks and published in April 2020. The report presents an overview of key factors regarding IoT deployment. The main topics include market challenges, strategic recommendations, IoT industry leaders, and total connected IoT units. Vendors must implement security procedures that are highly scalable and can cope as network architectures become increasingly complex, the author note.

(IS-2021-21) Forecast Outlook for Residential Security and Add-On Devices

This report was authored by Brad Russell from ESA Research and published in October 2020. The

report examines new trends regarding residential security monitoring and devices to help security companies grow their business. The main topics include projected growth trends in professionally monitored security subscribers, consumer interest in home control services, and smart home devices. The report will be useful to security company owners, IT professionals, technologists, and system integrators.

(IS-2021-20) Artificial Intelligence in the Field of Building Automation

This report from November 2020 is by Michael Kröder and Graham Martin from EnOcean Alliance and the IGT Institute. Their analysis covers the application of cloud-based artificial intelligence (AI) for building automation. The main topics include cognitive buildings, AI learning process, and applications. The report will be of interest to building owners and managers, IT professionals, engineers, and system integrators. EnOcean Alliance is a CABA member.

(IS-2021-19) A Review of Existing Test Methods for Occupancy Sensors

This report was published in August 2020 by the U.S. Department of Energy. It presents the results of a literature review regarding test methods for evaluating occupancy-sensor performance and categorizes those methods according to which spatio-temporal properties they were able to discern. The reviewed articles are representative of research published over the past 20 years.

The authors provide a technical discussion of the methods as well as suggestions for future test-method development.

(IS-2021-18) Financing a Net-Zero Economy

This October 2020 report from Ceres examines the impact of climate risk on loan portfolios of the largest U.S. banks. Over half the syndicated lending of major U.S. banks is exposed to climate transaction risk due to inadequate preparation for emissions reductions in line with the Paris Climate Agreement, the analysis shows. Banks may face substantial losses from this direct exposure. Incremental climate risk and the financial system's interconnectivity could result in balance-sheet contagion. Detailed analysis, case studies and modelling are provided. Recommendations include actions to assess and disclose risk; improve measurement and decision-making tools and methods; and act to mitigate climate risk and its ultimate impact.

(IS-2021-17) Transforming Smart Building Technology

This white paper from Planon from July 2020 discusses how real-time integration of smart building technology with an Integrated Workplace Management System (IWMS) enables better management of energy costs and improved efficiency. The systems bring together features of building modeling, computer-aided facility management, building management, and fault detection diagnostics within the IoT ecosystem of a Smart Building. A real-time and dynamic integration of a smart building technology platform with an IWMS offers the potential to boost ROBy monetizing the combination of the technical building setup and the functional business

context.

(IS-2021-16) Wireless Lighting Control – Simple to design, Cost-Effective, and Flexible

This report from Lutron published in July 2020 discusses the merits of wireless lighting control, which removes the need for communication wires and allows for fewer power wires and less conduit. Wireless lighting control makes it possible for cost and complexity to be reduced, while design/ installation flexibility and scalability are enhanced. Another significant feature of wireless systems is that the keypads, sensors, and remotes are often battery powered, further eliminating cost and complexity while expanding the opportunity for installing flexible control wherever it is needed in the space.

(IS-2021-15) LoRa Devices: Smart Home Business Case Overview

This August 2020 report from Semtech discusses the merits of LoRa devices and the LoRaWAN protocol to address the connectivity challenges of traditional platforms. LoRaWAN-based networking is a platform of choice for low-power, wide areas networking (LPWAN)-based IoT solutions, the report notes. Applications and case studies discussed in the report include water leak detection, senior care in the home, precision gardening and antique & art preservation.

(IS-2021-14) Transition Faster Together

Subtitled “Setting the scene: Solutions, strategies and policies for a clean energy future,” this report was authored by Ditlev Engel from DNV GL - Energy and published in September 2020. It outlines the need to transition the energy economy and deliver on sustainable development goals. Ten measures to achieve this transition are discussed, including solar, EV charging, green hydrogen, rail expansion and carbon capture. The technology solutions proposed cut across three vital areas: renewables, power grids and energy use and efficiency.

(IS-2021-13) Guide for Sustainable Projects

This report was prepared by The American Institute of Architects and published in September 2020. It provides general background information on topics of interest to those pursuing sustainable projects, and explanation of new provisions in AIA's recommended approach to sustainable projects. Four main topics include: general background about sustainable projects; Sustainable Projects Exhibit; sustainable considerations in AIA Agreements; and a discussion of an example of a Sustainability Plan. AIA's resources aim to “advance, disseminate and advocate” for design practices that integrate built and natural systems and enhance both the quality and environmental performance of the built environment.

(IS-2021-12) COVID-19 Impact - Offices Will Find a New Purpose

In July 2020, JLL reported on a global survey of 3,000 employees from diverse industries focusing on the importance of physical office space in ensuring organizational success in the post-

pandemic world. Tackling this challenge demands a rethinking the office as a social hub, a shift from merely “surviving” to “thriving” in remote-work arrangements, and ensuring that the workplace functions “elastically” but still as a single community. Key findings outlined in this report include: the need for hybrid/elastic models; “tech empowerment” as a significant booster of productivity; the home work environment’s crucial role in productivity; offices as “anchors” to corporate culture; and the new imperatives of flexibility and empowerment. This report will be of interest to office planners, building innovators and building occupants.

(IS-2021-11) Characterization and Analysis of the Energy-Reporting Accuracy of Connected Devices

The authors of this June 2020 report, from the Pacific Northwest National Laboratory for the U.S. Department of Energy, Energy Efficiency and Renewable Energy explore the energy-reporting accuracy of market-available connected electrical outlets. The results of the study and subsequent related work may be relevant to stakeholders in industry-specification and standards- development organizations. The research methods employed could inform test- and measurement procedures and performance classifications for connected outlets, lighting products, and other building systems capable of reporting their own energy consumption.

(IS-2021-10) Cable Companies and Municipalities: Natural Smart Community Partners

This report from Connected Communities LLC was published in 2020. It makes the case that cable companies are uniquely well-positioned to help a growing ecosystem of smart community partners advance their objectives. They possess both dense network infrastructure across large service areas, and valuable experience deploying and managing wired and wireless networks designed to solve complex connectivity challenges. The analysis and case studies highlight that rather than approach partners with a one-size fits all approach to smart community deployments, cable providers are working with organizations to co-create approaches that best achieve common goals.

(IS-2021-9) Guide to Electric Vehicle Charging in Multi-Residential Buildings

This 2020 report from Pollution Probe and The Delphi Group sets out to demystify the process of installing electric vehicle (EV) charging infrastructure in multi-unit residential buildings. Looking at both new and existing buildings, the research explores key technical considerations, potential challenges and opportunities, stakeholder roles and responsibilities, and regulatory instruments. The report should interest building owners and managers, policy makers, as well as condominium boards and others involved in the planning and installation of EV charging stations.

(IS-2021-8) Industry Perspective: Understanding Barriers to Smart Grid Adoption This September 2020 report from the MaRS Discovery District, *Industry Perspective:*

Understanding Barriers to Smart Grid Adoption, was prepared with support from Natural Resources Canada. The research used stakeholder interviews and secondary research to highlight key challenges and barriers facing the smart grid sector. The authors describe changes

that will be needed in the areas of policy and regulation; business models and market structure, energy sector culture/customer awareness; and technology and digitization. The report is intended for market players and policy makers focused on energy efficiency and smart grid development.

(IS-2021-7) The State of IoT and Smart Buildings

This report from April 2020 was led by Smart Energy Decisions and sponsored by Siemens. It provides a baseline of where the industry is today and what the current trends in building energy management and control could bring. Respondents were surveyed about current IoT deployments, key drivers, barriers encountered, and rewards realized—both intentional and unintentional—with connected facilities. The gap between legacy systems and new digital connectivity, and lack of internal knowledge to achieve corporate buy-in, are cited as prohibiting factors.

(IS-2021-6) The Case for Deep Retrofits

The size, scale, and condition of multi-residential buildings should make them a key target segment for scaling up deep retrofits, notes this August 2020 report from the Atmospheric Fund. The authors write that current business case evaluation for energy retrofits places an overwhelming emphasis on simple payback based on energy cost savings, at the expense of more robust Life Cycle Cost Analysis (LCCA). It is argued that incorporating financial metrics like Net Present Value and Internal Rate of Return would improve the accuracy of business case evaluation.

(IS-2021-5) National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy

This report from the National Energy Screening Project, released in August 2020, is intended to help guide the development of “cost-effectiveness tests” for more robust benefit-cost analyses (BCAs) of distributed energy resources (DERs). It sets out a systematic approach for gauging investment cost-effectiveness by consistently and comprehensively comparing the benefits and costs of individual or multiple types of DERs against each other and with alternative energy resources. The research will be of interest to those involved in energy policy, smart grid development, and protocols and standards.

(IS-2021-4) Future Energy: The Technologies Shaping the Energy Transition

This August 2020 report by Wood Mackenzie Limited highlights technologies needed to achieve a decarbonised future. Challenges and opportunities linked to *green hydrogen*, and what might need to change to make this technology a leading decarbonization strategy are discussed. The research goes on to explore the growing potential of *carbon capture and storage* in decarbonization strategies. In reference to *zero-carbon heating*, the report asks if heat pumps could soon displace gas in homes. Finally, the report discusses *offshore wind* as a zero-carbon technology that continues to attract major capital.

(IS-2021-3) No Capital Needed: Your Guide to No-Cost Energy Projects

This report by Enel X published Sept 2020 notes that as the grid adapts to new realities, utilities and electric grid operators are making changes to their rate structures and market rules. They are imposing new and increasingly complex charges on their customers' bills, and offering financial compensation for large energy consumers that help alleviate some of their most complex challenges. For commercial- and industrial (C & I) energy consumers, this creates incentives to invest in distributed energy resources (DERs) that can manage facility exposure to the high costs of consuming energy from the grid. New opportunities could emerge for flexible financing options to help C&I energy consumers integrate and upgrade DERs to capture that value without taking on the risk of a capital investment.

(IS-2021-2) Three Essential Elements of Next-Generation Building Management Systems

This July 2020 white paper by Schneider Electric notes that building stakeholders face increasing pressure to save more energy, reduce costs, and maintain availability—all while enhancing occupant experience and well-being. “Achieving these varying objectives is best solved by a new type of building management systems (BMS) that goes well beyond HVAC controls.” The authors argue that these modern next-generation BMSs benefit stakeholders by being a more open integration platform that uses IoT, cloud computing, data analytics, and artificial intelligence technologies to get more out of available resources and connected systems. The paper will be of interest to building owners, facility managers, and system integrators.

(IS-2021-1) Smart Buildings: A Foundation for Safe, Healthy and Resilient Cities

This blueprint by the Smart Buildings Super Cluster released in August 2020 aims to inform smart city stakeholders about the design of smart buildings within the broader framework of the smart city. The discussion centers on the smart building, exploring how smart buildings can be deployed to advance diverse smart city objectives. These include accelerating the deployment of smart city, Internet of Things (IoT) enabled, connected infrastructure; infusing robust and adaptive features into the smart city infrastructure through integrated smart building designs; and providing a roadmap to sustainable advantage and ROI for communities that adopt this approach. The report will be of interest to policy makers, municipalities, developers, integrators, property owners, and managers.

(IS-2020-187) 7 Ways Technology Will Transform Buildings in the Next Decade

This June 2020 report is by 75F. It has been roughly 15 years since new technology has been applied to building energy management systems (EMS), and within those years, technology has evolved significantly. Because of this, across the industry EMS systems are being supplanted by additional software layers and complexity to help understand the equipment installed in place and how it can be optimized. In comparison, a predictive solution that leverages cloud-based algorithms can provide a building solution that enables everything within the envelope to function more efficiently, save more energy, and increase occupant comfort. The report will be

of interest from the perspective of energy management, building operations, large buildings controls/automation, and analytics.

(IS-2020-186) Customer Preferences Dictate the Future of Smart Home Business Models

This report was authored by SmartEnergy IP™ and published in 2020. The analysis draws on the results of two surveys of 5,000 adults conducted in the U.S. prior to and during the COVID period, with the aim of understanding consumers' smart-home preferences and identifying potential business opportunities for utilities in the connected-home market. Results showed that energy management is a key driver for consumer adoption of smart home technology; thermostats ranked first on a list of home products favored by consumers, followed by security and lighting. The paper concludes with a discussion of the critical role of utilities in rolling out smart home solutions.

(IS-2020-185) Climate & Resilience: Shaping the Future of Cities

This report was authored by Gensler Research Institute in the U.S. and published in 2020. The analysis focus on carbon impact reduction of the built environment which entails both new constructions (embodied carbon) and existing buildings (operating carbon). Five core strategies are proposed for advancing climate resilience, focusing on such concepts as Reuse, Water, Energy, Materials. Specific actions within each of these categories are explained and exemplified by real case studies. Lastly, the report offers an illustration of the energy savings obtained by the building portfolio of the firm.

(IS-2020-184) PIMs for Progress

This report from Rocky Mountain Institute, published in July 2020, reviews select examples of PIMs (performance incentive mechanisms) and provides a simple taxonomy of the results to identify important lessons for future PIM development. By exploring why some PIM proposals are rejected by regulators and others are accepted, as well as what happens to PIMs after acceptance, lessons can be learned about how these regulatory tools can best be leveraged in a shifting electricity landscape. Recommendations are provided regarding the need to leverage data, align incentives, focus on outcome-based PIMs, prioritize flexibility and learning, and support stakeholder participation. Barriers to success are discussed and examples are provided.

(IS-2020-183) Training the Workforce for High-Performance Buildings

This September 2020 report from ACEEE examines how to address the current skills gap related to high performance buildings. Facility managers, building operators, engineers, equipment installers, and other onsite technicians all face new skill and knowledge demands that professionals can prevent high-performance buildings from delivering on their promise, adversely impacting their energy savings, indoor environmental quality, cost effectiveness, and long-term viability. This report has a survey of 111 building owners/managers, operators, tradespeople, technicians, and service providers, five categories of technical skills are essential for the high-performance buildings workforce.

(IS-2020-182) Why LoRawan is the Foundation for Smart Building Success

This May 2020 paper from the LoRa Alliance provides insights on the current evolution of the smart buildings market and compares LoRaWAN technology to legacy approaches. Smart buildings present an obvious sector of the market in which Internet of Things (IoT) enabled services can generate efficiencies, improved user experiences and profits. The early energy focus of IoT applications has now widened to encompass applications that support the new ways that people use the buildings they live and work in. Popular applications include room and desk sharing, individual environmental control, predictive maintenance, and many others.

(IS-2020-181) The Experts' Assessment – The Workplace Post-COVID-19

This IFMA report was prepared by Nordic Foresight and published in September 2020, with support from JLL and EPOS. What are the long-term consequences of the COVID-19 pandemic? To help organizations and its members prepare for a new future state, IFMA conducted a study based on a real-time Delphi methodology, where industry-leading subject matter experts from around the world engaged in a month-long consensus seeking debate, using quantitative and qualitative methods. The results point towards significant shifts in how organizations will operate in the future. These shifts will require complex adaptations within enterprises. Leadership, facilities management, human resources, and information technologies departments will have to develop new ways to organize and collaborate.

(IS-2020-180) Building a Case for Net Zero - A Feasibility Study Into the Design, Delivery, and Cost of Net Zero Carbon Buildings

This report was prepared for Advancing Net Zero by UK Green Building Council and published in September 2020. "Real-world" implications for achieving new net zero buildings are examined in this study that explains how new buildings can be designed to reach new zero-performance targets, and the implications for costs. The analysis discusses both design changes and cost changes for net zero offices and multi- residential buildings. Case examples and their outcomes are provided.

(IS-2020-179) Cimetrics Guidelines for COVID-19 Response

This report was prepared by Cimetrics and published in September 2020. The discussion summarizes current recommendations in the U.S. from ASHRAE and the CDC related to air distribution systems, quantifies the financial impact, and demonstrates how building analytics can be used to facilitate decision- making and operational management. Parameters for shutdowns and re-openings are discussed, along with examples.

(IS-2020-178) Mind the Gap: A Roadmap to IT/OT Alignment

This whitepaper by Tenable from September 2020 highlights that Operational Technologies (OT) are increasingly identified as targets for cyber-security threats in the Industrial Internet of Things

(IIToT) ecosystem. To address the problem by aligning Information Technology (IT) and OT environments requires an alignment of different mindsets, technologies and even approaches to the business environment. C-Suite support and oversight, along with regulatory compliance requirements, will help IT and OT to work in tandem at the level of security, technologies and processes.

(IS-2020-177) Power grids solutions, strategies and policies for a clean energy future

This report was authored by DNV-GL and published in June 2020. The analysis presents key drivers for energy transition and the current obstacles. Solutions, strategies and policies needed to achieve energy transition are presented and discussed in detail. Several interviews with electric utilities CEOs about energy transition are also presented.

(IS-2020-176) Programs to Promote Zero-Energy New Homes and Buildings

This report from September 2020 was authored by Steven Nadel from the American Council for an Energy-Efficient Economy (ACEEE). As baseline building energy codes become more stringent, a growing number of program administrators are focusing all or a portion of their new-construction programs on zero-energy buildings. This brief is intended to aid these efforts by providing information on current programs and thereby support program implementers considering zero-energy programs. The analysis discussed 20 programs (13 which are residential-focused and 7 which serve commercial buildings). The report will be of interest from the perspective of energy policy and zero-net energy programs.

(IS-2020-175) Renewable Energy and Jobs

This report was authored by The International Renewable Energy Agency (IRENA) and published in 2020. Global employment opportunities provided by renewable energy are evaluated. Employment opportunities provided by different types of renewable energy (wind energy, solar energy, hydropower, biofuels) in different countries are presented and compared.

(IS-2020-174) Energy Savings from Networked Lighting Control (NLC) Systems with and without LLLC

This report by Northwest Energy Efficiency Alliance (NEEA) was published on November 5, 2020. This report presents data from Networked Lighting Control (NLC) systems, including those with and without Luminaire Level Lighting Control (LLLC), in 194 buildings across a variety of building types in North America, with an average of 13 weeks of monitoring data per building. The study found that the average energy savings from all NLC systems to be 49%.

(IS-2020-173) Five Strategies for Making Your Building Healthy and Safe - Indoor Air Quality and COVID-19

This 2020 report from ENTOUCH presents strategies that can be applied to improve building

indoor air quality and help prevent the spread of COVID virus through HVAC systems. In particular, the analysis focuses on: 1) filtering the air, 2) managing air flow and ventilation rates, 3) controlling air humidity, 4) using ultraviolet germicidal irradiation, and 5) continuous monitoring of air quality.

(IS-2020-172) Next Steps for 5G – Survey Report

This report was prepared by Telecoms.com for IEEEExplore, Thales and CommScope and published in August 2020. Currently, 5G is on track to achieve 2 billion subscribers by the end of 2024. Yet as this survey of 70 mobile operators across 40 countries revealed, there are mixed results to date regarding performance expectations. High costs and a lack of consumers realizing “gigabit per second” speed were contributing factors. Various 5G technologies designed to address customer concerns, operational challenges, security, different ecosystems and OTT/Cloud solutions are surveyed, and future technologies and likely market implementations are discussed.

(IS-2020-171) Bank of Things White Paper — Next Generation Financial Infrastructure

This report by SPD Bank and Huawei was published in August 2020. The Business of Things (BoT) connects physical entities engaged in financial activities and digital spaces, providing data used in customer profiling, business modelling and risk management. Technological architectural frameworks, infrastructure, 5G connectivity, data storage, security and various technology and business challenges are examined. Supported by BoT, new opportunities for the next generation of financial infrastructure will arise.

(IS-2020-170) How Energy Efficiency Can Help Rebuild North Carolina's Economy - Analysis of Energy, Cost, and Greenhouse Gas Impacts

This September 2020 report from the American Council for an Energy-Efficient Economy (AEEE) sets forward six recommendations on how investments in clean energy could help mitigate the financial impact of the COVID-19 pandemic on North Carolina's economy. Analysis of energy types and their associated financial and greenhouse gas impacts is provided. The report will be of interest from the perspective of energy management and energy policy.

(IS-2020-169) The Power and Potential of Home Warranty Programs

This September 2020 report by American Water Homeowner Services notes that, from the utility's point of view, home warranty programs help to ensure that customer-owned service lines and appliances are properly maintained and inspected on a regular basis. Having warranty services also ensures higher adoption rates, and in addition, personalized offerings that are based on a customer's unique circumstances have proven to be critical, the report notes.

(IS-2020-168) Putting Customers & Climate First

This blueprint was released by Illinois' Office of the Governor in August 2020. It proposes new measures to accelerate the State's transition to a cleaner energy matrix, with new proposals that include utility reforms, consumer protections, electrification of the transportation sector, and support for clean tech companies. Under the theme of renewable energy growth, the blueprint calls for, among other items, new wind and solar energy development incentives and the deployment of energy storage systems and programs.

(IS-2020-167) Reimagining Grid Resilience

This July 2020 report from the Rocky Mountain Institute illustrates the vulnerabilities, catastrophic risks and technological challenges affecting the grid. A new framework and recommendations for addressing resilience risks are provided. A case study examining resilience options for public safety power shutoffs is also provided. The report will be of interest to industry professionals involved in recommending or monitoring energy policy.

(IS-2020-166) Powering Paradise: How Hawaii Is Leaving Fossil Fuels and Forging a Path to a 100% Clean Energy Economy

This August 2020 report from the Rocky Mountain Institute provides an overview of Hawaii's success to date in achieving its goal of moving to 100% renewable energy. The report is divided into five areas: Leadership, Rooftop Solar, Renewables, Reinventing the Grid and Reimagining the Utility Model. Three lessons emerge: willingness to experiment, clear guidance from leadership and stakeholder engagement. In 2015, Hawaii was the first US state to proclaim a 100% renewable energy target for each of its six separate island electric systems, and many other states, municipalities and utilities have since followed suit. The report will be of interest from the perspective of utilities management and energy regulation.

(IS-2020-165) Programs to electrify space heating in homes and building

This ACEEE report on space heating, published in June 2020, describes current programs designed to foster the uptake of high-efficiency heat pumps as a primary heating system, while gradually reducing the use of fossil fuels in buildings. Findings show that most of these programs in different U.S. regions target the residential sector and smaller commercial buildings. Areas with high use of delivered fuels (fuel oil and propane) are more suitable candidates for these programs since the economics of electrification work better than areas served by natural gas. The report will be of interest to industry professionals in the HVAC sector all those involved in recommending or tracking regulatory policy.

(IS-2020-164) Application of Wireless Power Transfer (WPT) in Smart Home and Building Applications

This CABA White Paper describes the key technologies, standards, implementation aspects, and current opportunities and challenges associated with Wireless Power Transfer (WPT). After decades of research, WPT has now reached the required maturity level to be used widely, but its application in smart homes/buildings will require early-stage cooperation between engineers,

architects, building owners and designers.

(IS-2020-163) IES Committee Report Germicidal Ultraviolet: Frequently Asked Questions

This report by the IES Photobiology Committee came out in April 2020 in response to COVID-19. The committee set out to provide objective and current information on germicidal ultraviolet irradiation (UVGI) as a means of disinfecting air and surfaces. Germicidal UV (GUV) refers to using ultraviolet radiant energy to inactivate bacteria, mold spores, fungi or viruses. When the process is applied in a given location, it has generally been referred to as ultraviolet germicidal irradiation (UVGI). Because of the public's concern about ionizing radiation (e.g., X-rays and gamma rays), the term GUV avoids needless concerns about a link with that type of radiation.

(IS-2020-162) CBRE Expert Perspectives on the Journey Ahead - Reopening the World's Workplaces Real estate services giant CBRE (Coldwell Banker Richard Ellis) published this article in June 2020, based on the panel presentation it held to share insights on the industry as local economies continue to reopen. From public health and mass transit, to individual wellbeing and the global economy, COVID-19 has had far-reaching effects on our society and communities at large. As the industry navigates uncertainties and the evolving pandemic, experts are rethinking, adapting and redefining what it means to reopen the economy and our work environments safely and effectively.

(IS-2020-161) "Smart Building" trends – a comparison of wireless standards for automation and control

This February 2020 report by GT - Institut für Gebäudetechnologie GmbH (The Institute for Building Technology) describes how building automation systems have evolved as more sensor data are factored into control algorithms. Value-added services using sensors to enhance environmental control, lighting, elevator maintenance, etc. are discussed. Eleven wireless communication protocols to support sensors for these applications are evaluated and scored. The top two were EnOcean (for commercial buildings and professional installation in homes) and Z-Wave (for do-it-yourself home automation).

(IS-2020-160) Potential Opportunities to Reduce HVAC Energy Using Lighting Sensors in Commercial Buildings

This June 2019 paper by the Lighting Research Center in the U.S. reports on a study examining the potential for using occupancy data from lighting systems to reduce HVAC energy use in large commercial buildings, typically buildings 100,000 ft² (9,300 m²) and greater. It reinforces the concept of employing Building Automation Systems using sensor information from one system to control other systems and having a central monitoring and control location. Challenges and energy saving opportunities on taking this approach are discussed.

(IS-2020-159) Beneficial Electrification of Water Heating

This January 2019 report by the Regulatory Assistance Project (RAP) examines electric heater heating opportunities available today and in the near future. It explores technology options for electrification of water heating such as electric resistance (ER) water heaters and air source heat pump (HP) water heaters. Each option is assessed against certain predefined criteria (e.g., saving consumers money, making the grid more flexible and emissions reductions).

(IS-2020-158) The State of IT Operations & Cybersecurity Operations 2020

General IT operations groups and IT cybersecurity teams need to work closely together to accomplish their objectives. However, their goals sometimes conflict with one another. To better understand how businesses are managing those sometimes-conflicting goals and relationships, Dark Reading and InformationWeek surveyed 115 cybersecurity and technology professionals, primarily in North America. Among those surveyed, 85% are concerned about cybersecurity, but 50% devote 2% of their budget and 25% devote 15% of their budget to cybersecurity. About half of respondents noted that cybersecurity issues are being factored into project planning.

(IS-2020-157) The Advent of Private LTE & 5G Networks

This report was authored by Harbor Research and published in April 2020. It examines business opportunities (\$200 billion by 2025) for companies deploying 5G cellular technology for a private wide area network (WAN) using licensed, shared, or unlicensed radio bands. The provider could be a 5G operator or the company could buy, install, and operate the equipment. This opens the door to on-premises 5G instead of, or in addition to, Wi-Fi, Ethernet, Bluetooth, and similar technologies. The implications of this shift for strategic decision making are discussed.

(IS-2020-156) Bridging the IT and OT Cybersecurity Divide

While OT shares some similar operating systems, network connections, digital architectures, and cybersecurity risks as IT, there is definitely not a one-to-one relationship between the two worlds, writes Peter Vescuso in this article from *Automation 2020* (April 2020). There remain many unique constraints to securing the operational world of industrial control systems (ICSs). Organizations need to open the lines of communication between IT and OT. "Experts from both domains must start to work cohesively to bolster the resiliency of the business no matter which side of the house the cyberthreats target."

(IS-2020-155) Mercku | Wi-Fi: The Definitive Guide

This report was authored by Mercku and published in June 2020. This report provides a summary of the history and technology of Wi-Fi communications for wireless Internet access. Factors affecting Wi-Fi performance are discussed, such as building materials. Differences among Wi-Fi generations are explained. The report examines advanced Wi-Fi solutions and the future potential of Wi-Fi.

(IS-2020-154) Keeping Customers Connected

This report was authored by Ericsson Consumer & Industry Lab and published in June 2020. Approximately 11,500 consumers were surveyed for their reactions to physical restrictions on movement and gatherings during the 2020 pandemic, and their use of remote connections via fixed and mobile Internet connections. They were questioned about which technology they used and the perceived benefits as a substitute for in-person meetings. The impact of emerging communications and computer-based technologies is discussed.

(IS-2020-153) JLL Seniors Housing & Care Investor Survey & Trends: COVID-19-Update

This JLL report from Spring 2020 notes that across the seniors housing and care sector, owners and operators have faced the unprecedented challenges of the COVID-19 era head-on, and are quickly and increasingly adapting to apply learned best practices that insure the health and wellbeing of their residents. To shed more light on the full impact of COVID-19 on market valuations, current and future, JLL Valuation Advisory updated its Spring 2020 Investor Survey (conducted pre-COVID-19) to reflect the sentiment and underwriting practices of market professionals.

(IS-2020-152) Four Pillars of the Industrial IoT

This report by Siemens Digital Industries Software from 2019 summarizes "Industry 4.0" based on connectivity of physical devices and enterprise systems, control, digitization for data analysis, and smart machines based on AI (artificial intelligence), IoT, (Internet of Things), and augmentation. The key benefits are reduced downtime and lower operating costs.

(IS-2020-151) Enterprises Building Their Future with 5G and Wi-Fi 6

This report from Deloitte was published in May 2020. It reports on a survey of 415 executives in the U.S. who are planning to adopt 5G cellular communications and Wi-Fi 6 in-building wireless networks. These technologies are expected to affect most companies, but not replace existing wireless technologies. Many executives see these technologies as adding innovation and a competitive advantage for their companies, primarily in efficiency, but are concerned about cybersecurity and backward compatibility.

(IS-2020-150) OT Cyber Integrity: You Cannot Secure What You Cannot See

This report was authored by PAS Global, LLC and published in February 2020. It describes the challenges of evaluating on OT (Operational Technology) installation for cybersecurity. The biggest challenge is dealing with so many heterogeneous systems. An in-depth inventory of OT systems is recommended. The paper will be of interest from the perspective of large building controls/automation and cybersecurity.

(IS-2020-149) CaGBC: Accelerating to Zero Carbon Skills Gap Report

This report was authored by the research team at the Canada Green Building Council (CaGBC)

with support from Environment and Climate Change Canada, Government of Canada and released in April 2020. This is a study examining the zero carbon building skills gaps and training needs of Canadian engineers, architects and renewable energy specialists. It puts forward solutions to address the existing gaps in the skills required to deliver zero carbon buildings in Canada. It also identifies training requirements and recommends delivery models to drive zero-carbon-building skills training.

(IS-2020-148) Building a Better World of Energy for Tomorrow

This report was authored by SSE (Scottish and Southern Energy) and published in July 2020. This is a progress report on actions taken by SSE in support of the UN Sustainable Development Goals. SSE cut carbon production, increased the production of renewable energy, and developed plans to accommodate 10 million electric vehicles. Data showing progress are presented. The report is of interest from the perspective of energy management, corporate social responsibility and climate-related disclosures.

(IS-2020-147) Smart Buildings Features and Key Performance Indicators

The authors of this 2020 report, from the Polytechnic University of Milan in Italy, write that quantifying building energy performance through the development and use of Key Performance Indicators (KPIs) is an essential step in achieving smart building goals in new and existing buildings. The analysis begins with an explanation of basic smart-building features and technologies and goes to propose a framework of performance indicators organized into nine groups. The research is of interest from the perspective of intelligent buildings performance metrics.

(IS-2020-146) IoT network slicing on virtual layers of homogeneous data for improved algorithm operation in smart buildings

Writing in the journal *Future Generation Computer Systems*, the authors examined temperature Internet of Things (IoT) devices for smart buildings. Their study used an “IoT slicing technique” to improve the ability of an algorithm to self-correct deviations when indoor temperature data is acquired by IoT networks. A case study result is provided to demonstrate the efficacy of the proposed IoT slicing method. This study will be of interest from the perspective of data architectures and IoT systems.

(IS-2020-145) Simplifying IoT at the Edge Overcoming IoT Complexity with Flexible Device Management

This report was prepared for semiconductor and software design company ARM by CIO Dive and published this year. Advances in sensor technologies and dynamic machine learning modeling drive increasing amounts of data to be collected and processed in primary applications right at the edge. IoT edge gateways connect old and new systems, empowering organizations to automate with data collection and management at the endpoints—without ever going to the cloud. Intelligent buildings and smart grids can benefit from this technology.

(IS-2020-144) How Seamless Engagement Can Bridge Silos and Drive Utility Customer Value

Vlocity and Salesforce commissioned Utility Dive's Brand Study to survey 215 retail energy sector professionals to better understand emerging opportunities for residential customer engagement. The resulting report, published in September 2020, provides examples of "seamless, coordinated, consumer- focused" energy efficiency programs most likely to increase customer satisfaction. The benefits and challenges of mapping customer energy journeys across multiple communication platforms using an integrated approach are reviewed. The results of the survey will be particular interest to utilities and industry players involved in energy management.

(IS-2020-143) Energy Efficiency in Real Estate Listings: A Controlled Experiment

ACEEE provided new data in August 2020 showing that home buyers value information on energy efficiency in real-estate listings. It was most valued (in terms of willingness to pay) by relatively wealthy and educated home buyers. Energy information in real estate listings should be presented using an intuitive energy scoring system, the authors propose. The research will be of interest from the point of view of energy management, smart utilities, and energy policy.

(IS-2020-142) How to Design Multi-User Microgrid Tariffs

This August 2020 report from the Smart Electric Power Alliance proposed a framework that may be used to guide the development of a multi-user microgrid tariff for communities and smaller groups of customers. Strategic considerations for regulators, utilities and stakeholder are described, and a detailed microgrid tariff framework is discussed. The report will be of interest to energy management and energy policy players.

(IS-2020-141) Growing a Greener Economy: Job and Climate Impacts from Energy Efficiency Investments

This September 2020 report from ACEEE was published in September 2020. The report analyzed the impact of various energy efficiency programs across the building-, transportation- and industrial sectors, with estimates for net job creation, carbon emissions reductions and energy savings. A \$83.5 USD investment would create 1.3M job-years and reduce CO₂ emissions by 906MMT, the analysis shows. Substantial energy cost savings would result, spurring the development of long-term markets for advanced green technologies/practices and creating additional economic and environmental benefits.

(IS-2020-140) Top 10 Global CRE Trends

This report was authored by Christian Beaudoin from JLL and published in August 2020. The report explores how firms can reinvent their corporate real estate strategies in response to ever-changing business priorities and a challenging operating landscape and economic environment. Top trends identified include the concept of the "augmented workplaces" achieved through digitally-enabled real estate; activation, quality and governance of "fast data" as data production

and consumption increase exponentially; and a radical rethink of performance metrics used in corporate real estate. The report's findings will be of interest to business- and building owners, architects, technologists, and IT professionals.

(IS-2020-139) Pandemics and the Built Environment

This report by the International Initiative for a Sustainable Built Environment, released in July 2020, looks at how expectations and opportunities for the built environment have shifted with COVID-19. The report explores impacts of changes in personal and household behaviour under pandemic conditions, and their impact on pathways to a sustainable built environment. Aspects of urban systems (e.g., neighbourhood features and density) are discussed in relation to pandemic and post-pandemic measures. The authors also look at key requirements for multiple building types, from building entries and shared facilities to public washrooms and lifts in high-rise buildings. The report will be of interest to building owners, contractors, business owners, health professionals, and environmentalists.

(IS-2020-138) Virtualizing the Cable Headend

Taking an in-depth look at the company's virtualization platform for broadband and video service delivery, this May 2020 Commscope report begins with an overview of cable access evolution and distributed access architecture (DAA). DAA seeks to alleviate crowding in head ends and hubs by moving some functionality to the edge of the network, typically the access nodes. While that is an important step in modernizing the cable headend, the report notes, to fully unlock the benefits of elasticity and agility, operators need to also migrate over time to a fully virtualized environment in which "the management plane, video plane and data plane are virtualized." The report will be of interest to engineers, technologists, video services providers, telecom operators, and IT professionals.

(IS-2020-137) The Hidden Drains & Drivers Impacting Your Asset Recovery

This report by PTC was released in December 2019. The report describes how manufacturers are implementing new technologies and approaches to solve the "hidden drains"—while optimizing the key drivers—behind asset efficiency. The main topics include approaches to address unplanned downtime, workforce productivity, and capital expenditures. The report will be of interest to facility owners and operators, engineers, IT professionals, and system integrators.

(IS-2020-136) Office Outlook: The outbreak of COVID 19 ground office market activity to a halt, with the path to recovery clouded in uncertainty

This report was authored by Scott Homa and Phil Ryan from JLL and published in July 2020. It focuses on the impact of the COVID outbreak on the U.S. ground office market and the uncertainty around future recovery. The main topics include key trends (leasing, sub-leasing, and occupancy losses), an overview of the industry, and market details by state. The report will be of interest to building owners and operators, renters, and investors.

(IS-2020-135) Enabling a Sustained RAN for a Greener Bottom Line

This report by Greenwave Wireless Research from August 2020 underlines that as carriers scaled network capacity and with the rollout of 5G technology, networks became more complex—with power optimization becoming more important than ever. Focusing on energy efficiency strategy for wireless networks, this paper explores aspects that operators and vendors should consider when it comes to managing energy consumption in mobile networks. The report will be of interest to operators and vendors.

(IS-2020-134) Enabling Digital Transformation with IoT Performance and Properties Measurement

This report by Fujitsu was published on May 7, 2020 by the Industrial Internet Consortium. It investigates the need to measure multiple aspects of an industrial digital transformation solution along its lifecycle and essential role of performance tracking and measurement. The analysis shows how metrics serve different purposes on the way to planning, governing and managing a solution. Engineers, technologists, IT professionals, and system integrators may find the report useful.

(IS-2020-133) Achieving a Green Recovery for China: Putting Zero-Carbon Electrification at the Core

This joint Rocky Mountain Institute / Energy Transitions Commission (ETC) report from June 2020 sets out a green stimulus package for short-term recovery and long-term growth. The proposed blueprint discusses the need for new technology-based infrastructure (5G, AI, IoT); green/energy efficient urbanization investment; stronger promotion of green consumption (EV); and accelerating funding for zero-carbon electrification. The anticipated investments and results are compared with the outcomes of previous stimulus program. This report, part of a series focused on “Green Stimulus and Recovery,” will be of interest from the perspective of investment/financing, technology development, and public policy.

(IS-2020-132) Adapting to Climate Change | For Facility Management Professionals

This 2020 report from the International Facility Management Association’s FM Research & Benchmarking Institute describes strategies that can be undertaken to help reduce the impact of climate change. The report reviews the major topics of risk management, how to conduct a climate change risk assessment, relevant climate change components, and factors that influence mitigation. The report provides models, checklists, matrices, and scorecards, along with successful use cases. This paper is relevant for facility management leaders and practitioners.

(IS-2020-131) Better Buildings: Working in Partnership for a Resilient and Innovative Energy Future | 2020 Progress Report

This 2020 report from the U.S. Department of Energy highlights successes achieved to date in

improving energy, water and waste efficiency by 950 member organizations. Progress linked to “market leadership,” “better information,” “innovation and emerging technologies” and “workforce development” has resulted in savings to date of \$5B, the report notes. The report provides an overview of various services, programs and technologies, along with a case studies, tools and additional resources. This paper will be of interest from the point of view of investment/financing, public policy, technology, and energy/water/waste management.

(IS-2020-130) Soft Landings - The Benefits to Commercial Property Owners

Published in June 2020 by the Better Buildings Partnership (BBP) in partnership with BSRIA, this report highlights the significant gap between design expectations and operational building performance of buildings which affects the energy efficiency and environmental expectations of the end user. “Soft landings” describes a proposed six-phase framework for construction professional, covering inception to post-occupancy evaluation. Illustrative examples, benefits and case studies are provided. This paper is relevant for property managers, commercial developers and commercial tenants.

(IS-2020-129) The Future of Global Office Demand

In this June 2020 white paper from JLL, the authors discuss the function and purpose of the office from the perspective of both the corporate occupier and the employee. Four key factors—remote working, office design, technology, and, commuting patterns—are described as key to shaping the future of office design. The report predicts that changing spatial patterns of office demand—already in motion prior to COVID-19—will accelerate the move toward a diverse office market ecosystem through the rise of hyperconnected major cities, suburbs and smaller cities. This paper is relevant for investment/financing, government, technology, urban planners and business leaders.

(IS-2020-128) The Impact of COVID-19 on Flexible Space

This JLL white paper from July 2020 predicts a continuing trend towards flexible space, with the potential for 30% of all office space to be consumed “flexibly” by 2030. While social distancing requirements negatively impact the profitability of the high seating density co-working model, private office spaces are anticipated to weather the storm, with remote and flexible working arrangements becoming common. The tenant- and investor-related implications of this seismic change are described. This paper is relevant for investment/financing, commercial property manager, commercial property developers, tenants and business leaders.

(IS-2020-127) The Role of Gas in the Energy Transition

The Rocky Mountain Institute highlights the importance of adapting global methane emissions standards and the need for transparent and accessible data in this March 2020 publication. As many investors, regulators and consumers continue to apply pressure for the staggered phase-out of natural gas, novel data-driven approaches to emissions visibility, as well as a robust certification standard, are required to achieve the reductions needed. This paper would be of

interest to government regulators, technology business leaders, and the energy-sector.

(IS-2020-126) Power over Ethernet: Basics 2020

This CABA White Paper describes the fundamentals of Power over Ethernet (PoE), with explanations on the technology's current state and the applicable codes and standards. PoE devices typically support sensors at every end point, and a denser sensor network enables more special customization of indoor environment conditions. It is also conceptually straightforward to make building data available to building occupants through mobile devices, and to enable their input to control decisions. These advantages promise to deliver behavioral and organizational productivity benefits based on occupant well-being.

(IS-2020-125) Overview of ESR - Operating Reserves Qualification & Technical Requirements & ARS Applicability

This report was published by the Alberta Electric System Operator in April 2020 and provides overview of the short-term qualification and technical requirements for energy storage facility participation in the operating reserves market. Applicability of Alberta Reliability Standards to energy storage facilities is also considered. The report is useful for engineers, regulators, and professionals working in the energy sector.

(IS-2020-124) One Digital World

This article was prepared in July 2020 by Black & Veatch and deals with the importance of advanced communication networks. The topics include 5G networks, safety, sustainability, mobility, clean technology, grid modernization, and connectivity. The article will be of interest to business owners, engineers, technologists, and IT professionals.

(IS-2020-123) State of Green Business 2020 Report

This report by GreenBiz Group, from June 2020, provides an annual assessment of the corporate sustainability performance of major global companies listed on the S&P Global 1200 index and major U.S. companies listed on the S&P 500® index for the State of Green Business Index. The analysts find businesses moving more quickly to “reduce the business risk that comes with these threats to natural capital and human well-being.” The report will be of interest to policy makers and businesses.

(IS-2020-122) Smart Cities Beyond the Hype - How Far Away are Truly Intelligent Cities that Improve Quality of Life for Citizens?

In this SmartCities Report published in January 2020, reports on a survey of 105 city leaders and executives from telecommunications companies, systems integrators and other suppliers. Respondents were asked for their views on how close cities are to achieving these aims and what

were the lessons learned so far. The report highlighted “constantly moving” goalposts when it comes to realising smart objectives. The results will be of interest to energy providers, technology vendors, utilities, city planners and policy makers.

(IS-2020-121) 2020 Utility Energy Efficiency Scorecard

Published in February 2020 by AEEE, this report ranked the 52 largest US electric utilities on utility-sector energy efficiency programs and policies in 2018. The report covers 20 metrics that were developed to reflect utility performance and allocates 50 total possible points across three categories. It describes how utilities are innovating to meet changing system needs, but utility business models are slow to change. The report will be of interest to policy makers, utilities, and all those involved in energy management.

(IS-2020-120) Position Statement on Germicidal UV-C Irradiation

This report released in May 2020 by the Global Lighting Association presents current UV-C safety knowledge. Topics covered include safeguards to avoid human exposure to irradiance hazards/excessive ozone concentrations and compliance criteria. The report will be of interest to technicians, technologists, engineers, lighting professionals, and users of equipment that includes germicidal UV-C technology.

(IS-2020-119) Plan B Global and Regional Strategies for the Built Environment Under Climate Change

This April 2020 report prepared by the International Initiative for a Sustainable Built Environment discusses how climate change is presenting an existential crisis to all human societies and settlements. Topics covered include buildings, urban areas, excess consumption, inefficiencies, emissions, and a need for resilience. The proposed audience for the report includes urban planners, policymakers, energy professionals, and policy makers.

(IS-2020-118) What's in Store Post COVID for Retail

This 2020 JLL Research white paper examines the long-lasting impacts of the COVID-19 pandemic on retail and consumer behaviour across thirteen retail sectors. Considerable variance is seen across retailers and sectors. Data to March and April, with projections by sector, is provided. A long “road to normalcy” is forecast. This paper is of interest from the perspective of investment/financing, public policy and retail business planning.

(IS-2020-117) Switch Consolidation - Is the Time Right?

This 2020 report from Finley Engineering provides an overview of a telecommunication switch consolidation trend and offers key considerations for carriers who may want to explore this option. Topics include regulatory implications, a need for consultation with appropriate regulatory counsel, potential savings, and types of switch consolidation. The report will be of

interest to engineers, integrators, technologists, and professionals involved in standards development.

(IS-2020-116) SSE: A Greenprint for Building a Cleaner, More Resilient Economy

This report published in May 2020 by SSE discusses a number of steps policymakers could now take to develop an innovative, low-carbon infrastructure and drive a green recovery following COVID-19 pandemic. Topics include policy proposals, net zero power systems, electricity transmission networks, electric vehicles, and green jobs.

(IS-2020-115) Smart Gas Metering

This report was published in March 2020 by Sensus and features interviews with utility professionals who have deployed gas Advanced Metering Infrastructure (AMI) to their customers, as well as vendors and consultants. It offers guidance on gas AMI deployment, including the key components of any gas AMI rollout and responds to critical questions to consider for a foundation of a gas AMI program.

(IS-2020-114) Measuring the Impact of COVID-19 on Business Operations & Purchasing Priorities Across the Net-Zero Sector

NetZero Build Summit released this publication just prior to the August 2020 conference. The results of a survey asking industry professionals for their perspectives on the future of the net-zero sector are presented. The structure of the survey allowed respondents to give their views on the prospects for the industry growth, business continuity and challenges—before, during and post-pandemic.

(IS-2020-113) Mandatory Building Performance Standards - A Key Policy for Achieving Climate Goals

This June 2020 white paper from AEEE explores building performance standards across different national jurisdictions. To date, multiple approaches exist, and different cities are pursuing a variety of different approaches suited to their community needs and requirements. It is argued that complementary policies are required to help cover costs faced by building owners, and that further analysis is needed to determine how performance standards apply in critical markets, such as affordable housing.

(IS-2020-112) Machine Learning Explained - The Three Essentials for Video Analytics

This 2020 article by Calipsa and explains the basics of machine learning, breaking down the essential elements that every system needs to get started. Information is also provided on how machine learning is applied to the Calipsa video analytics platform to make it accurate at improving crime prevention. The article will be of interest to IT professionals, computer scientists, and cybersecurity experts.

(IS-2020-111) Is Your Digital Future in the Right Hands?

This report published by KPMG in October 2019 illustrates the result of a survey about digital transformation and technology innovation in the real estate industry around the globe. It explores the drivers for digital investments, the property life-cycle stages that are most likely to see investments in IT initiatives, the current state of integration of internal systems. The report also looks at data strategies and cyber security concerns and concludes with a section on how the industry is opening up to new technology-driven business models, including Property as a Service.

(IS-2020-110) How to Bridge the IT & OT Cybersecurity Divide - Protecting Against Industrial Control Systems Threats & More

This edition of AUTOMATION 2020, published by Automation.com, focuses on how companies can be resilient in the face of cyberthreats and how to protect against threats to industrial control systems. It looks at the latest on USB port intrusion threats and previews the next big step in EtherNet/IP security. The article is intended for a broad audience, including business owners, IT professionals, engineers, and cybersecurity experts.

(IS-2020-109) Wirescore's Guide on Protecting Your Home Network from Cyber Attacks

This report was published by Wirescore in April 2020 and explains what types of security attacks are common among work from home employees during Covid-19. Recommendations are made regarding security measures that can be taken to stay protected. The report aimed at the general public as well as security professionals.

(IS-2020-108) Data Driven Metadata Tagging for Building Automation Systems - A Unified Architecture

This article was prepared in February 2020 by the National Renewable Energy Laboratory and BrainBoxAi. It presents a Unified Architecture (UA) for automated point tagging of Building Automation System (BAS) data, based on a combination of data-driven approaches. The information will be useful for building

(IS-2020-107) How Enterprises Are Managing Endpoint Security Threats

This Dark Reading report, published in April 2020, reports on a survey of 120 IT and cybersecurity professionals on their biggest endpoint security concerns—and their preparedness to deal with them. Topics covered include an overview of endpoint security issues, security polices, security apps, multi- factor authentication, the rise in security issues due to mobile end-point devices, and strategies to mitigate risks. The report may be of interest of business owners and security professionals.

(IS-2020-106) Get to the Point - Why a Point to Multipoint RF Network is Necessary

This report released by Aclara in May 2020 describes why a point-to-multipoint RF network is a necessary foundation to enable distribution automation applications of the future and for grid modernization to succeed. The topics covered include grid modernization, comparison of RF network architecture, distribution automation, and point-to-multipoint networks. The report will be of interest to utility operators, engineers, and technology developers.

(IS-2020-105) Evaluation of a green and sustainable building project

This academic paper looks at environmental assessment schemes for green buildings in China. It proposes an evaluation approach using an algorithm that takes into account the operation stage to ensure the implementation effect of the whole life cycle. A case study of a building in the city of Nanchang to test the methodology is illustrated.

(IS-2020-104) CABA Smart Home as a Service – Executive Summary

Providing a comprehensive examination of all aspects of Smart Home as a Service (SHaaS), this report set out to understand how use cases, customer environments, buying behaviors, and evolving ecosystem interactions all impact and influence the development of the connected home market. The report by Harbor Research, Inc., a CABA member, became available for purchase in the CABA Store in July 2020 at the end of a four-month embargo period. The 27-page Executive Summary of the report is freely available for download [here](#).

(IS-2020-103) An Overview of Security and Privacy in Smart Cities' IoT Communications

This report offers an overview of cyber security and privacy issues involved in the design and implementation of smart cities applications. It explains the characteristics as well as the IoT-based architecture of a smart city. Solutions and challenges are also discussed in the article, published in *Transactions on Emerging Telecommunications Technologies*, an academic journal.

(IS-2020-102) Switch Automation Makes Strides in Digital Facilities Management

This report from Verdantix, published in September 2019, is part of a series which supports real estate and facilities executives' "digitization journey." Digital facilities management software vendor Switch Automation has introduced a solution set that covers the building IoT journey from data availability to asset control, taking real estate customers from initial readiness audits to custom IoT solutions. Firms from across the commercial real estate spectrum may benefit, regardless of the state of their IoT deployments.

(IS-2020-101) Physical and Operational Security for Transfer Switches

This white paper released in March 2020 by ASCO Power Technologies/ Schneider Electric sets out an approach for evaluating device security "from the inside out." When securing transfer switches and other power system devices, a layered security model enables facilities to look

from the inside of a device outward to the various system boundaries that impact physical and operational security. The report explains how common-sense security measures such as securing equipment enclosures and rooms and applying password protections mitigate routine threats to reliable operation.

(IS-2020-100) California Power Outages: Mitigating the Effects of Planned Blackouts on Small and Mid- Sized Businesses

In 2019, a large California power provider announced that it would cut power to communities in times of extreme wildfire risk, and the ensuing blackouts caused major business disruptions and economic losses. This document describes outage impacts and presents options for installing backup power equipment at small and mid-sized businesses. While the full economic impacts of California's planned outages may not yet be fully realized, the effects on small and mid-sized businesses demonstrated a consistent pattern. Businesses without access to backup power closed and languished; those that stayed open did so by accessing secondary (sometimes off-site) power sources.

(IS-2020-99) Implications of Sustainable Features

This paper examines key sustainable features and their implications for life-cycle costing in green buildings. The impacts of sustainable features on construction costs, maintenance and operational savings are examined. The research looks at two case studies from Sri Lanka focusing on green industrial manufacturing buildings.

(IS-2020-98) Trends in Sustainable Architecture Design in the United Kingdom: A Delphi Study

This paper published in February 2020 in *Sustainable Development*, an academic journal, looks at the concept of sustainability in contemporary architectural design. It explores the attributes which characterize different approaches to sustainable building design. The research was developed through a consultation process with several sustainable architects in the UK. It seeks to provide an original typology of sustainable practice.

(IS-2020-97) Demystifying LTE and Cellular IoT Technology for Utility Companies

This report was published in April of 2020 by Sierra Wireless. It provides an overview of how LTE cellular networks can help improve grid intelligence, operations and data management; how public cellular networks compare to other communication networks (such as radio mesh, fixed point-to-point, private cellular, etc.) including technical choices for investments; and explores the future evolution of connected IoT for utilities.

(IS-2020-96) A Road Map for Successful Conversation to a Fully Electric Fleet

This Burns & McDonnell white paper provides a road map for electric utilities and transit agencies to complete an efficient conversion to electrified vehicle fleets. The following aspects

are examined: operational assessment, market analysis, energy requirements, charging needs, facility need, utility interconnection, on-site power, financial analysis and phasing implementation. The paper will be of interest to government, transportation, utility and business leaders.

(IS-2020-95) Changing the Way the Grid's Future is Planned

The report by Burns & McDonnell deals with the required transformations of the electric grid to meet the needs of current consumers. The topics covered include changes affecting the electric grid, grid planning, holistic distribution planning, grid modernization, and foundation for grid transformation. The report is useful for electric utility owners and operators, electrical engineers, policy makers, and city planners.

(IS-2020-94) Testimony by the ACEEE at Congressional Hearing on Saving Energy: Legislation to Improve Energy Efficiency and Storage

Lowell Unger, Senior Policy Advisor with the American Council for an Energy-Efficient Economy, appeared before the U.S House of Representatives Subcommittee on Energy in February 2020. His presentation examined aspects such as industrial competitiveness, building codes, the importance of saving energy, industrial assessment centers, federal energy management, and water management performance. The report will be of interest to policy makers, engineers, manufacturers, professionals working in the energy sector, and consumers.

(IS-2020-93) AHR Expo 202 Economic + Industry Report

This 2020 survey for the AHR 2020 Expo gauges 1,400 members' prospects for the new year, focusing on: areas of growth, market segments with highest performance, potential threats, challenges and opportunities. In summary, business prospects continue to be good or excellent with 70% expect growth of at least 10%. Light commercial, hospital and residential were viewed as the top segments. Maintenance/replacement, retrofit/reno and new construction are the top market prospects. Also included - eight industry sector leaders including trade associations such as CABA provide their unique views and perspectives in their areas of expertise. This paper is relevant for HVAC technology/service/suppliers and business leaders.

(IS-2020-92) DC Microgrids in Buildings

This report by CSA Group deals with trends in direct current (DC)-based distribution technology, including standards development. The topics covered include background on DC technology, industry drivers, DC microgrid case studies, codes and standards, and microgrid advantages and challenges. The report will be of interest to engineers, technologists, electric utility owners and operators, and system integrators.

(IS-2020-91) User Guide for Local Clean Energy Self-Scoring Tool, Version 4.0

This paper from the American Council for an Energy-Efficient Economy provides a

comprehensive guide for using the ACEE's Local Clean Energy Self-Scoring Tool. Policy evaluation covers buildings, energy & water utilities, transportation, government operations and community-wide initiatives. Comparisons and benchmarking tools are provided with respect to the 2019 City Scorecard. This paper is relevant for policy makers, communities, utilities and business leaders.

(IS-2020-90) Lighting Control Application Guide for Open Offices

The report by the Lighting Controls Association describes various control strategies applicable to open office spaces to minimize operating costs, achieve energy code compliance, and promote more productive workspaces. The topics covered include time-based control, manual control, vacancy sensing, daylight-responsive control, combining strategies, open workstations, flexibility and personal control, energy codes, retrofit options, institutional task tuning, demand response, and integration with building management system. The report will be of interest to building owners and operators, engineers, technologists, lighting professionals, and system integrators.

(IS-2020-89) How Utility Companies Can Reduce Operating Costs With Vehicle Area Networks

This white paper from Sierra Wireless describes how consolidating connectivity over a vehicle area network (VAN) reduces high costs for utilities, while increasing field productivity. At the heart of a VAN architecture is a vehicle-based cellular gateway or router that establishes a continuous, reliable and secure internet connection for field personnel, giving workers access to corporate applications and enabling two-way communication that keeps them productive. This white paper will be of interest to utility companies, technology developers and system integrators.

(IS-2020-88) Lighting & Lighting Controls: Following an OPR to design lighting systems This addition to the Consulting and Specifying Engineers eBook Series describes the many

factors lighting designers must consider when specifying lighting systems and lighting controls for nonresidential buildings, including the owner's project requirements. Following that section in the ebook, the authors examine commissioning light occupancy sensors. Installing lighting occupancy sensors and commissioning the devices have many benefits, including reducing operational and maintenance costs. This resource will be of interest to engineers, builders, building operators, and system integrators.

(IS-2020-87) Electric Vehicles in a Distributed Energy World

This research from Enbala explains why conversations in utility board rooms around electric vehicles are shifting dramatically. Traditionally there has been a focus on EVs as potential grid destabilizing problems. With the burgeoning EV market accompanied by a dramatic change in mindset, EVs are increasingly seen a unique opportunity to achieve heightened levels of positive customer engagement while balancing supply and demand swings and enabling new ways to participate in wholesale energy markets. The research will be of interest to researchers, technology suppliers, utilities, integrators and policy makers.

(IS-2020-86) Features and Benefits of Bluetooth Connectivity

This October 2019 report from Silicon Lab covers a variety of Bluetooth technologies, with discussion on where and why they should be used within smart homes. The topics covered include an overview Bluetooth 5, the highlights of Bluetooth mesh networking technology, multiprotocol Bluetooth and Zigbee connectivity, practical Bluetooth low energy and sub-GHz integration approaches, plug-and-play Bluetooth Xpress module for home automation, and product design. The report will be of interest to engineers, technologists, product designers, IT professionals, and system integrators.

(IS-2020-85) Creating Zero Carbon Communities: The Role of Digital Twins

This paper from Navigant and Integrated Environmental Solutions (IES) explains that a comprehensive reduction in urban emissions requires an increased focus on transforming energy use in buildings and transport, as well as a shift from fossil fuels to renewable energy sources. A holistic approach to the decarbonisation of city operations, infrastructure, and services is proposed. Digital twins have an important role to play in understanding and managing the complex integration of multiple assets and systems that characterize community-scale projects, the paper argues.

(IS-2020-84) Leveraging IoT sensors and analytics to optimize energy efficiency

This white paper from IOTA Communications explains that the energy consumption of a commercial building is continuously changing, based on a number of dynamic conditions— there is no static model of energy use. Better energy management, then, relies on having the right data at the right time, which allows building managers to be flexible and agile in their approach to energy reduction. This whitepaper discusses some of the parameters the IoT monitors and analyzes to uncover energy efficiency solutions, and describes two of the most impactful strategies organizations are implementing today—demand response and demand control. The document will be of interest to building developers, building operators, systems integrators, and technology suppliers.

(IS-2020-83) What is Li-Fi? The Evolution of Integrating Li-Fi Technology into Smart Lighting and Control Systems for the Intelligent Building

This CABA White Paper explains key differences between Li-Fi and Wi-Fi, including comparison of RF Wireless and Optical Wireless Technologies; discussion of Li-Fi and Wi-Fi IEEE/ ITU Standards and Link Speed; the benefits and drawbacks of Li-Fi; and Li-Fi applications. As a member benefit, CABA members can get White Papers developed complimentary and you can join CABA White Papers under construction or view other completed White Papers on the CABA web site.

(IS-2020-82) State of CRE Operations 3.0

With the rapid proliferation of technology in the Commercial Real Estate (CRE) industry, building

operations and maintenance is poised for disruption. This report from Facilio presents an overview of this phenomenon and presents the results of a survey of CRE leaders and facility management experts from across the US, the Middle-East and India. occupancy sensors. The authors begin by discussing how attitudes towards data-driven operations has fundamentally changed today. The report will be of interest to professionals involved in buildings operations and property management.

(IS-2020-81) Understanding Energy Efficiency as a Dynamic Resource in the Built Environment

This paper from BrainBox AI explains that dynamic modulation systems driven by Artificial Intelligence (AI) engines are the next disruptive innovation in the building industry. The traditional approach to building management has been to add intelligence to the different control systems in a building. However, these existing systems remain isolated and do not work together. By combining these systems with the outside environment and occupant behaviors, dynamic modulation represents an important paradigm shift in the world of building management by bringing together the Internet of Everything (IoE) and AI.

(IS-2020-80) Accelerating energy renovation investments in buildings

At today's renovation rate of around 1% of buildings per year, a timely transition of the EU building sector towards climate-neutral levels by 2050 cannot be ensured. This white paper from the European Commission provides a country-by-country overview of the most important public schemes identified across the EU, and investigates new private financial products in place to stimulate more energy efficiency investments in residential, commercial and public buildings. Good practices are identified based on the criteria of impact, cost effectiveness, ambition level of energy efficiency upgrades, funding sustainability/continuity, scalability and outreach to hard-to reach groups.

(IS-2020-79) Canada Proptech Journey - How Canadian companies are faring in the digital age

KMPG's International's 2019 Global PropTech Survey analyzed responses from real estate companies across the globe. identifying the latest advancements and challenges in digital adoption. This report explores where Canadian companies stand in comparison to their global counterparts. In Canada only 36% have a digital strategy with 8% company wide and 28% only in certain areas.

(IS-2020-78) Protecting Transfer Switches from Water-Related Damages

This paper from ASCO Power Technologies explains that transfer switches provide important functions by transferring loads to alternate sources when power outages occur. Both the functions they provide and the energy they manage require their safe operation. Because contact with water can degrade transfer switch condition and performance, it is important to understand how water-damaged equipment can impact facilities. Water ingress into transfer switches and other critical power equipment can impact operability, reliability and service life. This document summarizes measures for mitigating water-related risks throughout the

equipment lifecycle.

(IS-2020-77) State of Demand Side Energy Management: North America 2020

This report from CPower examines what the grid and energy markets of tomorrow will look like, with insights on what organization can do today to position for success when the future arrives. This book seeks to answer those questions with a market by market analysis of the issues, trends, and regulations the experts at CPower feel your organization should understand in 2020 to make better decisions about your energy use and spend.

(IS-2020-76) Transforming Markets for VPPs in Europe

The report was prepared in November 2019 by Navigant Research and describes how Europe is pushing the envelope on the virtual power plant (VPP) concept. The topics covered include European experiments for next generation VPPs, expanding VPP markets beyond country borders, linking energy trading to grid reliability via VPPs, and Europe's initiative to take VPPs to the next level. The report is useful for electric utility owners and operators, electrical engineers, technologists, government officials, and policy makers.

(IS-2020-75) Over-the-Top: The cloud-based path to video innovation

The report published by Amazon in September 2019 discusses the accelerating growth in over-the-top (OTT) video markets, compares hardware- and cloud-based approaches to creating live and on-demand OTT video workflows, and gives examples of organizations that architected OTT services with a cloud-centric approach. The topics covered include transformation of the media industry, building a disruptive technology foundation, and OTT content providers on Amazon Web Services (AWS). The report will be of interest to media company owners and operators, IT professionals, and cloud service providers.

(IS-2020-74) Evolving home gateway architecture to enable the smart home

The report published by Calix in April 2019 discussed the importance of Wi-Fi technology in homes to ensure reliable Internet access to all devices connected to the home network. The topics covered include service providers' contractual obligations, signal extenders, the importance of service provider's connection with the users, service upsells, and technical ownership of the smart home. The report is useful for home owners, Internet service providers, engineers, technologists, and system integrators

(IS-2020-73) Insights and strategies for smart home insurance programs

This report from LexisNexis Risk Solutions reports on a consumer study of 2,500 US participants focusing on smart home and the internet of Things (IoT). Results show that smart home insurance programs are still in the beginning stages. Carriers that take strategic steps to better understand their policyholders' appetite and adoption of smart devices can respond

appropriately and gain a competitive advantage.

(IS-2020-72) Where's the ROI?

This report from SmartCitiesWorld discusses how smart cities can deliver social, economic and environmental benefits, providing a three-dimensional return on investment. It examines an emerging or growing trend in smart cities, highlighting progress so far and future potential, as well as spotlighting case studies from cities around the world. Examples from Paris, France and Guangzhou, China are discussed. This paper will be of interest to city planners and public policy makers.

(IS-2020-71) Digital Vision for Mobility

More change is now underway across the transport and logistics industry than at any time since the invention of the combustion engine, begins this opinion paper from Atos. It goes on to discuss how digital technologies such as process automation, analytics and artificial intelligence are critical for transport and logistics providers to improve customer experience while optimising use of assets and reducing emissions. This paper is useful for public policy makers and transport authorities.

(IS-2020-70) Unsettled Future: Trends and Opportunities Impacting Energy Networks

This report discusses the U.K.'s strategy to achieve net zero carbon emissions. It comments on options currently being evaluated such as the renationalisation of the power industry, increased use of renewables, vehicle electrification, power storage technologies, incorporation of hydrogen-based technology for space cooling and heating, blockchain-based technologies for energy trading. The paper concludes by providing a summary of what is needed to remove the existing barriers and drive investments.

(IS-2020-69) Moving Forward in a Complex Environment

This paper from JLL talks about the impacts coming from the expanded role of facilities management. And just like the tides of technology moving it along, this transformation has brought greater demands, higher stakes, and a workforce that expects more. Organizations are tasked with creating people-focused environments powered by streamlined services and data-driven solutions. The paper goes on to discuss three main drivers behind the transformation. The document will be of interest to technology innovators and facility managers.

(IS-2020-68) Key Factors for Successful Solar Construction

This 2019 Burns and McDonnell white paper examines the key factors required in the current marketplace, specifically contractor knowledge and experience, to ensure successful completion. Thirteen factors are reviewed, including: site selection, geotechnical investigation, pile design & installation, underground cable sizing, SCADA requirements and module installation & wire

management. This paper is relevant for firms considering solar power installations.

(IS-2020-67) Energy poverty through the lens of EU research and innovation projects

This 2019 EU Commission Joint Research Centre white paper studied 31 innovation projects in 30 countries grouped into the following categories: Digital Technologies, Behavioural Change, Financing, and Sharing of Best Practices. Key findings, consumer insights and emerging trends are highlighted, contributing to the knowledge and best practices to help eliminate energy poverty experienced by more than 50 million Europeans, This paper is relevant for regulators, government, utility and business leaders.

(IS-2020-66) Energy Needs for Sustainable Buildings

Buildings and transportation account for the lion's share of primary energy consumption globally. This article from the Indian Institute of Technology explains in plain language core theoretical concepts associated with energy building performance such as building orientation, solar energy gains, HVAC systems. It also discusses how alternative sources of energy (biofuels, batteries, geothermal and solar energy) are slowly making their way into the energy demand for building and transport.

(IS-2020-65) Energy Infrastructure Update

This December 2019 Office of Energy Project reports highlights the key project in the following areas: natural gas authorizations, hydropower requests for applications, electric generation online, and electric transmission completions. Metrics provided include number of projects, capacity.

(IS-2020-64) 2020 State of Commercial & Industrial Power Reliability Report

This 2020 S&C Electric survey, in collaboration with Frost & Sullivan, of 255 C&I USA companies representing \$4B in revenues provides a market assessment of power reliability issues, the impact of poor reliability and considerations of alternative energy options. Analysis includes: an audit of outages, the impact of outages, and mitigating strategies to improve reliability. One-third of companies surveyed would pay more for reliable power and quick restoration of outages, and two-thirds are investing in options to ensure reliability. This paper is relevant for utility and business leaders.

(IS-2020-63) International Journal of Energy Management, February 2020

This journal was published in February 2020 by the Association of Energy Engineers and deals with current topics in energy management. The topics covered include movable solar shades, energy performance targets for a crude producing facility, utility rate design, roles of combined heat and power in a commercial near-zero net energy demonstration, and integrating solar power with thermal storage. The report is useful for professionals working in the energy sector,

engineers, technologists, and system integrators.

(IS-2020-62) 2019 Residential Lighting

This 2019 Residential Lighting Guide is designed to serve as a resource for industry professionals involved in the design, construction or retrofit of California's buildings. The guides include compliance requirements and recommendations for implementing the Energy Code in New Construction, Addition or Alteration projects and covers: the compliance process; concepts and principles; technologies, systems and control strategies; compliance requirements; and, requirements and recommendations in practice. This paper is relevant for anyone involved in the California commercial building industry.

(IS-2020-61) Making the case for energy storage

This report provides an overview of energy storage solutions. A cost-benefit analysis is illustrated for three scenarios with different technology configurations. Then, an analysis on congestion relief at transmission facilities is also performed. Finally, an investment evaluation for reliability upgrades in the transmission and distribution system is carried out using two battery configurations.

(IS-2020-60) Imagining an electric world

This paper is a theoretical dissertation about a future electrified world which in view of the author is inevitable. Challenges and opportunities are discussed along with industry sectors being impacted by that change, such as transportation, heating & cooling, infrastructure and other. The author concludes that this transition will signify that a lot of jobs will be created and a lot more lost in every facet of the economy.

(IS-2020-59) REAL-TIME WATER DATA: THE KEY TO AMERICA'S SMART CITIES

This report exemplifies the application of real time data using remote sensors in the Great Lakes region (US & Canada) for the purpose of monitoring water quality in water bodies. It is discussed how the concept of smart infrastructure is evolving as cities and utilities rely on this type technologies to better design and maintain public infrastructure.

(IS-2020-58) Achieving 100% Renewable Energy

This report analyzes Florida's renewable energy plan. It provides a market and policy context. Then, using an estimated load it discusses the mix of energy sources that could potentially be used to supply this electric demand, with a special emphasis on solar sources and some considerations about cost of investment. Lastly, the author lists some tips that utilities and regulators should consider when starting down a path that leads to 100% renewable energy.

(IS-2020-57) The State of Industrial Internet of Things 2019

This paper discusses the application of Internet of Things (IoT) in manufacturing settings where the drivers are operational effectiveness and productivity. It begins by exploring typical environments where IoT is found, how value is achieved (e.g. IoT analytics measuring the interaction between multiple assets), followed by providing cases to show the impacts and benefits across different functions in organizations. Lastly, it emphasizes the importance of data sourcing as a crucial component of IoT and gives some insights about how early adopters might quickly make the transition from ad-hoc trial test cases to full-scale production.

(IS-2020-56) Resistors Play a Vital Role in Smart Grid Sensors

This EBG Resistors white paper highlights the need for power sensors to be as smart as the grid they monitor. A series of FAQs are provided to help designers and technology managers understand the new requirements being placed on power sensors used in SmartGrid applications, and how those requirements affect the selection of their voltage sensing components. A conceptual model is provided. This paper is relevant for SmartGrid designers and technology managers.

(IS-2020-55) Digitization and the Future of Energy Management

This 2019 DNV GL - Energy white paper highlights the important role energy efficiency plays in reducing total energy demand in transportation, buildings and manufacturing. A global survey of 2,000 energy professionals indicates digitization can improve operational efficiency by 55% and cost efficiency by 40%. Six technologies were identified as important for investment. Digital skills training, creativity and employees with sufficient combined data and domain expertise were skillsets identified as key future workforce priorities. This paper is relevant for C-Suite and business leaders in the technology and energy sectors.

(IS-2020-54) Optimized energy system design based on active energy-saving technologies in very low-energy smart buildings

This article explores ways to minimize energy consumption for existing commercial buildings so that it can be turned into a very low-energy building. A case study of an office building in Pakistan is used as a pilot. Three-layer of measures are proposed to achieve energy savings (building simulation, energy-efficient technologies, monitoring and measurement). Each type of measure is described and a financial analysis is also performed.

(IS-2020-53) Future trends and main concepts of adaptive facade systems

This academic paper in *Energy Science & Engineering* identifies the most promising adaptive facade technologies and suggests an analytical framework for future trends and technological classification of adaptive facade systems in buildings such as dynamic solar shading, chromogenic facades, solar active facades, and active ventilated facades. It was developed in consultation with subject matter experts with a focus on the European context.

(IS-2020-52) Why Australia Is a DER Innovation Hot Spot

The report was prepared in September 2019 by Navigant Research and deals with factors that have contributed to making Australia a global leader for distributed energy resources (DERs). The topics covered include the evolving DER market in Australia, supporting technology for DERs and virtual power plants, and leveraging Australia as a test bed for global DER adoption. The report is useful for electric utility owners and operators, engineers, technologists, system integrators, government officials, and policy makers.

(IS-2020-51) The Wi-Fi Evolution

This report was prepared in August 2019 by Qorvo and deals with the evolution of the IEEE 802.11 standard commonly referred to as Wi-Fi. The topics covered include a description of the following protocols: 802.11-1997, 802.11-a,b,g,n, ac, and ax. The report is useful for engineers, technologists, system integrators, and IT professionals.

(IS-2020-50) IoT Design & Development

This report was prepared in September 2019 by EEWorld and deals with industrial IoT (IIoT). It describes the commercial dynamics and market trends that are defining this particular sector. In addition, the report provides details of the various design issues being faced by engineers as they look to develop and implement IIoT systems, and then explains how these challenges may be overcome. The report is useful for engineers, technologist, and IT professionals.

(IS-2020-49) Super-B for IoT: Improving QoS in LoRa Networks

The report was prepared in May 2019 by Longview and deals with the new Super-B protocol for LoRa wireless technology. The topics covered include inherent benefits of LoRa, improved quality of service (QoS), description of Super-B protocol, implications for the enterprise, and an introduction to the Longview organization. The report will be of interest to engineers, technologists, system integrators, and IT professionals.

(IS-2020-47) How Blockchain Will Disrupt Business

This report published in November 2019 by CBS Interactive (ZDNet) provides an overview of blockchain technology and its impact on business. The topics covered include blockchain adoption challenges, implementation, promise of electronic voting, content consumption, benefits, feedback from healthcare industry, predictions on future industry impact, and automotive application. The report is useful for business owners, investors, software developers, and IT professionals.

(IS-2020-46) Overcoming the Smart Home Market's Top Challenges

The report was prepared in December 2019 by IoT World Today and provided recommendations for improving growth in the smart home market which is currently fragmented and unsecure. The topics covered include steps to unleash the smart home market and better-informed smart home consumers. The report is useful for smart home equipment designers and manufacturers, system integrators, technologists, engineers, and IT professionals.

(IS-2020-45) IoT: Putting the “smart” into smart cities

This report from June 2019 by Ingram Micro provides a primer on the Internet of Things (IoT) as applied to smart cities. The topics covered include a definition of a smart city, IoT deployments in smart cities, use cases (traffic flow, security, efficiency of utilities, municipal services, sustainability), and how IoT can address challenges such as infrastructure, integration, privacy, and security. The report is useful for city planners, policy makers, government officials, engineers, system integrators, and IT professionals.

(IS-2020-44) The Modern Workplace

The report from Condeco deals with trends driving workplace change and business readiness to respond to these challenges. The topics covered include digital transformation and the workspace, adapting the physical workspace for efficiency, meeting room trends, and flexible working. The report is useful for business owners, architects, builders, and interior designers.

(IS-2020-43) Optical Fiber and the Future Electric Utility

The report is from AFL Global and examines deployment of fiber optic cabling in electric utility networks as part of smart grid modernization efforts. The topics covered include the evolution of fiber in electric utilities, future fiber uses in electric utilities, and best practices for building fiber network for electric utilities. The report is useful for owners and operators of electric utilities, electrical engineers, technologists, and system integrators.

(IS-2020-42) Advancing Automation Sensors & Instruments

The report was prepared in November 2019 by Automation.com and deals with new instruments and sensors for today’s process and industrial automation industries. The topics covered include smart transmitters, smart sensors, powering of wireless instruments and sensors, and sensors and systems for computer-controlled production of automobiles. The report is useful for technologist, engineers, IT professionals, system integrators, and automation equipment manufacturers.

(IS-2020-41) Artificial Intelligence for Energy: How Smart Algorithms Can Improve Planning

This report was released in December 2019 by Miner & Kasch and discusses how electric utilities can gain new efficiencies, capabilities, and opportunities by leveraging cloud computing, artificial intelligence (AI), and machine learning tools. The topics covered include utility use cases for AI,

national grid's investment in AI for utilities, overcoming barriers to AI adoption, and initial steps toward an AI-enabled utility future. The report is useful for electric utility owners and operators, IT professionals, engineers, and software developers.

(IS-2020-40) White Paper on Connected Lighting and the Integrated Home

This report by the Consortium for Energy Efficiency (CEE) describes how the emergence of connected lighting presents opportunities for the integrated home. The topics covered include lighting of tomorrow, integrated home framework, characterization of connected residential lighting as part of the integrated home, barriers to connected lighting, commercial applications, next generation lighting systems, and leverage the strengths of the lighting for tomorrow competition model. The report may be useful for lighting professionals, technologists, engineers, and system integrators.

(IS-2020-39) 2019 State of Green Business

This report from May 2019 by the GreenBiz Group deals with world of sustainability and the ten trends sustainability professionals should be tracking in the year ahead. The topics covered include corporate sustainability, value of reuse, the importance of soil for climate action, deforestation, electric buses and trucks, energy productivity, green loans, super pollutants, greenhouse gas emission disclosure by companies, and science-based targets for environmental impacts on water, land use, biodiversity and oceans. The report is useful for environmentalists, business owners, government officials, scientists, engineers, and policy makers.

(IS-2020-38) Shaping Autonomous Vehicle Deployment to Meet Climate and Energy Goals: A Policy Toolkit for Cities

This report released in December 2019 by the American Council for an Energy-Efficient Economy presents the outcomes that cities should strive for when incorporating autonomous vehicles (AVs) into their transportation systems and describes major challenges that may arise as AV deployment proceeds. The topics covered include desired outcomes such as low emission, efficiency, and space optimization, and the recommendations for transportation policies to achieve the outcomes. The report is useful for city planners, government officials, AV manufacturers, policy makers, and engineers.

(IS-2020-37) Video Surveillance in the Smart Era: Unlocking the Potential through Cloud Sponsored

The report was prepared in September 2019 by the International Data Corporation (IDC) and deals with the transformation of video surveillance technology; how it has evolved beyond being an integral component of safety/security processes to new use cases. The topics covered include surveillance ecosystem in the smart era, use cases (district / building security, operations management, sales in retail stores), implementation challenges, benefits of cloud-based solutions, and the NXN'S smart video surveillance service. The report is useful for video surveillance professionals, engineers, technologists, IT professionals, system integrators, and

business owners.

(IS-2020-36) NIST Cybersecurity Framework and BAS

This January 2020 paper by Anto Budiardjo was among a series of articles published to coincide with the second annual New Deal for Buildings Cybersecurity Summit at AHR Expo 2020. Budiardjo and the panelists merge their voices to tell the story of how cybersecurity touches buildings, from identifying components, all the way to responding and recovering following an attack. Budiardjo examines the NIST Cybersecurity Framework, with particular reference to its five core functions: identify, protect, detect, respond, and recover. The article will be of interest to technology developers and cybersecurity professionals.

(IS-2020-35) Estimating Office and Multifamily Building Energy Retrofit Hurdle Rates and Risk Arbitrage in Energy Efficient Investments

This research paper develops a substantial, large-scale database of building energy use, energy audit reports, land use, and financial characteristics in New York City to empirically model the hurdle rate for energy retrofit investments, using actual audit data per permitted renovation work. The model considers different property types and building characteristics. Median IRRs of 20% for Multifamily and 24% for Office are consistent with the estimated return of a bundle of NPV-positive energy conservation measures. This paper would be of interest to investment/financing, government, regulatory, construction, property management and business leaders.

(IS-2020-34) A Different Look at Commercial Real Estate Performance Insights into Energy Efficiency Improvements

This April 2019 paper discusses the environmental performance dynamics of commercial buildings and examines the efficacy of green labels like LEED to bring about reductions in energy consumption. A dataset of 26,000 buildings in the US was used for the analysis. The results indicate that the commercial real estate sector is gradually obtaining reductions in energy consumption. The types of upgrades linked to the most significant improvements in energy efficiency for commercial buildings are also discussed.

(IS-2020-33) Effect of Energy Benchmarking and Disclosure on Office Building Marketability

This paper examines the effect of energy benchmarking on the marketability of commercial buildings in a selection of U.S. cities (New York City, San Francisco, Chicago, Washington DC). The analysis suggests that it is difficult to determine if the policy impacts on energy efficient buildings are more positive than less energy-efficient buildings since there are other multiple factors influencing real estate performance. Further research is needed to ascertain if disclosed energy performance has an impact on marketability.

(IS-2020-32) Connected Thermostats and Low-Income Energy Programs

Although smart thermostats have been proven to drive substantial HVAC savings, they lag behind with respect to other energy efficiency technologies used by utilities in the US, in particular for low-income programs. To foster the adoption of smart thermostats, a program called Nest Power Project has been rolled out in partnership with utilities countrywide and the benefits for weatherization programs in houses are explained.

(IS-2020-31) Estimates of Building Component Energy Savings for Use in a Property Condition Assessment This paper presents the results of a study carried out in the US to estimate energy savings data obtained from efficiency upgrades of key building components using parametric energy simulations. The method used is aligned with the ASTM Standard Guide for Building Energy Performance and Improvement Evaluation in the Assessment of Property Condition. The percentage savings metrics can be applied to the actual energy use of a building to estimate the savings for a given building. Energy efficiency metrics for office and retail buildings -pre 1980/post 1980/post 2004- are illustrated in graphs for different climate zones in the US.

(IS-2020-30) How a Fully-Digitalized Grid Improves Utility Planning and Operations and Empowers New Business Models

This paper explores the transformation currently underway in the electric utilities sector. Among several factors, the emerging trend of Distributed Energy Resources (DER) is at the heart of this pace of change. The drivers and barriers for this transformation are discussed. It argues that traditional tools are obsolete, thus making a case for software solutions to be deployed to facilitate the integrated planning process and accelerating the conversion of utility's operations, business models and customer engagement.

(IS-2020-29) Mobility as a Service: Cities on the Move

This SmartCitiesWorld trend report examines the emerging trend of Mobility-as-a-Service which brings together various transportation options in a city and allows citizens to plan their route, choose their preferred mode of travel, and book and pay for everything via one app.

This network effect will reduce the use of personal automobiles, encourage more sustainable forms of transportation and save the equivalent of 90 hours travel time per annum per MaaS user. Pilot trial results are provided. This paper is relevant for urban planners, transportation, technology and business leaders.

(IS-2020-28) Beyond Environmental Building Certification: The Impact of Environmental Interventions on Commercial Real Estate Operations

The report was prepared in April 2019 by York University and the University of Guelph and deals with the impact of monitoring and tenant engagement on building energy efficiency. The topics covered include research methodology, data sources, results, summary, and implications which show that monitoring and tenant engagement can impact decreased energy consumption. The report is useful for building owners and operators, engineers, environmentalists, and energy professionals.

(IS-2020-27) Next-Generation PoE: IEEE® 802.3bt White Paper

The report was prepared in March 2019 by Microchip Technology and deals with the IEEE Power over the Ethernet (PoE) standard 802.3bt. The topics covered include future proofing PoE, prior standards, and new features of 802.3bt. The report is useful for engineers, technologists, IT and telecom professionals, and system integrators.

(IS-2020-26) The Future of Carbon Capture and Storage is Looking Up

This 2020 Burns & McDonnell white paper examines carbon capture utilization and storage technologies, which can capture 90% of a power plant's carbon dioxide emissions. Both amine-based conventional absorber processes and membrane technologies are reviewed. DOE funding through 45Q tax credits for sequestration is examined. Opportunities and challenges are analyzed. This paper is relevant for investment/financing, government, technology, utility and business leaders.

(IS-2020-25) 12 strategies to step up global energy efficiency

The report was prepared in November 2019 by ACEEE, AEEE and ECEEE and deals with general principles to serve as the foundation for energy efficiency policies and recommended strategies to enable the change. The topics covered include principles that support efficiency, energy demand by sector, and 12 strategies for global urgent action on energy efficiency. The report is useful for government officials, policy makers, engineers, technologists, energy professionals, and environmentalists.

(IS-2020-24) Commercial & Industrial Lighting Lifetime and Peak Demand Savings Analysis The report was released in November 2019 by the Alliance to Save Energy and deals with the lifetime and peak demand savings potential from commercial and industrial lighting efficiency measures. The topics covered include technical reference manual (TRM) research, lifetime saving potential, peak demand savings, and cost effectiveness. The report will be of interest to building owners and operators, engineers, technologists, lighting experts, and energy professionals.

(IS-2020-23) Large Supply Pipeline Sets Stage for Market Growth in 2019: North American Data Centre Report

The report was prepared in August 2019 by CBRE Research and deals with the growth of wholesale data centre supply pipelines and strategies to meet demand. The topics covered include national (U.S.) data centre overview, state of the market, supply and demand insights, market pricing trends, capital market trends, and outlook for the second half of 2019. The report is useful for data centre operators, electrical engineers, and energy suppliers.

(IS-2020-22) The Standard Issue 002 U.S. Public Research Report

The report was prepared in September 2019 by the U.S. Green Building Council and deals with actions that can be taken to address climate change and create healthier living environments. The topics covered include environmental threats, turning anxiety into action, solving environmental problems, importance of family, green buildings, and carbon footprints. The report is useful for environmentalists, the general public, policy makers, and city planners.

(IS-2020-21) Building Rural Broadband Success

The report was prepared in October 2018 by Finley Engineering and deals with broadband access across rural America. A case study of partnership with Pinnacle Telecom and Barry Electric Cooperative is presented. The topics covered include the importance of partnering, smart grid opportunities, key lessons learned, and future outlook. The report is useful for telcom and electric utility owners and operators, electrical engineers, city planners, and government officials. Topics covered include the importance of partnering, smart grid opportunities, key lessons learned, and future outlook. The report is useful for telcom and electric utility owners and operators, electrical engineers, city planners, and government officials.

(IS-2020-20) 2020 Cybersecurity Report

The report released in January 2020 by Check Point Research offers a review of recent major cyber incidents, adds predictions for the year ahead, and recommends best practices for organization to be safe from cyber attacks. The topics covered include a timeline of 2019's major cyber events, Check Point's cyber security predictions, cyber security trends, global malware statistics, high-profile global vulnerabilities, review of 2019 cyber threat predictions, recommendations to prevent the next cyberattack, and zero trust networks best practices. The report will be of interest to business owners and managers, IT professionals, cybersecurity experts, and the general public.

(IS-2020-19) Digital facilities management: Leveraging the power of people, data and technology

This report explains how facilities management relies on data and technology to overcome the challenges posed by today's traditionally managed buildings. It makes an analogy based on the theory of Maslow's Hierarchy of needs to create the Building Management Hierarchy of Needs which covers all the way from OPEX reduction to brand reputation. It identifies the obstacles and set of solutions available to navigate the hierarchy of needs and how to implement an effective smart building program while investing in the right technology.

(IS-2020-18) Harmonized Data Collection From The Field

This Solar United white paper describes the value of a quality infrastructure (QI) system, comprising the total institutional network and legal framework that formulates and implements standards, testing, certification, metrology and accreditation. A comprehensive QI reduces costs throughout the PV life cycle, with examples provided. The impacts of IoT, AI/machine learning,

and simulation modeling are discussed. This paper is relevant for those utilizing PV technology.

(IS-2020-17) Extending the Benefits of Nonresidential Energy Efficiency to Low-Income Communities

This 2019 research study from the American Council for an Energy-Efficient Economy illustrates the challenges community-serving institutions face participating in energy efficiency programs. Additional outreach efforts and incentives to existing programs, rather than program redesigns, positively impact participation rates. Changes to public policy are discussed. This paper is relevant for government, utility and business leaders.

(IS-2020-16) Dispatchable Renewable Energy for a Lower-Carbon Utility Future

This Utility Dive report prepared for Mitsubishi Hitachi Power Systems provides an overview and merits for adding renewable hydrogen capacity to power systems. Green hydrogen, produced using off peak renewable energy, can be effective for energy storage, the report notes. Dual-fuel natural gas / hydrogen gas turbine technology is discussed as a proven and reliable power source. This paper is relevant for technology and business leaders.

(IS-2020-15) How to Collect Data from Legacy Systems to Improve Operations

This paper from Machine Design, developed together with Siemens Digital Industries Software, sets out to respond to two questions: How, specifically, can organizations connect existing systems— some which are several decades old and use an array of outdated and incompatible communication protocols and methods—to next-generation systems so they can maximize the industrial IoT's promised competitive advantages? Just as important: how do organizations achieve such integration quickly, cost- effectively and with little to no downtime?

(IS-2020-14) Remote Working

This paper by Condeco Software Inc. studies the business benefits of telework for organizations. The evidence to date suggests that allowing people the freedom to manage how, where and when they work from seems to have a significant impact on employee engagement. It also discusses how this trend raises questions about how corporations should administer workspaces to reduce underused office space and re-invest in remote working solutions. The analysis presents a 10-step process intended to guide facilities managers into becoming "corporate placemakers."

(IS-2020-13) 2019 Grid Integration Highlights

This 2019 Smart Electric Power Alliance survey provides a technology market gap and trend analysis in the following areas: electric vehicle market; battery storage market; customer engagement; and, challenges to utility business models. Each section includes the key challenges and corresponding opportunities. This paper is relevant for investment/financing, government,

technology, utility and business leaders.

(IS-2020-12) Smart Cities: A Business Leader's Guide

This TechRepublic CBS Interactive white paper provides a leader's guide to understanding and transforming cities into smart cities. With \$135 billion in technologies projected to be spent on cities by 2021, smart cities will evolve from discrete flagship projects to sizable market opportunities which will improve the quality of life for citizens and visitors. Examples of smart cities are provided. Links to additional resources including on planning, lessons learned and spending projections are provided. This paper is relevant for technology, urban planning, and government business leaders.

(IS-2020-11) The State of Physical Access Control: Impact on the Enterprise

This HID Global paper provides the results of a November 2016 survey on physical access control systems and technologies. The pros and cons of various technologies are discussed. A comparative summary of common physical access control system features is provided, and includes market sizing for planned upgrades. A new framework of access controls as a component of an integrated building management approach is provided.

(IS-2020-10) Big Questions = Big Questions for the Engineering and Construction Industry This 2019 FMI white paper examines the challenges of big data usage, and provides opportunities for the engineering and construction (E&C) industry to use data analytics and its benefits as a business tool. Currently, 95.5% of the 2.5 quintillion bytes of data produced daily in the E&C industry is not used. Examples include: predictive modeling used to create customized visualization tools to better manage design costs; better work flow management processes; and, improved business performance management. The report is particularly relevant for engineering and construction business leaders.

(IS-2020-9) BuiltWorlds 2019 European Market Annual Report

Key findings are distilled from BuiltWorld's Global Summit in Paris, which brought together industry leaders, innovators, and disruptors from all corners of the European market. Examples of significant infrastructure projects are provided. The report also provides takeaways from visits to some of France's biggest construction companies. Insights are provided on the increased role of robotics on jobsites; trends in offsite construction; waste elimination through technology; vertical integration in design, development and fabrication; and, the importance of data in the IoT and digital twin solutions.

(IS-2020-8) Building a Hyperconnected City

The report was prepared in November 2019 by ESI ThoughtLab and deals with business case, best practices, challenges, and performance metrics around becoming a hyperconnected city—one that drives huge benefits to stakeholders by interlinking its assets through the latest technology. The topics covered include hyperconnected city index, city maturity classification, the value of hyperconnected cities, the path to a hyperconnected future, overcoming roadblocks, return on investment, and case

studies. The report is useful for city planners, government officials, policy makers, engineers, and IT professionals.

(IS-2020-7) 2019 Utility Demand Response Market Snapshot

This report covers utility demand response (DR) programs in the U.S. Using the results of a survey representing 64% of total U.S. customer accounts, the report analyzes demand response data from mass market (residential + small businesses) as well as commercial and industrial markets. The analysis describes policy work being developed countrywide and DR market trends related to each type of existing DR programs. Challenges and opportunities for utilities such as energy storage, electric vehicles and demand flexibility for smart homes are discussed.

(IS-2020-6) Wireless charging: the key to workplace mobility, productivity & engagement

This report illustrates the results of a survey of 2,000 employees to measure impact on workplace mobility. Mobility contributes in maximizing utilization of employees' workspace. Some studies indicate that assigned desks in the workplace are only occupied about 20% to 40% of the time. Thus, a strategy combined with technology like wireless charging become vital to reach that goal. Benefits like real estate saving and higher employee engagement are also discussed.

(IS-2020-5) Clean-Energy-Based Economic Development: Parallel Tracks for State and Local Policy

This paper debates how local and federal policymakers could foster clean energy technologies as an engine of economic development strategy in the US. It discusses five complementary paths (local incentives, funding for R&D and start-up firms, cluster deepening, substitution of energy imports, stimulating local demand as a complementary component) and provides specific examples from similar approaches taken by other industries in the past.

(IS-2020-4) Corporate Energy & Sustainability Progress Report

This 2019 GreenBiz Research / Schneider Electric reports reports on the results of a survey of 309 industry leaders. It provides guidance to help organizations align how energy purchase/usage can reduce environmental impacts and build sustainable operations. Findings include: CapEx may be a misleading barrier, data quality/usage is still a struggle, setting public targets strengthens

speed of execution, smarter energy purchasing remains a key unresolved challenge, and technology continues to gain traction. Examples are provided. This paper is relevant for investment/financing, government, technology, utility and business leaders.

(IS-2020-3) The Speed of the Energy Transition

This white paper by the World Economic Forum from September 2019 compares two transition scenarios - gradual and rapid, how they differ and the signposts to observe indicating which narrative will dominate. Considerations include: clean technologies, new regulatory policies, changing business models, and differing consumption patterns. This paper would be of interest to clean energy industry professionals and policy makers.

(IS-2020-2) Fixed-Mobile Network Convergence: The Key Role of Fibre

A quantitative study on the value of fixed-mobile network convergence was prepared by the FTTH (Fibre to the Home) Council Global Alliance. This white paper reports on the results of the study, providing detail on the assumptions, technologies and network architectures required to provide seamless service through the convergence of 5G and fixed asset networks. To reduce the cost of deploying fibre, operators can take advantage of the fact that there will be significant overlap between the coverage and footprint requirements of 5G and fixed access networks – and thus the fibre deployment requirements of both will be similar.

(IS-2020-1) Building to Grid

This Navigant white paper, published in Q4 of 2019, examines the core requirements of industry transformation for "flexible, integrated, value-generating energy resources." The research focuses on the market shift currently underway as intelligent buildings interact with the grid creating a more fluid, dynamic energy ecosystem. Five core market components are reviewed, including: customers, policy & regulation, technology, business models and operations. Recommendations and pathways to success are provided. The report is of interest to anyone involved in the future of energy management, the grid and energy usage in buildings.