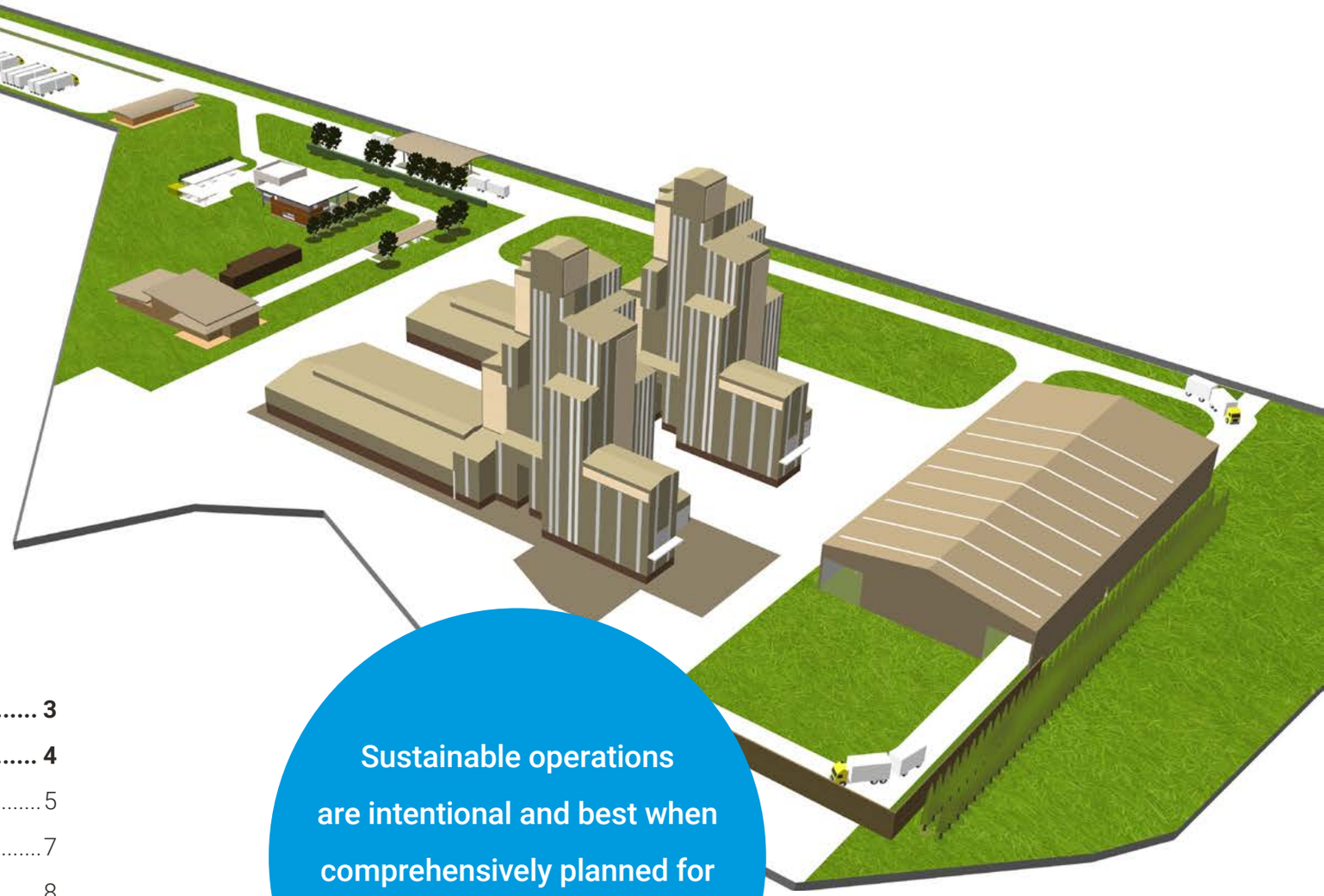
BLACK & VEATCH

Future-Ready Commercial Facilities

Sustainable Design for Net-Zero Companies



Contents

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Introduction

Companies are setting environmental, social, and governance (ESG) goals to actively protect the environment and mitigate climate change impacts. A top approach is to reduce the carbon footprint of their operations by occupying green buildings and campuses. These sustainable structures are designed to enhance society, environment, culture, and economy by prioritizing energy, water, and resource efficiency, cutting operational costs, slashing carbon footprints, and speeding corporate decarbonization. In the U.S., only 21% of the current building stock is green.[1] This opens an immense opportunity for investors, developers and building owners to increase sustainable operations. Through green development and retrofits, developers can divest from carbon-heavy assets that will likely depreciate as the globe transitions to net-zero and instead focus on in-demand green-certified structures.

Sustainable operations are intentional and best deployed when comprehensively planned for maximum cost-efficiency and system integration. **Black & Veatch works behind the scenes to keep developers ahead of the net-zero curve** by planning and designing sustainable water, energy, and transportation systems optimized using digital data and processes.

Smart Facility Systems

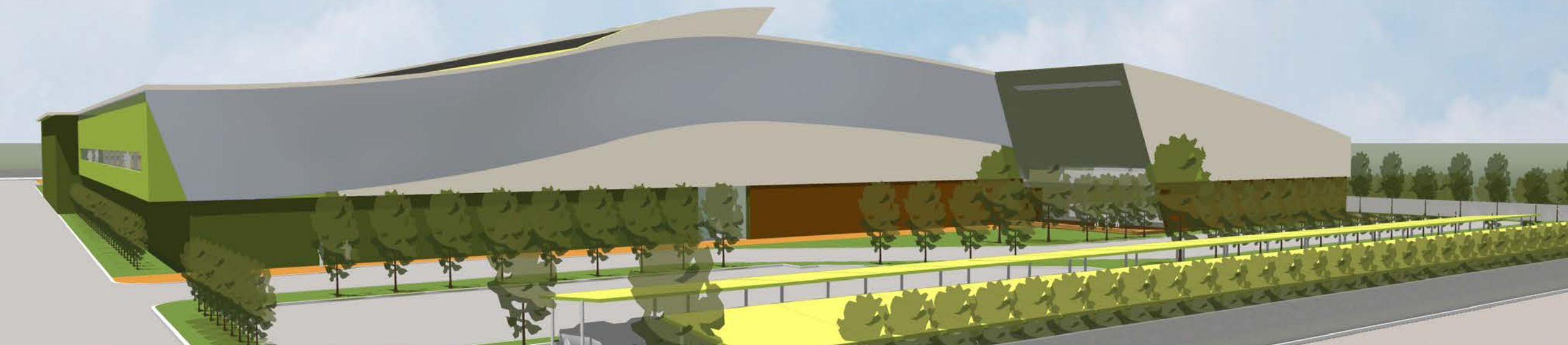
The time is right for green development. About 88% of industrial businesses are focused on sustainable manufacturing[2] and 80% of commercial companies have committed to sustainability goals.[3] About 60% of real estate developers who lease office space to tenants plan to invest in new technology to enhance sustainability in the next six to 12 months, and 53% have talked with new tenants about their sustainability goals.[4] Companies are focused on sustainable practices, and so are their clients and consumers. Consumers are more likely to align their spending with companies that produce or provide sustainable products and infrastructure following the market shift to environmentally friendly buying options.[5]

The combined dynamic of advanced technology evolution, low green building stock, climate change, and the drive to decarbonize Commercial and Industrial (C&I) processes is priming the real estate market for an upsurge in sustainable development. With thoughtful design, developers will net strong gains from their green buildings.

Holistic design is critical. Green buildings do not spotlight one building system over another. Instead, they focus on all systems to design an ideal clean structure where people aspire to work, live, learn, and shop. Green buildings leverage the natural environment and engineering to use clean versions of essential functions, such as water reuse, renewable energy, and zero-emission transportation. Developers who implement green building practices lower the impact of their buildings on the surrounding community and align with ecology and climate.

Precision design and integration are essential to ensure the seamless operation of complex systems and functions, and projected cost savings pencil out as estimated. Technology integrators such as Black & Veatch have a comprehensive view across systems and sustainable design. They ensure that buildings function optimally and are future-proofed to avoid costly efficiency upgrades as green codes become more rigorous and weather more unpredictable.

Rocky Mountain Institute estimates that green buildings have a 3% to 7% higher occupancy rate and can charge almost 4% more rent. In fact, a developer that immediately sells the building upon project completion will nab 17% higher sale value over a similar building that is not sustainable.[6]



Zero-Emission Transportation

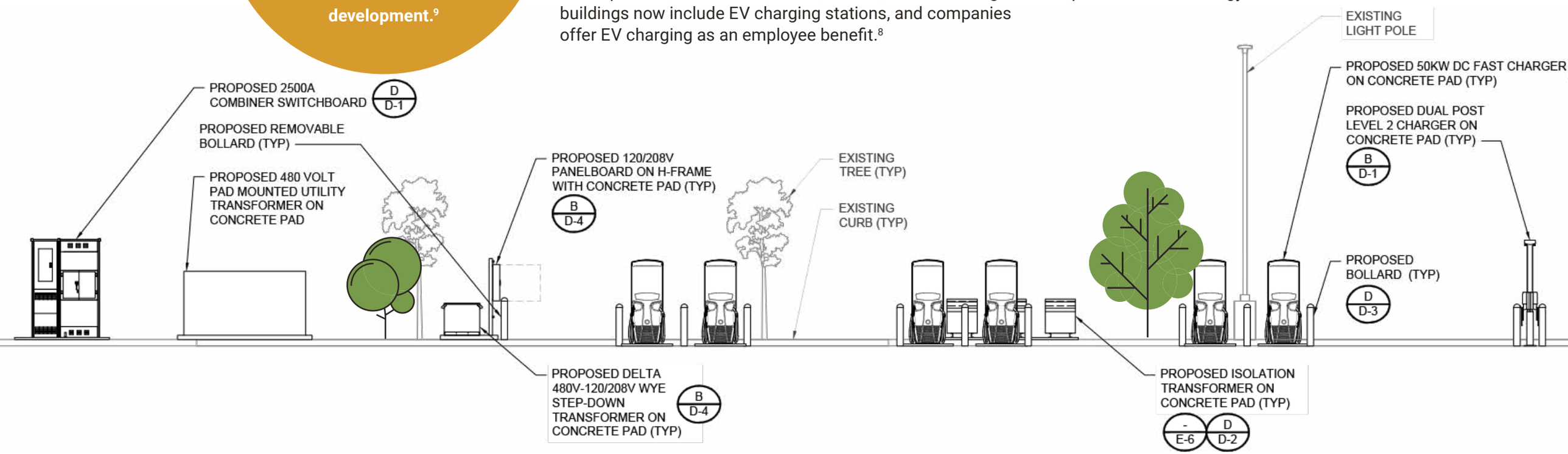
According to the Department of Energy, 14 states and 27 cities, including Vancouver, have implemented mandatory EV infrastructure code provisions as part of new commercial and residential development.[9]

Transportation accounts for 29% of total gross U.S. greenhouse gas (GHG) emissions—the largest contributor across all economic sectors.[7] For this reason, many businesses are electrifying their fleets and providing EV charging stations at their locations to slash emissions, better serve their customers, demonstrate sustainability commitments, and support work cultures that promote resilience.

Investors and developers who include charging infrastructure and the electric power needed to support charging will stay ahead of EV adoption and charging demands. EV adoption is growing, stoked by massive federal funding and the ever-expanding consumer and commercial fleet EV models. Mixed-use residential developments, retail stores, hotels, offices, and coworking buildings now include EV charging stations, and companies offer EV charging as an employee benefit.[8]

Building codes, ordinances, and legislation show that communities are doubling down on clean transportation. According to the Department of Energy, 14 states and 27 cities, including Vancouver, have implemented mandatory EV infrastructure code provisions as part of new commercial and residential development.[9] Following rising EV adoption trends and stringent decarbonization goals, similar laws will likely expand across North America.

EV charging construction risk, change-orders, and delays are expensive. Black & Veatch developed a 10-step approach to EV charging deployment to control project cost and timeline. Developers who follow these guidelines will navigate the potential pitfalls of EV charging, such as power delivery delays. They will also net valuable cost efficiencies, such as optimized onsite energy.



Five Key Considerations for Zero-Emission Transportation

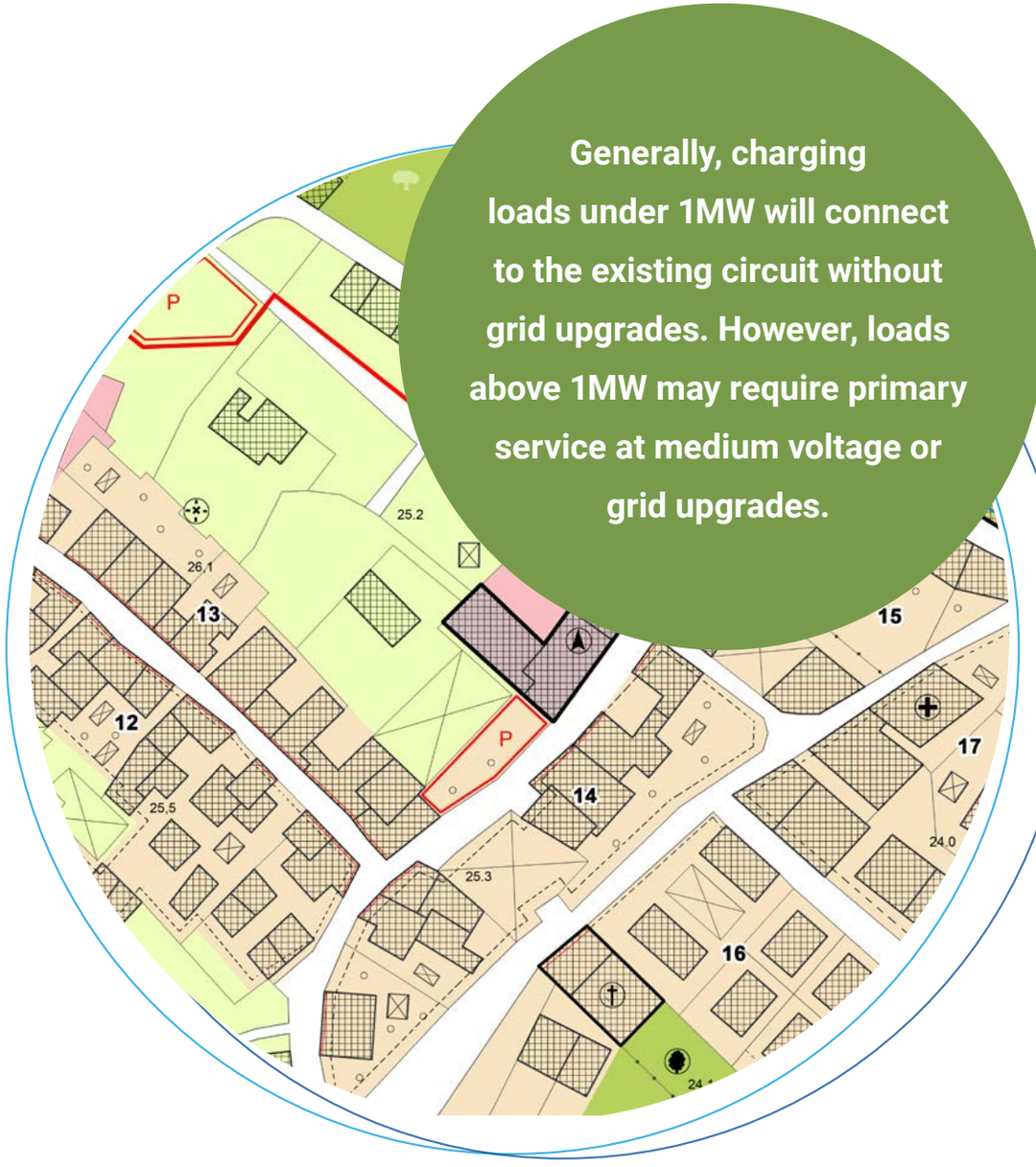
Charging Use & Technology Options:
Determine the number of chargers needed relative to planned occupancy. Identify available grants and incentives. Consider types of charging technologies, communications networks, and software platforms for EV charging coordination and management. Supply chain bottlenecks create long lead times for equipment such as switchboards. Order equipment early.

Electric Power Demand & Onsite Generation:
Integrate onsite charging stations, renewable energy, and storage to use green energy to minimize peak demand charges, balance loads, and reduce operational costs. Equipment upgrades to grid elements and facilities may be required to support onsite charging. New building construction and retrofits require electrical and utility interface planning, cooling design, and space for equipment.

Site Selection, Planning, & Utility Coordination:
Consider zoning, permitting, physical space, communications, and power supply. Several factors can dramatically affect schedule and cost, such as distance from the development to a substation and required distribution circuit upgrades. Start local and regional utility engagement early to develop a power delivery roadmap that leverages utility programs and charging rates.

Permits, Approvals, & Grid Upgrades:
Zoning, land use, permitting, and right-of-way requirements become more complex with larger-scale developments and increased power levels. Generally, charging loads under 1MW will connect to the existing circuit without grid upgrades. However, loads above 1MW may require primary service at medium voltage or grid upgrades. As charging demand rises, grid upgrades could include a new feeder, substation upgrades, or new transformer banks. Power delivery can add two to 48 months or more to the schedule—plan ahead.

Construct & Commission:
Construction starts when a developer receives all permits and approvals, including a signed/sealed drawing package and a utility design package. If new or upgraded electric service is required, the utility will complete their infrastructure construction before energizing the site. After inspection and commissioning, conduct regular and preventative maintenance of charging equipment to ensure the physical infrastructure and user interface function properly, accurate power supply, and safe charger operation.

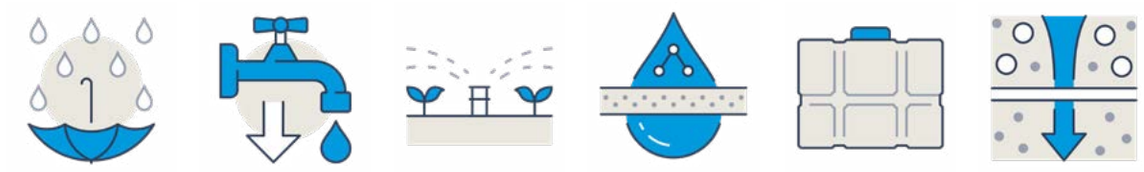


Integrated Water/Reuse

The C&I industry is the second largest consumer of public water in the U.S., accounting for 17% of withdrawals from public water supplies.[10] According to the U.S. Environmental Protection Agency, heating/cooling, process rinses, medical equipment cleaning, restrooms, and landscaping use the most water in C&I facilities.[11] When industries and businesses curb their water use, they protect community water supplies, which is especially important in areas with depleted aquifers or continued drought.

Stormwater and wastewater are coming into focus as sustainable options for C&I processes that do not need pure drinking water. For example, the data center industry consumes large amounts of water to cool their servers and other equipment. Potable water was the primary source, but alternative cooling methods have emerged, including treated wastewater.

C&I facilities could potentially reuse water from several onsite sources[12] such as:



Rainwater/stormwater | Condensate from air handler equipment | Foundation drain water | Treated gray water | Cooling equipment blowdown | Filter and membrane (e.g., reverse osmosis system) reject water

In many cases, facility owners and developers can make process changes to use stormwater and wastewater without significant capital investment. These changes are also under a developer's oversight and control, simplifying application. An increasing number of property owners now reuse water for irrigation of golf courses or building landscaping, for indoor toilet flushing, or as industrial process water for manufacturing.

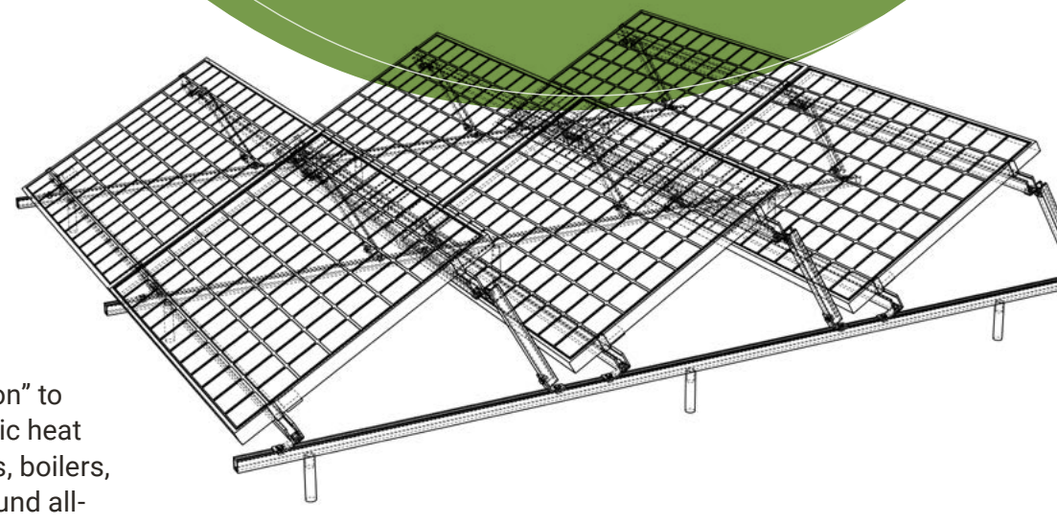
Support of sustainable C&I operations starts with making informed decisions that consider sources and discharge in tandem with building operations. As developers build and improve the facilities of the future, Black & Veatch suggests they:

- Conduct a water audit, condition assessment, and evaluation to characterize water use, locate and fix leaks, and identify discharges that may be reused
- Choose water-efficient fixtures, machinery, and equipment
- Align facility processes with sustainability goals
- Lean on integrated water design, digital tools, and operation & maintenance solutions to guide efficient water use
- Look for incentives. Some water, wastewater, and energy utilities offer incentives when facilities make process changes that improve water or energy efficiency

Facility owners and developers often can make process changes to use stormwater and wastewater without large capital costs.

Resilient, Decarbonized Energy

On average, 30% of the energy used in commercial buildings is wasted due to system inefficiencies[16] like outdated electrical systems, inefficient energy sources, and weakened building envelopes.[17]



In the U.S., commercial buildings consume 35% of electricity and generate 16% of all carbon dioxide emissions.[13] In Canada, over 555,000 commercial and institutional buildings use as much energy as 10.7 million households,[14] rendering the building sector Canada's third-highest carbon emitter.[15] On average, 30% of the energy used in commercial buildings is wasted due to system inefficiencies[16] like outdated electrical systems, inefficient energy sources, and weakened building envelopes.[17] Given the number of commercial buildings in North America, the infusion of clean energy sources and strengthened building systems would radiate positive impacts countrywide.

Reliable, resilient energy is a priority for commercial entities—if systems go down, they lose revenue. Some tenants require always-on energy systems dictated by the nature of their services, such data centers, research facilities, and retail buildings that double as emergency shelters. Additionally, green-certified buildings help businesses and organizations meet their sustainability goals and differentiate themselves as a green business, which is becoming an important distinction with consumers.

Some developers electrify more than just transportation. Many use "beneficial electrification" to incorporate efficient technologies, such as electric heat pumps, to swap out fossil fuel-powered furnaces, boilers, and water heaters.[18] As landmark legislation around all-electric buildings continues to hit the books—54 districts in California alone have established building decarbonization ordinances[19]—developers in some states are shifting from natural gas in favor of electric-ready design to reduce carbon outputs of their buildings.

Each site is unique, and understanding performance constraints helps design engineers identify the best system components and configurations for operational efficiency and return on investment.

New Facility Construction and Existing Building Retrofits

When designing new construction, defining energy system goals and determining the viability of clean energy technologies and energy efficiency options at the site is important. Each site is unique, and understanding performance constraints helps design engineers identify the best system components and configurations for operational efficiency and return on investment.

For existing building retrofits, facility owners will benefit from an energy audit to benchmark energy uses. This process will help identify low-cost strategies and design solutions that modernize capabilities and increase sustainability. With a more complex redesign, it is essential to understand how legacy, new, and emerging technologies play together, paying attention to their interfaces.

In addition to energy efficiency strategies such as additional insulation, energy-efficient heating and cooling, glazed windows, and lighting control, many projects include solar photovoltaic panels and battery energy storage systems to power buildings with clean energy, reduce GHGs, and reduce operational costs. Depending on the end use and location, a developer may add a microgrid to ensure reliable energy supply. Used in combination, these clean energy technologies:

- Counter the rising cost of delivered energy
- Monetize energy sources to control operational expenditures
- Provide a localized solution to powering buildings with greater climate risk or remote location
- Create a self-contained, reliable energy system for critical businesses
- Balance energy fluctuations and mitigate intermittency from renewables

Communications and Digital Technologies

To attract tenants, real estate developers have to provide more than just buildings. Driven by the on-demand culture, tenants seek services that enhance their connectivity, experience, and productivity. As a result, developers have to think like technologists and build spaces that provide enabling environments, ambient intelligence, interactive workspaces, and other automated, connected services that create higher-quality experiences for tenants.[20]

As real estate goes digital, developers who establish communications capabilities will not only attract more tenants, but also open pathways to additional revenue; with more services, developers can also implement service charges. Black & Veatch suggests that real estate developers consider these communication technologies as they design or retrofit their buildings:

Building Operation Automation. Automation of lighting, HVAC, security, parking, water, and energy systems enable remote management of facility operations, which is often more secure, productive, and profitable than traditional management. Automation controls building systems better for greater tenant comfort and optimal resource use, aligned with sustainability goals.

Smart Sensors & Data Analytics. Sensors enable developers to capture the full benefit of digital real estate. Sensors gather data about building functions and uses so owners can make insightful decisions about managing buildings toward greater comfort, health, and productivity of tenants. Buildings that demonstrate higher sales or productivity can garner higher rents. Facility owners can also use data to hyper-personalize building services as a value-added or charged service.[21]

Private Networks. Some facility uses, such as a data center or research laboratory, may be best run on a private network. With a private network, like private LTE and 5G LAN, developers control and secure mission critical operations to the highest standards, leverage maximum uptime and uninterrupted mobility, and seamlessly integrate with existing IT infrastructure.

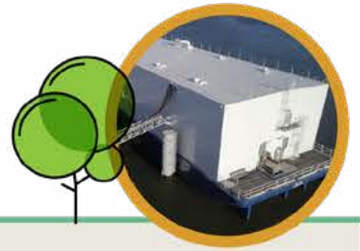
Building Information Modeling (BIM) and Digital Twin Technology. More complex facilities may benefit from digital modeling. BIM's digital depiction of a facility or connected campus helps control construction costs and risks by enabling project analysis before the shovel hits the ground. A digital twin is a scalable virtual model that provides virtual walk-throughs and real-time insight into how building assets and processes work together toward improved performance. It can also monitor the efficient use of resources and waste reduction to help companies achieve their sustainability goals. With virtual walk-through capability, a developer can market a facility before it's built, which could speed up leasing, sale, and return on investment.

Sustainable Infrastructure

Alongside commercial and industrial leaders and developers, Black & Veatch planned, designed, constructed, and commissioned several first-of-a-kind facilities that fulfill their functions while cost-effectively conserving natural resources.

Nautilus Zero-Water Consumption Data Center (California)

This 7-MW facility uses recirculated water from a nearby source to cool the data center. It consumes no water, produces no wastewater, and requires no refrigerants or water treatment chemicals, cooling towers, or computer room air handlers. It uses one-third of the power that traditional computer room air-conditioning would use.



Shell Microgrid Design and Construction (Texas)

Black & Veatch designed and constructed a microgrid at the Shell Technology Center, incorporating solar PV, a natural gas-fueled reciprocating engine, and battery storage technology to create a sustainable, resilient, and flexible microgrid system.

Clean Transportation Services for a Confidential Global Logistics Real Estate Company (United States)

Black & Veatch delivered a complex go-to-market business plan to provide scalable, commercial EV infrastructure solutions to accelerate the electrification of its customers' fleets. We provided location and customer strategy, vendor evaluation, go-to-market models, opportunity sizing, organizational design and team sizing, and scale-up strategy.

Florida Power & Light Campus Microgrid System (Florida)

Black & Veatch and Overland Contracting Inc. designed and installed a microgrid on the Florida International University College of Engineering and Computing campus. The project included 3-MW battery storage, 1-MW load bank, and a microgrid controller integrated with an existing 1.41-MW carport solar generation.

University of Kansas Welcome Center Rooftop Solar and Battery Storage (Kansas)

Black & Veatch donated rooftop solar panels and battery storage to power the university's new 30,000-square-foot welcome center. The solar panels will lower the university's carbon footprint, power digital exhibits, and provide enough annual power to run the field lights at David Booth Kansas Memorial Stadium for 50 football games.

Sound Planning to Optimize Return on Investment

Electrification, renewable energy, sustainable design, and digitization are growing megatrends that will continue to drive infrastructure investments. The desired outcome is for these investments to continue to hold value and generate a profitable return over time. However, investments in newer technologies carry inherent risks that could affect project profitability. Acknowledging these risks up front while developing strategies for mitigating them will keep infrastructure development projects on track. These risks can impact profitability, of course, but also the environment, stakeholders, and communities.

Infrastructure projects require a strong business case to justify the project, secure funding, align stakeholders, and maximize returns. Good planning and evaluation upfront are as important as good design and execution. A step-by-step approach ensures equal care and attention at this pivotal point.

Step One – Evaluate the Business Case: A good investment starts with a good business case. Investors must carefully evaluate the considerations to avoid risk that can destroy the business model.

Vital questions to ask and evaluate during this process:

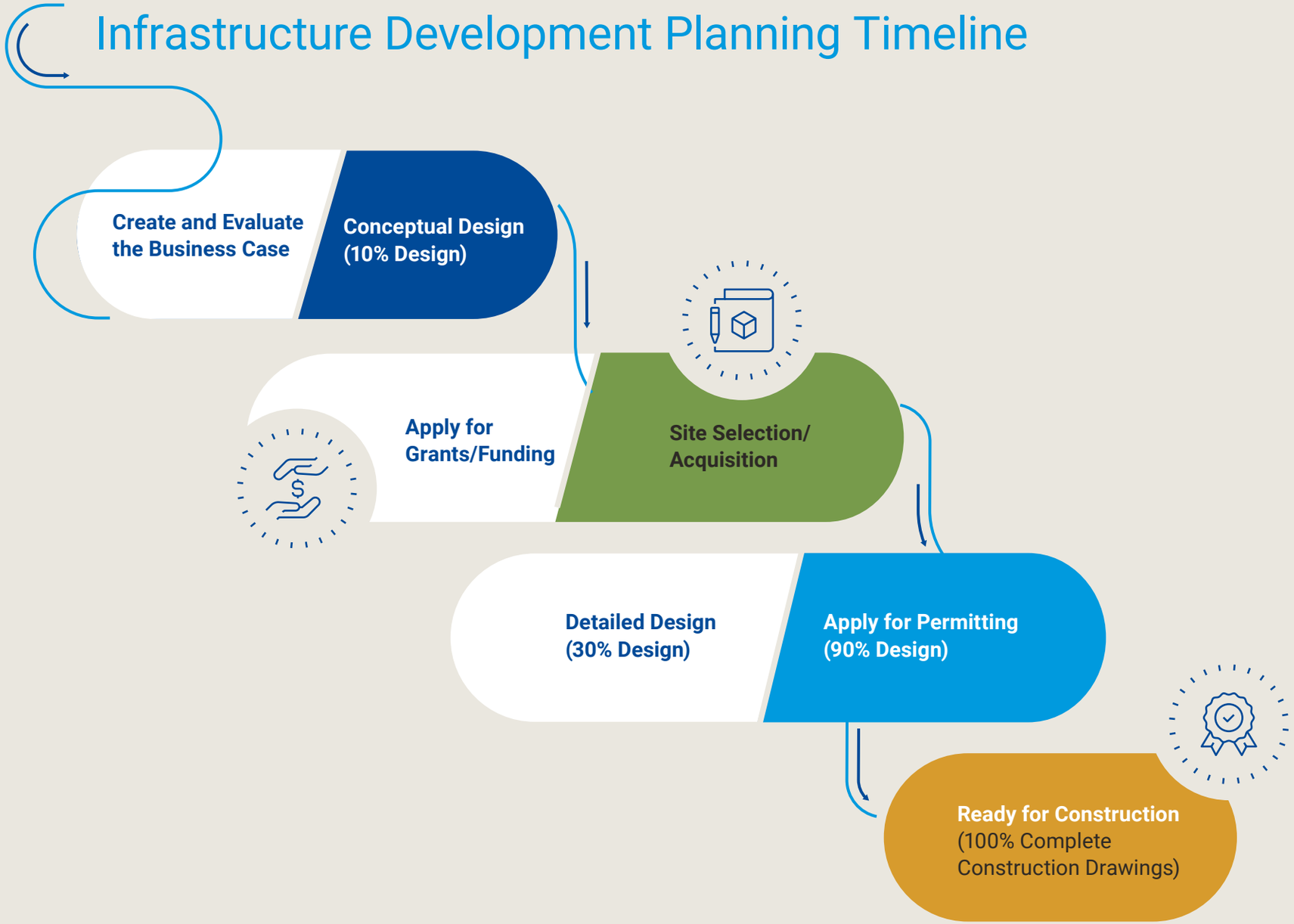
- What are the economic opportunities and incentives?
- How can you drive toward sustainability goals?
- What is your position relative to your competition?
- What potential risks do you need to mitigate?
- How much will this cost vs income/revenue potential?
- Does the business case take into consideration all of the key factors?
- What incentives can be included to improve the business case?

With these questions answered, business advisors can run scenarios to evaluate which options—including ownership, financing, locations, and technologies—will lead to the best outcomes. In addition, this stage involves estimating the expected revenue streams over the project's lifespan, which could include factors such as energy sales, tax credits, and other incentives. It's important to consider the costs associated with the project, including capital expenditures, operating expenses, and maintenance costs, to determine the overall investment profitability potential.

Step Two – Create Conceptual Designs: With the business model established, conceptual site designs (10% Design) will help projects move forward. A 10% Design includes a conceptual site layout, electrical one-lines, and general cost estimates. In this early engineering stage, the team includes all critical elements and account for adequate space and power supply for future site additions. The designs could include factors such as the selected technologies, the size and location of the project, and the materials and construction methods. Providing a visual representation of the potential design communicates the project's vision to all stakeholders.

Step 3 – Develop Rough Order of Magnitude Estimates: The final stage of planning, before detailed design, involves developing rough order of magnitude estimates for the project's costs and revenues. This will involve creating a detailed budget that considers all the relevant factors, such as the cost of materials, labor, and equipment, and financing costs. Companies like Black & Veatch, that also perform the design, engineering, procurement, and construction, understand the true costs (based on actual costs and identified hidden risk factors) so the estimates are reliable. Unreliable estimates can change the financials, which can destroy the business case.

It can't be overstated: choosing the right partner to develop the project front-end—from the business case to site selection, design, and project cost estimates—is vital to optimize outcomes and returns.



Environmental Considerations – Integration of Sustainable Principles

Next-generation facilities are designed to be sustainable. From technology that enhances energy efficiency to predictive analytics used to assess and prepare for future climate impacts, the commitment to responsible sourcing and design starts before construction begins.

In fact, when developers bring sustainability initiatives into project pre-planning, they realize greater value and the structure provides greater community benefit. This optimizes long-term project costs while simultaneously ensuring alignment of environmental, societal and governance goals like reducing GHG emissions and imported water use, minimizing the use of virgin natural resources, and protecting specific classes of individuals. By integrating sustainable principles into all aspects of project planning, organizations can achieve a cost-effective, resilient design that works in sync with the environment and local communities.

Data-Driven Design

It is no secret that data drives decisions, which is increasingly evident in sustainable design. Data analytics can inform purchasing and site design decisions, but such analysis is also critical to meet regulatory reporting and federal funding requirements.

- **Climate Trend Analysis for Risk Mitigation.** Analysis of large-scale climate trends can expose potential climate threats that facilities may sustain in years to come. As severe weather events across the globe continue to impact physical assets, supply chains, and people, understanding and mitigating risks is essential to ensuring resilience. Physical climate analytics assess whether existing infrastructure and/or physical assets will sustain damage or impairment due to extreme weather and climate change. These quantitative and qualitative insights can help organizations understand what, where, and when they should prioritize climate risk mitigation.
- **Geographic Information System (GIS) Tools to Maximize Cost Savings.** Developers can use GIS-based automated routing tools to analyze geographic data sources as a part of the site selection process to maximize cost savings and achieve sustainability goals. Nationwide maps and GIS data can provide routing analysis anywhere within the U.S., but more custom routing analysis should be considered to address specific environmental, landowner, historical or other project concerns.
- **Infrastructure Rating Tools to Reduce Emissions and Energy/Water Use.** Additionally, sustainable development can benefit from infrastructure rating tools such as Envision™ that measure and track resource use. Through data analysis, these tools help identify local sourcing options and reduce emissions, energy, and water use. Developers can increase resource stewardship without sacrificing functionality or cost by aligning sustainable goals with data analysis tools.

Using data and pre-planning, developers have the power to design facilities at the intersection of innovation and sustainability. Developers and tenants will strengthen their reputation as a sustainable company, and developers increase the marketability of their facilities as preference toward sustainable operations continues to increase.

Embrace Ecological Resilience

Sustainability actions often occur within the operational confines of a building or facility campus. But the best plans for sustainable systems work across geography and ecology to emphasize an area's natural resilience features and work in sync with Mother Nature.

Babcock Ranch, Florida illustrates this idea. When Hurricane Ian, a Category 4 storm, slammed into Florida in October 2022, it knocked out electricity to 2.6 million Floridians. However, shops, offices, grocery stores, restaurants, and homes in Babcock Ranch sustained no power or internet loss despite being just 24 miles from the storm's landfall.

Sustainable design engineering and construction practices are at the heart of Babcock Ranch's resilience. Previously drained cattle ranchland was allowed to revert to natural wetlands, which function like retention ponds to uptake excess rain and floodwater. Native plants compose 75% of the community's landscaping, withstanding high winds and soggy conditions to lessen storm impacts. Streets move water away from homes and businesses, and electric distribution wires and communication infrastructure are underground, protecting critical services.

To ensure long-term success, developers must balance sustainability goals and future capacity requirements with minimized environmental and landowner impacts.

When developers draw on the ecological processes of an area—like using native plants and wetlands for water control—they create a support system for resilience just as Mother Nature intended.

Sustainable Design to Strengthen Community Connection

Building resilient, sustainable facilities goes beyond constructing the physical asset – it completes the picture of a project's potential and its impact on the community it serves.

To ensure long-term success, developers must balance sustainability goals and future capacity requirements with minimized environmental and landowner impacts. It requires efficient planning, routing, design, and construction solutions; environmental assessments and permitting; and an understanding community.

Sustainable design strengthens this connection to the community. As more developers integrate sustainable design into their practices, the demand for sustainable materials and services will increase, spurring local and regional economies and benefitting the overall community's well-being. By respecting the natural environment and the people in it, developers can contribute to the growth and prosperity of a community while achieving responsible profit.

Two Ways Developers Optimize New Builds or Major Improvements:

1. Skip the Outdated "Design-Bid-Build" Method. By selecting an integrated design-builder such as Black & Veatch, developers who use a single point of contact minimize their risk and gain a more flexible process, better communication, clear accountability, and faster development with concurrent design and construction.

2. Manage Holistically Not Individually. Developers will save time and money, by swapping dozens (if not hundreds) of contractor relationships and agreements in favor of a single trusted partner. Black & Veatch manages all construction operations to deliver entire project portfolios across numerous sites simultaneously.

Conclusion

Companies are increasingly interested in delivering their goods and services from green buildings, facilities, and campuses. Investors, developers, and building owners turn to sustainable design and engineering to employ cleaner versions of essential systems, slash resource consumption, and evolve their building portfolio into the decarbonized era. With the tenant in mind, developers tap communication technology to adapt buildings to tenant use and expand services that add value and potential revenue streams.

A modular approach to green building design is a smart idea to future-proof investments. A holistic technology integrator, like Black & Veatch, will integrate smart facility functions with an eye on the future to plan, estimate, conceptualize, and accommodate retrofits for energy, communications, clean transportation, and water use technologies as they mature. With this insight, buildings will continue to evolve instead of deteriorating to outmoded stock that can no longer accommodate preferred commercial uses or align with new standards, regulations, technologies, and climate change impacts.

End Notes

1 U.S. Green Building Council. 2022.

2 SAP. 2021.

3 Honeywell. 2022.

4 Honeywell. 2022.

5 World Economic Forum. 2022.

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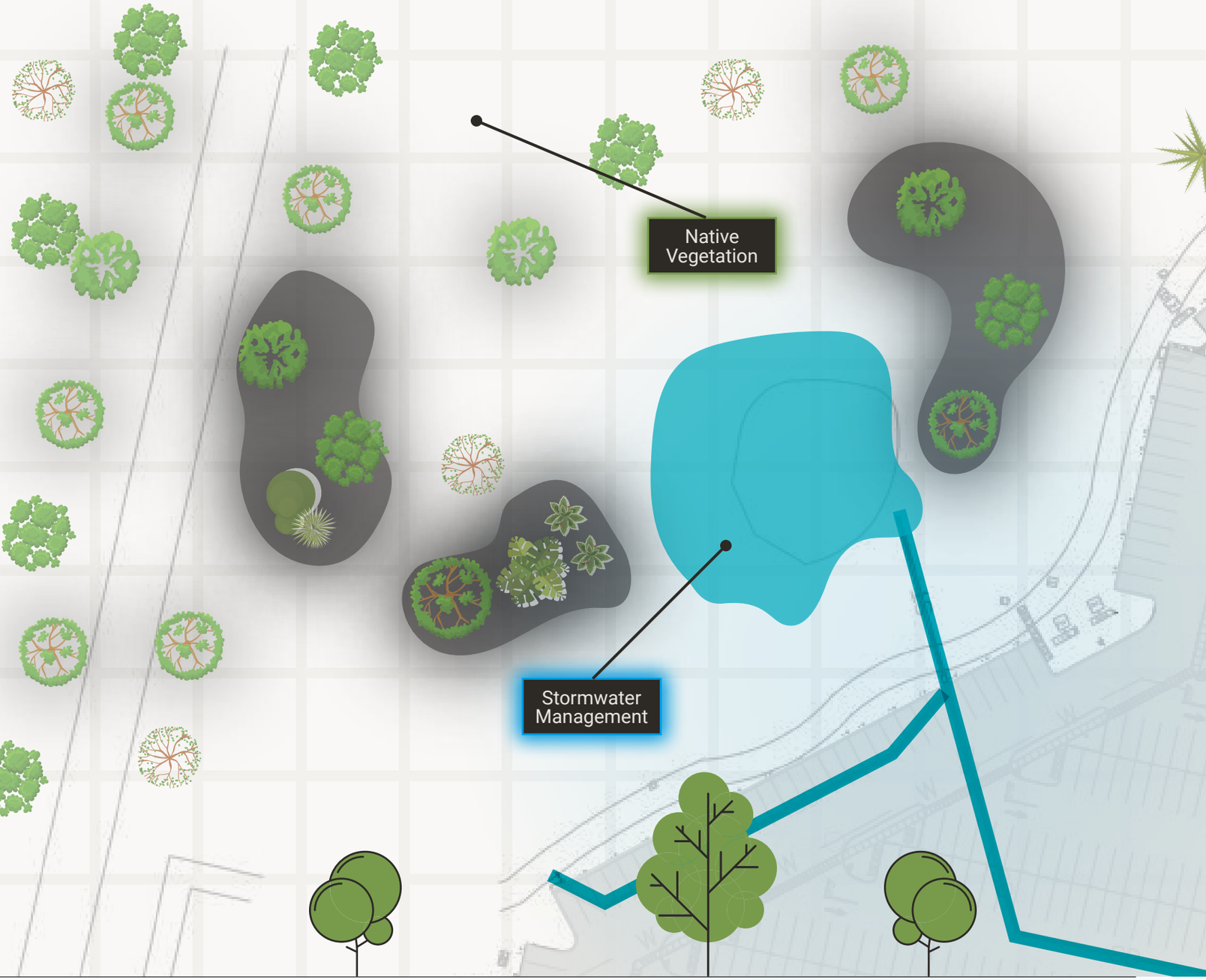
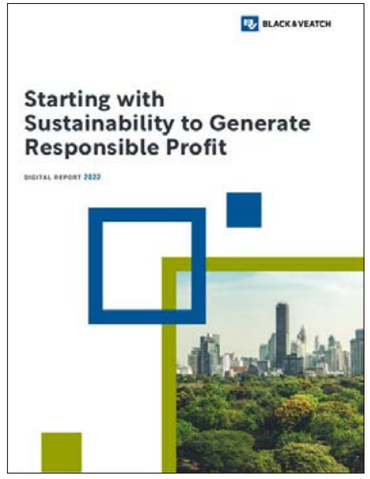


At Black & Veatch, our mission is to build a world of difference through innovation in sustainable infrastructure. We help organizations integrate a range of technologies to cost-effectively achieve resilience, sustainability, and growth.

Read Our Other eBooks to Stay Ahead of the Net-Zero Curve



Want to design sustainability and energy resilience into your facility?

Contact us