SUSTAINABLE ENERGY BUSINESS DISTRICTS

Enabling Clean Energy Deployment for Cities in China

Clean Energy Deployment Resource Guide Series

COMMERCIAL BUILDINGS

Commercial building owners are well positioned to take advantage of sharp price declines and new financing models for clean energy technologies to reduce operating costs and their environmental impact. This is especially true for property owners with multiple buildings in their portfolio. By taking a group purchase approach to project development, commercial building owners and commercial tenants can install advanced energy efficiency and renewable energy technologies more cost-effectively than ever before.

Falling prices for increasingly mature clean energy technologies and new innovations in financing have led to a surge in demand for cost-effective clean energy solutions. While early adopters have been government agencies and large corporations, there are a great number of small- to medium size commercial buildings worldwide that stand to benefit from clean energy upgrades. Energy performance contracting and other new financing models help avoid up-front costs for building equipment and renewable energy systems and can ensure immediate paybacks in many instances.

This resource guide is intended to provide commercial building owners and commercial tenants with an integrated approach to reducing the energy usage and environmental impact of their facilities by leveraging aggregated upgrades and innovative financing models for high-performance energy efficiency and renewable energy technologies.

PUBLIC- & PRIVATE-SECTOR COLLABORATION OPPORTUNITIES

It's well documented that buying in bulk saves time and money. This is true for small and large purchases, and across the commercial, industrial, and government sectors. The aggregated approach to building energy upgrades unlocks the power of group purchasing for commercial building owners that own multiple faciltiies, or combines the collective purchasing and negotiating power of a group of individual facility owners. Aggregating clean energy projects allows a consortium of building owners to reduce costs, avoid duplicating administrative time, simplify processes, and achieve energy and carbon goals faster.

Aggregated Energy Upgrades Across Building Portfolios Save Time & Money

In the private sector, many corporations are investing heavily in clean energy because the projects make econonic sense and support their sustainability goals. Large multinational companies, such as Walmart, IKEA, Apple, and others, have taken a portfolio approach to clean energy upgrades for their facilities. Walmart, for example, had more than 335 renewable energy projects in operation or under development across its global portfolio at the end of 2013, which are estimated to provide 2.2 billion kilowatt-hours of clean electricity generation to their facilities every year, according to its website. IKEA is also a clean energy leader with 40 megawatts of solar PV installed across 90% of its U.S. facility portfolio. Additionally, in 2014 IKEA purchased it's second U.S. wind farm with a capacity of 165 MW.

BUILDING PORTFOLIO APPROACH TO ENERGY AND CARBON REDUCTIONS

The Sustainable Energy Business Districts (SEBIZ) program adapted this model for private-sector use in China's business districts to aggregate distributed clean energy projects for commercial buildings. By aggregating project opportunities the SEBIZ program significantly reduced time spent and cost associated with evaluating, identifying, and pursing energy upgrade opportunities.

COMMON CHALLENGES

The following challenges were identified through the SEBIZ demonstration project in China:

- Lack of awareness among building owners of their buildings' clean energy potential and the benefits obtained through energy upgrades.
- Standardized and transparent procurement processes, such as RFQs and RFPs, are not common in the industry vendors identify qualified vendors for retrofit projects.
- Business owners are unable to effectively position their companies to benefit from the sustainability aspects of clean energy upgrades.
- Buyers and vendors were initially uncertain about the value proposition offered by the third-party independent facilitator.
- In China, there is little interest in paying for services separate from products.

BENEFITS & OPPORTUNITIES

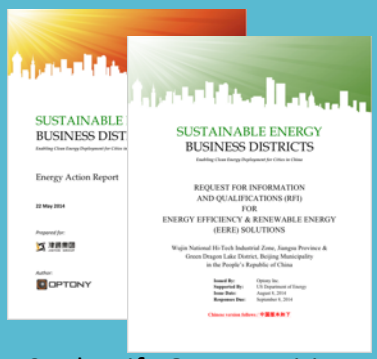
The aggregated approach to project development offers the following opportunities for participants:

- Simplification of clean energy retrofit and upgrade process encourages commercial building owners to take action.
- Project aggregation leverages economies of scale and reduces transaction costs to improve project economics for buyers and sellers.
- Reduced time and costs for solution providers associated with customer acquisition.
- Opportunities for participant recognition and branding when multiple commercial building owners opt-in to an organized program.
- Partner organization and independent facilitator provide reassurance to stakeholders that the process and transactions are transparent.

SEBIZ CLEAN ENERGY PROJECT AGGREGATION APPROACH

1. Establish Commercial Building Portfolio

2. Conduct Energy Audits & Benchmark Energy Data



3. Identify Opportunities & Issue a RFQ

4. Facilitate Buyer-Vendor Matchmaking

KEY BUILDING FOCUS AREAS & CLEAN ENERGY TECHNOLOGY SOLUTIONS

Deep reductions to energy consumption in commercial buildings can be achieved through the deployment of targeted energy efficiency and renewable energy technologies. In addition to lowering operating costs and carbon emissions, energy upgrades also support occupant comfort, increase property values, and encourage tenant retention. Market trends show that advanced clean energy technologies are already cost effective in many applications. Common considerations for commercial building owners interested in pursuing energy retrofits and upgrades are listed below.



Energy Efficient Buildings

Lighting and HVAC (heating, cooling, and ventilation) systems typically consume the most energy within commercial buildings, creating ample opportunities for improvement. Importantly, energy efficiency measures should be thoroughly explored and implemented before installing renewable energy generation systems in order to create a larger energy offset and generate more financial impact. Below are several key considerations for energy efficiency retrofits in commercial buildings.

BUILDING ENVELOPE

- Rooftops can be excellent assets in helping to achieve clean energy goals in the commercial building sector. They support solar PV systems, vegetated roofs, cool roofs, or a combination of uses.
- Fenestration (windows, doors, and skylights) plays an important role in building energy efficiency. Advanced window technologies can reduce unwanted heat loss or gain, while maximizing the harvesting of natural light.
- Insulation is critical for reducing energy loss through the walls, roofs, and floors, as well as improving building occupant comfort.
- Weatherization, which includes sealing seams, cracks, and openings, to protect against heat loss and gain, is one of the simplest and cost-effective approaches to efficient building envelopes.

LIGHTING

- Before choosing high-efficiency lighting fixtures, it is important to understand how daylighting can complement artificial lighting strategies.
- LEDs are generally considered to be the most efficient lighting technology on the market and significant price reductions have made their lifetime paybacks highly competitive.
- Light tubes can be used to transport and distribute natural daylight to interior rooms and areas where daylight is unavailable.
- Additional energy savings can be achieved by utilizing sensors and controls that adjust lighting levels based upon occupancy and daylight levels.

HEATING & COOLING

- As space heating and cooling account for a significant portion of total building energy use, improving the efficiency of these systems can provide significant returns on investment.
- Absorption chillers, heat pumps with high efficiencies, are well suited for heating and

The ultimate goal of the SEBIZ program is to help communities achieve environmental goals by reducing energy consumption and associated carbon emissions in the commercial building sector. The model accelerates the deployment of building retrofit projects, equipment upgrades, and on-site renewable energy generation, while expanding business opportunities in global clean energy markets. For more information, visit www.cleanenergyroadmap.com.

cooling large commercial buildings.

- Radiant floor heating systems offer many benefits, such as eliminated energy losses through ducts, increased occupant comfort, and can be powered by on-site renewable energy when integrated with solar thermal systems.
- Sensors and controls that adjust temperature settings based on occupancy comfort levels can create additional heating and cooling savings.



Energy Generation & Storage

On-site renewable energy generation reduces reliance on the electric power grid and improves overall energy efficiency and performance by reducing losses in the transmission and distribution systems. When combined with energy storage, commercial buildings can utilize renewable energy systems to enhance energy security and reliability throughout the year, including during peak hours. Below are several key renewable energy technologies that are available for immediate deployment in commercial buildings.

SOLAR PHOTOVOLTAICS

- Solar PV is typically among the most viable forms of on-site renewable energy generation for commercial buildings in urban settings.
- Solar PV can be installed on building rooftops, over parking areas as shade structures, or can be integrated into building materials.
- Parking area solar shade structures can be integrated with electric vehicle charging stations.

SOLAR WATER HEATING

- Solar water heating is an efficient technology with a long history of utilization for domestic and process uses.
- Businesses with high hot water demand, such as hotels or laundromats, are ideal candidates for solar thermal energy systems to offset electricity or natural gas loads reserved for heating water.

WIND ENERGY

- Small wind energy systems can be deployed in urban settings and are defined as turbines with a capacity rating less than 100 kilowatts (kW).
- Wind energy resources vary widely by location and can be difficult to assess in urban settings, so professional feasibility assessments are recommended.

CASE STUDY: Wujin Hi-Tech Industrial Zone

LED Retrofit Reduces Lighting Energy Use by 50%

Creation Technologies is a global electronics manufacturing services provider headquartered in Canada, with one of their 11 manufacturing facilities located in the Wujin National Hi-Tech Industrial Zone in Changzhou, China. In September 2014, Creation completed a lighting retrofit in which all T8 fluorescent tubes were replaced with T8 LED tubes. The power demand of each tube was reduced from 18 Watts to 9 Watts, which resulted in an immediate 50% increase in energy and financial savings. This retrofit was one of three recommendations made to the facility manager in the SEBIZ Energy Action Report, which the project team prepared following an energy audit performed several months prior. Additionally, the building owner is currently reviewing proposals for a rooftop solar PV system that is estimated to supply 60% of Creation's electricity usage. Together, all SEBIZ energy upgrade recommendations for Creation Technologies estimated the potential to reduce total annual energy usage by over 72%.


GEOTHERMAL ENERGY

- The earth can enable renewable heating and cooling of commercial buildings through the utilization of ground-source heat pumps (GSHPs).
- GSHPs use the earth as the source of heat in the winter and as the "sink" to remove heat from a building in the summer through an exchanger loop buried in the ground.
- Distributed geothermal projects are most cost-effective when implemented in coordination with new construction or a major retrofit.

BIOENERGY

- From biomass to biogas, bioenergy is a renewable, carbon-neutral energy source that comes in many forms and has many applications.
- Bioenergy includes any organic material that has stored sunlight in the form of chemical energy, such as wood, straw, sugarcane, manure and other agricultural byproducts.
- Use of bioenergy in urban settings must take into account appropriate precautions to minimize adverse effects on local air quality.

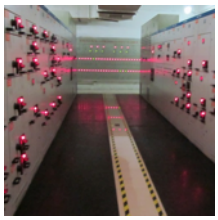
COMBINED HEAT & POWER (CHP)

- CHP, also known as co-generation, is the simultaneous production of electricity and heat for space and water heating, and potentially cooling (tri-generation), from a single fuel source.
- Commercial-scale CHP is generally defined as systems with a capacity rating of 1 kW to 10 MW.
- Typical end-users in the commercial sector include: light manufacturing, hotels, hospitals, and large urban office buildings.

ENERGY STORAGE

- Energy storage is emerging as an important component of the electric power grid that supports grid resiliency.
- Technologies such as batteries and thermal storage systems can be deployed within commercial buildings to optimize energy use.
- When combined with advanced software, battery storage systems allow a building to utilize the cheapest form of power available at any given moment





Building Operation

Even when equipped with advanced building systems and equipment, facilities can still fall short of achieving optimal performance if they are not properly operated and maintained. A building's peak efficiency depends not only on the design and installation of advanced materials and technologies, but also on building occupant behavior.

DEMAND SIDE MANAGEMENT

- Building energy management systems (BEMS) provide advanced methods to monitor, control and analyze a building's energy consumption.
- BEMS are critical for the integration and automation of sensors for lighting and HVAC systems, as well as monitoring plug-loads.
- Advanced energy management and control systems can be integrated with other advanced energy technologies, such as energy storage and demand response systems.

OCCUPANT BEHAVIOR

Energy efficiency strategies often focus on equipment upgrades and advanced technologies, without taking into account the significant impacts of occupant behavior on building efficiency. Below are a few occupant behaviors that offer simple ways to reduce energy consumption, provided by the Pacific Northwest National Laboratory:

1. Shut down computers at night.
2. Turn wall-mounted heating units down by five to ten degrees when leaving for the day or for extended periods during heating season.
3. Turn off overhead lights when leaving an office or conference room.
4. Use task and natural lighting instead of overhead lights when adequate.
5. Use less energy-intensive methods of managing thermal comfort including: adjusting window shades, drinking a hot or cold beverage, and appropriately dressing for the weather.

ANNUAL IMPACT POTENTIAL

Initial results from the SEBIZ pilot project in China's Wujin National Hi-Tech Industrial Zone demonstrated the potential for a 31% reduction in annual commercial building electricity usage via high-impact retrofit projects. The 31% reduction represents 16 million gigawatt-hours, 13,500 tonnes CO_2, and ¥18 million in avoided costs plus incentives each year. The scope of potential savings was identified across a portfolio of 46 facilities at 11 sites, but only took into account the top three clean energy opportunities. Additional retrofit opportunities for deeper energy reductions were possible, as well as other district-level projects such as district energy systems and microgrids.

GETTING STARTED

To implement the SEBIZ model in your district or for your building portfolio, consider starting with the following steps:

1. Appoint sustainability or energy manager that will be responsible for program implementation and accountable for goal achievement.

2. Conduct on-site energy audits across an entire portfolio of facilities. Discuss opportunities to leverage an aggregated approach with others your immediate area.

3. Establish qualified solution provider group by issuing a Request for Qualifications with documented clean energy opportunities.

4. Create project finance partnerships with groups such as Energy Service Companies or Energy Performance Contractors.

For other resource guides in this series about the SEBIZ model and approach to project aggregation, visit www.cleanenergyroadmap.com/about/sebiz.

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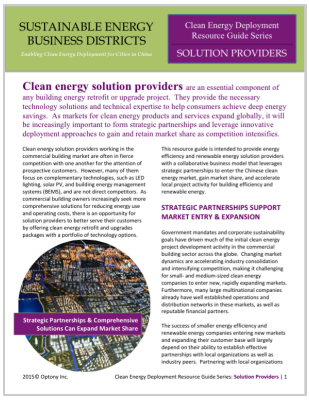
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SOLUTION PROVIDERS

Clean energy solution providers are an essential component of any building energy retrofit or upgrade project. They provide the necessary technology solutions and technical expertise to help consumers achieve deep energy savings. As markets for clean energy products and services expand globally, it will be increasingly important to form strategic partnerships and leverage innovative deployment approaches to gain and retain market share as competition intensifies.

Clean energy solution providers working in the commercial building market are often in fierce competition with one another for the attention of prospective customers. However, many of them focus on complementary technologies, such as LED lighting, solar PV, and building energy management systems (BEMS), and are not direct competitors. As commercial building owners increasingly seek more comprehensive solutions for reducing energy use and operating costs, there is an opportunity for solution providers to better serve their customers by offering clean energy retrofit and upgrades packages with a portfolio of technology options.

Strategic Partnerships & Comprehensive Solutions Can Expand Market Share

This resource guide is intended to provide energy efficiency and renewable energy solution providers with a collaborative business model that leverages strategic partnerships to enter the Chinese clean energy market, gain market share, and accelerate local project activity for building efficiency and renewable energy.

STRATEGIC PARTNERSHIPS SUPPORT MARKET ENTRY & EXPANSION

Government mandates and corporate sustainability goals have driven much of the initial clean energy project development activity in the commercial building sector across the globe. Changing market dynamics are accelerating industry consolidation and intensifying competition, making it challenging for small- and medium-sized clean energy companies to enter new, rapidly expanding markets. Furthermore, many large multinational companies already have well established operations and distribution networks in these markets, as well as reputable financial partners.

The success of smaller energy efficiency and renewable energy companies entering new markets and expanding their customer base will largely depend on their ability to establish effective partnerships with local organizations as well as industry peers. Partnering with local organizations

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LOCAL GOVERNMENTS

Local governments have the unique ability to support and influence the deployment of clean energy solutions in their communities. This is especially beneficial when there are discrepancies between national- and local-level sustainability goals and resources. By leveraging public-private partnership models and collaborative approaches to clean energy technology deployment, public agencies and district-level organizations can help create and expand local markets for building efficiency and renewable energy technologies.

Despite well-intentioned efforts to advance clean energy in cities and countries across the world, tangible project activity in the commercial building sector has been slow to move past high-level policies and pilot programs. Some regulatory mandates exist, but there is often a major disconnect between national goals and on-the-ground implementation. Furthermore, the lack of technical expertise, resources, and focus, combined with a multitude of competing priorities, is limiting the impact that policymakers have been able to achieve thus far.

Clean Energy Aggregation Models Can Accelerate Carbon Reductions

This resource guide is intended to provide local governments and their communities with an integrated business model that leverages public-private partnerships to accelerate distributed clean energy project activity in the commercial building sector and achieve energy and climate goals.

DISTRICT-LEVEL APPROACH TO ENERGY AND CARBON REDUCTIONS

Citywide clean energy programs managed by government agencies are often ineffective at realizing their full potential due to the inability to adapt to shifting markets or having too broad of a scope. On the other hand, project development at the individual commercial building level lacks the scale necessary to achieve meaningful cost reductions. The Sustainable Energy Business Districts (SEBIZ) project team successfully piloted an alternative approach by working with leadership organizations at the district-level in China to aggregate clean energy project opportunities across a portfolio of commercial buildings.

COMMON CHALLENGES

The following challenges were identified through the SEBIZ demonstration project in China:

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