# SUSTAINABLE ENERGY BUSINESS DISTRICTS

*Enabling Clean Energy Deployment for Cities in China*

# China EERE Market Assessment Report

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## About Optony Inc.

Optony Inc. is a global research and consulting services firm focused on enabling government and commercial organizations to bridge the gap between clean energy goals and real-world results. Optony's core services offer a systematic approach to planning, implementing, and managing commercial and utility-grade solar power systems, while simultaneously navigating the dramatic and rapid changes in the clean energy industry—from emerging technologies and system designs to government incentives and private/public financing options. Leveraging our independence, domain expertise and unique market position, our clients are empowered to make informed decisions that reduce risk, optimize operations, and deliver the greatest long-term return on their clean energy investments.

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# 1. INTRODUCTION

China is globally recognized as the world leader in coal consumption and carbon emissions. This abundant, cheap energy source has powered China's manufacturing industry and urbanization efforts, but has also caused severe environmental degradation, including an air pollution crisis. In response, the central government has taken aggressive steps to stimulate its clean energy economy by implementing strict building energy codes, supporting green building standards, and promoting the adoption of renewable energy and electric vehicle charging infrastructure.

The buildings sector in China is the second largest energy consumer and accounts for about 28% of the country's total annual energy consumption.[1] From 1996 to 2008, the total floor space of commercial buildings increased from 2.8 billion square meters ($m^2$) to 7.1 billion $m^2$, according to the Lawrence Berkeley National Laboratory (LBNL). Currently, about 0.5 billion $m^2$ of new commercial building floor space is built every year.[2] This trend is expected to continue with the central government planning to add 350 million people to China's urban population by 2025.[3] Consequently, it is expected that China's building energy consumption will increase by 40% from 2009 to 2030, which will make it the largest building energy consumer in the world.[4]

The surging energy usage of commercial buildings and business districts makes energy efficiency and renewable energy (EERE) critically important for Chinese policymakers to achieve their environmental goals, such as the 16% and 17% reduction in energy and carbon intensity of the economy, respectively, included in China's 12th Five Year Plan. Achieving China's energy and climate goals will be critical in mitigating the impact of global climate change. To help achieve these important policy goals, Optony Inc. has developed the Sustainable Energy Business Districts (SEBIZ) model, which offers a project aggregation approach to building energy efficiency retrofits, equipment upgrades, and on-site renewable energy generation projects.

The purpose of this report is to review the existing clean energy policy framework in China that supports energy efficiency and renewable energy technology adoption in order to inform the successful implementation of the SEBIZ program.

The report is organized into five sections:

1. Introduction to the SEBIZ project and an overview of relevant energy consumption in China.
2. Key policies and financial incentives that are driving clean energy technology adoption.
3. Assessment of market conditions for energy efficiency and renewable energy technologies.
4. Summary of challenges facing local governments, commercial building owners, and clean energy solution providers.
5. Conclusion with policy recommendations for SEBIZ implementation.

## 1.1 Sustainable Energy Business Districts Program

The SEBIZ program is helping to address China's rising urban energy needs and carbon emissions at the city-level by deploying a successful district-level clean energy project aggregation model in targeted Chinese cities to aid in the achievement of policy goals under the 12th 5-Year Plan. This approach is designed to accelerate EERE technology adoption in commercial buildings by leveraging economies of scale to reduce transaction costs and simplifying the procurement process for both buyers and vendors. The program is being implemented by Optony Inc. and funded by the U.S. Department of Energy.

The ultimate goal of SEBIZ is to provide local governments with a proven model to help achieve climate goals by reducing energy consumption and associated carbon emissions in the commercial building sector through accelerated deployment of building retrofit projects, equipment upgrades, and on-site energy generation, while expanding business opportunities in China's clean energy market.

The SEBIZ model offers a solution for retrofit projects and new construction projects. The project team is working with two initial business districts: the Wujin National Hi-Tech Industrial Zone in Jiangsu Province (WIZ) and the Green Dragon Lake District in Beijing (GDL). Working with district-level organizations has a few advantages. Firstly, they tend to be more nimble than municipal and provincial governments. Additionally, they have less access to resources that the

first and second tier cities, yet are critical to the achievement of national policy goals. Finally, they help build trust and credibility among commercial building owners across the district.

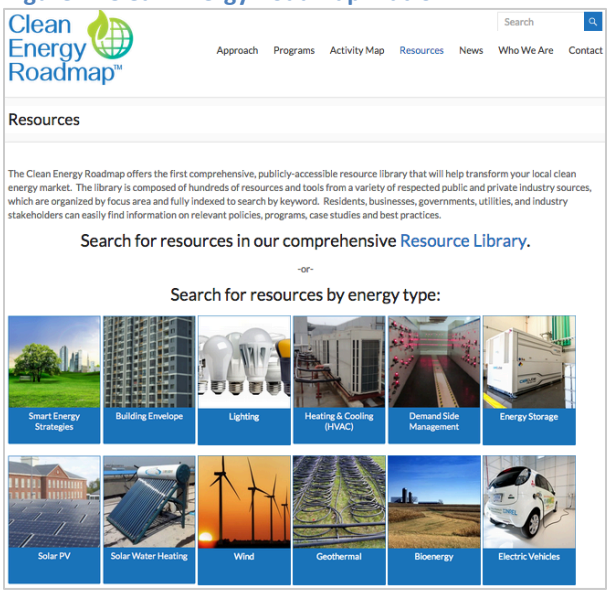
### WUJIN NATIONAL HI-TECH INDUSTRIAL ZONE

For retrofit projects in Wujin, SEBIZ provided 11 participating commercial building owners with the technical assistance and resources necessary to identify and pursue viable clean energy project development opportunities at their 46 facilities. The building portfolio approach builds scale for distributed EERE projects, which is important to attract sufficient vendor interest in smaller projects that are often overlooked. Optony Inc. has consistently found that project aggregation improves project economics by reducing administrative and other non-hardware costs.

### GREEN DRAGON LAKE DISTRICT

For new construction projects in the Green Dragon Lake district, the SEBIZ team conducted comprehensive research of advanced clean energy technologies available for immediate deployment and summarized available incentives at the national and municipal levels in China. The information was presented in a Sustainable Energy Planning Report. Furthermore, the project team has researched and curated a global best practice policy and program resource library with relevant low-carbon urban planning models that are publicly available and categorized by energy type at www.cleanenergyroadmap.com/resources/.

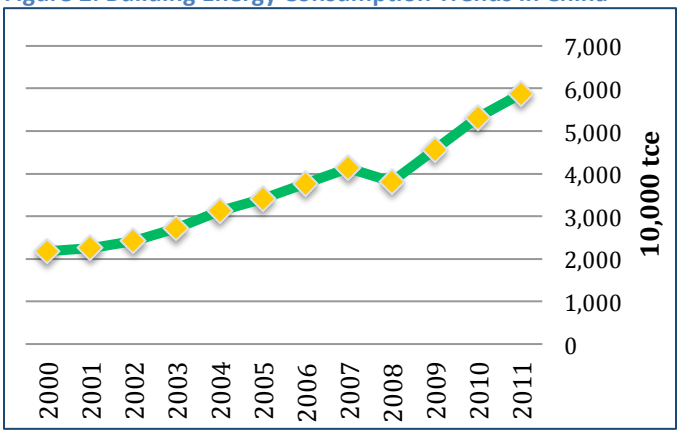
**Figure 1: Clean Energy Roadmap Platform**




## 1.2 Energy Trends in China's Commercial Building Sector

China is the world's leading market for new construction, which is driven largely by urbanization. According to McKinsey Global Institute, 350 million people will be added to China's urban population by 2025 and over one billion people will live in Chinese cities by 2030.[5]

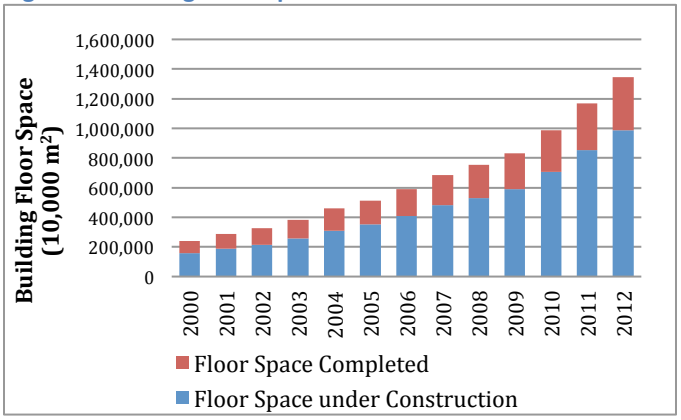
**Figure 2: Building Energy Consumption Trends in China**




Source: National Bureau of Statistics of China[6]

The building sector is the second largest energy consumer in China and accounts for approximately 28% of the country's total annual energy consumption.[7] It is expected that China's building energy consumption will increase by 40% from 2009 to 2030, which will make it the largest building energy consumer in the world.[8] Both building floor space under construction and at completion grew at a rapid pace between the years 2000 and 2012, as shown in the figure below.

**Figure 3: Building Floor Space Added in China Since 2000**

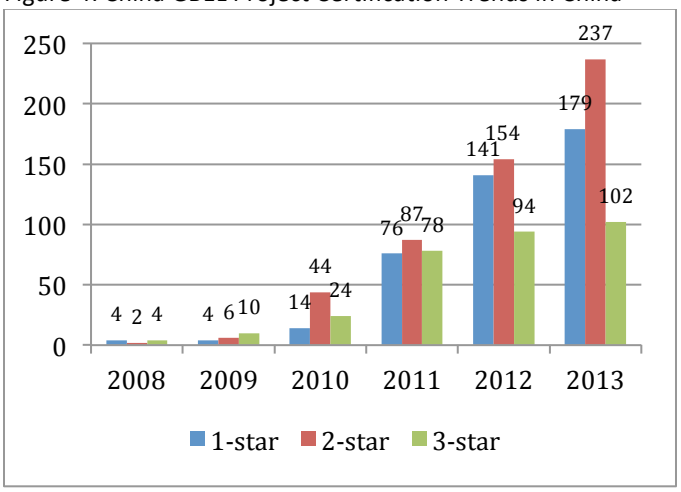



Source: National Bureau of Statistics of China[9]

Similar to the U.S., space heating and cooling and service water heating in China account for the majority of total energy use in China's commercial building sector, with the dominant fuel type being fossil fuels. On-site coal and oil combustion satisfy a significant portion of building heating needs in some regions, which provides a considerable opportunity for fuel switching to cleaner energy sources. This would contribute to the achievement of national renewable energy and carbon reduction goals, which will in turn help mitigate the country's severe air pollution problem.

With an increasing focus on energy intensity and low-carbon energy sources within China's five-year planning (FYP) framework, as well as green building requirements, China's central government is placing more of an emphasis on green building codes and standards to reduce energy consumption within the commercial building sector. The U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) standard is a widely used green building project certification program across the globe. However, China's own Green Building Evaluation and Labeling (GBEL) program, established in 2008, is becoming more prominent in China and increasingly integrated into building code standards by the Ministry of Housing and Urban-Rural Development (MOHURD).

Figure 4: China GBEL Project Certification Trends in China




Source: China Green Building Network[10]

# 2. POLICY FRAMEWORK

Policy is a primary driver of clean energy market activity in China and EERE policies have evolved substantially over the past ten years. Current building energy codes and standards, as well as mandates are becoming more aggressive. Although the policy framework for efficiency and renewables is coordinated nationally, different agencies are responsible for different policy areas, which can complicate implementation. Below is a brief overview of the key agencies and organizations that are driving clean energy policy in China.

**Table 1: U.S. and China Green Building Policy Comparison**

| Policy | U.S. | China |
|---|---|---|
| **Codes and labeling plan** | States implement codes largely based off of codes developed by private sector and compliance levels vary widely. LEED system established in 2000 is popular and growing steadily, requirements updated regularly (LEED v4 was released in 2013) | National level building efficiency codes for residential and commercial buildings, compliance occurs at design stage. GBEL system established in 2007 with uptake slow at first but now growing more rapidly, update for GBEL expected in 2014 |
| **Government-led targets and demonstrations** | Municipal and federal level LEED building mandates helped galvanize early LEED activity | 12th Five Year Plans has requirements that 80% of new large commercial buildings will need to have GBEL rating; many cities have more aggressive targets |
| **Education and awareness programs** | LEED education and professional development key to success; LEED committee leads come from private sector, improving quality, applicability, and popularity of LEED standards | GBEL process is entirely government driven, with missed opportunities to involve other stakeholders; workforce development and education is lacking |
| **Fiscal policy** | Grants and tax credits available at local level; evidence of rent and sale price premiums for LEED buildings | Tiered incentives available for 2-star and 3-star GBEL buildings; higher upfront cost of green buildings remains a barrier |
| **Integrated design** | Early promotion and integrated design incentives available in California | None |

Source: Lawrence Berkeley National Laboratory[11]

**Table 2: China's Key Clean Energy Stakeholders**

| Clean Energy Stakeholder Summary | |
|---|---|
| National Government | • National Development and Reform Commission (NDRC), including the National Energy Administration (NEA)<br>• Ministry of Housing and Urban-Rural Development (MOHURD)<br>• Ministry of Finance (MOF)<br>• Ministry of Industry and Information Technology (MIIT)<br>• State Administration for Industry & Commerce<br>• State Grid Corporation of China<br>• China Southern Power Grid Company |
| Industry Associations | • China Association of Building Energy Efficiency<br>• China Insulation & Energy Efficiency Materials Association<br>• China Fenestration Energy Efficiency Performance Labeling<br>• China Heating Ventilation and Air-Conditioning<br>• China Illuminating Engineering Society<br>• China Solid State Lighting Alliance<br>• China National Renewable Energy Centre<br>• China Renewable Energy Industry Association<br>• ESCO Committee Of China Energy Conservation Association (EMCA)<br>• National Solar Industry Association<br>• Architectural Society of China<br>• U.S. China Energy Cooperation Program |
| Research Institutes | • China Academy of Building Research<br>• China Building Materials Academy<br>• Energy Research Institute<br>• China Electric Power Research Institute |

Source: Pacific Northwest National Laboratory[12]

For building efficiency, MOHURD issues building codes and standards that regulate construction and manages the Green Building Evaluation and Labeling (GBEL) program. MOHURD also develops regulations and policies of building materials and issues energy efficiency labels for windows and doors, according to the Pacific Northwest National Laboratory (PNNL).[13] As for low-carbon development planning, MOHURD oversees China's Eco-Cities program.

The National Development and Reform Commission (NDRC) is China's main economic coordinating agency and is responsible for developing national renewable energy and climate change policies.[14] NDRC is responsible for leading the development of China's Five-year Plan (FYP) framework, which has set forth energy efficiency, renewable energy, and climate goals. As for low-carbon development, NDRC administers the Low-Carbon City program and its sub-agency, the National Energy Administration (NEA), oversees the New Energy City program that has plans for 100 new energy cities, 1,000 new energy demonstration parks (city level), and 200 green energy counties (rural level), according to the China National Renewable Energy Centre.[15]

## 2.1 Energy & Climate Goals

Chinese policymakers have set ambitious clean energy and climate targets in recent years. Generally, national level targets are set by the central government and then assigned accordingly to provincial-level governments for implementation with mechanisms for measurement, verification, and accountability.[16] Below is a list of China's primary national policy goals related to clean energy and climate change.

### CLEAN ENERGY

1. Energy intensity target: 16% reduction by 2015, under 12th Five-Year Plan.
2. 11.4% non-fossil fuels in primary energy consumption by 2015, under 12th Five-Year Plan.
3. Increase the non-fossil fuel share of all energy to around 20% by 2030, which will require 800-1,000 gigawatts (GW) of new wind, solar, nuclear, and other zero emission generation capacity by 2030.[17]
4. 14 GW of solar PV deployment in 2014 (6 GW utility-scale and 8 GW distributed).

### CARBON EMISSIONS

1. Carbon intensity target: 17% reduction by 2015, under 12th Five-Year Plan.
2. 40-45% reduction in carbon intensity nationwide by 2020, relative to a 2005 baseline.
3. Peak carbon emissions by 2030.

The achievement of these aggressive energy and climate goals will be critical in mitigating the impacts of global climate change, while helping to improve public health through improved air quality.

## 2.2 Key Policies & Incentives

This section provides an overview of clean energy policies that are relevant to the implementation of the SEBIZ program. Appendices B & C provide a timeline for all China's policies related to energy efficiency and renewable energy.

### ENERGY EFFICIENT BUILDINGS

To date, energy efficiency policy in China has focused heavily on the energy intensity of the industrial sector, which has been steadily falling since the 1980s. According to the 12th FYP, policymakers will build upon that progress and focus more on the commercial building sector as the country anticipates new construction to continue in order to accommodate new residents and businesses resulting from the country's substantial urbanization effort.

According to a report by LBNL, there are three main best practice building efficiency policy focus areas driving adoption in China: building energy codes, building energy labeling, as well as financing and incentive programs.[18] However, there are other complementary approaches that are being implemented and having an impact, such as the GBEL's voluntary green building labeling program and appliance labeling program, among others.

This section summarizes several relevant energy efficiency policy focus areas presented by LBNL as they relate to the commercial building sector and SEBIZ program implementation in China.

Commercial Building Retrofits

Key financial incentives for energy efficient building retrofits were included in China's 12th FYP. In 2011, the Ministry of Finance (MOF) and MOHURD issued a "*Notice on Commercial Building Energy Efficiency Efforts*" to expand existing incentives for commercial-scale public and private buildings. This notice set the targets for reducing commercial building energy intensity (energy use/floor area) by 10% in commercial buildings and a 15% in large commercial buildings, which are directly relevant to the SEBIZ business district approach to clean energy technology deployment. Furthermore, 40 cities were chosen to receive a national retrofit subsidy of ¥20/$m^2$ to meet more stringent 20% and 30% reduction targets for government and large commercial buildings, respectively.[19] These more aggressive targets are in line with the potential for a 31% energy intensity reduction in the Wujin National Hi-Tech Industrial Zone business district identified during SEBIZ energy audits.

**Table 3: Summary of China's EERE Incentives Relevant for SEBIZ Implementation**

| Type | Level | Description | Associated Policies |
|---|---|---|---|
| Green Buildings | National | **Incentive:** GBEL 2-star: ¥45/$m^2$; GBEL 3-star: ¥80/$m^2$<br>**Eco-City Incentive:** ¥50M for eco-city funding. Criteria include: 1) all new construction must be certified as GBEL 1-star or above; 2) more than 30% of new construction must be GBEL 2-star or above; 3) the city constructs more than 2 million $m^2$ of new green buildings within 2 years. | Notice On Expediting The Development Of Green Building[20] |
| | Beijing | **Incentive:** GBEL 2-star: ¥22.5/$m^2$; GBEL 3-star: ¥40/$m^2$<br>**Fee exemption:** green building certification fee exemption | Notice On Green Building Labeling Subsidy[21] |
| Green Roofs | Beijing | **Incentive**: ¥50-100/m2 for green roof within government plan[22] | Notice On Promoting Urban Vertical Green Landscape Construction[23] |
| Distributed Solar PV | National | **Incentive**: ¥0.42/kWh for 20 years.<br>**Tax exemption**: 50% of VAT exemption from October 1, 2013 to December 31, 2015. | Notice On 2014 Annual New Construction Scale Photovoltaic Power Generation[24] |
| Solar Water Heating | Beijing | **Incentive**: ¥200/$m^2$ for qualified buildings | Interim Measures Subsidies For Beijing Solar Hot Water Systems.[25] |
| Geothermal Heat Pumps | Beijing | **Incentive**: GWHP and SWHP: ¥35/$m^2$ [26]<br>**Incentive**: GCHP and WWHP: ¥50/$m^2$<br>**Incentive**: 30-50% rebate depending type | Notice On Further Promotion Of Geothermal Energy Development And Utilization In Beijing.[27] |

Green Buildings

MOF and MOHURD also provide financial incentives to support the expansion of the green building market. Since 2012, financial incentives of ¥45/$m^2$ have been available for qualifying 2-Star rated green buildings under China's GBEL program and ¥80/$m^2$ for qualifying 3-Star rated green buildings, as shown in Table 3. These incentives are designed to help China meet its goal of constructing 1 billion $m^2$ of additional certified green buildings floor space by 2015 and increase the share of green buildings to 30% of new construction by 2020. [28]

## RENEWABLE ENERGY TECHNOLOGIES

Renewable energy technologies will play an increasingly important role in accelerating the utilization of low-carbon fuel sources in China. Renewable energy markets have been driven largely by surging energy demand and environmental degradation, as well as efforts to support the solvency and expansion of domestic renewable energy industries, such as solar PV.

The passage of China's Renewable Energy Law in 2005 aimed to establish a market for renewables and was supported by the 11th FYP policy framework with incentives to encourage the deployment of building-level distributed renewable technologies such as solar PV, solar water heating, building integrated solar PV, and geothermal heat pumps.[29] China's focus on distributed renewables continued under the 12th FYP framework with new subsidies for solar PV and other technologies that are relevant for the SEBIZ program. At a provincial level, renewable energy targets and the related Renewable Energy Law, which consists of a feed-in-tariff and mandatory grid connection, are key measures to help increase the use of renewable sources for the power sector, according to the International Renewable Energy Agency (IRENA).[30]

This section summarizes several relevant renewable energy policy focus areas presented as they relate to the commercial building sector and SEBIZ program implementation in China.

Solar PV

The central government offers a distributed solar PV incentive via a feed-in tariff of ¥0.42/kWh, according to the *Notice On 2014 Annual New Construction Scale Photovoltaic Power Generation.*[31] The tariff does not apply to PV projects benefiting from central government investment subsidies. The tariffs have been set for a period of 20 years, but to sustain market competition tariffs and subsidies will be reduced in correlation with production costs and generation scale.[32]

Solar Water Heating

Beijing offers a solar water heating (SWH) incentive of ¥200/$m^2$ for qualified buildings, according to the *Interim Measures Subsidies For Beijing Solar Hot Water Systems*.[33] A few other provinces offer SWH incentives, but they are not relevant to the SEBIZ business districts.

Wind

The urban wind resource in most Chinese cities is insufficient for viable projects. As such, policies and incentives for this technology were not reviewed.

Geothermal

Geothermal heat pump (GSP) technology, also referred to as ground-source heat pump, is the only equipment being supported by the Chinese government to take advantage of geothermal energy in an urban setting. China's central government offers strong financial incentives, as seen in Table 3.

Bioenergy

In dense urban settings, the use of biomass as an energy source is largely viable only as combined heat and power (CHP) for district energy applications. While relevant for commercial buildings, this technology was deemed out of scope for SEBIZ commercial building retrofit projects.

## CLEAN ENERGY DEMONSTRATION PROJECTS

Demonstration projects, such as Eco-Cities, Low-Carbon Cities, and New Energy Cities, have been a common method for Chinese policymakers to fund pilot projects in order to determine successful approaches to low-carbon development. The central government has allocated ¥50 million in funding to support the construction of "green" eco-cities and eco-districts. In 2011, the MOF and NDRC issued the "*Notice of Fiscal Policy for Energy-Efficient and Emission Reduction Demonstration Provinces and Cities*" to support these efforts. Through this notice, financial incentives were provided to three cities and five provinces to support six

initiatives focusing on green buildings and building energy efficiency. MOHURD has also discussed the possibility of providing limited national subsidies to developers for using more efficient building materials and renewable technologies[34], which could greatly benefit the Green Dragon Lake district.

# 3. MARKET ASSESSMENT

This section assesses the key market opportunities for deploying energy efficiency and renewable energy technologies in China's commercial building sector.

## 3.1 Energy Efficiency

Due to the expected continuation of China's new construction boom, one of the key market drivers with the greatest potential for energy savings are strong energy efficiency standards for new construction. Energy efficient building design can reduce the need for energy consumption before ever installing equipment. Nonetheless, China's rapid new construction will certainly lead to growth in equipment use associated energy use, which offers excellent prospects for potential savings from energy efficiency. This has certainly factored into China's focus on energy intensity within the FYP framework, as well as its strengthening of building and appliance standards.

**Figure 5: Green Building Investment Potential**

| Program/Sector | Expected Investments (2011-2015) (billion $)* |
|---|---|
| New buildings | 16.5-24.8 |
| Energy efficiency retrofits (residential) | 1.5-3.6 |
| Energy efficiency retrofits (public) | 3.5-8.6 |
| Renewable energy | 1.1-1.2 |
| Green buildings | 7.9-13.2 |
| Rural buildings | 1.3-2.0 |

Source: Pacific Northwest National Laboratory[35]

When approaching the market opportunity for building energy efficiency in China it's important to segment the market into new construction and existing building retrofits, as the approach to serving these respective markets differs substantially. Pursuing the new construction market might involve working with real estate developers and getting product specifications included into the building design phase, whereas retrofit projects require a high degree of interaction with commercial building owners and might be based on energy audits and/or retrocommissioning.

Sector-specific market potential figures and tables provided below were obtained from a presentation delivered by the Pacific Northwest National Laboratory.[36]

### BUILDING ENVELOPE

Rapid growth in demand for insulation and energy efficient windows is expected in China. China's insulation market saw an annual growth rate of 15.1% from 2006 to 2010 to 4.1 million tons in 2010. Low-emissivity glass industry saw an annual growth rate of 58% from 2006 to 2010, with market share jumping from 1.3% to 7% during that period. Growing demand and higher profit margins (12% to 15%) for high-efficiency products. [37]

### LIGHTING

Lighting design standards are creating significant demand for high performance lighting. Other policy drivers include incentives and the phase-out of incandescent bulbs. LED market share is forecasted to grow rapidly through 2020. [38]

**Table 4: Forecasted Market for Lighting Technologies**

| | Unit | 2011 | 2012 | 2016 | 2020 |
|---|---|---|---|---|---|
| Total Market | $ Billion | 12.6 | 14.3 | 19.8 | 25.4 |
| Incandescent | % | 7 | 6 | 1 | 0 |
| CFL | % | 19 | 17 | 12 | 6 |
| LED | % | 12 | 18 | 46 | 69 |
| Others | % | 62 | 59 | 41 | 25 |

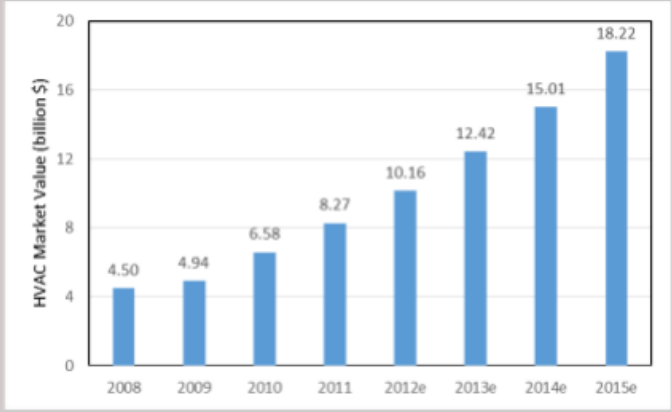
Source: McKinsey & Company 2012[39]

### HVAC & CONTROLS

China has the Largest HVAC market in the world, which is predicted to reach $18.3 billion in 2015. China's

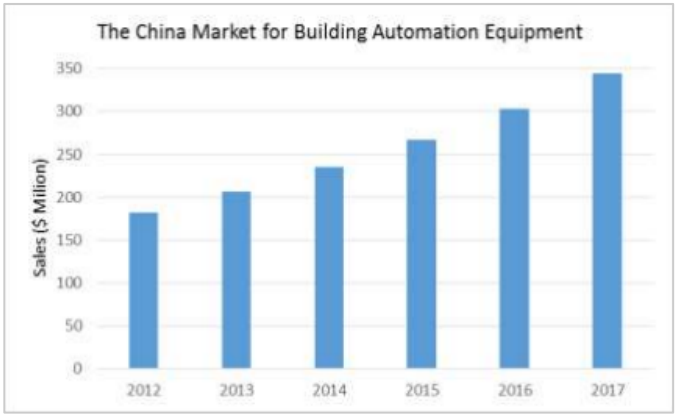
market for HVAC controls is forecasted to grow at 13.7% annually, reaching $344.5 million in 2017.[40]

**Figure 6: Market Growth for HVAC Equipment in China**




Source: Frost & Sullivan 2012[41]

**Figure 7: Market Growth for Building Controls in China**




Source: IMS Research[42]

## 3.2 Renewable Energy

Renewable energy technologies will play an increasingly important role in meeting rising electricity demand in China. Market growth will continue to be driven by strong policy support, new business models, and innovative financing models. This section provides an overview of historical and future market growth figures for distributed renewable energy technologies.

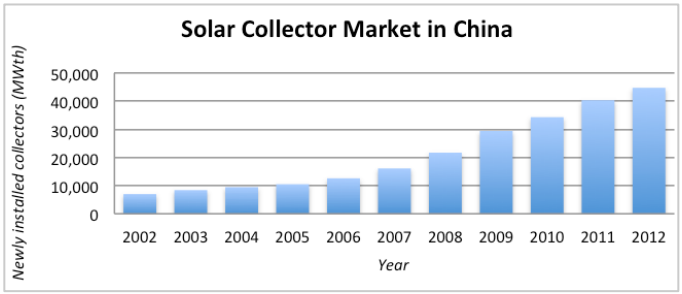
### SOLAR PV

China's National Energy Administration (NEA) estimated that just under 10GW of PV was connected to the grid in 2014, which falls short of the government's 14 GW target allocated in its quota, according to Bloomberg New Energy Finance.[43] Market research firm IHS predicts that distributed solar PV in China will struggle to achieve its aggressive targets, but continue to grow through policy support and new business models. IHS forecasts that distributed solar PV installations will reach 4.7 GW in 2015, an increase of nearly 20% over 2014.[44]

### SOLAR WATER HEATING

The market for solar thermal collectors in China has grown steadily with the annual growth rate of 3.3% through 2012, as shown in the figure below. Domestic hot water is the most typical application. Through the end of 2013, total installed capacity was 310 million $m^2$ with a growth rate of 20.3%, according to the International Energy Agency (IEA).[45]

**Figure 8: Market Growth for Solar Collectors in China**




Source: International Energy Agency[46]

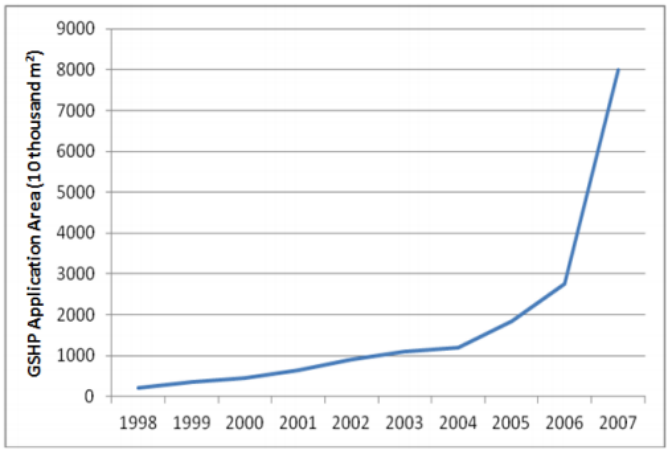
### WIND

The urban wind resource in most Chinese cities is insufficient for viable projects. As such, the market for this energy source was not assessed.

### GEOTHERMAL

China's geothermal heat pump industry has seen an explosive growth since 2005, as shown in the chart below, due to the strong financial incentives by the central government. Growth in GHP installations exceeded 60% in the past two years, according to Oak Ridge National Laboratory.[47]

**Figure 9: Market Growth for Geothermal HPs in China**




Source: Oak Ridge National Laboratory[48]

**BIOENERGY**

While CHP systems powered by biomass for a district energy applications are relevant for commercial buildings, this technology was deemed out of scope for SEBIZ commercial building retrofits. As such, the market for this energy source was not assessed.

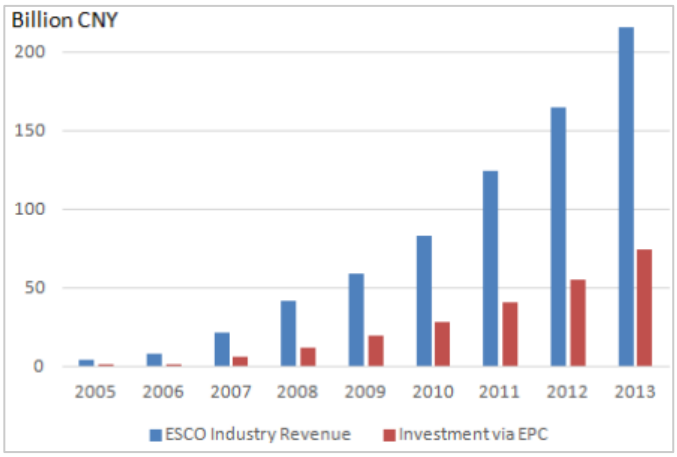
## 3.3 Financing Structures

Project financing continues to be a critical component of clean energy markets. Market growth for energy efficiency and renewable energy technologies has accelerated rapidly thanks in part to new business models offered by energy service companies (ESCOs) that help energy consumers overcome the upfront cost hurdle. The section provides an overview of two leading financing structures that currently exist in the Chinese clean energy market: energy performance contracting and leasing models.

**ENERGY PERFORMANCE CONTRACT MODEL**

In 2010, China's State Council instructed local governments agencies to support the development of the energy services industry and extended financial incentives for qualified energy efficiency projects using the energy performance contracting model (EPC).[49] Funding was provided to three new pilot Chinese ESCOs that were started with assistance from their hometown provincial-level governments to help make the EPC business model work. The creation of private sector ESCOs quickly followed the government's pilot project and the industry grew so fast that in 2011 there were approximately 3,900 ESCOs operating China. Annual EPC investment in China increased from $100 million in 2003 to $12.75 billion in 2013, according to PNNL.[50] Strong growth is expected to continue in the coming years due to significant market opportunities and financial incentives for ESCOs.

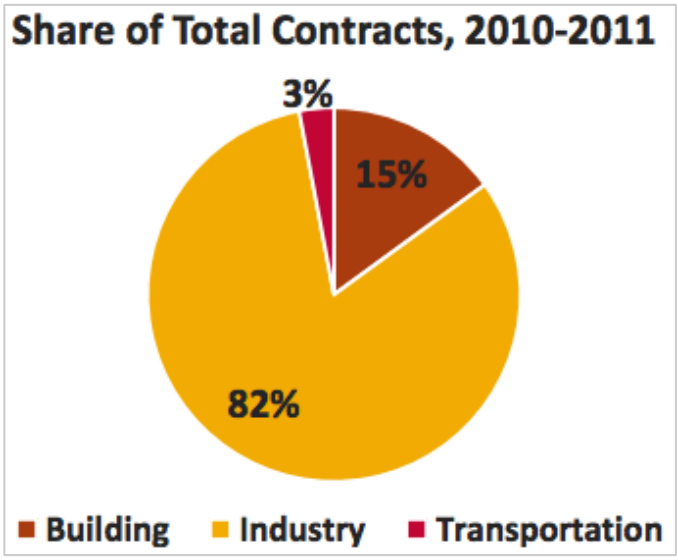
**Figure 10: China Energy Performance Contract Market**




Source: EMCA & IFC, 2012; GBPN, 2013; CESI, 2014[51]

Currently, there are two main types of contracting arrangements for EPCs in China: shared savings and guaranteed savings models. Initially, shared savings was the dominant model, due partly to government incentives and tax advantages, but in 2014 they each had about half of the market, according to a white paper by PNNL and LBNL.

**Figure 11: China Energy Performance Contract Market**




Source: EMCA & IFC, 2012[52]

### LEASING MODELS

A policy notice issued by China's NEA in 2014 encouraged the creation of new financing models for distributed solar PV. The potential new structures that were highlighted include leasing models, loan guarantees, and strategic partnerships between banks and solar PV installers.

One particular model that has already taken hold in China is the leasing model for solar PV. This third-party financial arrangement is often for solar PV installations and is structured as a roof lease by the commercial building owner to the project developer. The developer compensates the host building owner with a regular roof lease payment, sells the energy generated to the electric utility, and collects the feed-in tariff subsidy from the central government. This model is not fully mature, but could be a viable solution for commercial building owners participating in the SEBIZ program to install distributed solar PV equipment on their roofs with no upfront cost and immediate returns.

# 4. CHALLENGES

China's energy efficiency and renewable energy targets are among the most aggressive in the world. There is potential for significant improvements in environmental and public health conditions if the central government is successful in achieving its goals. However, despite existing policy mandates and generous subsidies, market participants have been slow to take action and demonstrate results.

Several specific challenges were identified through the SEBIZ program and are described below according to stakeholder group. Additionally, Table 5 presents general market challenges and opportunities observed by Optony Inc. in both the China and U.S. that are common to the commercial building sector.

### LOCAL GOVERNMENTS

- Local action is critical to meet China's ambitious energy and climate goals, but local governments often prioritize GDP growth over low-carbon development due, in part, to the central government's incentive structure and local tax revenue earnings.
- Trickle down mandate implementation tends to be the extent of local government ambition for EERE policy and program development. Few municipalities desire to exceed national targets for the benefit of their constituents.
- Expertise, focus, resources, budget, and competing priorities remain significant challenges. There is a lack of defined roles for "sustainability managers" within local governments and commercial enterprises, which contributes to the local lack of clean energy and low carbon expertise.
- Local clean energy activity is often limited to pilot projects that test approaches to EERE technology deployment. Further, national programs that have funding to address resource issues haven't been fully implemented due to poor program planning.
- Grid electricity distribution capacity constraints were found to restrict growth in business districts. This could be overcome through a combination of EERE technologies, but decisionmakers were not aware of such a solution.

### COMMERCIAL BUILDING OWNERS

- Many commercial building owners are not aware of the potential and achievable benefits from implementing energy upgrades. Further, many existing buildings have never had an energy audit or retrocommissioning performed.
- There is a lack of familiarity with the benefits of leveraging third-party expertise. Additionally, there is a general lack of interest in paying for services separate from products, as services are not tangible and a less familiar type a work product compared to manufactured goods.
- Standardized and transparent procurement processes, such as RFQs and RFPs, are not common for energy upgrades in the commercial building sector, which makes it difficult to find qualified vendors for retrofit projects with advanced, unfamiliar technologies.
- Many existing buildings aren't equipped with advanced building energy management systems, which make it difficult to monitor building energy and perform diagnostics. This technology gap makes the identification of potential EERE technologies opportunities and peak load reduction

strategies, such as demand response programs, challenging.
- Business owners and tenant businesses are unable to effectively position their companies to benefit from the sustainability aspects of clean energy upgrades.
- Large developers with ambitious sustainability goals still make poor energy-related decisions when it comes to equipment procurement choices, such as lighting and HVAC.

## CLEAN ENERGY SOLUTION PROVIDERS

- Major EERE vendors operating in China have appetites for large, multi-million RMB projects and are less interested in smaller projects without project aggregation and preferred vendor status on a district-wide basis.
- The standard solution provider's approach to marketing and company/product positioning in China lacks sophistication, such as value propositions tailored to specific market segments.
- Existing solution providers and new market entrants appear to be capacity constrained and unable to meet the demand for energy upgrades across China's commercial sector. The cause is likely to be insufficient human and capital resources as well as lack of contacts for relationship building.
- Various business model innovations, such as project aggregation and buyer-vendor matchmaking, have proven successful in the U.S., but vendors need to fill in know-how gap of energy consumers.
- Advanced metering techniques, such as virtual net metering, are not being utilized to expand solar ownership options to energy consumers that don't have access to a roof suitable for generating solar power.

**Table 5: Challenges and Opportunities for Clean Energy Technology Adoption in the Commercial Sector**

| CHALLENGES | OPPORTUNITIES |
|---|---|
| **Upfront Cost.** Commercial building owners or businesses often lack sufficient capital to finance their own efficiency improvements and savings accrue over time. Customers tend not to make investment upgrades for this reason, even with short paybacks. | **Energy performance contracts**, such as the shared or guaranteed savings models, are becoming increasingly popular and available in the market. Customers need to be comfortable with calculation methodologies. |
| **Savings & Payback Expectations.** Building owners tend to be willing to make improvements only when paybacks are short (1-2 years) or if the savings are too significant to pass up. Projects with small savings, even if economically viable, often lose out to competing priorities. | **Energy performance contracts**, such as the shared or guaranteed savings model, technically offer immediate paybacks. Education and awareness building about this financial model would be effective. |
| **Split Incentive.** This issue is very common in the commercial building sector when buildings are not owner-occupied. Generally, owners do not receive the benefit from an EERE investment and tenants have no incentive to make a EERE investments in buildings they do not own. | **Expand/explore innovative financing models**, such as energy performance contracts, green leases, and Property Assessed Clean Energy (PACE) financing, in order to allow savings from energy upgrades to pay off investments over an extended period of time with no upfront cost to owner or tenant. |
| **Lack of Awareness.** Building owners and occupants are often unaware of the impact their actions have on energy use or the potential benefits that can be attained from energy efficiency measures. | **Training and awareness building** about the relative cost-effectiveness of energy efficiency measures can have an impact, especially when combined with other benefits such as occupant comfort and worker productivity. |
| **Competing Priorities.** Energy upgrades are only one of many important considerations a building owner or developer has to take into account when making operational decisions. | **Whole building approach to EERE upgrades** can simplify the process for building owners and vendors. Recognition programs can be effective in encouraging action as well. |
| **Low Concern for Occupant Comfort**. In China it is not uncommon for commercial building occupants to work in conditions that lack sufficient lighting levels or thermal comfort in order to reduce operational expenses. | **Training and awareness building** about increased worker productivity and retention benefits associated with building occupant comfort. This can be even more effective when combined with a campaign for behavioral awareness. |
| **Transactions Costs.** Building-level distributed EERE projects often lack the scale necessary to be economically viable due to relatively high transaction costs associated with small projects. | **Project aggregation models,** such as the SEBIZ portfolio approach to distributed EERE projects, help reduce transaction costs by bundling projects to build scale and simplify processes. |

# 5. CONCLUSION

Accelerating improvements in building energy performance can an effective strategy to reduce the energy intensity of the commercial sector to help China's policymakers achieve their energy and climate goals. Furthermore, advancing models to unlock the potential in the untapped distributed renewable energy market would help achieve China's policy goal associated with non-fossil energy generation in the power sector by 2020.[liii] Additional potential benefits include: enhancing China's role in climate negotiations, fostering energy security, increasing economic development and job creation, as well as stimulating innovation. Below are several initial recommendations for implementation of the SEBIZ program in China.

## INITIAL RECOMMENDATIONS

- **Continue strengthening building energy codes.** The market for new construction projects in China is expected to continue growing at a rapid pace. The installation of energy efficient materials and equipment during new construction and major renovations is the most cost-effective approach and locks-in the energy savings over time.
- **Adopt incentive structure to increase local focus.** The support of local governments in clean energy market transformation is essential for achieving measureable impact. Appropriate incentive structures should be instituted in order to motivate public officials to prioritize support for enhancing market conditions for low-carbon development.
- **Additional support of distributed generation**. This shift is already underway in China, as the NEA's "policy notice" announced in 2014. Commercial buildings are an important resource for helping the central and local governments in achieving their distributed solar PV goals and benefits associated with decentralized energy generation.
- **Commercial Energy Benchmarking Requirements**. Local governments in the U.S. have increased transparency of energy consumption in public- and private-sector commercial buildings through local ordinances that require owners of non-residential buildings to annually benchmark their buildings' energy use and publicly disclose the results. This data allows for the development of future targeted policies that promote energy efficiency and onsite generation.
- **Renewable portfolio standards.** One key market driver for renewable energy in the U.S. has been a mandate by state governments for utility and grid operators to meet a specified portion of their electricity generation needs with renewable energy sources.
- **Time-based electricity pricing**. Electricity tariffs that recognize the value of energy consumed at different times of the day send strong price signals to consumers, support solar power generation, and help unlock innovative approaches to peak load reduction.
- **Interagency clean energy program coordination.** There are a multitude of programs in place that support low-carbon in China as well as the U.S. These programs may be able to achieve greater impact with increased cooperation among relevant agencies nationally, and internationally in coordination with the U.S. Department of Energy and its national laboratories.

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