China’s Remarkable Success in Developing ESCOs: Current Status, Policy Drivers, and Prospects

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Abstract

China accounts for around 59% of the global ESCO market. The history of the Chinese ESCO market goes back to 1998, over a decade after the appearance of ESCOs in the US and other parts of the developed world. The rapid increases in the number of ESCOs in the market and their growth in market revenue make China a remarkable success story in using ESCO business models as an important instrument for improvements to energy efficiency in industry, commercial and public buildings, and public facilities. This article examines the status of the ESCO market in China, the policies that drive it and their evolution. China has set itself the ambitious target of peaking its energy consumption and GHG emissions by 2030 and achieving carbon neutrality by 2060. The national strategy to develop a green and circular economy promises enormous potential for the further development of ESCOs as effective market mechanisms in implementing energy efficiency projects. The article also offers an assessment of the remaining barriers to ESCO development in China and makes some recommendations for how to address them. China's approaches to developing an ESCO market and experiences with it can provide useful advice and examples to many other countries in their efforts for develop ESCO markets and devise the associated policies.

1. Introduction

The concepts of the energy performance contract (EPC) and the energy service company (ESCO) were introduced in China in 1998 by a World Bank/GEF "China Energy Conservation Project". A major achievement during Phase I of this project (1998-2006) was the establishment of three pilot ESCOs and a demonstration of their feasibility in China by means of multiple EPC projects. Phase II of the project (2002-2010) involved further support in the form of an "ESCO Loan Guarantee Programme", for which USD 22 million worth of guarantees were put into an account managed by the Ministry of Finance to underpin the commercial loans several Chinese banks made to EPC projects. The loan guarantees effectively reduced the risks for the commercial banks and expanded ESCOs' access to bank loans. Another outcome of Phase II was the establishment of the Chinese ESCO Industry Association (EMCA) in 2003, which plays an important role in promoting public awareness of ESCOs and EPC business models and in providing training for ESCOs.[1] Since then, thanks to government and international support, the ESCO market has developed quickly in China. In 2014, China became the largest ESCO market in the world, and its share of the global ESCO market has kept increasing since then.

This article will provide an overview of the status and history behind China's remarkable success in ESCO market development, the evolution of the country's general ESCO policies, and its policies in specific sectors. It assesses the barriers to further ESCO development in China and offers some solutions and policy recommendations.

2. Current status and trends of ESCOs development in China

According to the latest data from the IEA (2018),[2] China's ESCO market revenue was USD 16.8 billion in 2017, representing 59% of the global total.

2.1 Current status

According to China's ESCO Association, EMCA, the total size of China's ESCO market revenue increased by 9.4% to reach 522.2 bn RMB (or USD 75.9 bn) in 2019.[3] The number of enterprises engaged in energy conservation services reached 6547, with 761,000 employees in the sector. China's total investment in energy conservation and efficiency improvements is 114.1 billion RMB. The annual energy savings from ESCO projects in 2019 were 38.0 million tons of coal equivalent (MtCe), and the annual CO_2 savings capacity was 103.0 million tCO_2.

In terms of sectoral distribution, as can be seen in Figures 1a, 1b, and 1c, the Chinese ESCO market is mainly concentrated in four sectors: industry, public buildings, commercial and industrial buildings, and public facilities. Public facilities include street lighting and utilities. Figure 1a shows the distribution of ESCO projects in terms of the numbers of projects in each sector, while Figure 1b shows the distribution of investment, and Figure 1c the expected savings from these projects.

From the three figures, we can see that from project numbers to investment, and finally to energy-saving capacity generation, the degree of concentration of ESCO projects in industry increases, indicating that they are generally larger and generate more energy savings. ESCO projects in public facilities are the opposite: project size and each project's energy savings tend to be smaller.

2.2 Trends

The overall development trends in China's ESCO market are shown in Table 1. After the ESCO concept was introduced into China in 1998, the first few years constituted the initial stage of ESCO market development. The decade between 2005 and 2015 was a period of rapid development. Since then, although the market is still growing, the growth rate has slowed down in terms of both the number of ESCOs operating in the market and the number of employees. The actual energy savings capacity of ESCO activities in 2019 was the same as in 2017.

2.3 Sector distribution

According to the IEA, China's ESCO market is mainly focused on industry and non-residential buildings. As in Korea, India and Thailand, industry dominates the Chinese ESCO market due to government policies that provide incentives for industries to engage with ESCOs in implementing energy efficiency (see Table 2).

[1] EMCA and IFC, 2012. China Energy Service Company (ESCO) Market Study.
[2] IEA, 2018. *Energy Efficiency 2018 - Analysis and outlooks to 2040.*
[3] EMCA, 2020. ESCO Industry Development Report 2019. http://shoudian.bjx.com.cn/html/20200113/1035938.shtml. The big difference between the IEA data and the ECMA data indicate big differences in the scope of data.

Table 1. Development trends in China's ESCO market

	2005	2010	2015	2017	2019
Number of ESCOs	80+	782	5426	6137	6547
Employment (persons)	16,000	180,000	607,000	685,000	761,000
Revenue (bn RMB)	4.7	83.6	312.7	414.8	522.2
Investment (bn RMB)	1.3	28.8	104.0	111.3	114.1
Annual energy saving capacity (million tCe)	0.6	13	33.5	38.1	38.0
GHG emission reduction ($MtCO_2$)			84	103	103

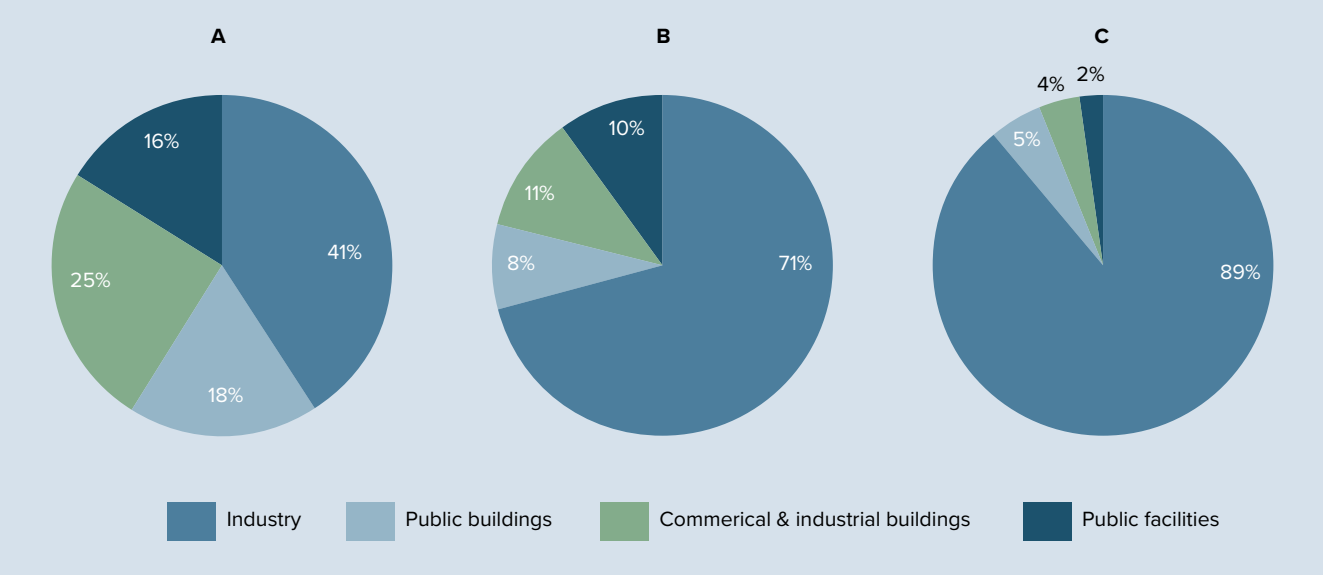
Source: 2005, 2010, and 2015 data from NDRC,[a,b] and 2017 and 2019 data from EMCA.[c]

[a] A Review of the Energy Saving Service Sector during the 12th Five-year Plan Period: https://www.ndrc.gov.cn/xwdt/gdzt/xyqqd/201707/t20170703_1197806.html;

[b] Rapid development of the energy-saving service sector - a review of the energy-saving during the 11th Five-year Period. http://www.gov.cn/gzdt/2011-10/08/content_1963940.htm

[c] EMCA, 2020. ESCO Industry Development Report 2019. http://shoudian.bjx.com.cn/html/20200113/1035938.shtml

Figur 1. a, b and c



Source: EMCA, 2020, ESCO Industry Development Report 2019. http://shoudian.bjx.com.cn/html/20200113/1035938.shtml. The big difference between the IEA data and the ECMA data indicate big differences in the scope of data.

Table 2. ESCO revenue based on end-use sectors

	Industry	Non-residential buildings	Residential buildings
China	55%	45%	
EU	20%	80%	
USA		90%	10%
Japan	30%	70%	
Canada		100%	
Korea	75%		25%
India	100%		
Thailand	60%	35%	5%
Mexico	70%	30%	

Source: IEA, 2018. *Energy Efficiency 2018 – Analysis and outlooks to 2040.*

Table 3. ESCO revenues, public vs private sector, 2017

	Private sector	Public sector
China	90%	10%
Canada	10%	90%
EU	20%	80%
US	15%	85%
Japan	62%	38%
Korea	85%	15%
Mexico	80%	20%

Source: IEA, 2018

In China, 90% of the ESCO market is in the private sector. This is different from the ESCO market in developed countries, but more similar to the situation in Asia and some developing countries. The concentration of ESCO market revenue in the private sector indicates more favourable policy settings for ESCO engagement in the private sector than in the public sector (IEA. 2018). As shown in Table 3, the majority of the Chinese ESCO market is in industry and commercial and industrial buildings. In contrast, public buildings and facilities only account for a small share of the market.

2.4 Business models

Globally, ESCOs typically engage in three types of contract in their operations: shared savings contracts, guaranteed savings contracts, and fee for service contracts. The first two types are also known as energy performance contracting (EPC) and are the main business models that distinguish ESCOs from other service companies in implementing energy efficiency. In shared savings contracts, an ESCO not only provides technical support to energy efficiency project design and implementation, it is also responsible for upfront project financing. Hence, it carries both the performance risk and the financial risk of the project.

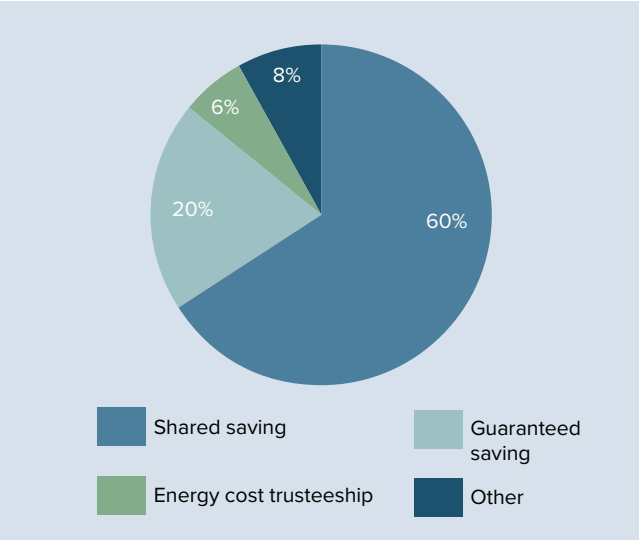
The guaranteed saving contract differs in that it is the facility owner, not the ESCO, that is responsible for financing the energy efficiency project. In such contracts, the ESCO guarantees the facility owner a certain percentage of the energy savings (see Figure 3).

In fee for service contracts, the ESCO provides specified energy efficiency services for an agreed fee. The facility owner is responsible for financing the energy efficiency project and receives all the cost savings. The ESCO does not have to guarantee a specified level of energy savings, but nor will it get a share of the savings from the energy efficiency project. Hence, this type of contract is not performance-based.

In the early periods of China's ESCO market development, the majority of the energy performance contracts (EPCs) were shared saving ones (see Figure 2). This was partly because facility owners were not familiar with EPC business models and lacked confidence in ESCOs, and partly because government policies limited some incentives to the shared saving EPCs. Moreover, government subsidies to EPCs were only applicable to the shared saving EPCs.

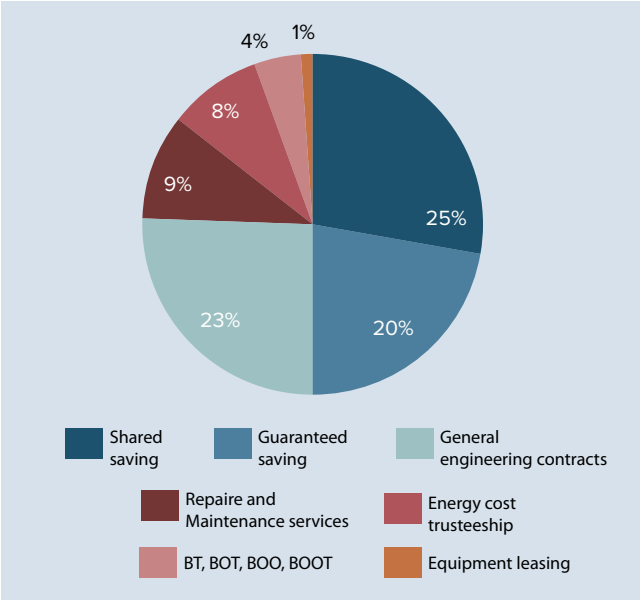
This situation has gradually changed. As the ESCO market has developed further, facility owners have increased their capacity to assess and fund energy efficiency opportunities. They are also more willing to fund energy efficiency actions and undertake the financial risks. The government's policies

Figure 2. Business models of ESCO market in China, 2010-2011



Source: IFC & EMCA, 2012. China Energy Service Company (ESCO) Market Study. https://www.ifc.org/wps/wcm/connect/5d1cfd04-36fc-4f80-9900-c419940bd69b/IFC+final+ESCO+report-EN+.pdf?MOD=AJPERES&CVID=jZVnBBO

Figure 3. Types of different energy performance service contracts by ESCOs, 2019



Source: EMCA, 2020. ESCO Industry Development Report 2019. PPT presentation. Available at http://shoudian.bjx.com.cn/html/20200113/1035938.shtml (accessed on 21 October 2020).
Note: BT- build-transfer; BOT: build-operate-transfer; BOO - build-own-operate; BOOT: Build-own-operate-transfer

have changed and now offer equal treatment to different business models of energy efficiency services. The Chinese ESCO market has witnessed some diversification and innovation of business models, and the proportion of sharedsavings contract has been declining (see Figure 3).

A very frequently used type of contract in Europe is the 'chauffage' contract, where an ESCO takes over complete responsibility for providing the client with an agreed set of energy services (e.g. space heat, lighting, motive power, etc.).[4]

2.5 ESCO size, ownership and types

The Chinese ESCO market consists of many small companies and a small number of large companies conducting the majority of the EPC projects. As can be seen in Table 4, the market has some tendencies towards concentration. While in 2010, small and micro-ESCOs received 78% of ESCO market revenues, in 2019 their combined share declined to 40%.

Table 4. Business revenue distribution among ESCOs of different sizes

Type of ESCOs	Share of ESCO market revenue	
	2010	2019
Micro-ESCOs (annual revenue ≤5 m RMB)	39%	16%
Small ESCOs (5 m RMB <annual revenue ≤ 20 m RMB)	39%	24%
Medium ESCOs (20 m RMB <annual revenue ≤ 100 m RMB)	18%	51%
Large ESCOs (100 m RMB <annual revenue)	4%	9%

Source of data: 2010 data from IFC & EMCA, 2012; 2019 data from EMCA.

[4] https://e3p.jrc.ec.europa.eu/articles/energy-performance-contracting#toc-1 Energy Performance Contracting

3. Evolving Policies

There are many factors behind the boom in the Chinese ESCO market. One is its national context, especially the increasingly strong and comprehensive national policies for energy conservation and GHG emissions reductions, as well as public awareness of the need for energy savings. The binding energy-saving and GHG emissions targets for the public sector and industry, as well as the high energy prices for small and medium industrial and commercial energy users, make up the demand for ESCO services. This article will focus on the policies that are directly related to ESCOs and EPCs. An overview of the relevant Chinese policies on ESCOs and EPCs is given in Table 5.

The 2007 Amendment to the Energy Conservation Law introduced a supportive overall framework for the energy service sector and relevant businesses. Over the years, China has introduced a whole set of supportive policies for ESCO and EPC development, from registration to operation via fiscal and taxation support to financing, as well as a long list of standards and rules for the measurement, monitoring and verification of EPCs. The 13th Five-Year Plan for National Development includes Energy Performance Contracting (EPC) as one of its key energy conservation projects and sets a target of doubling the ESCO sector's revenue by 2020 compared to the 2015 base.[5]

The targets for ESCO sector development in 2016-2020 are as follows:[6]

- Expanding and enhancing the energy conservation service sector's development innovations to the EPC business model, improving the benefit-sharing mechanism and promoting energy cost custody, guaranteed savings and equipment leasing services to meet the needs of the different energy-consuming enterprises.
- Support the provision of energy consultation, assessment, monitoring, testing and inspection, auditing and certification services. Encourage ESCOs to integrate upstream and downstream resources and provide one-stop EPC services, including diagnosis, designing, construction and operations.
- Encourage ESCOs to expand their services from single equipment and single content to energy system optimization and area energy efficiency improvements.
- The target is to increase the added value of ESCO services to 600 billion RMB by 2020.

3.1 Main policies on ESCOs and their evolution

In 2010, the State Council issued a document entitled *"Opinions on Accelerating Energy Performance Contracting (EPC) and Facilitating the Development of Energy Conservation Service Sector".* The document created a favourable policy environment for EPC dissemination in four respects.

First, the government increased its fiscal support. EPC projects are included in the scope of the national fiscal budget investment and the supporting scope of the National Special Fiscal Fund for Energy Conservation and Emission Reduction. The government also issued "Provisional Regulations on the Fiscal Rewards for EPC". In 2010, the central budget allocated 2 billion RMB to support ESCOs in implementing EPC projects for energy conservation.

Second, it set out preferential taxation policies. EPC projects are provisionally exempt from paying the business tax, as well as corporation tax for the first three years, the latter being halved for the next three years. When ESCOs transfer assets formed from EPC implementation to the facility's owners for free at the end of the energy performance contracts, they are exempt from paying VAT. All reasonable payments by facility owners to ESCOs under the EPC can be deducted from their current taxable income.

Third, the document improved the relevant accounting rules. When government agencies and public institutions use EPCs for energy conservation retrofitting, their payments to ESCOs should be treated as energy expenses in accountancy terms. When public institutions and enterprises use EPCs for energy conservation retrofitting, under the contract their payments to ESCOs should be treated as accounting expenses. The transfer of energy efficiency equipment to the host institution at the end of the EPC period is treated as a donation by the ESCO, which means they do not need to pay any tax on the asset transfer.

The fourth aspect was further improving financial services for ESCOs. Banks and other financial institutions are encouraged to introduce innovative credit products based on the financing needs of ESCOs, expand the scope of col-

[5] State Council, 2016. *Overall Plan for Energy Conservation and Emission Reduction during the 13th FYP*. Issued by the State Council

[6] The Development Plan for Energy Conservation and Environmental Protection Sector as part of the 13th FYP, jointly issued by the NDRC, MIIT, MOST, MOE.

Table 5. Overview of China's Main Policies on ESCOs and EPCs

Category	Sub-category	Specific measures	Policy Documents
Administration	Abolishing the ESCO registration system	It is forbidden to restrict the business operations of ESCOs based on their qualifications and registration.	*"State Council's Notice on the Overall Plan for Energy Conservation and Emission Reduction during the 13th Five-Year Period"* (2016)
	Establishing a blacklist system	Establishing a blacklist system of defaulting ESCOs, energy users, and third-party organizations, and list the defaulters on the national credit information sharing platform.	*"State Council's Overall Plan for Energy Saving and Emission Reduction during the 13th FYP"* (State Council, 2016) *The Action Plan for Energy Conservation by All during the 13th FYP* (NDRC, 2016)
	Establishing a registry and administration platform	The government establishes an online platform for an EPC registry and encourages energy users and ESCOs to register their EPCs in the registry.	The Action Plan for Energy Conservation by All during the 13th FYP (NDRC, 2016)
Legislation	*Energy Conservation Law* National People's Congress Original law: in 1997, amendments in 2007, 2016, and 2018	Contents on ESCOs: Article 22: "The state encourages the development of energy service organizations, supports them carry out consultation, designing, testing, auditing, and certification services on energy conservation." "The State supports energy conservation organizations to carry out awareness raising, technology training, piloting, and other public services regarding energy conservation." Content on EPC: Article 66: "The state shall use fiscal, taxation, and price policies to support demand-side management, **energy performance contracting**, and voluntary energy saving agreements."	The most important amendment was one in 2007 which extended the law from the original 50 articles to 87 articles. The other two amendments were minor.
Fiscal budget	Include in the national budget	EPC projects shall be included in the national investment budget and the support scope of the national budget for the special fund for energy conservation and emission reduction.	*"Notice on Speeding up EPC Implementation and Facilitating ESCO Development"* (General Office of the State Council, 2010)
Tax incentives	Corporate VAT exemption and reduction	The business revenue ESCOs receive from their EPC projects will be exempt from paying VAT, and the assets created from EPC implementation and transferred for free to project owners are expected from paying VAT.	*"Notice on Speeding up EPC Implementation and Facilitating ESCO Development"* (General Office of the State Council, 2010) *"Notice on the Policies Regarding the VAT, Business Tax, and Corporate Tax to Support the Development of Energy Conservation Services* (Ministry of Finance and State Taxation Administration, 2010)
	Tax exemption and reduction	ESCOs' income from EPC projects shall be exempted from paying corporate income tax during the first three years of receiving revenue. The tax rate is half the normal rates during the second three-year period.	*"Notice on Speeding up EPC Implementation and Facilitating ESCO Development"* (General Office of the State Council, 2010) *"Notice on the Policies Regarding the VAT, Revenue Tax, and Corporate Tax to Support the Development of Energy Conservation Services"* (Ministry of Finance and State Taxation Administration, 2010) *"Announcement on Preference Policies for the Corporate Income Tax for the EPC projects by ESCOs"* (NDRC, State Tax Administration, 2013)
Accounting rules	Accounting of equipment transfer	Upon expiration of energy performance contracts, the equipment transfer from ESCO to the facility owner is treated as donations.	*Notice from the General Office of the State Council on Facilitating the Development of Energy Service Sector* (2010)

Category	Sub-category	Specific measures	Policy Documents
Financial support	Using expected income as collateral	The state encourages banks and other financial institutions to accept the use of carbon emission right, pollution emission right, expected revenue from EPCs, and franchise revenue as collaterals for loans, and supports the leasing and other innovative financing services.	*13th FYP Plan on the Development of Energy Conservation and Environmental Protection Sector*
	Fixed asset collateral	ESCOs can use the fixed assets they invest in under EPCs as collaterals when applying for loans from banks.	*Notice from the General Office of the State Council on Facilitating the Development of Energy Service Sector* (2010)
	Risk-sharing	The government guides and supports various financial guarantee institutions to provide risk-sharing services.	*State Council's Overall Plan on Energy Conservation and Emission Reduction during the 12th FYP* (2011)
	Transaction platform	Establishing an asset transaction platform based on EPC assets	*State Council's Overall Plan on Energy Conservation and Emission Reduction during the 13th FYP* (2016)
	Investment fund	The government encourages social capital to set up investment funds targeting at energy conservation service sector.	*State Overall Plan on Energy Conservation and Emission Reduction during the 13th FYP* (2016) *Action Plan for Whole Society Participation in Energy Conservation during the 13th FYP* (NDRC, 2016)
	Green bonds, interest subsidies	The government supports ESCOs to issue green bonds and the combination of investment, bond issuance, and loans to facilitate the development of EPCs.	*State Council's Overall Plan on Energy Conservation and Emission Reduction during the 13th FYP* (2016)
	Insurance	Explore the development of green insurance and innovate insurance products targeting at EPCs and third-party involvement in environmental pollution reduction.	*13th FYP Plan on the Development of Energy Conservation and Environmental Protection Sector* (2016, NDRC, MIIT, MOST, MOEE)
Public institutions	Business model selection	Public institutions should prioritize EPCs during their energy efficiency retrofitting; the government actively supports public procurement of EPC services and explores the business model of energy use and cost custody.	*State Council's Notice on Energy Conservation and Emission Reduction during the 12th FYP* (2012) *State Council's Overall Plan for Energy Conservation and Emission Reduction* (2016)
	Payments to EPCs treated as energy expenses in public spending.	When government agencies engage EPC services for energy retrofitting, the payments to ESCOs under EPCs should be treated and reported as energy expenses in accounting.	*Guidance on Speeding up EPC Development and Promoting Development of the Energy Service Sector* (State Council, 2010) *Energy Conservation Plan for Public Institutions during the 13th FYP* (State Council, NDRC) *Notice on Improving the Energy Efficiency of Public Buildings and Key City Construction* (MOHURD and China Banking Regulatory Commission, 2017) *State Council's Overall Plan on Energy Conservation and Emission Reduction during the 13th FYP* (2016)
	Public institutions may seek EPCs in energy conservation.	Public Institutions may adopt **energy performance contracting** and commission energy service companies to conduct energy conservation diagnosis, designing, financing, retrofitting and operations management. During their energy efficiency retrofitting, public institutions should conduct an energy audit and cost-benefit analysis, specify the energy-saving targets, and check and assess whether the energy-savings targets are achieved through measurement and data collection.	*Bylaw on Energy Conservation for Public Institutions* (Standing Committee of the National People's Congress in July 2008)

Category	Sub-category	Specific measures	Policy Documents
	Public institutions can preserve part of their energy cost-savings and other incentives.	Improve the subsidy policies for EPCs of public institutions and the partial preservation of energy cost-savings, stimulate social investment in energy conservation projects in public institutions, and facilitate the development of the ESCO sector.	The Energy Conservation Plan for Public Institutions during the 12th FYP (Government Offices Administration, State Council, 2011)

Table 6. The ESCO certification system

Name	Criteria	Focus	Categories	Grading	Validity
ESCO Certification and Grading	*Instructions on Promoting Energy Performance Contracting and Energy Service Sector Development* (State Council, 2010); *Regulations on ESCO Certification and Grading* (amended in 2018)	*Overall competence*	Industry Building Public Facility	AAAAA AAAA AAA AA A	2 years
ESCO Credit certification and grading	*Provisional Regulations on Credit Evaluation and Grading for Energy Conservation Sector (Enterprises)* (China Energy Conservation Association, 20	Credit, operation	Production; Service	AAA, AA, A BBB, BB, B CCC, CC, C	3 years
Certification for the Qualification to Conduct EPC Services	Requirements for the Certification for Enterprises for Conducting EPC Services	Service quality, process control, service performance	Boilers (kilns), waste heat and waste pressure utilization, motor system energy saving, energy system optimization, building retrofitting, solar PV	AAAAA, AAAA, AAA, AA, A	3 years

laterals, simplify loan applications and approval procedures, and provide project financing and guarantee services to ESCOs. ESCOs should be allowed to use the fixed assets generated from their investments in EPCs as collateral when they apply for bank loans.

3.1.1 ESCO and EPC administration

At the beginning, all ESCOs were subject to government approval and registration. To seek registration by the National Development and Reform Commission (NDRC), they needed a recommendation from the Ministry of Industry and Information Technology (MIIT). This system has shifted to a system of voluntary registration, namely an ESCO certification system based on the ESCO's technical competence, economic capacity and credit record. Enterprises that default on their contracts and promises are blacklisted, and information about this is made publicly available. Table 6.

3.1.2 Tax incentives and government subsidies

The ESCOs that implement shared saving EPCs can enjoy the preferential policies of a "3-year exemption" and "3-year half rate" for corporate income tax payments based their income from such projects. If the contracting period is shorter than six years, then the actual preferential tax period is the duration of the shared saving EPC.[7]

3.1.3 Subsidies from national and local governments

EPC projects are included in the supporting scope of national budget investments and the national special budget fund for energy savings and emissions reductions. The energy retrofitting projects that ESCOs implement via EPCs can receive subsidies or rewards. Subsidies from local governments can be applied in advance and settled on the basis of actual

[7] State Taxation Administration and NDRC, 2013. Announcement on Preferential Policies on Corporate Income Tax for EPC Projects. http://www.chinatax.gov.cn/n810341/n810755/c1149419/content.html

energy savings and emissions reductions. *The Interim Measures for the Management of Financial Incentive Funds for EPC Projects* issued by the Ministry of Finance and NDRC in 2010 and more than 2 billion RMB from the national fiscal budget was allocated to the special fund. This also set the standards for central budgetary rewards of RMB 240/tCe, while the rewards from province-level fiscal budgets should be at least RMB 60/tCe.[8]

In 2015, the *Interim Measures for the Management of Fiscal Incentive Funds for EPC Projects* were replaced by the *Interim Measures on the Management of Subsidies for Energy Saving and Emission Reduction*. The 2015 Interim Measures stipulate that fiscal subsidies should be results-based rewards; EPC projects can receive some grants in advance, and then the subsidies should be settled on the basis of actual energy-saving effects.[9] In January 2020, the Ministry of Finance updated the 2015 version of the Interim Measures on the Management of Subsidies for Energy Saving and Emission Reduction and extended the duration of the financial rewards to 2022.[10] Upon expiry, the government may consider whether to continue offering the subsidies for longer.[11]

3.1.4 Financing

The financing policies for EPCs include encouraging banks and other financial institutions to accept the assets ESCOs invest in EPCs and their expected revenues from EPCs as collateral for bank loans, guarantees, insurance products for risk management and green bond issues. The Beijing Environmental Exchange has set up an investment and financing platform for EPC assets where ESCOs can sell their future revenue flows from EPC projects and raise funding for new EPC projects.[12] The government also encourages public-private partnerships in the funding of energy efficiency projects and ESCOs and green bond issues by ESCOs. It also supports the development of EPCs by innovatively combining investments, bonds and bank lending.[13]

From 2009 to 2017, another international project financed with World Bank loans and GEF grants was aimed at supporting innovation in energy conservation financing and policy improvements, as well as the NDRC and the National Energy Conservation Centre. These projects involved USD 350 million of loans from the World Bank and USD 13.5 million of grants from 2009 to 2017. The NDRC is the Chinese partner, while the China National Energy Conservation Centre was responsible for day to day project management. Three Chinese banks, China Import and Export Bank, Huaxia Bank and Minsheng Bank, were the local financial institutions that re-lent the World Bank loans to finance energy conservation, waste-heat utilization and coal substitution projects in such industries as iron and steel, electricity, chemicals, building materials and petrochemicals. The loans leveraged over RMB 20 billion of investment in energy conservation and generated an annual energy-saving capacity of 4.41 MtCe and an annual CO_2 generating capacity of 10.77 Mt. The USD 13.5 million was spent on policy study and capacity-building for energy conservation.[14]

Seeing lending to energy efficiency projects and opportunities as a new business opportunity, some commercial and local banks, such as the Beijing Bank, Industrial Bank and Shanghai Pudong Development Bank, offer loans for EPC projects. Financing has been a key area in the various efforts to boost ESCO market development in China.

3.2 Policy drivers of ESCO markets in different sectors

3.2.1 Industrial sector

As the world's factory, China has a large industrial sector. In 1990, industry accounted for 70% of China's primary energy consumption and 67% of its final energy consumption. Improving industrial energy efficiency has been a priority of the government's various policies and efforts to achieve improvements in energy efficiency and emissions reductions. The rapid boom in heavy industry and construction since the early 2000s makes slowing down the industrial sector's demand for energy a difficult task. After almost three decades of strong efforts to make energy efficiency improvements, industry still accounted for 66% of China's primary energy consumption and 65% of its final energy consumption.[15]

[8] Exchange rate of RMB: since 2008, the USD/RMB has been in the range between 6 and 7.
[9] http://www.gov.cn/gongbao/content/2015/content_2912375.htm
[10] http://www.gov.cn/zhengce/zhengceku/2020-02/21/content_5481719.htm
[11] Provisional Regulations on the Administration of the Energy Conservation and Emission Reduction Subsidies (MoF), 2020 version (Issued to replace the 2015 version).
[12] China Beijing Environment Exchange, https://www.cbeex.com.cn/article/ywzx/htnygl/
[13] State Council, 2016. Overall Plan for Energy Saving and Emission Reduction during the 13th FYP.
[14] Enhance energy-saving financing and support the thriving and expansion of energy saving sector – conclusion meeting of the China Energy Saving Financing Project is held in Beijing. 2017/06/06. https://www.ndrc.gov.cn/fggz/hjyzy/jnhnx/201706/t20170606_1134137.html
[15] NSBC, 2020. China Statistical Yearbook 2020.

Table 7. Energy efficiency targets for big energy consumers

	Key programs for big energy users	GDP decrease in energy intensity in the industrial sector	
	Big energy users	Target	Actual
11th FYP (2006-2010)	Top 1000 Programme	-20%	-19.1%
12th FYP (2011-2015)	Top 10,000 Programme	-16%	-18.4%
13th FYP (2016-2020)	Top 100, 1000, and 10,000 Programme	-15%	

The main policies for industry include energy-intensity targets for key industrial sectors, products and processes, energy efficiency targets for large industrial energy users (see Table 6), and using energy efficiency as a criterion before new investments in industrial projects can be approved. The enterprises on the list have to report their annual energy use and GHG emissions, subject themselves to government inspections, and release their energy and emission performance data to the general public. The government can require enterprises that are failing to meet their targets to take immediate corrective action or be forced to close down their polluting and inefficient industrial facilities. As a result, the industrial sector has been able to meet the energy-intensity targets through the rapid deployment of efficient technologies. Apart from subsidies and tax incentives for investments in energy efficiency, the government also uses energy prices as a tool to motivate energy efficiency actions. It is strong policies promoting energy efficiency in the industrial sector and the relatively high returns from energy efficiency investments that make industry the most important component of the ESCO market in China.

Moreover, the focus on motivating improvements to energy efficiency in energy-intensive sectors in the form of technology catalogues, standards and guidance on energy efficiency auditing, benchmarking, diagnosis, measurement, monitoring, verification and certification also support ESCO services in the industrial sector. The National Promotion Catalogues for Key Energy Saving Technologies are intended to stimulate energy savings and emissions reductions in all industrial facilities. The catalogue targets both equipment manufacturers and energy users. The first version of the catalogue was issued in 2008, and as of early 2020 it has been updated ten times. The NDRC makes the different versions of the catalogue available on its website, and various fiscal and taxation measures are linked to the adoption of the technologies featured in the catalogue.[16]

As the governing authority for the industrial sector, the MIIT has actively engaged in standard-setting in assessing and calculating energy savings in various industries, which can help avoid controversies over EPCs and other energy service contracts by ESCOs. For instance, in 2012, the MIIT published technology catalogues, technical guides and application case studies for energy savings and emissions reductions in eleven key industries.[17] In 2017, it launched an "Action Plan for Industrial Energy Saving and Green Development Standardization" (2017-2019), focusing on establishing a set of energy-saving standards for such industries as iron and steel, building materials, metallurgy and machinery manufacturing. In August 2020, it published guides for Industrial Energy Saving Diagnosis (IESD) services in six key industries: iron and steel, cement, electronics, textiles, food and paper, as part of an "Action Plan for Industrial Energy Saving Diagnosis (IESD)", facilitated the development of IESD services, and further enhanced the standards and quality of IESD services.[18]

3.2.2 Commercial buildings

Like other sectors, the commercial sector faces many mandatory requirements and financial incentives regarding energy savings, including using EPCs for energy renovation

[16] SEforALL Industrial Energy Accelerator, 2020. *China Energy Saving and Low-Carbon Technologies Catalogue and Financial Incentives to Promote Energy Efficiency Technologies*. Available at https://www.industrialenergyaccelerator.org/

[17] 2012. Technology Catalogue and Technical Guides Issued for 11 Key Industries. http://news.cncaa.org/17283.html

[18] MIIT Issued Guidance on Energy Saving Diagnosis for 6 Key Industries. http://www.solidwaste.com.cn/news/313673.html

purposes. Unlike many other countries, however, in China the electricity, natural gas and heating prices for industry and commercial consumers are higher than those for households, providing an additional motivation for businesses to take energy-saving actions.[19]

In China, energy prices are controlled by the government, and the Price Department at the NDRC sets the benchmark prices, while local DRCs decide their own local prices. The prices differ for different energy-user groups, including households, large industrial clients, ordinary industrial and commercial users, and agricultural users. Among them, the energy price for households is the lowest, while those for ordinary industrial and commercial users are the highest. Despite repeated government efforts to reduce the prices for industry and commercial users, they remain higher than those for other user groups. As energy prices vary from province to province, Tables 8, 9, and 10 use the prices for electricity, heating and natural gas in Beijing to illustrate the high energy prices that commercial consumers need to pay.

A price range is given because there is a progressive tier-based price structure for households, while for industrial and commercial consumers electricity prices depend on their voltage requirements and are divided into two parts, one based on installed capacity, the other on actual usage. In Table 7, the median levels are the level for the middle tier or middle capacity and consumption level.

3.2.3 Public buildings

In October 2008, the State Council enacted an *"Energy Conservation Bylaw for Public Institutions"*[20] setting out the various measures public institutions should adopt to save energy and improve energy efficiency. The measures include using energy efficiency as a criterion in deciding public procurements of products and services, establishing quotas for energy consumption and annual targets for energy conservation, carrying out energy audits and energy management, collecting data and reporting energy use. Public institutions' performances in respect of energy conservation will be evaluated on the basis of their total energy use in different years, per-capita energy use and per-floor area energy use. The government also regularly publishes a catalogue of energy efficiency products and services to support public procurement.

One barrier to energy conservation by public institutions was that public institutions used to fund their energy bills and fixed asset investments from different budget lines, making it impossible for them to engage ESCOs to undertake energy performance contracting.[21] This barrier was removed in 2010, and local public institutions can now include their payments to ESCOs for EPCs as part of their energy expenses and pay them from the government budget.

The government is calling for the implementation of preferential tax policies to ESCOs and encouraging governments at all levels to enhance their support to EPCs. Payments by government agencies and public institutions to ESCOs for EPCs are treated the same as energy expenses.[22]

To encourage energy savings in public buildings, the Chinese government has issued detailed technical guidance on energy consumption monitoring, data collection and transmission, as well as metering equipment installation, the building operations of hospitals, colleges and universities, government office buildings and large public buildings.[23] In 2016, the Ministry of Housing and Urban-Rural Development (MOHURD) issued Guidance for Energy Auditing for Public Buildings.[24]

3.3 Various standards for ESCO services

China has issued over two hundred standards and guidance documents related to energy savings. These standards and guidance provide a solid technical basis for various aspects of ESCO services. The most important one is the *General Technical Rules for Energy Performance Contracting*, issued in 2010 by the Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and the Standards Administration of China (SAC), which only recognizes the shared savings contract model. In 2020, the document was updated to include all three models of ESCO services: shared savings, guaranteed savings, and services not linked to the results of energy savings. Table 11 lists the most important national standards affecting ESCO services.

[19] Xianli Zhu, 2020. "A Review of China's Energy Efficiency Policies for the Industrial Sector Since 1990". Chapter 9 in Energy Efficiency in Developing Countries: Policies and Programmes, edited by Suzana Tavares da Silva and Gabriela Prata Dias. Routledge Talor & Francis Group, London and New York.

[20] Decree No. 531 of the State Council of People's Republic of China, *"Energy Conservation Bylaw for Public Institutions"*. The bylaw was amended in 2017, but the amendment is related more to changes in government approval procedures, not energy conservation requirements.

[21] IFC report mentioned this?

[22] State Council, 2016. Overall Plan for Energy Saving and Emission Reduction during the 13th FYP.

[23] http://ecpi.ggj.gov.cn/gather-news

[24] https://www.emca.cn/site/content/109387.html

Table 8. Energy prices in Beijing, 2020

	Households	Ordinary industrial and commercial clients	Large industrial clients	Agricultural electricity use
Electricity (RMB/KWh)	0.44-0.79 Median: 0.53	0.32-1.73 Median: 0.85	0.33-1.07 Median: 0.66	0.31-0.93 Median: 0.6

Source: Electricity sales price in Beijing. http://fgw.beijing.gov.cn/bmcx/djcx/jzldj/202003/P020200331428682714728.pdf

Table 9. Heating prices in Beijing, 2020

			6 downtown districts	Other
Residential	Based on floor area (RMB/m² per season)		16.5/24depending on fuels and suppliers	
	Based on metering	Basic price (RMB/m² per season)	7, 12, 18 depending on fuels and suppliers	
		Use (RMB/KWh)	0.16	
Non-Residential	Based on floor area (RMB/m² per season)		45	43
	Based on metering	Basic price (RMB/m² per season)	18	18
		Use (RMB/KWh)	0.36	0.33

Source: Beijing Municipal Government. http://csglw.beijing.gov.cn/csyxbz/fwxx/grfw/201912/t20191203_824589.html

Table 10. Natural gas prices in Beijing, 2019

Uses		Heating season	Non-heating season
Households	Tier 1: 2.61, Tier 2: 2.83, Tier 3: 4.23		
Gas for electricity generation		2.57	2.29
Gas for heating and cooling	Downtown	2.75	2.47
	Outskirts	2.51	2.23
Industrial and commercial use	Downtown	3.15	2.87
	Outskirts	2.91	2.63
Filling stations for compressed natural gas	Residential	2.12	2.10
	Non-residential	2.61	2.33

Source: Beijing Price, 2019. http://www.beijingprice.cn/c/2019-05-01/489008.shtml

Table 11. China's National Standards for ESCO Services

	Year of issue and amendment	Standard No.
General Technical Rules for Energy Performance Contracting	2010, 2020	GB/T 24915
General principles for the Energy Balance of Equipment Using Energy	1981,2009	GB/T/2587
General Principles for the Calculation of Overall Energy Consumption	1981, 1988, 2008	GB/T/2589
The General Principles for the Energy Balance of Enterprise	1993, 2009	GB/T/3484
Determination of Energy Savings in Organizations	2009, 2018	GB/T/13234
General Principles for Monitoring and Testing of Energy Savings	1994, 2009	GB/T/15316
Technical Guidance for Energy Auditing	1997, 2019	GB/T/17166
Requirements on Energy Management Systems	2009, 2012	GB/T23331
General Technical Rules for Measurement and Verification of Energy Saving	2012	GB/T 28750
Operation Guide for Energy Saving Measurement and Verification	2015	GB/T 30045

Source: prepared by the author.

4. Remaining barriers to ESCO development and solutions

4.1 General barriers to EPC development

One main barrier often mentioned to the deployment of EPCs is the lack of finance. Chinese ESCOs still mainly rely on their own equity funding as the main source, plus bank loans. Existing data indicate that in 2017, 65.2% of ESCO funding came from their own equity funds, 28.1% from bank loans. Many banks still find it risky and complicated to offer loans to EPC projects. A lack of finance delays project implementation and constrains the expansion of the ESCO market.[25]

Other barriers are limited technical capacity and irregular market competition. The Chinese ESCO market includes a large number of small ESCO companies that lack technical capacity and experience of doing projects. The fierce market competition sometimes leads to price wars and poor services, which damage clients' confidence in ESCO services.

Although China has established over two hundred standards for energy efficiency actions in different sectors, there remain some gaps in technical and commercial standards, as well as in rules for specific areas of EPC projects and implementation, for instance, in industries that are not energy-intensive. This makes it difficult to implement EPCs in specific areas.

Another issue is the continuity of subsidies and the coordination of different incentive systems. The existing policy indicates that the subsidies for EPC projects will last until 2022, at which point the future of the policy will be decided.

4.2 Barriers to ESCO services in the residential building sector

Globally, there is little ESCO presence in the residential building sector. Apart from the usual issues of difficult coordination with residential buildings, ESCOs face some additional barriers to operating in the residential buildings market in China. Residential buildings in Chinese cities are mainly high-rise apartment blocks, most of which were built after the housing reform of the late 1990s. According to the 2018 *China Urban and Rural Construction Yearbook*,[26] in 2018 China had 8.78 billion square meters of heated floor area, of which 72.9% are in residential buildings and the rest in public and commercial buildings. Traditionally, central heating is only available in the north of the country and is considered a kind of social benefit provided by municipal governments. Local governments are obliged to ensure that all households can achieve a minimum indoor temperature of 18°C during the heating season. The start and end dates of the heating season are fixed by the city. For instance, in Beijing, the heating season runs from 15 November to 15 March of the following year. However, the central heating service can start early if the daily average temperature falls below 5°C for five consecutive days.[27]

Local residents' heating bills depend on the size of their apartments and a fixed rate in RMB per square meter of floor area per heating season. Residents can neither adjust nor turn off the heating supply to their apartments. Often only around 80% of the heating charges can be collected. The heating price system means that any energy cost savings from their building retrofitting goes to the heat supply company instead of the household. This system prevents ESCOs from taking on projects in China's residential building sector. Despite the recent reform to introduce the metering of residential heating supplies, progress has so far been limited.

In summary, there are two key barriers to energy efficiency retrofitting based on EPC: 1) the majority of households pay for heating based on the size of their apartments, not on their metered usage of heating; and 2) the low energy prices for households mean a longer payback period for investments in energy efficiency. Moreover, the lack of properly enforced energy performance certification for buildings mean that even households with energy meters face the risk of being unable to recover their investment in energy efficiency retrofitting when they sell their apartments.

4.3 Barriers to EPCs in the transport sector

During the pilot stage of ESCO development under IFC support, there were two pilot EPC projects for the transport sector. However, as the energy efficiency retrofitting of transport infrastructure tends to have a long payback period and low returns, and because the majority of China's transport infrastructure is relatively new, as in most other parts of the world transport EPCs are rare and have a low potential for further development.

[25] http://www.cnseia.com/zixun/nyjy/jnrz/95193.html

[26] MOHURD, 2019. 2018 China Urban and Rural Construction Yearbook. Available at http://www.mohurd.gov.cn/xytj/tjzljsxytjgb/index.html, accessed on 9 November 2020.

[27] https://finance.sina.com.cn/china/dfjj/2020-10-09/doc-iivhuipp8716932.shtml

4.4 Possible solutions

In the residential sector in the last two decades, the government has been promoting energy, especially the metering of heating. However, progress is mainly visible in new buildings. Energy efficiency retrofitting in residential buildings needs effective enforcement of energy efficiency certification for buildings and large investments in heating pipe and meter retrofitting, as well as changes in social attitudes to heating, to the move from a public welfare service to market-based services and to energy prices, especially heating pricing reform for the residential sector.

The existence of a large number of small ESCOs with low capacities is a commercial phenomenon. This issue can be addressed through market competition, support policies for mergers and acquisitions, and further capacity-building, certification and accreditation. The existing accreditation system for ESCOs is voluntary, and only a small number have been accredited. Further technical qualification and financial capacity, as well as business performance accreditation, can develop the market further.

Regarding the financing barriers, the government needs to create innovative ways to increase the role of ESCOs further, like allowing large and successful ESCOs to raise funding by listing on the stock market and issuing a green bond, as well as increasing government guarantees and the national revolving fund for EPC projects.

Although launching a national emissions trading system may to some extent fill the gap in financial incentives for EPCs, the prevailing uncertainty is a barrier to investments in energy efficiency projects. The government needs to decide its subsidy policies as soon as possible to provide certainty for investments in EPC projects. It also needs to study the effects of its efforts to reduce energy prices for industries and commercial consumers on the profitability of energy efficiency projects and opportunities, as well as find ways to avoid them having negative impacts on energy efficiency actions.

5. Conclusion

Since the ESCO and EPC concepts were introduced into China in 1998, in less than three decades the country has become the largest ESCO market in the world. China's experience with these concepts offer a valuable model for other countries seeking to use ESCOs to achieve energy efficiency and emissions reductions. The country's strong policies for improving energy efficiency are playing an important role in this process. Other factors include effective international support and an industrial association that helps improve awareness and offers training.

China has pledged to peak its carbon emissions by 2030 and to achieve carbon neutrality by 2060. In the country's efforts to build a resource-efficient and circular economy and to improve its international competitiveness in green and efficient technologies, ESCOs have bright market prospects.