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CHINA

Industrial Energy Accelerator
CHINA Diagnostic



About the Industrial Energy Accelerator

In partnership with key government agencies and industry stakeholders, the Industrial Energy Accelerator works on the ground to rally government, industry and finance around solutions that ignite change in industries. We then take our knowledge and experience to the world, sharing what we have learned to inspire a global movement for industrial energy efficiency. We currently operate in Indonesia, China, Mexico, Brazil and Morocco, five major industrial countries responsible for around 26% of the world's energy consumption.

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During the 2015 Paris Climate Change Conference, China made a commitment to reduce carbon dioxide emissions per unit of GDP by 60% to 65% in 2030 compared to 2005, alongside development goals of structural economic transformations.

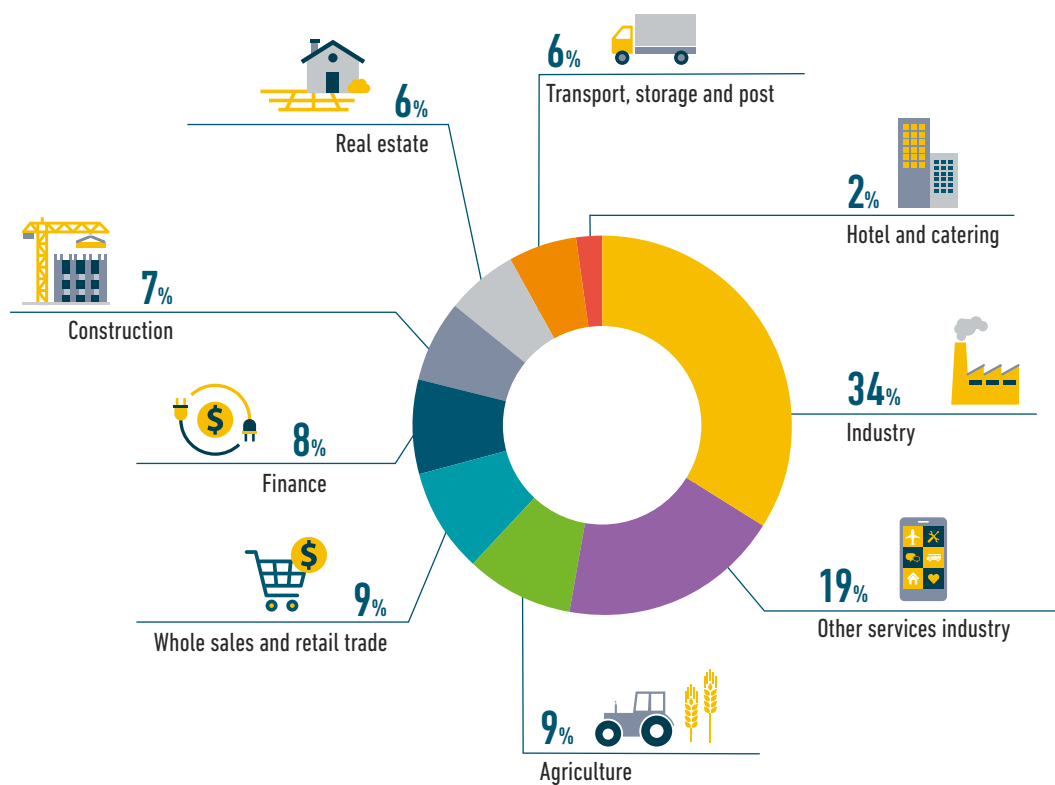


Getting to know the target market: China's industrial sector profile

Present industrial sector and sub-sectors of energy consumption

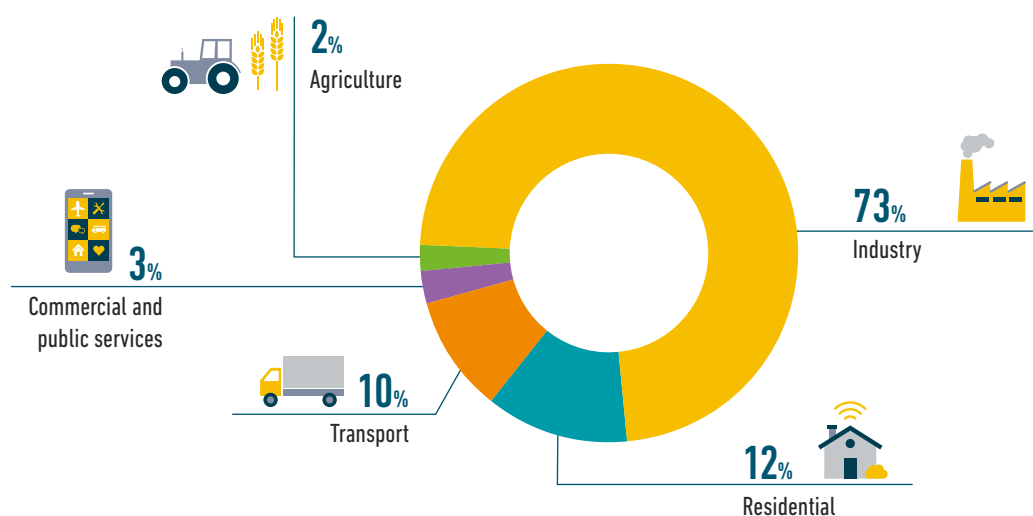
According to the National Energy Statistics of China 2016, China consumed 3,009.14 Mtoe in 2015. The residential sector accounts for 12% of this, services (including public and commercial sector) 3%, agriculture 2%, transportation 10% and industrial 73%, making it the largest consumer of energy. Meanwhile, national statistics show that the industrial sector represented 34% of national GDP in 2015 (National Statistics Bureau, 2017), implying the industrial sector is central to the economy and therefore will play a major role in reducing energy intensity by 2020.

The industrial sector has been split into nine sub-sectors, identified by fuel types and energy consumption. Electricity and coal are the main fuel sources across these nine sub-sectors, and metal and metal products, non-metallic minerals, energy production, mining and quarrying are the top four highest energy-consuming sub-sectors. (National Energy Statistics Yearbook, 2016)



Source: National Statistics Bureau, 2017

Figure 1. Sub-sector GDP contribution in 2015, NBS, 2017



SOURCE: National Energy Statistics Yearbook, 2016

Figure 2. Sub-sector energy consumption in 2015, NBS, 2017

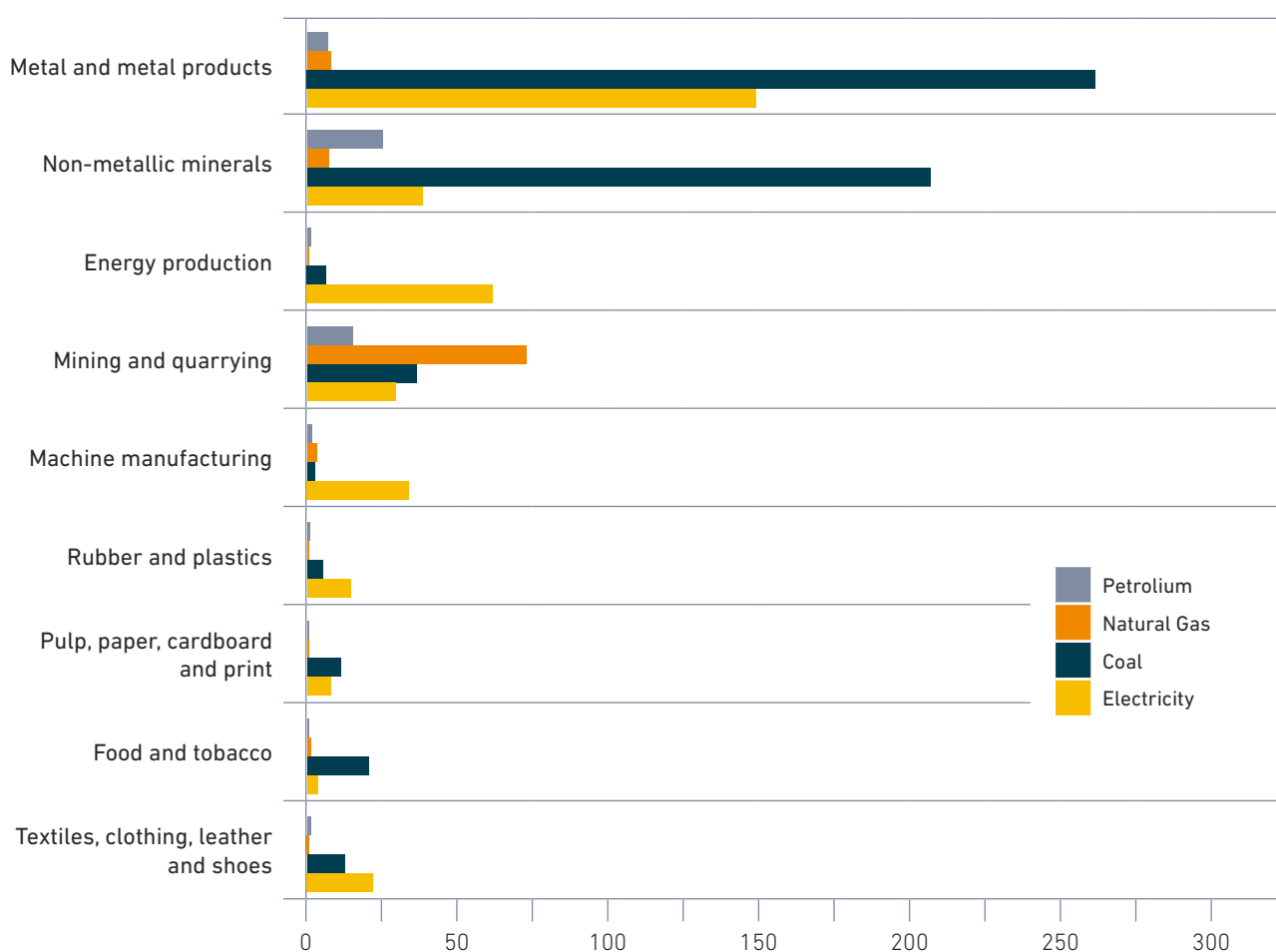
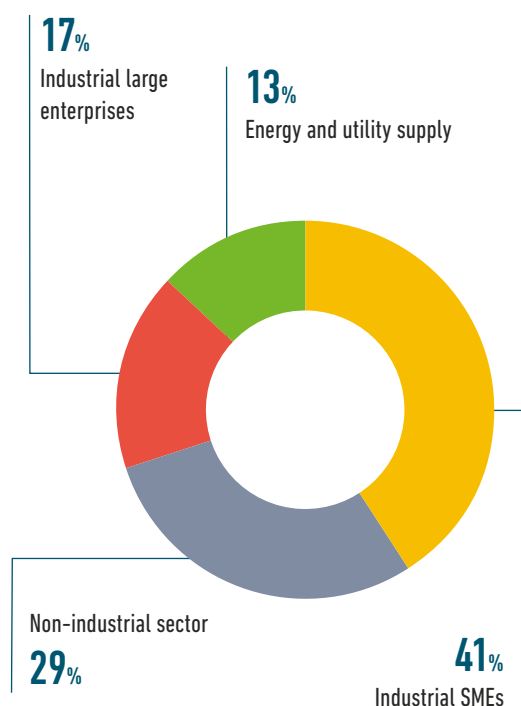


Figure 3. Industry sub-sector energy consumption by fuel-type (Mtce), China, 2015

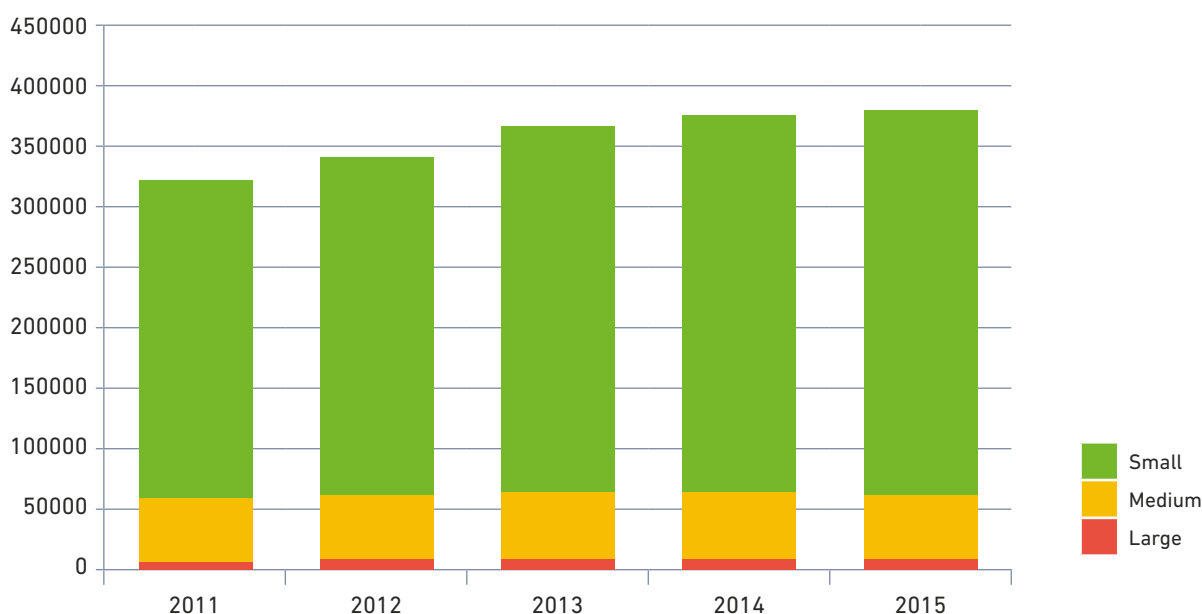


Source: Study on the Potential of Sustainable Energy Financing for SMEs in China, IFC, 2012

Graph 1. Small, large, and non-industrial energy consumption in 2010, IFC, 2012

The International Finance Corporation (IFC), a sister organization of the World Bank and member of the World Bank Group, investigated eight provinces regarding their energy consumption across thirty-nine sectors. Large industrial enterprises, including state-owned enterprises in energy and utility supply sector, accounted for 30% of energy consumption, well below the energy consumption of industrial SMEs, who have accounted for 41% of energy consumption during their period of rapid growth between 2011-2015 (IFC, 2012). This IFC research highlights the large energy consumption of Chinese SMEs, therefore outlining the need for a focus on SME energy efficiency.

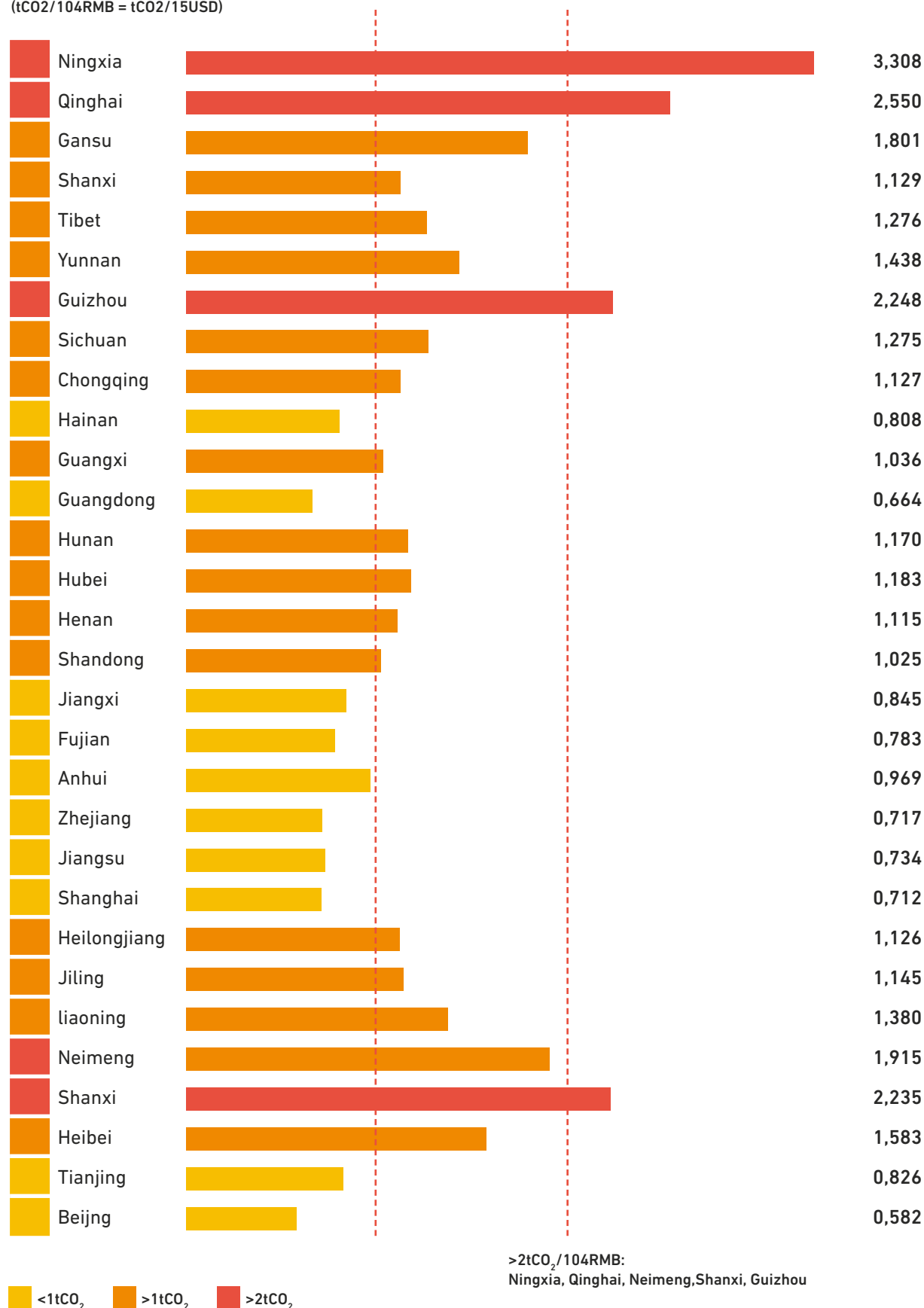
China also experiences particularly acute regional differences in energy intensity. According to China's Carbon Emission Report 2015 from Harvard Kennedy School, Ningxia, Qinghai, Neimeng, Shanxi and Guizhou have energy intensities over 2 tCO₂/104RMB (equals 2 tCO₂/15USD), the highest across all provinces. This can be explained by two factors: firstly, these regions serve as the energy and resource base, which provide the electricity and industrial materials; secondly, the secondary sector, including mining, manufacturing and construction industry etc., is the pillar industry in the region and requires a large energy supply. Furthermore, with rudimentary facilities and outdated technologies, energy efficiency standards in these regions are below the national average (China's Carbon Emission Report, Harvard Kennedy School, Zhu, Liu, 2015).



Source: NBS, 2017

Graph 2. Number of industry company by size (2011-2015), NBS, 2017

China regional energy intensity in 2010
(tCO₂/104RMB = tCO₂/15USD)



Graph 3. China regional energy intensity in 2010, Harvard Kennedy School, Zhu, Liu, 2015

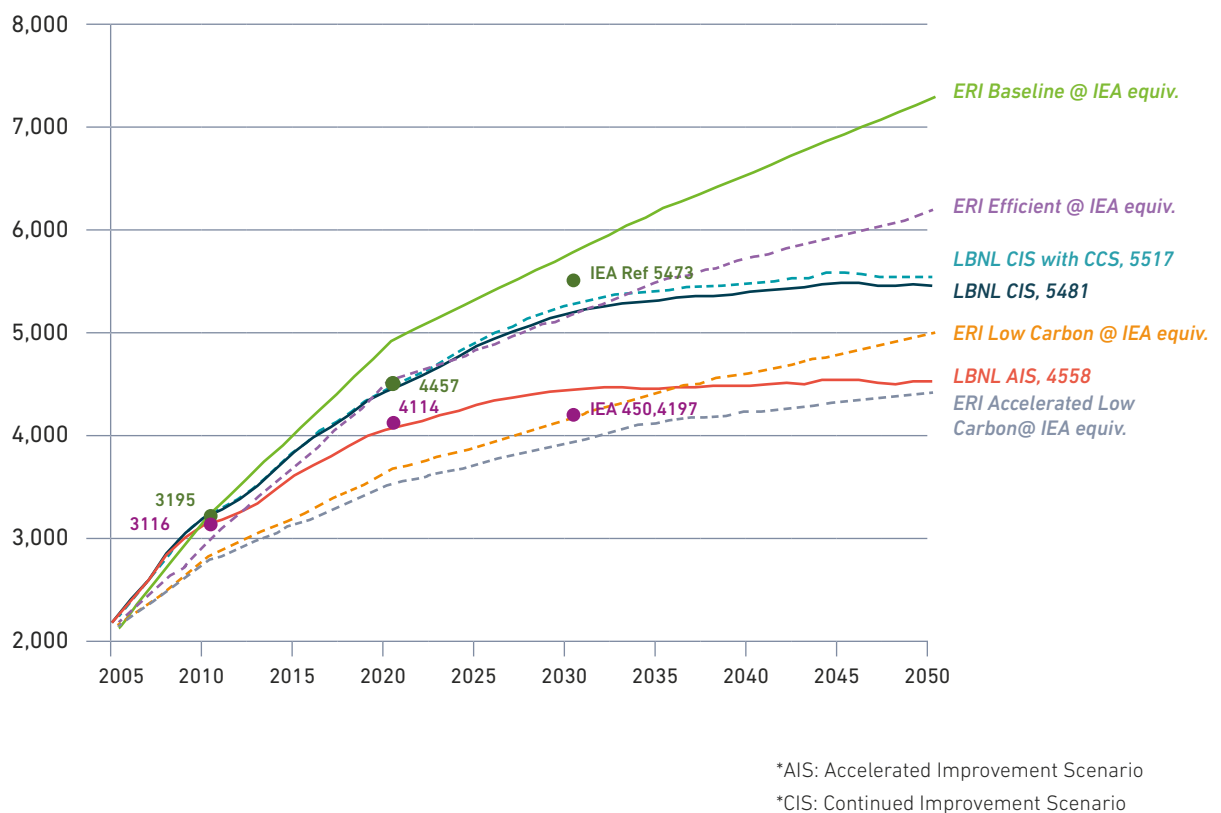
Future industrial sector and sub-sectors energy consumption

UC Berkeley Laboratory used a range of scenario models to assess China's energy consumption from 2005 to 2050, according to their results; energy consumption is projected to at least double from 2005 to 2050. In the Accelerated Improvement Scenario (AIS), energy consumption in 2050 is expected to be 2,250 Mtce higher than in 2005, whereas in the baseline scenario, the difference is 5,481 Mtce. The huge difference between the AIS and baseline scenarios highlights a large potential market for energy conservation and energy efficiency in China (China End-Use Energy Model, LBNL, 2012).

Despite a large increase in overall energy consumption, both past trends and future projections indicate a steady decrease in coal consumption. Specifically, the past five years have seen a decrease in coal consumption from 70% to 64% and a notable increase in the consumption of electricity generated from other sources. With the rapid decrease of coal consumption and the rapid development of clean energy, the proportion of coal in primary energy

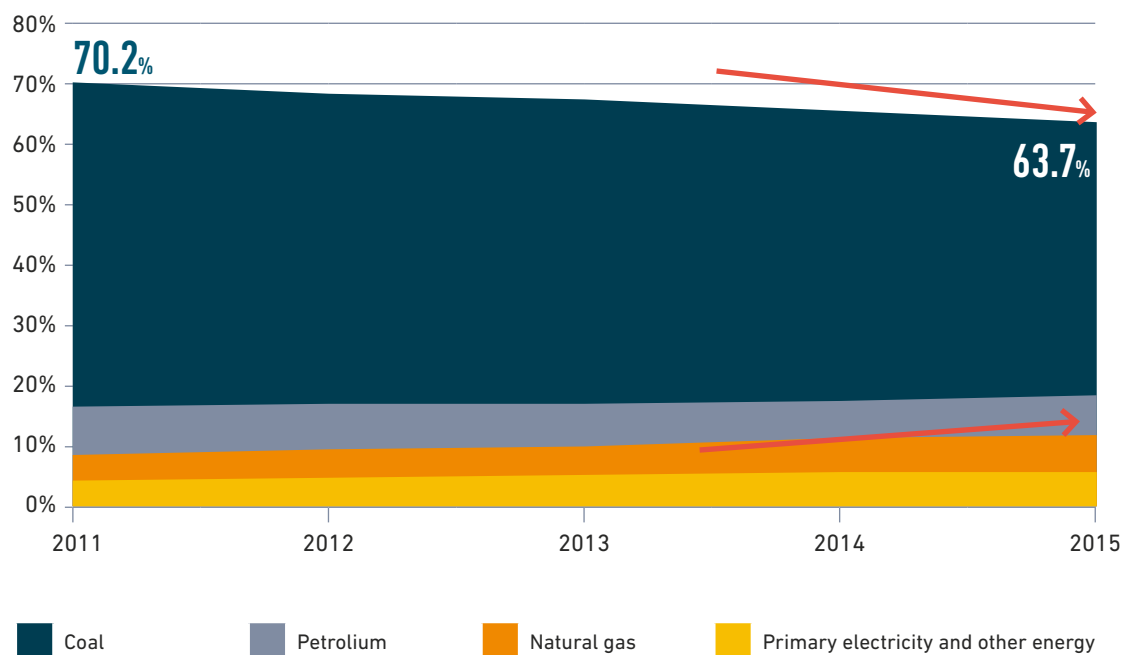
consumption is expected to significantly drop to 58% in 2020, and 29% in 2050 (NBS, CNPC Research Institute, 2016). Nevertheless, in 2030 fossil fuels are still expected to account for 80% of energy generation.

In a high renewable energy penetration scenario, where over 60% of end-use energy consumption is electricity, the energy system in 2050 is highly efficient. The 2050 renewable energy penetration scenario of China's 2050 High Renewable Energy Penetration Scenario and Roadmap Study is optimistic: with energy efficiency 90% higher than in 2010, primary energy consumption would be equivalent to 3.4 billion tons of coal, with renewable energy accounting for 62%. However, generally, future energy consumption is shifting towards clean energy and reaching a situation where renewable energy accounts for about half of the overall energy consumption (China 2050 High Renewable Energy Penetration Scenario and Roadmap Study, Energy Foundation, 2015).



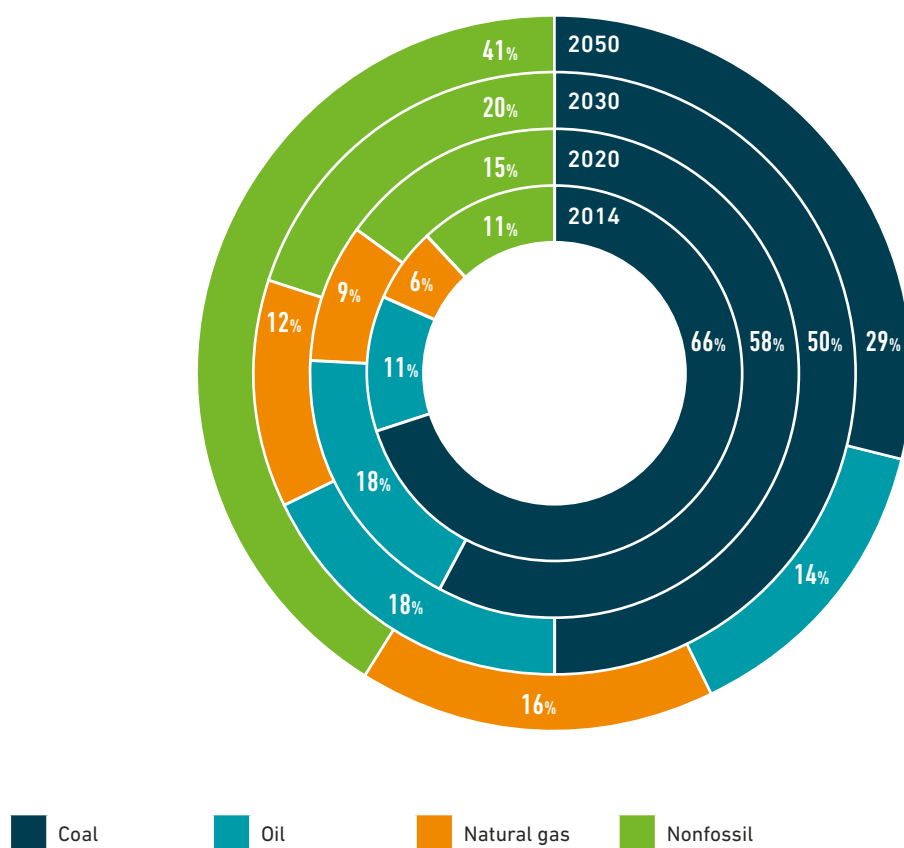
Source: LBNL, China End-Use Energy Model

Figure 4. China's primary energy consumption in different scenarios, LBNL, 2012



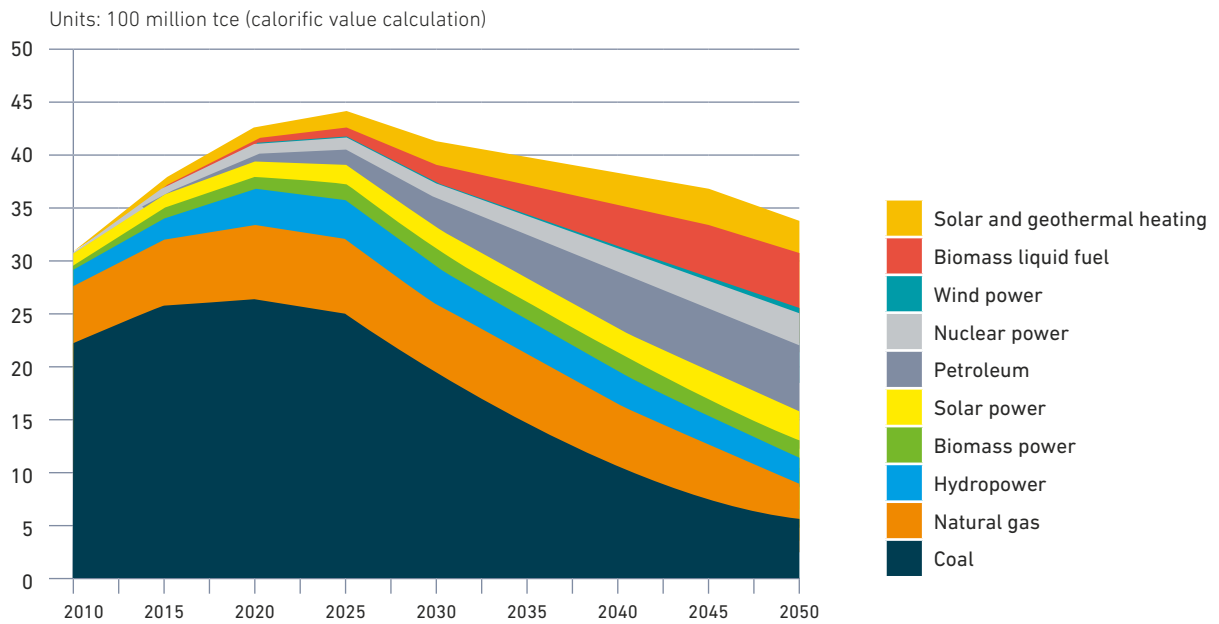
Source: NBS, 2016

Figure 5. Total energy consumption and composition (2011-2015), NBS, 2016



Source: National Bureau of Statistics of China, CNPC Research Institute, 2016

Figure 6. China's energy structure from 2014-2050, NBS & CNPC Research Institute, 2016



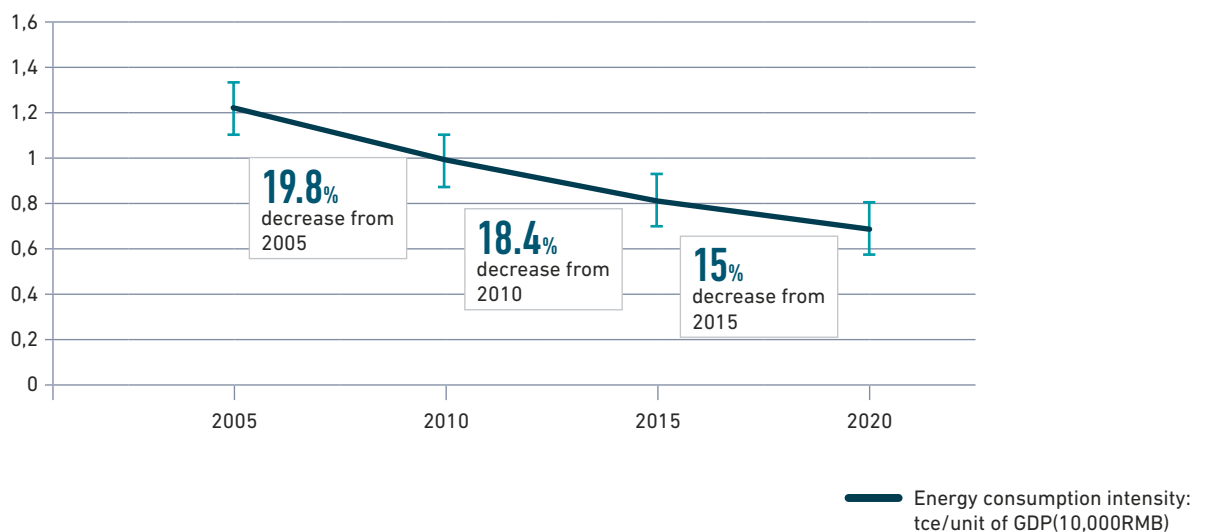
Source: China 2050 High Renewable Energy Penetration Scenario and Roadmap Study, Energy Foundation, 2015

Figure 7. China 2050 high renewable energy penetration scenario, Energy Foundation, 2015

China energy consumption saving goals for 2020

During the 2015 Paris Climate Change Conference, China made a commitment to reduce carbon dioxide emissions per unit of GDP by 60% to 65% in 2030 compared to 2005, alongside development goals of structural economic transformations. In order to achieve these, China has set an ambitious five-year target to reduce energy consumption: consumption

per unit of GDP is to decrease 15% from 2015 to 2020. For coal-fuel power generation, the average coal consumption will drop below 310 grams of standard coal per kWh. Power-line loss rates are to be kept within 6.5% (China 13th FYP, NBS, 2016). These goals undoubtedly create opportunities for improving industrial energy efficiency in China.



Source: NBS, China 13 8 TH FYP

Figure 8. China projected energy consumption saving (2005-2020), NBS, 2016

Drivers for industrial energy efficiency in China

National guidelines and regulations

In setting up the framework for industrial energy efficiency, different government bodies have launched several key national regulations and guidelines. The National People's Congress approved the 2016 amendment of Legislation on Energy Saving that has been in effect since April 2008, aiming to improve energy saving and energy efficiency. The State Council has launched two key files to instruct national energy saving and emission reduction: the 12th FYP for Energy Saving and Emission Reduction and the 13th FY Integrated Work Plan for Energy Saving and Emission Reduction. Also, Made in China 2025 included energy saving products and the renewable energy industry as one of the promoted industries to accomplish the target of becoming a manufacturing powerhouse by 2025.

At the ministry level, the National Development and Reform Commission has delivered the 2016-2030 Strategic Plan for Energy Production and Consumption Revolution, and the 13th FY Energy Saving Action Plan for All. The National Energy Administration has issued a Guideline for 2016 Energy Work and the Ministry of Industry and Information Technology has released a 2016-2020 Plan for Green Industry Development. They comprise a guideline and regulation system for energy affairs, based on national laws and regulations.

TABLE 1. Key national regulations and government bodies

National Regulations and Guideline	
NPC	Legislation on energy saving 2008-04-01
State Council	13Fy integrated work plan for energy saving and emission reduction
	12 FYP for energy saving and emission reduction, 2012
	Made in China 2025
Ministry-Level Guidelines	
NDRC	2016-2030 strategic plan for energy production and consumption revolution
	13 Fy energy saving action plan for all
NEA	Guideline for 2016 energy work
MIIT	2016-2020 plan for green industry development

Industrial energy efficiency supporting policies

China has a series of industrial energy efficiency (IEE) supporting policies and programs (Figure 8), including EnMS promotion. According to the overview of the energy saving policy system for key enterprises by the Energy Research Institute of National Development and Reform Commission, the IEE policy system is well established. It is comprised of laws and regulations, standards benchmarking, target setting, incentives, services and management as well as the EE market. In terms of specific codes and standards, an Energy Management System

Requirement GB/T23331-2012 was issued for growing EnMS uptake, with necessary management advice to improve energy performance. In terms of allowances and rewards, Interim Measures on the Administration of Subsidies for Energy Saving and Emission Reduction launched by the Ministry of Finance in 2015 formulates how the subsidies for energy saving and emission reduction are to be used. Specifically, during the 12th FY, each energy-saving technology renovation project can acquire 240-300 RMB (~34-43 USD) per tce of energy saving.

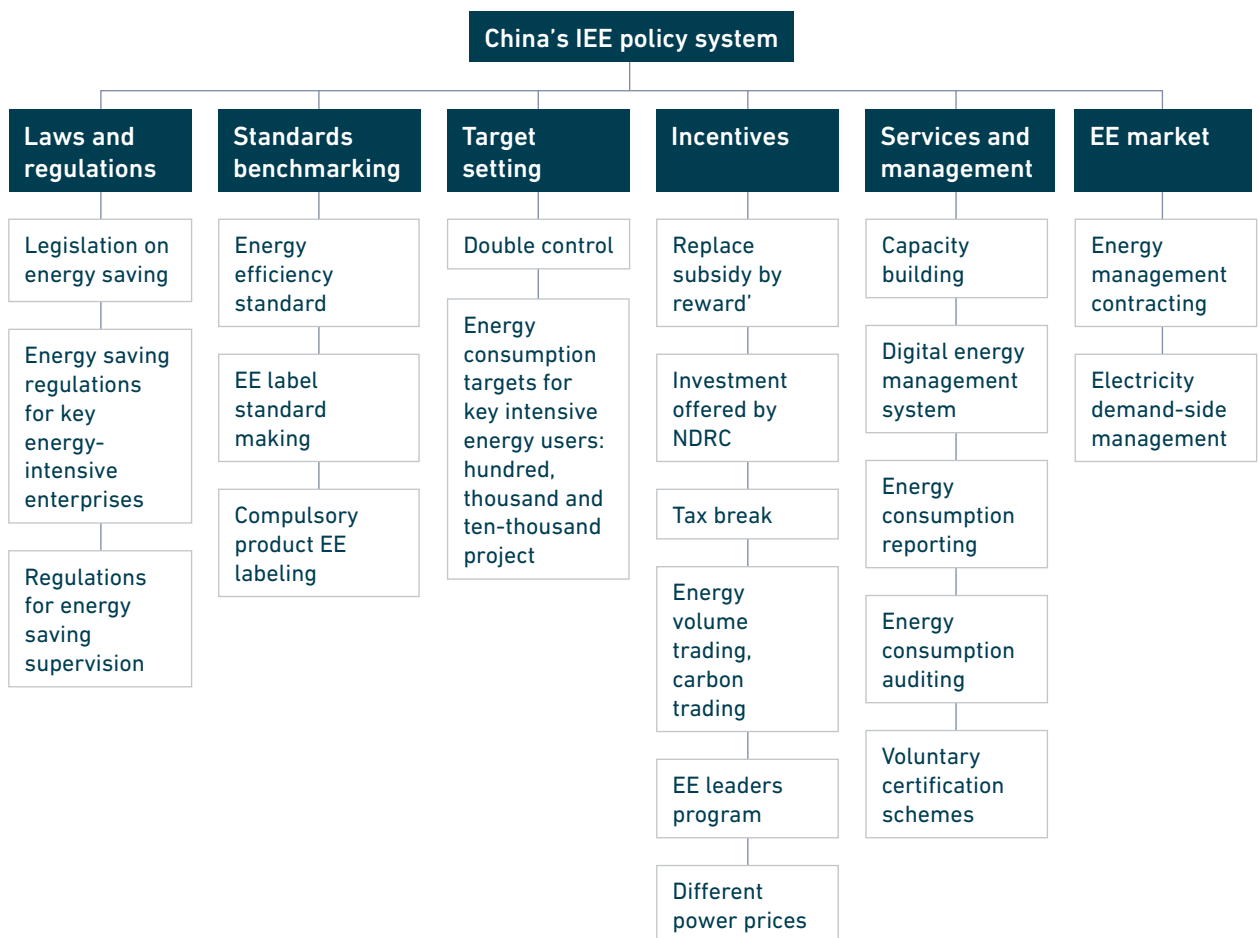
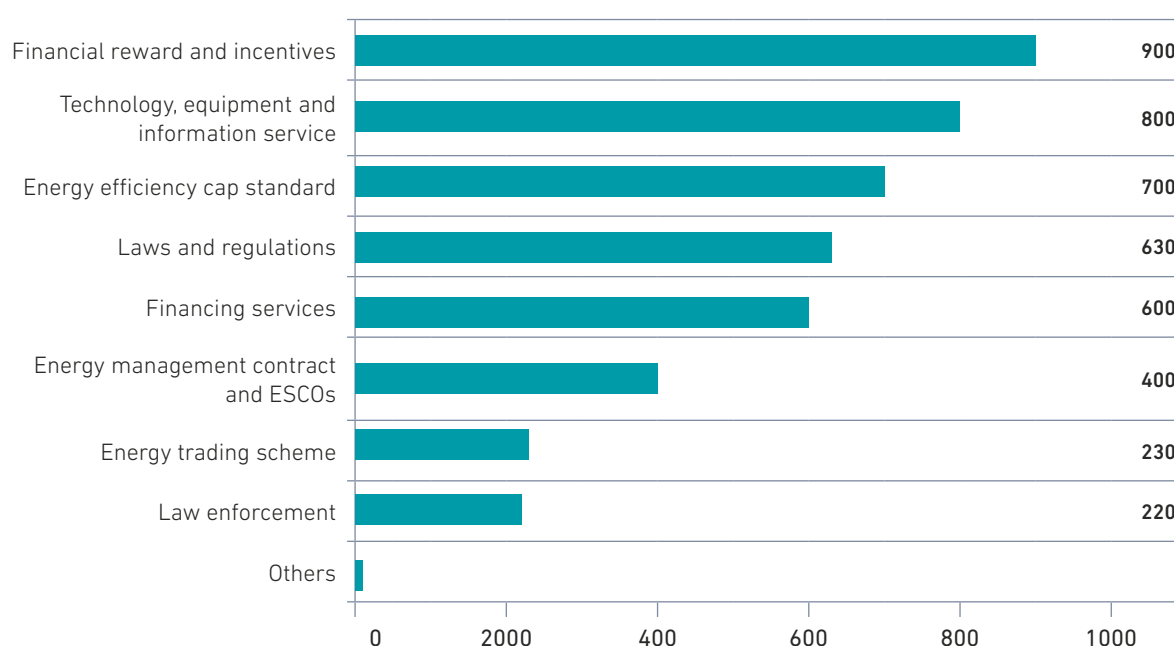


Figure 9. China's IEE policy system, ERI & LBNL & Carbon Trust, 2016

The Energy Research Institute carried out an investigation of 1,300 key energy-intensive enterprises and found that policy support including financial rewards and technology information sharing are the most helpful from the enterprises' perspective (Graph 4). For most enterprises, such financial rewards provide funding support as well as help to show government's determination on energy efficiency promotion, therefore constituting a highly helpful policy. Policies related to technology, equipment and information services were regarded as the second most important for enterprises.

However, the investigation also indicated the limited services ESCOs currently provide to enterprises. In their answers, only 48% of enterprises would go to ESCOs for energy management services. In addition to the fact that energy service companies are much smaller in scale compared to their enterprise clients, enterprises also have concerns related to data disclosure and are not willing to share related information externally (Market-Oriented Energy Efficiency Mechanism for Key Energy-Intensive Enterprises, ERI, 2017).



Source: Market-Oriented Energy Efficiency Mechanism for Key Energy-Intensive Enterprises, 2017

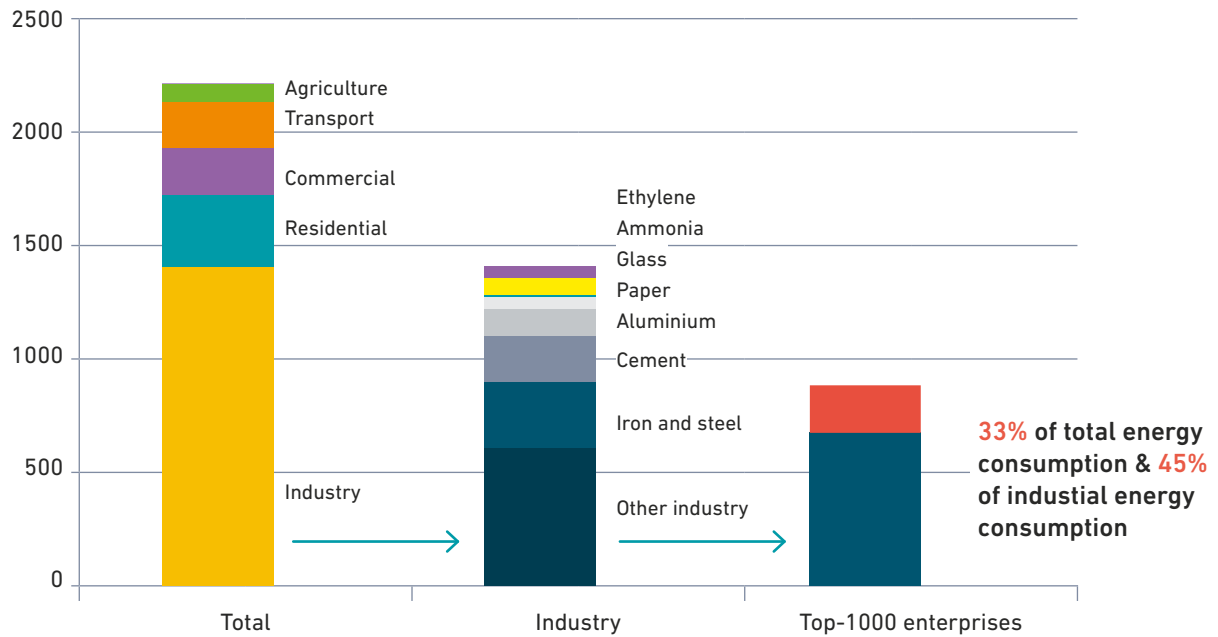
Graph 4. Survey result among key enterprises on the effectiveness of EE policies, ERI, 2017

IEE supporting programs

In 2005, the Chinese government announced an ambitious goal of reducing energy consumption per unit of GDP by 20% between 2005 and 2010. Responsibility initiatives for achieving specific quantified energy savings, monitored annually, have been established top to bottom through China's government hierarchy and with all major energy consumers. Prominent and complementary energy efficiency programs have been included in the 1,000 Large Industrial Enterprises Energy Conservation Action Plan to develop and implement specific energy efficient programs in the top 1,000 industrial energy consumers. These firms account for about 33% of

China's total primary energy consumption and 47% of industrial energy usage in 2004 China. Under the program, 2010 energy consumption targets were determined for each enterprise, with the goals of improving the IEE of these industrial energy users to save 100 Mtce between 2006 and 2010. The components of the program include energy auditing, increasing IEE investment and introducing a reward and punishment system. In 2008, NDRC reported that the Top-1,000 Program enterprises had saved 38.17 Mtce (1.1 EJ) altogether in 2007 (NDRC, 2008).

Primary energy consumption 2005
(million tce)



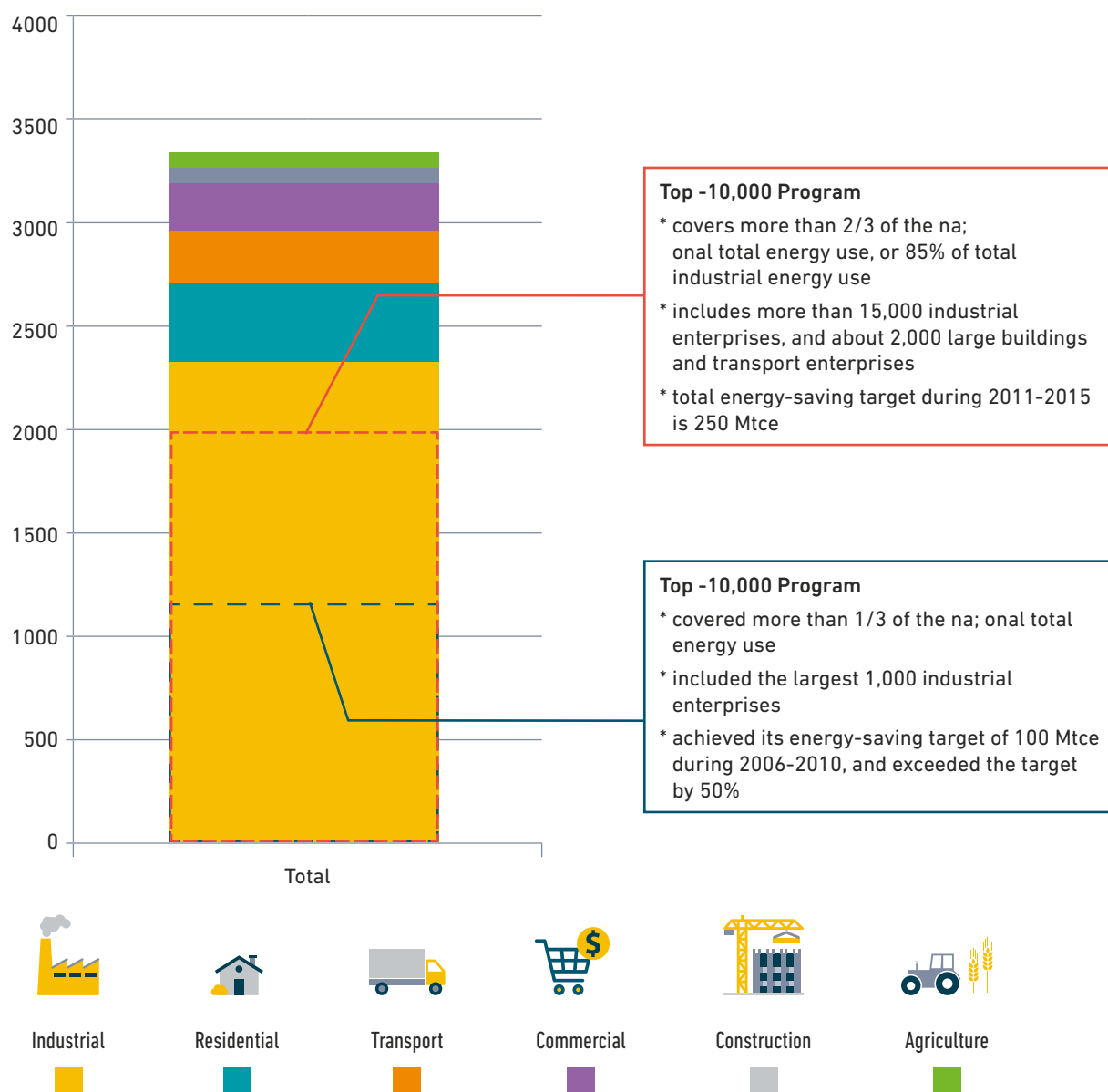
Source: China Energy Group, *The Challenge of Reducing Energy Consumption of the Top-1,000 Largest Industrial Enterprises in China*

Figure 10. Energy consumption of China, China's industrial sector and the top-1,000 energy-consuming enterprises, China Energy Group, 2005

Because of the success of the Top-1,000 initiative, the program has been expanded to the Top-10,000 initiative, which started from 2011 in the 12th FYP. The Top 10,000 Program aims to cover two thirds of China's total energy consumption, or 15,000 industrial enterprises that use more than 10,000 tce per year. The target of the Top 10,000 Program is an absolute energy-saving target of 250 Mtce by 2015 (NDRC, 2015). The 250 Mtce target was allocated to local provinces as well as cities, and each province has different targets depending on its development status.

The "Hundred, Thousand and Ten-Thousand" Energy Conservation Action under the "Double Control" target is also a core program in the whole policy system. Double Control is the control of both energy consumption and energy intensity, and the "Hundred, Thousand and Ten-Thousand" initiative was brought

up in the national 13th FYP as a key action plan to achieve the Double Control targets. In the program, energy consumption and energy intensity caps were set for key energy users in the industrial, building, transportation, logistics and public facility sectors. All the key energy users were divided into three categories: "Hundred Key energy users" with over 3 million tce energy consumption in 2015, "Thousand Key energy users" with over 0.5 million tce energy consumption in 2015, and "Ten-Thousand Key energy users" with energy consumption between 10 thousand to 0.5 million tce in 2015. Double Control targets of the key energy users were assigned to local governments who were consequently responsible for implementing the program, supervising enterprises and evaluating the results. Currently the program is still in operation, and has had success locally.



Source: NBS, 2013. Note: Mtce >> EJ = 0.0293; EJ >> Quads = 0.9478

Figure 11. Energy assessments under the top 10,000 program

TABLE 2. Energy consumption and energy intensity caps, NDRC, 2017

	Energy intensity per unit of GDP comparing to last year	Energy consumption comparing to last year
2016 Achievement	-5%	1.40%
2016 Target	-3.40%	3%
2017 (first three quarters)	-3.80%	2.80%
2017 Target	-3.40%	<45tce

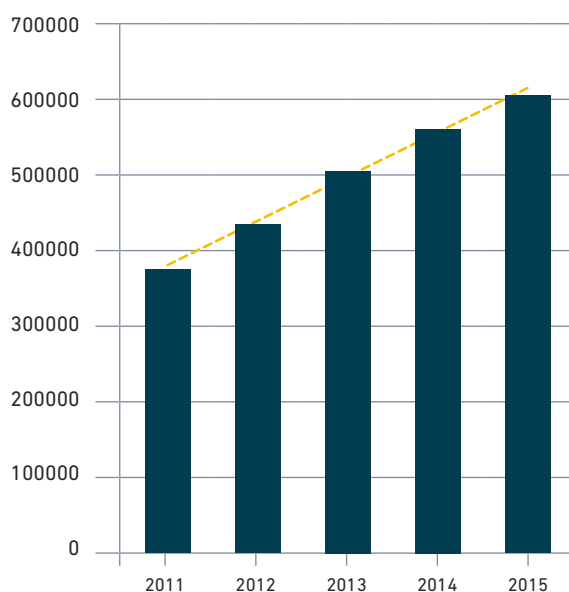
Is there a supply chain for industrial energy efficiency in China?

Characterization of ESCO market and pipeline, existing finance mechanisms and technical assistance initiatives

General profile of energy service industry

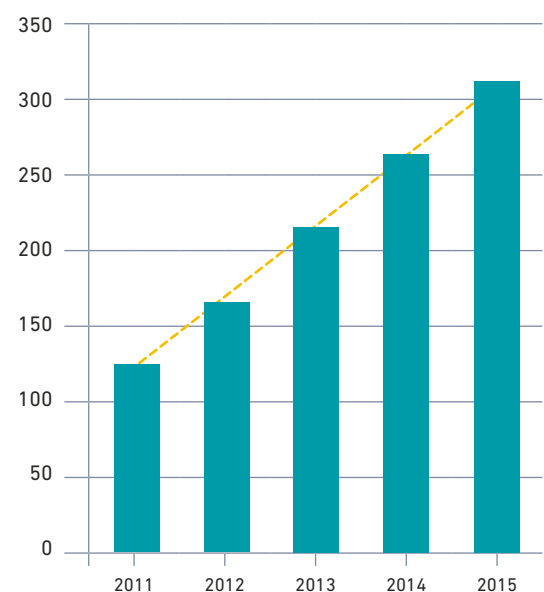
The scheme of Energy Performance Contracting (EMC) was introduced to China through a World Bank project in the mid-1990s aiming to encourage energy users to hire professional Energy Service Companies (ESCOs). These ESCOs helped develop energy saving projects through analysing energy saving potential, energy-efficiency project financing and energy management services. In 2012, EMC related programs were involved as one of the key supporting sectors in the 12th FYP, and with stronger policy

incentives, as well as program support (such as the Top 10,000 Initiative), the ESCO sector embarked on a period of rapid growth between 2010 and 2015. By 2015 there were 3,210 registered ESCOs operating in China, with a total of 607,000 employees. The total value of output of all ESCOs in 2015 was over 300 billion RMB, while the same number of ESCOs in 2011 equated to only 125 billion, indicating a fast and significant development in the energy saving service industry over five years (EMCA Statistics).



Source: EMCA Statistics

Graph 5: Number of employees in ESCO industry (2011-2015), EMCA

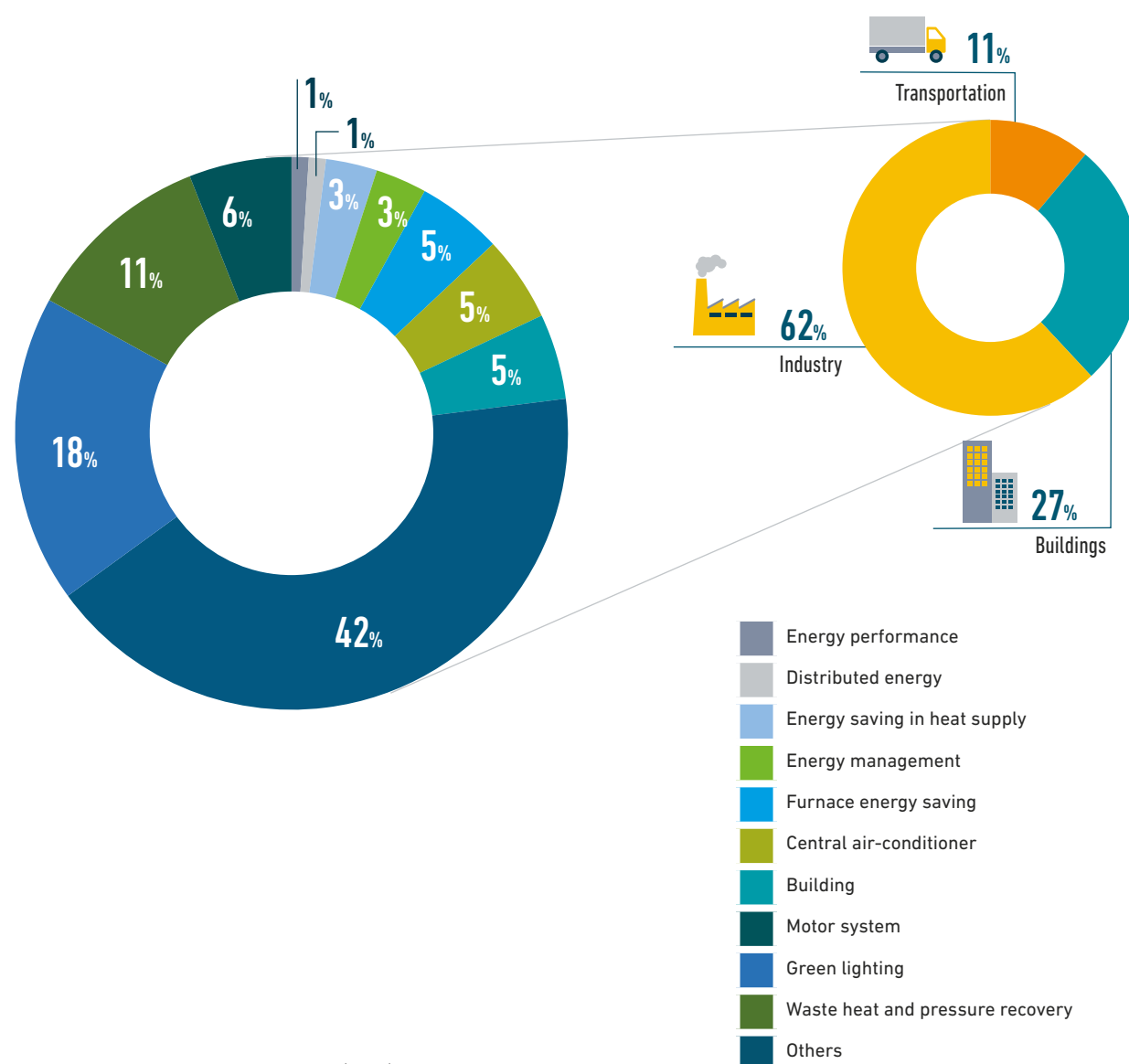


Source: EMCA Statistics

Graph 6: Total value of output (2005-2011), EMCA

With positive support from government policies, tax and subsidies, the energy service industry has grown rapidly in the past decades, and ESCOs have provided services to energy users in the industrial, building and transportation sectors. Of the 1,059 energy efficiency projects implemented through 2011-2015, the industrial sector accounted for 62% of the total investment. Technological investments in motor systems, green lighting, waste heat and pressure recovery comprised of the majority of total investment at 42%, 18% and 11% respectively, according to the 1,059 Energy Project Contracts from 2011 to 2015 collected by EMCA (1,059 Energy Project Contracts, EMCA).

Table 3 below shows a list of the main third-party organizations promoting policy framework for industrial energy efficiency in China. International organizations such as World Bank, ADB and UNIDO have been providing capital investment, technical support and training, as well as global experience through programmes, such as CHUEE and CHIEF, which have helped facilitate energy-efficiency project development in China. Meanwhile, industrial associations, research institutes and think tanks, such as CNIS (China National Institution of Standardization) and CECA (China Energy Conservation Association), are playing a positive role in helping China policy makers set energy saving standards, promote EE retrofit projects and accelerate the deployment of EE technology.



SOURCE: 1,059 Energy Project Contracts (EPCs) collected by EMCA

Figure 12. Distribution of major technologies in terms of investment amount (2011-2015), EMCA

TABLE 3. Key stakeholders of IEE supply chain in China

International Organizations	
World Bank	IEE projects, CEEPI, CHIEF
IFC	IEE projects, CHUEE
UNIDO	IEE projects, 2013 South-South Cooperation in the Energy-Saving and Environmentally-Friendly Industry
ADB	IEE project: Promoting Resource Conservation and Energy Efficiency
Government affiliated institutions	
CNIS	Energy efficiency standard, green products
ERI	Study on policy framework on IEE
NECC	Drafting energy technology list for enterprises
ADB	IEE project: Promoting Resource Conservation and Energy Efficiency
Government affiliated institutions	
CECA	China Energy Conservation Association
Central Iron & Steel Research Institute	R&D Center for iron & steel industry
CCRI	China Coal Research Institute, R&D Center for coal utilization and conservation; safety projects
CPCIF	China Petroleum and Chemistry Industry Federation; association for chemical and petroleum industry
EMCA	Provide practical technical assistance and services to emerging ESCOs and potential ESCOs and to foster their rapid growth
MPI	China Metallurgical Planning and Research Institute, main R&D institute to support government Metallurgical Planning projects
CBMF	China Building Material Federation; leading industry association in building materials.

Technical assistance and awareness raising initiatives

Numerous internationally-funded projects were initiated by organizations like the World Bank, IFC, and UNIDO to improve industrial energy efficiency in China.

Six major international projects were identified in Table 4 that demonstrate the range of international assistance China has received in the past 10 years. Initiatives were jointly implemented by governments,

multilateral international organizations, international banks and research institutions. The targets and outputs of these projects, fitting the distinctive country context, mainly concern energy efficiency financing, technical assistance, policy support, information dissemination and facility sharing, and diversified capacity building etc.



TABLE 4. Technical assistance and awareness raising initiatives on the IEE topic

NAME OF INITIATIVE	TARGET MARKET	ORGANIZATION	MAIN TARGETS
2006-2012 China Utility-Based Energy Efficiency Finance Program (CHUEE)	End-users of major energy consuming sectors (buildings and industrial) in China	GEF/IFC MoF	Improve current lending and risk management practices Develop SME lending capacities of IFC's portfolio and non-portfolio banks Promote the energy efficiency equipment financing market Country Context/Target
2013-2016 China Energy Efficiency Promotion in Industry Project (CEEPI)	Industrial enterprises in general	GEF/World Bank MoF, MIIT	Policy support Capacity Building for Responsible Energy Managers Technical assistance (sub-grants to provide four training centres for setting up and implementing enterprise energy management programs as well as advancing the implementation of such energy management programs by selected enterprises) Information dissemination

NAME OF INITIATIVE	TARGET MARKET	ORGANIZATION	MAIN TARGETS
2017-2022 Developing Market-based Energy Efficiency Program in China	Potential EE projects that have difficulty receive technical and financial helps	GEF/IFC MoF	To increase overall investments in energy efficiency through: <ul style="list-style-type: none"> Partial risk guarantees Technical assistance programs Market outreach through information dissemination Providing trainings and technical assistance for financial institutions Facilitate financial intermediary lending mechanism for energy efficiency projects Assistance to support the independent verification of energy conservation lending for the performance-based GEF grant and to monitor energy saving
2013 South-South Cooperation in the Energy-Saving and Environmentally-Friendly Industry	China & Thailand China & Indonesia	UNIDO MIIT	TA to support: <ul style="list-style-type: none"> National energy conservation measurement system (ECMS) Demonstrate energy conservation project for government office buildings Proposal for a pilot energy conservation project in an enterprise Identification of at least one organization to be accredited for validation and verification of energy conservation
Market-oriented Energy Efficiency Mechanisms for Key Energy-Intensive Enterprises	NDRC and local government agencies	Carbon Trust ERI	<ul style="list-style-type: none"> Improved South-South cooperation facilitates technology exchange mechanisms within Asia and accelerates the adoption of energy-saving technologies in the targeted sectors and countries. Growth of the energy saving industry in China is strengthened through the adoption of a going global strategy under the larger framework of the One Belt One Road Strategy.

What are the barriers limiting industrial energy efficiency in China?

Barriers per category and prioritization

Literature findings

Twenty-five key reports, including governmental, academic, multilateral and think tank sources, were reviewed to identify existing barriers for industrial EE in China.

TABLE 5. Key reports reviewed

Government reports
China 13FYP: Energy Conservation and Emission Reduction Integrated Work Plan, State Council
2016-2030 Energy Generation and Consumption Strategy, NDRC, 2016
Progress and Outlook on China Industrial Energy Conservation, MIIT, Wang Wenyuan
Academics
The Challenge of Reducing Energy Consumption of the Top-1000 Largest Industrial Enterprises in China, Wang, Yun, 2010
Energy Efficiency Policies and Measures in China, Ying Chen, 2015
Total Factor Energy Efficiency of China's Industrial Sector: A Stochastic Frontier Analysis. Xiaobo Shen, 2017
Overview of current energy-efficiency policies in China, Nan Zhou, 2010
The Challenge of Reducing Energy Consumption of the Top-1000 Largest Industrial Enterprises in China, Lynn Price, 2010
International multilaterals
Energy Efficiency 2017, IEA, 2017
Energy Efficiency Market Report 2016, IEA
China's Booming Energy Efficiency Industry, WRI, 2008
Good Practice and Successful stories on Energy Efficiency in China, UNEP, ERI, 2017
2013 China Industry Conservation Report, Energy Foundation, 2013
PEOPLE'S REPUBLIC OF CHINA: Preparing the Energy Conservation and Resource Management, ADB, 2008
China Utility-Based Energy Efficiency Finance Program, 2006-2012, IFC
China Energy Efficiency Promotion in Industry Program, 2011-2016, WB
China Energy Efficiency Financing Program Program, 2008-2016, WB
Developing Market-based Energy Efficiency Program in China, 2017-2022, 2022

Assessment of China's Energy-Saving and Emission-Reduction Accomplishments and Opportunities During the 11th Five Year Plan. LBNL, 2010

China's Industrial Energy Consumption Trends and Impacts of the Top-1000 Enterprises Energy-Saving Program and the Ten Key Energy-Saving Projects, 2012

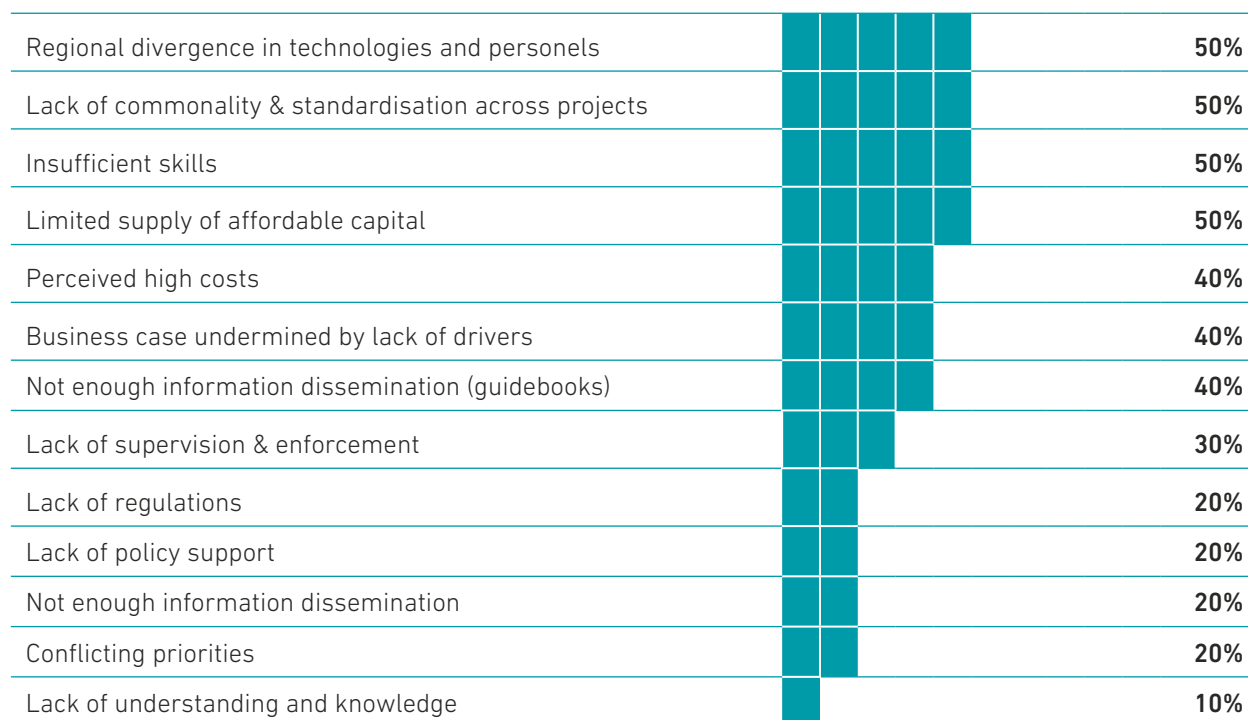
Achieving China's Target for Energy Intensity Reduction in 2010: An exploration of recent trends and possible future scenarios, LBNL,2006

Energy Efficiency Improvement and Cost Saving Opportunities for the Vehicle Assembly Industry, LBNL, 2008

Analysis of Energy-Efficiency Opportunities for the Cement Industry in Shandong Province, China, LBNL, 2009

Developing an Energy Efficiency Service Industry in Shanghai, 2004

All the barriers have been organised into four categories: management and commitment, policies and regulations, technical expertise and capacity and financial resources. Via the use of a wide range of literatures, the four most prevalent barriers have been identified as: the limited supply of affordable capital, insufficient skills, a lack of commonality and standardization across projects, and regional divergence in both technologies and personnel.



Graph 7. Barriers identified by % of literatures as important in IEE

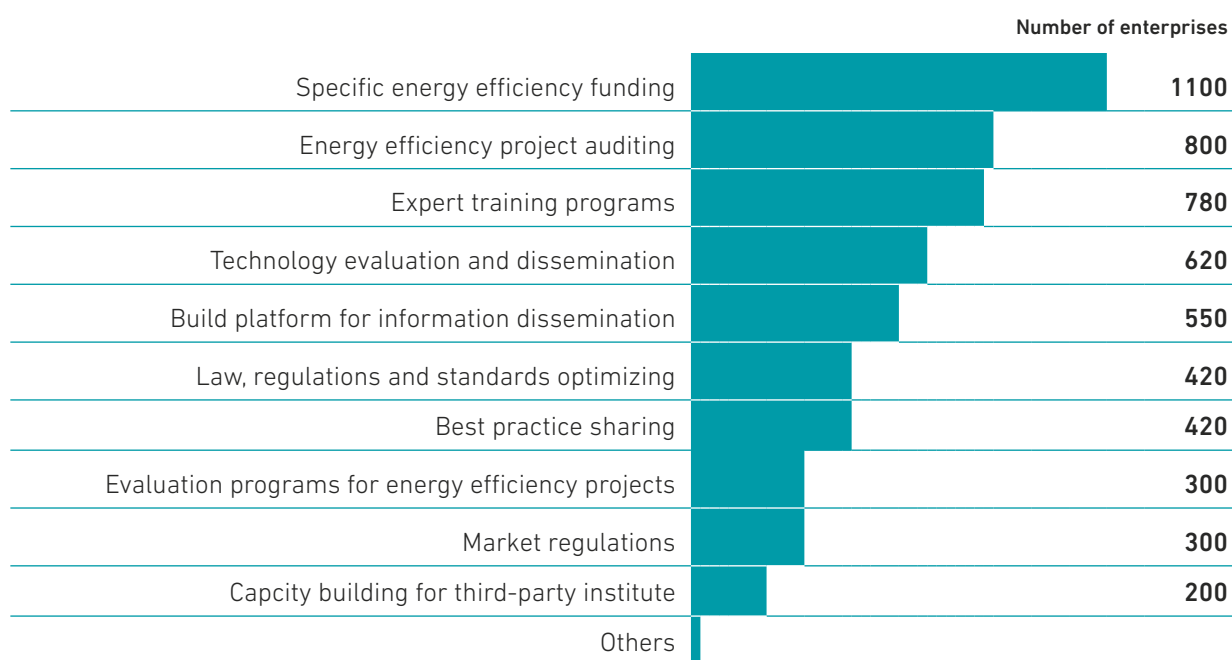
**TABLE 6.** Categorical Barriers Identified as Important in IEE

Management and commitment				
Lack of understanding and knowledge	■			10%
Conflicting priorities	■	■		20%
Not enough information dissemination	■	■	■	40%
Policies and regulations				
Lack of policy support	■	■		20%
Lack of regulations	■	■		20%
Lack of supervision and enforcement	■	■	■	30%
Not enough information dissemination (guidebooks)	■	■		20%
Financial resources				
Business case undermined by lack of drivers (i.e. no business case due to low energy prices or subsidies)	■	■	■	40%
Perceived high costs	■	■	■	40%
Limited supply of affordable capital	■	■	■	50%
Technical expertise and capacity				
Insufficient skills	■	■	■	50%
Lack of commonality & standardisation across projects	■	■	■	50%
Regional divergence in technologies and personnel	■	■	■	50%

ERI investigation

The Energy Research Institution of NDRC carried out an investigation of 1,300 key energy intensive enterprises, suggesting that funding, technology and outcome evaluation are the most important focus areas for future energy-efficiency efforts. The investigation showed that around 90% of enterprises in the study were interested in government-based financial assistance, such as the provision of guaranteed loans and efficiency funding. Furthermore, due to the existence of information asymmetry, most enterprises highlighted a lack of platforms and channels to learn about energy efficiency techniques and products. The study also revealed that diagnostic projects, which would identify energy saving potential for specific projects, are in demand.

Overall, the investigation revealed a number of gaps in the industrial EE sector, which include: specific EE funding, EE project auditing to mitigate information asymmetry, and expert training programs and technology-related dissemination to meet the demand of diagnostic projects. These gaps present a number of opportunities to improve the industrial EE sector in China.



Source: Market-Oriented Energy Efficiency Mechanism for Key Energy-Intensive Enterprises, 2017

Form 9. Survey result among key enterprises on importance of future work on IEE, Market-oriented energy efficiency mechanism for key energy-intensive enterprises, ERI, 2017

Interviews with stakeholders

During the investigation, in-depth interviews were carried out with a wide range of stakeholders, including representatives of multilaterals, government affiliated institutions, industry associations and companies. This enabled the analysis to involve insights from different aspects regarding barriers in the industrial EE sector. The results were summarised as four barriers identified in the literature review: management and commitment, policies and regulations, technical expertise and capacity and financial resources.

Regarding management and commitment, the interviews revealed three main barriers for stakeholder engagement. Firstly, energy management is not always applied effectively. An energy management system (EnMS) is a collection of procedures and practices to ensure the systematic tracking, analysis and planning of energy use in industry. The use of EnMS is one of the most effective approaches to improve energy efficiency. Despite this, in many cases, EnMS is used by enterprises merely

to gain credibility. Consequently, the benefit of EnMS as an effective tool to improve energy efficiency is often overlooked.

Secondly, energy consuming industrial enterprises may lack internal drive and encounter market-based problems, resulting in unreliable commitments to energy efficiency. Specifically, industry end-users pay attention to government policies and this may affect the impact of savings as an incentive on the market, which may not necessarily drive firms.

Thirdly, due to the slowdown of market growth at a macro level, industrial enterprises are often experiencing economic hardship whilst attempting to maintain their operation and development. Therefore, energy efficiency projects may not be perceived as a priority. Furthermore, “over-capacity” issue leads to further problems to firms when attempting to improve energy efficiency.

Multilaterals

Todd Johnson, World Bank, Energy Sector Coordinator, China

Government affiliated institutions

Prof. YU Cong, Professor Researcher of the Energy Research Institute (ERI)

LI PengCheng, China National Institute of Standardization (CNIS)

CHEN Lili, CNIS

XIU Qinxu, National Energy Conservation Center(NECC)

Industry associations

CHAI Bo, Deputy Director of General Office Department of China Energy Conservation Association (CECA)

LI Xiaoliang, Vice Director of Industrial & Development Department, China Petroleum and Chemical Industry Federation (CPCIF)

ZHANG Guoguang, Senior Engineer, China Coal Research Institute (CCRI)

Companies

XU Mingchao, Senior Engineer, CECEP Consulting

QIU Fengqing, Senior Engineer, SinoCarbon

ZHEN Tan, Rene Group

Figure 13. Stakeholders Interviewed from Different Sectors across IEE

Concerning policy and regulations, many interviewees stated that, despite a number of relevant laws and regulations existing at a conclusive stage, the implementation of these policies and regulations needed to be improved further. Specifically, there are three major policy and regulations barriers for stakeholder engagement.

The first barrier relates to standards and accreditation. Currently, China faces a lack of standardized operational guidelines and methodologies for energy saving MRV, at both a project and firm level. There is also a lack of transparency and credibility in the accreditation process and institutional framework, plus limited support from third-party verification institutes.

Secondly, the interviews suggest that problems exist in market regulations, whereby the Chinese regulatory and legal system is not well-established for the energy efficiency industry. For example, when industry firms fail to pay ESCOs, claiming they are not satisfied with their services, it is often difficult for ESCOs to operate in the legal system and defend themselves.

Thirdly, there are currently problems in the policy framework concerning the proper enforcement and implementation in the IEE sector. Although there is a comprehensive policy framework to support IEE in China, including trials of many innovative business mechanisms, problems still exist in the administration of these policies, and the clarification of certain details are necessary.

Another concern mentioned in the interviews included technical expertise and capacity, suggesting various challenges on both a domestic and international scale. In regards to technical expertise, interviewees highlighted that research should be focused on how to improve the integrated impact of several techniques rather than simply promoting the application of specific techniques.

The lack of channels to distribute and market the large range of IEE related technologies in the market was also highlighted as a barrier for the EE sector. In particular, existing platforms for IEE technologies lack credibility in regards to rating and accessibility, and despite the existence of a number of foreign technologies and foreign authentication systems, the market is not open enough to benefit from these.

There are also issues in the energy saving industry, as even though ESCOs are highly skilled in the field of energy saving, they do not always trust in their own experience or advice. Furthermore, ESCOs are lacking in-depth industry knowledge to help end-users promote energy efficiency in a more systematic way, rather than replacing forms of

previously used technologies. Capacity building of higher quality is also in demand, however, existing deficiencies in these technologies must be addressed and understood before attempting to improve capacity. For example, where training provided is not operational or factual enough, trainees do not find training necessary or beneficial and therefore fail to understand existing deficiencies in EE technologies. Despite a considerable amount of research on building standards, capacity building and database, technical expertise and capacity issues still exist.

Lastly, interviewees explained that limited financial resources were the largest obstacle for enterprises when attempting to improve EE in the industrial sector. In terms of loans, it is often difficult for enterprises to apply for affordable loans by using technical details regarding energy saving benefits. Currently, environmental benefits and energy saving impacts have not yet been fully integrated into the financial ratings and there are limited financial institutions, which include these forms of loan considerations. Furthermore, many SMEs are unable to provide sufficient information required by financial institutions, which results in increased financial risks and costs. For end-users and energy service suppliers, most agree that lack of finance opportunities is the core barrier for ESCO development.

For ESCOs to be successful, there must be suitable financial options. Furthermore, ESCOs have been heavily relying on their partnerships with SOE and the government in order to survive. Overall, high up-front costs and relatively long pay-back periods have made it extremely difficult for enterprises to improve energy efficiency through financial loans.

Key barriers limiting China's industrial EE improvement in summary

Through the combination of desktop research and key stakeholder interview data, the key barriers limiting China's industrial EE improvement are summarised below:

1. Companies lack internal incentives when the government withdraws EE project rewards.
2. Measures and studies on how to improve the integrated impact of different EE technologies in a particular sector are not sufficient.
3. In order to improve EE performance in China, there must be a larger availability of consumption data and benchmarking, more data support from monitoring and data-collection systems and stronger use of EnMs.

The research highlighted that, in the future, high evaluation and risk control need to be introduced for financial institutes to give loans to SMEs, small-scale EE projects or ESCOs. Overall, the data suggests that China is in lack of a systematic means for gathering and disseminating energy efficiency technologies or products.

Trends of transition in China's industrial EE improvement

From this research highlighting the key barriers for China's industrial EE improvement, the study has found four key trends in transition in order to improve China's IEE sector:

1. There must be a transition in awareness, whereby policy drive must transfer to market and internal drive in order to improve IEE sector. Furthermore, policy must improve from general standardized guidance into a customized guidance with more transparency and available data.
2. A transition in technologies application whereby firms concern will shift from a focus on one technique to an integrated perspective of multiple techniques in order to synergize the IEE sector.
3. There must be a transition in energy management where there is a better use of EnMs from firms and weak EnMs develops into digital EnMs or Big-Data EnMs in the future.
4. The research suggests a transition in EE finance where environmental impact of IEE projects will be properly integrated into the financial ratings, with the help of green project library or new conversion tools to determine financial ratings partly in terms of environmental impact.

What solutions can address remaining barriers?

Carbon Trust has performed diagnostic analytics and identified focus areas to proceed with in-depth work on one or more pillars.

These focus areas include:

- Policy measures options appraisal and cost-benefit analysis; analysis of supply chain skill gaps and delivery of capacity, analysis of supply chain skills gaps and delivery of capacity building training programs
- Pipeline appraisal and development of investment case studies
- Design of financial solutions and training financiers

From the research carried out on the selected pillars above, we will develop a market transformation program alongside knowledge dissemination with categorised outputs. For each pillar, both short-term and long-term plans have been developed, aiming at an initial GIEEA phase within one year, and larger scale activities for market transformation in three or more years.

Develop country-specific IEE policy measures

In order to mitigate barriers where companies lack internal incentives due to the government withdrawing from EE project rewards or are faced with economy-wide slow-down of market growth, there must be a clarification of roles for market energy users in the industrial sector. Carbon Trust has carried out in-depth studies to identify key market interventions and government guidance in the IEE sector.

Since the 13th FYP, existing subsidies are being replaced by more sustainable and market-oriented tools to incentivise firms. However, the term 'market-oriented mechanism' for EE has not been completely clarified in China. There is significant research on this, including Carbon Trust's previous work on market-oriented energy efficiency mechanisms for key energy-intensive enterprises in the 13th FYP and the evaluation of China's top-10,000 Action. Carbon Trust has made both short-term and long-term targets for the project as presented below in Table 7.

TABLE 7



Pillar # 1 Develop country-specific industrial EE policy measures

Activity	Initial Industrial Energy Accelerator phase
Description	Assessment on the implementation and enforcement of existing market-mechanism and business models in industrial sector
Time	1 Year
Example output	In-depth assessment study on mechanism and business models
Activity	Scaled-up activity for market transformation
Description	Handbook to identify the roles of government and market in aspects including technology dissemination, financial loans, capacity buildings etc.
Time	Years 3+
Example output	Policy report presenting industrial EE policy options and recommendations for implementation

Analysis of supply chain skills gaps and delivery of capacity building training programmes

Energy technology lists (ETLs) are a useful tool to stimulate market action for energy efficiency. ETLs can address a lack of systematic process for gathering or distributing EE products, and also inform EE firms on how to synergize business operations by amplifying the integrated impact of different EE technologies. Furthermore, ETLs will enable China to build on their platform to promote and share EE technologies within and beyond China.

From the ERI survey, technical details, case studies and further information on advanced global EE techniques can be added to existing ETLs. Currently, NECC is working on building a China-Global ETL to serve as a platform for technology transfer, both domestically and to Belt and Road Initiative (BRI) countries. The British ETL is the largest government verified list of energy efficient products in the world.

Carbon Trust has assisted the UK government in compiling the British ETL for around 10 years, including updating its qualification criteria for around 60 industrial or commercial technologies.

By integrating our experience on ETLs, Carbon Trust plans on assessing and improving the existing compilation of ETLs and carry out short-term and long-term distribution. To do this, Carbon Trust will perform comparative studies between UK and China ETLs, sharing British methods for compiling, promoting and screening ETLs, and also carry out in depth investigations to understand business needs. Specific short-term and long-term targets for the project are presented below in Table 8.

TABLE 8



Pillar # 2

In-country capacity building to develop local EE experts & management

Activity	Initial Industrial Energy Accelerator phase
Description	In-depth study on existing technology list in China with an emphasis on technology dissemination and assessment models
Time	1 Year
Example output	Report on existing technology lists Recommendations for implementing Chinese ETL
Activity	Scaled-up activity for market transformation
Description	Customize the ETL for China (technologies, assessment models, dissemination models) Research on technology demand of China's key energy-intensive enterprises
Time	Years 3+
Example output	Implement ETL Online technology exchange platform

Pipeline appraisal and development of investment case studies

With the availability of new data technologies, the lack of resources on consumer data and benchmarking can be resolved. Existing technologies such as Big-Data provides support for smart systematic and efficient EE management and Industry Internet can improve information integration. The use of concepts such as Big-Data and Industry Internet will improve the understanding and the implementation of EE, and will enable China to increase the integrated impact of different technology applications. Carbon Trust plans to conduct industry diagnostic research and develop a framework of an Industry Internet.

In previous work, Carbon Trust has conducted market analyses, including the assessment of available products, of D-EnMs markets in six countries through market research. Carbon Trust has acknowledged that industrial energy-intensive enterprises are key elements for the “Double Control” target raised in China 13th FYP, and therefore the projects short-term target is to conduct market research on D-EnMs in China, whilst the long-term target is to explore improvement of IEE with novel high-tech as presented below in Table 9.

TABLE 9



Pillar # 3

Develop a pipeline of investable industrial EE projects

Activity	Initial Industrial Energy Accelerator phase
Description	Market research on China’s digital energy management system, to increase the uptake and effectiveness of D-EnMS Small-scale training and advice for industry
Time	1 Year
Example output	Market Research on D-EnMS Recommendations for training and advice for industry
Activity	Scaled-up activity for market transformation
Description	Explore the potential to improve EE with the concept of “Industry Internet” which features “information integration, exchanges and big data management” for diagnostic analysis across industry sectors
Time	Years 3+
Example output	Diagnostic report for at least 100 enterprises In-depth analysis in building China’s “Industry Internet”

Design of financial solutions and training financiers

The ERI investigation suggests that funding sources are amongst the most pressing issues that hinder efforts in EE improvement. Since there are significant up-front costs to establish loans, many firms are limited from even putting forward loan requests. In particular, SMEs are in urgent need of effective assessment support for financial and third-party institutes to appraise and invest in energy projects. Therefore, TA support on how to conduct risk-control assessments for energy saving projects has been found to be useful for financial institutions who orient and control most of the finance for energy saving projects in China.

Carbon Trust has launched loan schemes for SMEs financing EE in the UK and also designed finance and advice schemes in Mexico, Brazil, South Africa and India. We have also evaluated the best international practice for Climate Investment Funds (CIF). For this project, we plan on reducing the cost of energy efficiency financing and to also explore different finance resources, this is presented in a two-step process below in Table 10.

TABLE 10



Pillar # 4

Generate financing solutions to unlock EE development

Activity	Initial Industrial Energy Accelerator phase
Description	Review international best practice for TA to financial institutions Initial TA support for third-party institute to assess energy saving projects
Time	1 Year
Example Output	Proposal for “best-in-class” financial institution training Workshops and training
Activity	Scaled-up activity for market transformation
Description	Toolkit to identify the greenness of EE finance project Green bond design and rating assistant for domestic projects to issue bond in overseas market Identify global financial sources to support industrial enterprises on EE loan
Time	Years 3+
Example Output	Toolkit for financial institutions to measure the impact of EE loan project Study report and case study for global EE business models Catalogue for enterprises

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