



Proceedings of the China-ASEAN Energy Efficiency Knowledge Exchange Workshop

June 2014

WORLD BANK GROUP

ESMAP
Energy Sector Management Assistance Program

ASTAE
Asia Sustainable and Alternative Energy Program

Energy and Extractives Global Practice

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Foreword

Energy efficiency is the largest and lowest-cost source of emission reduction. And it is also yields huge domestic development benefits, such as improving local air quality, enhancing energy security, reducing energy bills for consumers, increasing the competitiveness of industries, and creating jobs.

Energy efficiency is a top priority in the World Bank Group's energy business. The World Bank Group investment in energy efficiency and renewable energy hit an all-time high at nearly US$5 billion last year, accounting for 60 percent of the World Bank's energy portfolio.

Transforming China's energy sector towards a low-carbon path is the most important climate change mitigation action in the world. China has been a pioneer to dramatically reduce its energy intensity, and embarked on one of the most aggressive energy conservation campaigns in the world. As a matter of fact, China's energy savings from 1990-2010 accounted for more than half of the cumulative energy savings worldwide. The Government of China (GoC) has made energy conservation one of the top priorities for the nation, and has decoupled economic growth from energy and emissions growth. These achievements are largely thanks to the Chinese Government's commitment, ambitious targets, and effective policies for energy conservation and emission reduction. Therefore, China has a lot to offer to the world on their successful energy conservation experience, particularly for other Asian countries who also set aspiring goals to reduce their own energy intensity.

Against this backdrop, the China-ASEAN Energy Efficiency Knowledge Exchange Event was held in China from June 16-20, 2014, co-organized by the World Bank, the National Development and Reform Commission (NDRC) and National Energy Conservation Center (NECC) of China, with funding support from Asia Sustainable and Alternative Energy Program (ASATE) and Energy Sector Management Assistance Program (ESMAP) of the World Bank. Participants from China, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Singapore, Thailand, and Vietnam as well as other bilateral and multilateral organizations gathered in China to exchange knowledge, experience and lessons learned on energy efficiency policies and implementation, financing mechanisms, and business models of Energy Service Companies (ESCOs).

The workshop could not have been more timely. Knowledge sharing, particularly South-South knowledge exchange, is one of the top agendas for the newly established Energy and Extractives Global Practice at the World Bank. By bringing policy makers, financial institutions and practitioners from Asian countries together, it provided a platform for these countries to learn from each other and explore and implement the most suitable approaches to improve energy efficiency in their own country. The workshop not only showcased Chinese experience to other Asian countries who are preparing their own energy efficiency policies and projects, but also introduced good practice from other Asian countries to China. This rich experience and the lessons learned on energy efficiency policies, institutional frameworks, financing mechanisms, and delivery models are documented in the proceedings, which can benefit other countries around the globe as well.

Going forward, we must take advantage of the knowledge gathered here, to spur us to undertake more actions and to get to implementation on the ground to tap the huge energy saving potentials. The World Bank Group is committed to supporting China and other countries as they make the shift to a sustainable energy system. We will continue bringing together financial and technical resources so we can support our client countries and partners as they enhance their energy efficiency policies. We look forward to working with these countries to help them bring about important changes that will strengthen their future. It is our hope that this report will benefit countries around the world in their quest for a sustainable energy future.

Charles Feinstein
Director
Energy and Extractives Global Practice
The World Bank

Acknowledgements

This report presents the proceedings of the China-ASEAN Energy Efficiency Knowledge Exchange workshop, which was co-organized by the World Bank and China's National Development and Reform Commission (NRDC) and National Energy Conservation Center (NECC), with funding support from the World Bank's Asia Sustainable and Alternative Energy Program (ASTAE) and Energy Sector Management Assistance Program (ESMAP).

The World Bank team was led by Xiaodong Wang and included Dafei Huang, Hong Miao, Dan Xie, Kun Cao, Tianxiu Kang, Lucy Huang, and Li (in China); Cristina Hernandez and Inneke Herawati Ross (Washington DC); Ashish Khanna, Ashok Sarkar, and Nitika Surie (India); Ky Hong Tran and Thi Ba Chu (Vietnam); Pajnapa Peamsilpakulchorn and Chutima Lowattanakarn (Thailand and Malaysia); Dhruva Sahai and Sri Oktorini (Indonesia); Rome Chavapricha and Kaysone Vongthavilay (Lao PDR); China Chhun (Cambodia); and Theingi Min and Aye Marlar Win (Myanmar). The team would like to thank Charles Feinstein, Marianne Fay, Julia Fraser, Rohit Khanna, and Dejan Ostojic for their support and guidance.

The conference proceeding were prepared by Xiaodong Wang, Dafei Wang, and Nejteh Demirian; Anna van der Heijden edited the proceedings; Tianxiu Kang was responsible for the overall production of the process.

Finally, the team wishes to acknowledge the generous funding support from ASTAE and ESMAP.

Abbreviations

ASEAN	Association of Southeast Asia Nations
ASTAE	Asia Sustainable and Alternative Energy Program
BoB	Bank of Beijing
CO_2	Carbon dioxide
CHEEF	China Energy Efficiency Financing Program
CHUEE	China Utility Based Energy Efficiency Financing Program
EE	Energy Efficiency
EELMC	Energy Efficiency Labelling Management Center
EMCA	Energy Conservation Service Industry Committee of China Energy Conservation Association
EPC	Energy Performance Contracting
ESCO	Energy Service Company
ESMAP	Energy Sector Management Assistance Program
FYP	Five Year Plan
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoC	Government of China
GW	Gigawatt
IFC	International Finance Corporation
kW/kWh	Kilowatt/Kilowatt Hour
LNG	Liquefied Natural Gas
MDB	Multilateral Development Bank
Mt	Million tons
Mtce	Million tons of coal equivalent

MW/MWh	Megawatt/Megawatt Hour
NDRC	National Development and Reform Commission
NECC	National Energy Conservation Center
R&D	Research and Development
RESCO	Renewable ESCO
RSF	Risk Sharing Facility
SLES	Shandong Lu Dian Energy Saving Co., Ltd
SME	Small- and Medium-sized Enterprises
t	Ton (1,000 kg)
TA	Technical Assistance
tce	Tons of coal equivalent
tCO_2e	Tons of CO_2 equivalent
TJ	Terajoule
toe	Tons of oil equivalent
TWh	Terawatt Hour

Executive Summary

The China-ASEAN Energy Efficiency Knowledge Exchange workshop was held in Beijing and Xi'an, China from June 16-20, 2014. The workshop and study tour were co-organized by the World Bank and China's National Development and Reform Commission (NDRC) and National Energy Conservation Center (NECC), with funding support from the World Bank's Asia Sustainable and Alternative Energy Program (ASTAE) and Energy Sector Management Assistance Program (ESMAP). The workshop was designed to disseminate China's successful experience in energy efficiency and promote South-South knowledge exchange on energy efficiency between China and other Asian countries.

Workshop Overview

More than 30 participants attended the week-long event, including government officials, practitioners, and representatives of bilateral and multilateral aid organizations, ESCOs, and financial institutions from China, Cambodia, India, Indonesia, Lao PDR, Malaysia, Myanmar, Singapore, Thailand, and Vietnam. The workshop promoted South-South exchange of knowledge, experience, and lessons learned on energy efficiency (EE) policies and implementation, financing mechanisms, and business models of Energy Service Companies (ESCOs). The event not only showcased Chinese experience to other Asian countries, but also introduced good practices from those other Asian countries, such as India, Singapore, Thailand, and Vietnam, to China.

The workshop and study tour covered comprehensive topics on EE policies, financing, and ESCOs, covering: (i) EE target setting, allocation, regulations, and financial incentive policies in China; (ii) EE policies and targets in India (with a focus on the Perform, Achieve, and Trade scheme), Singapore (with a focus on the green building program), Thailand (including the Energy Conservation Fund and ESCO development), and Vietnam; (iii) ESCO business models in China (shared savings, guaranteed savings, outsourcing, leasing, and Super ESCO models); (iv) energy efficiency financing mechanisms (credit lines and partial risk guarantees) in China and the IFC CHUEE program; (v) EE policy implementation at provincial level and in key energy-intensive industries in Shaanxi province; and (vi) site visits to an ESCO project that installs solar PV at 1000 schools in Beijing financed by the World Bank, as well as to a cement company in Xi'an.

China Experience: Energy Efficiency Targets, Regulations, and Financial Incentives

The Chinese government's strong commitment, ambitious targets, and effective policies for energy conservation are the key success factors for China's achievements. From 1980-2010, China's energy consumption increased 5-fold to fuel an economy that increased 18-fold, indicating that energy and emission growth had been largely decoupled from economic growth. In addition, China's energy savings for 1990-2010 accounted for more than half of the cumulative energy savings worldwide. In its 11^{th} Five-Year Plan (FYP) for 2006-2010, the Government of China (GoC) set a mandatory target to cut energy intensity per unit of GDP by 20 percent; it then continued to pursue a further 16 percent reduction during its 12^{th} FYP (2011-2015). China's EE target setting is integrated into the country's long-term goals for sustainable development, climate change, and pollution control. After target setting, targets were allocated to the individual provinces based on an analysis of key factors—including economic development status, energy saving potentials, and total energy consumption in each province—as well as negotiations between the central and provincial governments. The targets were also allocated to the nation's top energy-consuming enterprises.

To achieve its ambitious targets, GoC has put in place a combination of strong administrative measures, stringent regulatory policies, and substantial financial incentives. First, the provincial leaders are held accountable for achieving the allocated energy intensity reduction targets. The government also signed responsibility contracts on specific enterprise energy saving targets with the nation's top 17,000 energy-consuming enterprises, which account for two-third of China's total energy use. Second, the government tightened energy efficiency standards for appliances, buildings, and vehicles. Finally, the central government provided more than US$15 billion during the 11^{th} FYP period (with additional funds coming from provincial governments) as incentives for EE investments, rebates for energy efficient consumer products, for technology R&D, and as compensation for the phase-out of inefficient stocks.

China Experience: Institutional Framework for Implementation

EE targets implementation requires an effective institutional structure as well as institutional champions. In China, the Energy Efficiency and Emission Reduction Leading Group, which consists of all relevant ministries and agencies, is chaired by the Premier. Implementation, however, rests at the provincial level. In Shaanxi province, the provincial government uses a range of comprehensive measures to improve energy efficiency in the industrial, buildings, and transport sectors in an integrated way, assisted by the Provincial Energy Conservation and Supervision Center. This comprehensive institutional framework allows the highest level of authority to coordinate all the key ministries horizontally, and assigns implementation responsibilities to the provinces and enterprises vertically; the system is further backed up with adequate resources and supported by the ability to engage multiple stakeholders, independence in decision making, and monitoring of results at the provincial level. Based on China's experience, these are the key ingredients for success when implementing EE targets and policies.

The Growth of China's ESCO Industry

China's effective policies have also been the driver for scaling up its ESCO industry and catalyzing investment in energy efficiency. The Chinese government's mandatory performance-based EE targets have created huge market demand for EE investments and ESCO services, whereas the absence of such policies in other countries has limited the impact of EE financing initiatives. In particular, the Chinese government's financial incentives to ESCOs—with rewards of 300 Yuan/ton of coal equivalent energy savings and tax holidays for ESCOs—have led to the boom of the Chinese ESCO industry.

The World Bank's long-term engagements with the government, from pilots to mainstreaming actions, have also made transformational impacts. Over the past two decades, the World Bank has been working with China to help the country move to more market-based approaches for energy conservation under three phases of World Bank/GEF-supported projects. The first, the Energy Conservation Project, introduced the Energy Service Company (ESCO) concept to China by establishing the first three ESCOs. Next, as the ESCO industry started to grow, the second-phase Energy Conservation II Project provided partial risk guarantees to help ESCOs access financing and established an ESCO Association. Finally, the China Energy Efficiency Financing (CHEEF) program is now supporting the mainstreaming of energy efficiency lending in the Chinese banking sector through EE credit lines.

Over the last few years, the ESCO industry in China has grown to nearly 5,000 companies with nearly US$10 billion in energy performance contracts in 2012. The success of this long-term sector engagement is largely thanks to the strong government commitment and support; interventions at the right time, when the Chinese government was searching for market-based solutions; and the continuity of the teams, both on the government and the Bank side.

Energy Efficiency Financing Mechanisms.

Engaging domestic banks through credit lines and partial risk guarantees has high leverage and good prospects of sustainability. CHEEF Phase I has financed nearly US$1 billion in EE investments to date, leveraging four times the amount of the IBRD loans, with substantial energy savings and emission reductions achieved. More importantly, the CHEEF program has substantially increased participating banks' capacity, confidence, and commitment to finance and mainstream EE investments through a learning-by-doing process; when the credit line is exhausted, participating banks may well stay in the EE financing business. Similarly, the partial risk guarantees provided by the WB/GEF Energy Conservation II project and the IFC CHUEE program have achieved a leverage ratio of 1: 5-7, with some of the participating banks becoming leaders in EE financing in China.

In addition, new ESCO business models and EE financing models are emerging. The Chinese ESCOs have gone a long way to expand the business models from the initial shared saving model to more recent leasing, outsourcing, and guaranteed saving models, as showcased in the workshop. Several Chinese banks also presented their new EE financing models, such as project-based financing using energy savings as collateral and buying out future energy saving revenue streams from ESCOs.

Other South and East Asian Country Experiences

East and South Asian countries also are placing a high priority on energy efficiency, with some Asian countries also setting energy efficiency targets. India's experience with its Perform, Achieve, and Trade (PAT) scheme, which puts EE obligations on key energy-intensive industry enterprises and allows them to trade, is very relevant to China as the Chinese government is planning its own Energy Saving Certificates trading scheme. The Singapore experience on policies and financing for building retrofit is also very relevant and timely when China expands its priority on EE from industry to buildings, given the rapid urbanization and fast growth in building energy demand. Thailand also has set its EE targets, under the EE Development Plan, and is an early mover in Asia to implement EE standards, establish an Energy Conservation Fund, and develop an ESCO industry. Vietnam has passed an Energy Conservation Law and has set EE targets under its National EE Program.

1. Overview

1.1 China's Achievements in Energy Efficiency

The Government of China (GoC) has made energy conservation one of its top priorities, embarking on one of the most aggressive energy conservation campaigns in the world. From 1980 to 2010, China's energy consumption only increased 5-fold, to fuel an economy that increased 18-fold. Over the same period, energy intensity per unit of GDP has declined by about 70 percent, as shown in figure 1.1. This indicates that energy and emission growth have been largely decoupled from economic growth. As shown in figure 1.2, China's energy savings for 1990-2010 accounted for more than half of the cumulative energy savings worldwide over the same period.

Figure 1.1 China energy intensity has dramatically decreased over the past 30 years

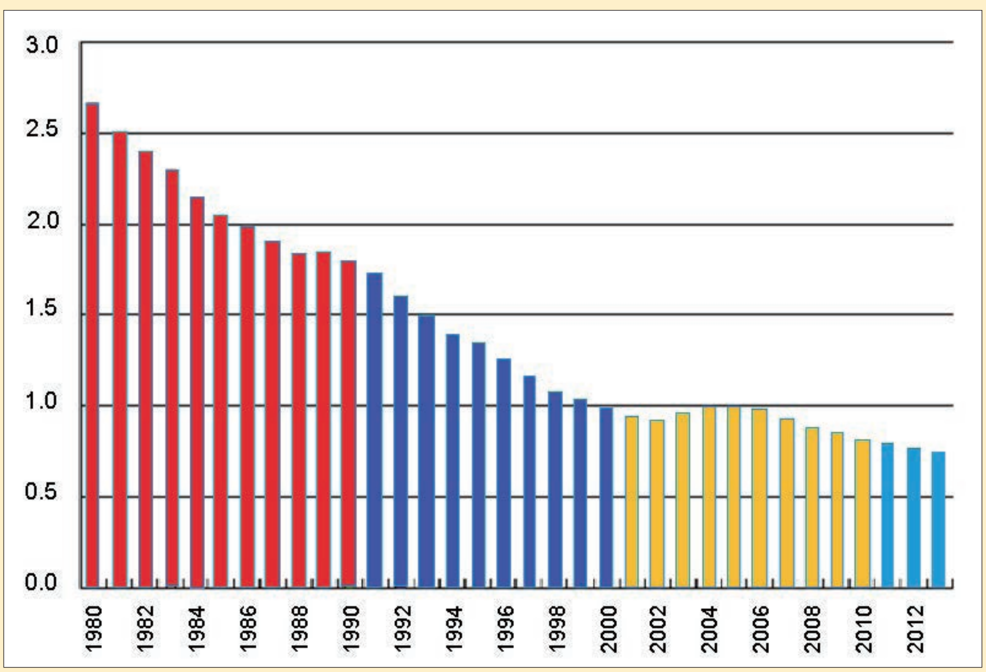
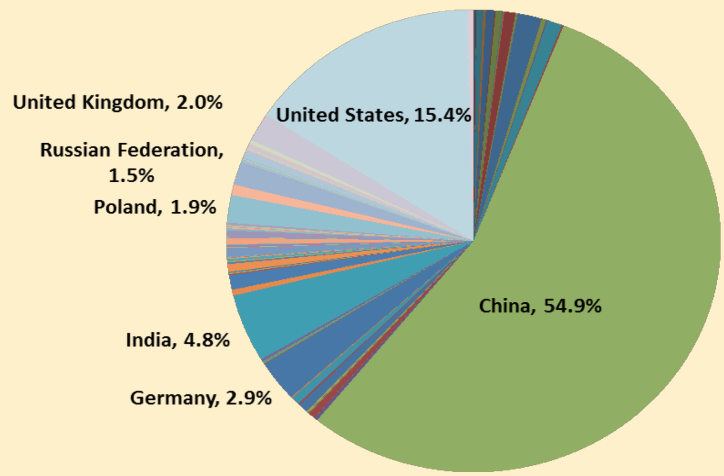
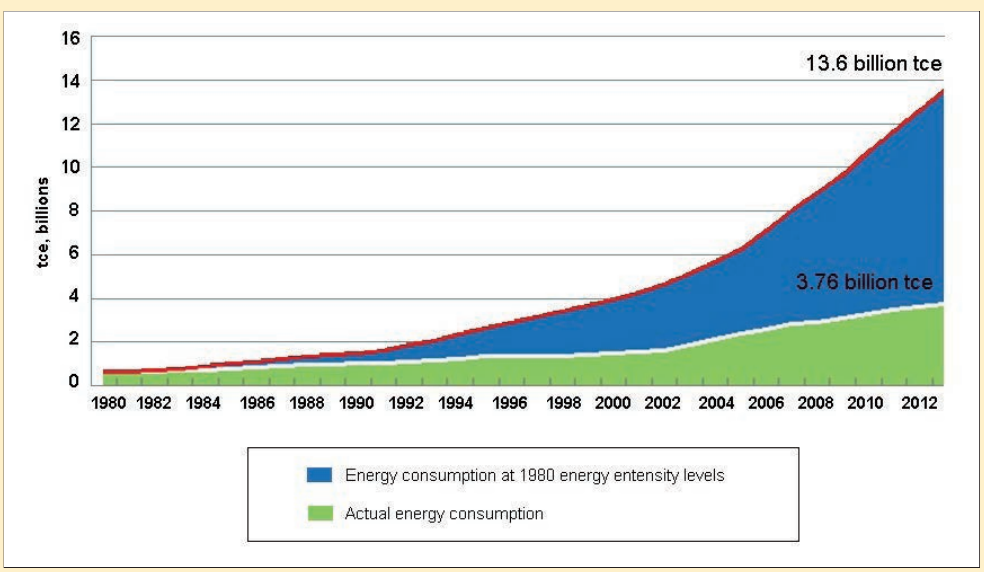


Figure 1.2 China accounted for more than half of the global energy savings from 1990-2010



Should China have progressed development with the same energy intensity levels as it had in 1980, China's aggregate demand for energy would have been 13.6 billion tons of coal equivalent (tce) by 2013, approximately 3.6 times more than the existing total energy consumption (figure 1.3).

Figure 1.3 Thanks to aggressive energy conservation efforts, China saved approximately 10 billion tons of coal equivalent by 2013



In recent years, the GoC set a mandatory target to cut energy intensity by 20 percent in its 11th FYP (2006-2010) and then renewed its commitment with a target of 16 percent reduction in its 12th FYP (2011-2015). To achieve these targets, the government has put in place a combination of strong administrative measures, stringent regulatory policies, and generous financial incentives. First, the provincial leaders are held accountable for achieving the allocated energy intensity reduction targets. The government also signed responsibility contracts for specific enterprise energy saving targets with the nation's top 17,000 energy-consuming enterprises, which account for two-third of China's total energy use. Second, the government tightened energy efficiency standards for appliances, buildings, and vehicles. Finally, the central government provided more than US$15 billion during the 11th FYP period, with additional funds from provincial governments, as incentives for EE investments, rebates for energy efficient consumer products, investments in technology R&D, and compensation for the phase-out of inefficient capital goods.

1.2 Southeast Asian and Indian Policies and Targets for Energy Efficiency

Countries in East and South Asia also are prioritizing energy efficiency, with some also setting energy efficiency targets. The following are some examples of EE policies and targets in India and Southeast Asian countries.

India. India's Bureau of Energy Efficiency is implementing a Perform, Achieve and Trade (PAT) scheme, which sets energy intensity reduction targets (in percentage) based on each unit of output in the baseline year. Targets are set for 478 plants in 8 energy intensive industries, accounting for almost one third of India's energy consumption, with industries allowed to trade with each other. Introduced with the National Mission for Enhanced Energy Efficiency (NMEEE), it was one of the eight missions outlined within the National Action Plan on Climate Change (NAPCC) launched in 2008 by the Indian government. The total national energy saving target under the PAT scheme amounts to 6.7 million tons of oil equivalent (toe). The PAT scheme is managed through the establishment of sub-groups for each PAT sector according to product mix, while development of energy performance indicators is done on a normalized basis at the baseline, generally affected by raw materials consumption, fuel type, process technology, and intermediates mix used. The advantage of the approach is that it introduces market based instruments within a regulatory framework to encourage compliance, by allowing companies to trade certificates that represent energy efficiency gains in exchange for cash from companies that did not achieve their efficiency targets. India's novel PAT scheme has encouraged the adoption of energy efficient and low-carbon technology, increasing the use of renewable energy, waste heat recovery, and use of alternate fuel and raw materials in the Indian Industry.

Singapore. Singapore's buildings account for 49 percent of the country's electricity consumption. Singapore's Building and Construction Authority (BCA) has been developing and enhancing the Building Energy Efficiency Approach to further sustainable development of the city-state with a target to achieve "Green" status for 80 percent of the buildings in Singapore by 2030, using a variety of innovative and incentive based measures. The building certification system follows the BCA Green Mark scheme introduced in 2005, which provides a certification based on the energy efficiency rating of a building. The Singaporean government has taken the lead, ensuring that all new and existing public buildings will be certified under Green Mark Platinum or GoldPlus standards. In terms of incentives, the government has sells land at discounted prices for developers who agree to comply with these same two certifications and provides incentives for the private sector to retrofit energy efficiency improvements through a S$100 million fund. The government also introduced the Building Retrofit EE Financing Scheme, providing credit facilities under favorable terms for commercial building owners, building management corporations, and ESCOs to carry out EE retrofitting projects under Energy Performance Contracting (EPC) arrangements. The Singaporean government has been supporting research and development (R&D) in green building technology (Ministry of National Development research fund, S$50 million), sustainable materials (62 projects, S$5 million), and sustainable construction (26 projects, S$15 million) and provided a S$5 million incentive for developments that demonstrate energy savings of at least 40 percent above the current base standard.

Thailand. Thailand was an early mover in the ESCO industry in Asia and has been the first nation in the region to establish an Energy Conservation Fund from its petroleum levy. Being a net energy importer, the nation's total energy import value sits at approximately 10 percent of GDP, with the industrial sector as the largest energy consumer at 36.4 percent of total energy consumption. The Energy Efficiency Development Plan (EEDP) set a goal to reduce energy intensity by 25 percent from 2005 to 2030, among which the transport and industrial sectors offer the largest energy savings. Containing energy growth in the transport sector requires mandatory fuel economy standards, fuel taxes and road pricing, and public transport infrastructure. Industrial-performance-based energy-saving targets can be more effective than the current input-based energy managers program. The government of Thailand has actively adopted policies and financing mechanisms to promote EE. The EE programs currently operating include (i) financial incentives in the form of a co-investing program (ESCO Fund), direct subsidies of 20-30 percent, tax incentives, and an ESCO scheme; (ii) standards and regulations for EE designated facilities, building energy codes, and labelling; (iii) awareness campaigns such as the Thailand Energy Award and media advertising; (iv) technical support including training and seminars, technical demonstrations, and guidelines and handbooks for EE; and (v) EE networking to establish R&D within universities and partnerships with professional associations.

Vietnam. The Vietnamese government has passed a Law on Energy Efficiency and Conservation, issued a series of decrees to promote EE by the prime minister, and set a target of 5-8 percent of energy savings from 2012 to 2015 compared to the forecast energy demand. The Vietnam National Energy Efficiency Program (VNEEP) is a national target program and the first-ever comprehensive plan to institute measures for improving energy efficiency and conservation in all sectors of the economy in Vietnam. VNEEP Phase I (VNEEP-I) from 2006–2010 aimed to start up all components of the program, and VNEEP Phase II (VNEEP-II) from 2011–2015 aims to expand each component, based on lessons learned from Phase I. In addition to the Vietnamese government's national programs, a number of parallel efforts have been initiated in direct cooperation with donor agencies. For example, the Ministry of Industry and Trade has a US$1 million EE subsidy fund, which provides up to 30 percent investment subsidies for EE projects with a subsidy ceiling of US$250,000 for each project. The government also provides funding for energy auditing, technical assistance, training, and promotion for energy conservation.

1.3 Workshop Objectives

China has considerable knowledge and experience with energy efficiency to offer on an international level. Global progress in EE would not have been as significant without China's enormous contribution. In addition, China sets an example for other developing countries in Asia. East and South Asian countries have made EE a priority and are interested in learning from China's successes and experiences developing and implementing EE policies, Energy Service Companies (ESCOs), and EE financing mechanisms.

These proceedings summarize the rich content of the presentations and site visits that formed the China-ASEAN Energy Efficiency Knowledge Exchange workshop. Specifically designed to disseminate China's successful experience in EE and promote EE in East and South Asian countries, the World Bank and China's National Development and Reform Commission (NDRC) co-hosted this South-South knowledge exchange workshop and study tour, which was financed by ASTAE and ESMAP, during June 16-20, 2014 in Beijing and Xi'an, China. More than 30 participants, including government officials, practitioners, and representatives of bilateral and multilateral aid organizations, ESCOs, and financial institutions from China, Cambodia, India, Indonesia, Lao PDR, Malaysia, Myanmar, Singapore, Thailand, and Vietnam gathered in China to share knowledge and exchange experiences and lessons related to EE policies, financing mechanisms, and ESCO business models. The workshop not only showcased the Chinese experience for the participating nations, but also introduced good practices from other Asian countries such as India, Singapore, Thailand, and Vietnam.

The workshop and study tour covered comprehensive topics on EE policies, financing, and ESCOs, covering six main themes: (i) EE target setting, allocation, regulations, and financial incentive policies in China (Chapter 2 of these Proceedings); (ii) EE policies and targets in India (with a focus on its Perform, Achieve, and Trade scheme), Singapore (with a focus on the green building program), Thailand (including the Energy Conservation Fund and ESCO development), and Vietnam (see Chapter 1; section 1.2); (iii) the success of China's ESCO industry and ESCO business models (shared savings, guaranteed savings, outsourcing, leasing, and Super ESCO models) (Chapter 3); (iv) energy efficiency financing mechanisms (credit lines and partial risk guarantees) in China (Chapter 4); (v) EE policy implementation at the provincial level and in key energy-intensive industries in Shaanxi province (Chapter 5); and (vi) site visits to both an ESCO project that installs solar PV on 1,000 schools in Beijing financed by the World Bank (box 3.1) and to a cement company in Xi'an (box 5.2). The detailed agenda of the workshop is included as Annex 1.

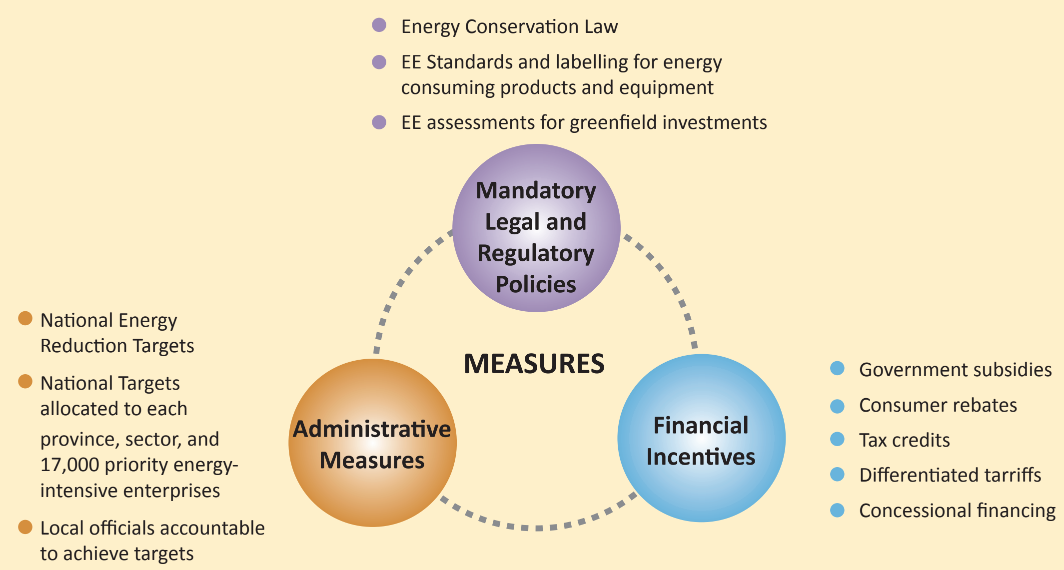
2. China's Energy Efficiency Policies and Institutional Framework

2.1 Overview

China's energy efficiency policies can be grouped into three clusters, as shown in figure 2.1, covering:

- **Administrative measures** that set a national energy intensity reduction target, then allocate the national target to each province, sector, and 17,000 priority energy-intensive enterprises, with local officials accountable for achieving these targets (see sections 2.2 and 2.3 for details);
- **Mandatory legal and regulatory policies** that adopt Energy Conservation Law, EE standards and labelling for energy-consuming products and equipment, and EE assessments for green field investments (section 2.4); and
- **Financial incentives** that provide government subsidies, consumer rebates, tax credits, differentiated tariff, and concessional financing (section 2.5).

Figure 2.1 China's energy efficiency policies can be grouped into three clusters



Given the fragmented nature of energy efficiency efforts, successful implementation of policy measures requires a strong national champion and effective institutional coordination among different sectors and between the national and local governments. Three decades of energy conservation efforts in China have established a coherent and comprehensive institutional framework, from the highest level of the national government to local governments, that is supported by a large cadre of think tanks, research institutes, and energy monitoring and supervision centers, both at the national and provincial levels (see section 2.6 for details).

2.2 Setting Ambitious EE Targets

Over the last three decades, China has experienced the fastest economic growth in the world. Energy consumption, however, was decoupled from economic growth; as the economy increased 18-fold and the urban population more than doubled (reaching 45 percent of the total population), energy consumption only increased 5-fold. This increased efficiency notwithstanding, China is now the largest energy consumer in the world, relying heavily on coal to meet 70 percent of its primary energy needs. Over the next two decades, energy consumption in the country is expected to double again. China's remarkable economic growth has led to twin energy challenges, namely environmental sustainability and energy security. China has many of the world's most polluted cities and is the largest emitter of greenhouse gases (GHGs) in the world. Meanwhile, the country is facing growing energy security concerns because of its increasing dependence on oil and gas imports.

Improving energy efficiency is the most cost-effective way to simultaneously address both challenges as increasing energy efficiency leads to not only energy savings, but also a conservation of scarce natural resources, improvements in local air quality, and enhanced energy security. The Chinese government thus has made energy conservation one of its top priorities, and China has embarked one of the most aggressive energy conservation campaigns in the world.

The government has undertaken an aggressive clean energy campaign through coordinated efforts on a national, provincial, and local level. From as early as the 1980s, China has been introducing energy conservation policies and standards. This work has now been expanded and developed considerably to include policies, guidelines, and enforcement practices that are on par with international standards, across all industries and products.

In terms of targets, the government has set a mandatory target to cut energy intensity (energy consumption per unit of GDP) by 20 percent in its 11th FYP (2006-2010) and renewed its commitment with a 16 percent reduction set for its 12th FYP period (2011-2015), after its remarkable accomplishment of more than 60 percent reduction in energy intensity from 1980 to 2005. Furthermore, it is widely expected that the upcoming 13th FYP (2016-2020) will adopt a mandatory total energy consumption cap in addition to the energy intensity reduction target. Finally, the GoC has pledged to reduce its carbon intensity by 40-45 percent from 2005 to 2020, to which energy efficiency is expected to make the largest contribution. Table 2.1 presents an overview of the various targets.

Table 2.1 China targets for reducing energy intensity and carbon intensity and increasing the share of non-fossil fuels for the 11th and 12th FYP

National Targets	11th FYP (2005-2010)	12th FYP (2011-2015)	Targets by 2020
Energy Intensity Reduction	20 percent reduction from 1.28 tce/GDP to 1 tce/GDP	16 percent reduction from 1.03 tce/GDP to 0.87 tce/GDP	
Share of Non-Fossil Fuel in Primary Energy Mix		Increase from 8.3 percent in 2010 to 11.4 percent in 2015	Increase to 15 percent by 2020
Carbon Intensity Reduction		17 percent reduction from 2011 to 2015	40-45 percent reduction from 2005 to 2020

China's energy efficiency targets are based on its three long-term goals and objectives, including: (i) long-term sustainable development goals; (ii) long-term efforts to combat climate change; and (iii) regional environmental pollution control objectives. In addition, the mandatory targets for energy conservation and emission reductions were expanded from four categories (reduction of energy intensity, reduction of SO2 and COD emissions, and increase of forest coverage) for the 11th FYP to nine categories (reduction of energy intensity, increase in the share of non-fossil fuel in the primary energy mix, reduction of carbon intensity, reduction of SO2, NOx, NH3-N, and COD emissions, and increase of forest coverage and forest stock) for the 12th FYP.

2.3 Allocating EE Targets to Provinces and Priority Enterprises to Hold Someone Accountable

To achieve these national-level targets, it is essential to hold someone accountable for effective implementation. The central government has allocated the national-level mandatory targets to each of the 31 provinces, holding provincial leaders accountable for achieving the allocated energy intensity reduction targets. The government also signed responsibility contracts on enterprise-specific energy saving targets with the nation's top 1,000 priority energy-intensive enterprises (accounting for one third of China's total energy consumption) during the 11th FYP, and expanded this to 17,000 priority energy-consuming enterprises (accounting for two-third of China's total energy use) during the 12th FYP. The energy-consuming enterprises are the ultimate core entities responsible for implementing EE measures.

The local officials are held accountable to achieve these EE targets, which is built into their performance evaluations. This administrative measure places the responsibility of sustainable development on local and provincial officials, ensuring that energy conservation becomes a key consideration in the pursuit of economic development.

Target allocation to provinces. The allocation of national targets to each province is done in three steps. First, the government adopts an analytical allocation framework that considers key factors, such as the province's economic development status, regional differences, potential for energy efficiency improvement, total energy demand, and EE performance during the 11th FYP. Next, the national government negotiates with the provincial governments if they had concerns about the impacts of these allocated targets on the economic development at the provincial level and had requested a compromise. In this phase, the coordination between the central and provincial governments also heavily relies on the analytical framework, which acts as the most valuable tool of persuasion for local and provincial government officials. Finally, after the consultation process, the central government makes its final decision on the target allocation.

Based on these three steps, the government allocated the 12th FYP energy intensity reduction target into five bands, as shown in table 2.2. Regions with higher GDP/capita and total energy consumption were assigned higher targets, such as for example Beijing, Guangdong, Shanghai, and Tianjin. Undeveloped regions were assigned less stringent targets, leaving more room for economic growth while still requiring them to reduce energy intensity.

Table 2.2 Allocation of national targets to provinces, municipalities, and autonomous regions

Energy Intensity Reduction Targets	18 percent	17 percent	16 percent	15 percent	10 percent
Province, Municipality, or Autonomous Region	- Tianjin - Shanghai - Jiangsu - Zhejiang - Guangdong	- Beijing - Hebei - Liaoning - Shandong	- Shanxi - Jilin - Heilongjiang - Anhui - Fujian - Jiangxi - Henan - Hubei - Hunan - Chongqing - Sichuan - Shaanxi	-Inner Mongolia - Guizhou - Guangxi - Yunnan - Gansu - Ningxia	- Hainan - Tibet - Qinghai - Xinjiang

Target allocation to enterprises. The government also signed responsibility contracts for specific enterprise level energy saving targets with large priority energy-intensive enterprises with energy consumption levels over 10,000 tce. The number of such priority energy-consuming enterprises expanded from 1,000 under the 11th FYP to 17,000 under the 12th FYP. Each province is responsible for allocating targets to the priority enterprises. These enterprise-level targets have been a key driver for energy conservation investments, including the implementation of boiler renovations, motor system energy efficiency programs, energy system optimizations, waste heat/pressure recovery, oil conservation, and building energy efficiency and green lighting.

Target allocation to sectors. Based on the national energy intensity reduction target, the government also improved the targets of energy consumption per unit of output for major energy-intensive sectors and equipment, such as for the power, iron and steel, chemicals, cement, refining, non-metallic minerals, and paper and pulp sectors; government and residential buildings; and rail, vehicles, shipping, aviation transportation, and motors. This level of granularity in target setting has been one of the key reasons China has made significant strides in energy conservation.

Another key aspect of the mandatory policies enforced on a national level has been the elimination of inefficient and outdated capacities in industries, such as those for electricity generation and in the iron and steel, aluminum, coke, cement, glass, paper and pulp, and chemicals industries. After inefficient equipment was phased out, it was replaced with more efficient stocks.

2.4 Implementing Mandatory EE Regulations

2.4.1 Laws and Regulations

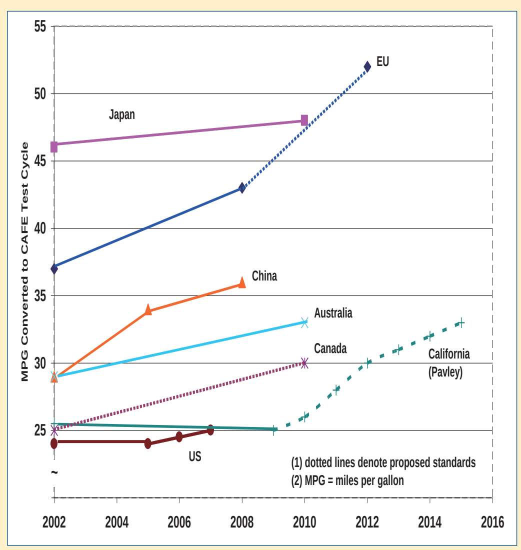
Energy Conservation Law. To support the country's energy conservation policy, China's Energy Conservation Law was legislated in 1997 and modified in 2007, enforcing legal jurisdiction over the policies developed on a national level. The law encompassed rules related to EE standards and labelling, energy efficiency assessment of green field investments, and improvements in the enforcement systems, all of which have become key factors in achieving outcomes.

Energy assessment for green field investments. This energy assessment is an important policy measure for the 12th FYP period as part of China's efforts to change the economic structure to discourage green field energy-intensive investments. For new energy-intensive investments, the government reviews and assesses the investments' energy efficiency levels prior to project approval. This assessment is also linked to a control on the incremental increase of total energy consumption.

2.4.2 Standards and Labelling

EE standards and labelling are among the most cost-effective measures to improve energy efficiency. Complying with efficiency standards can avoid or postpone adding new power plant capacity and reduce consumer prices. EE standards and labelling, targeted at major energy-consuming products and equipment, has been a priority policy tool for China's government. It has been effective in improving the EE of products and has led to the development of new technology innovations for energy saving and emissions reductions. As shown in figure 2.2, China's fuel economy standards are higher than those in the United States and Australia.

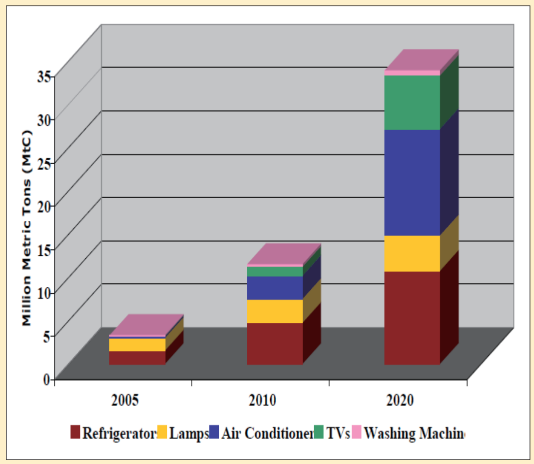
Figure 2.2 China has higher fuel economy standards than the United States and Australia



Source: Energy Foundation, 2009.

EE standards and labels form a system designed for consumers to understand EE and have active involvement in the selection of EE products and equipment, raising the requirements of the market while simultaneously influencing manufacturers to strive to develop energy efficient products. For example, as shown in figure 2.3, appliance energy efficiency standards in China could save 12 percent of residential energy in 2020 and reduce the need for 34 large-scale coal-fired plants by that same year. Refrigerator efficiency standards in the United States have saved 150 gigawatts in peak power demand over the past 30 years, more than the installed capacity of the entire U.S. nuclear program.[1] Efficiency standards and labelling programs cost about 1.5 cents a kilowatt-hour, which is much cheaper than any electricity supply option.[2] The average price of refrigerators in America has fallen by more than half since the 1970s, even as their efficiency has increased by three-quarters.[3]

Figure 2.3 Appliance efficiency standards could yield energy savings equivalent to 34 large-scale (1,000MW) coal-fired power plants by 2020



China's system for EE standards and labelling for end-use products and equipment consists of four components, including (i) laws and regulations (Energy Efficiency Labelling Regulation and Certification for Energy-Efficient Products Regulation); (ii) policies, such as those for a top runner program, energy-efficient products catalogue, consumer rebates, tax credit, and bulk government procurement of efficient products; (iii) an institutional framework for developing and implementing EE standards and labelling; and (iv) EE standards, testing, and certification. Figure 2.4 presents an overview of China's EE standards and labelling system.

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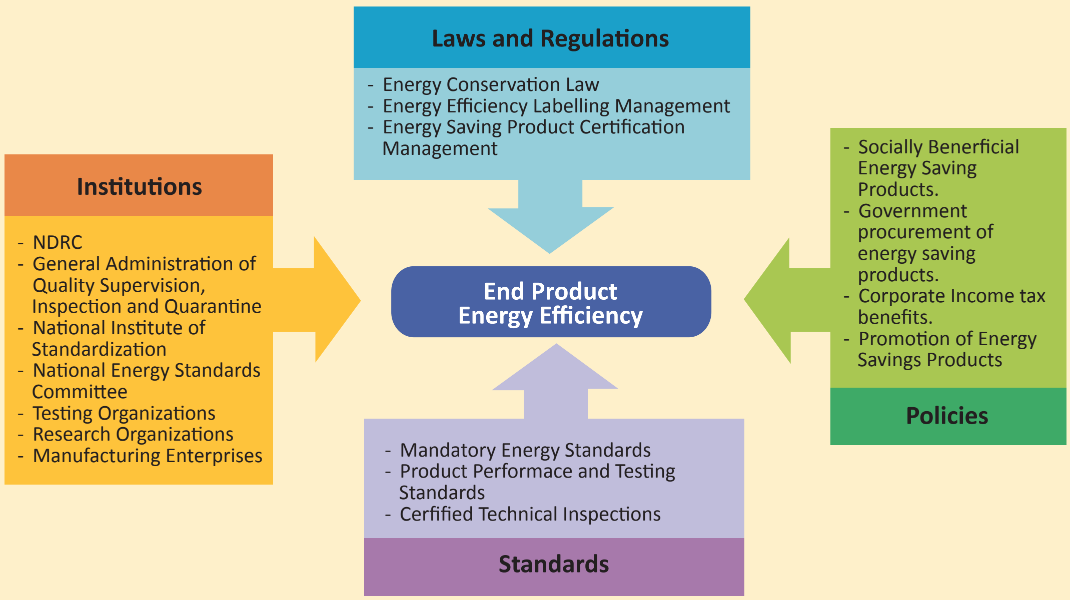
1 Goldstein 2007.

2 Meyers, McMahon, and McNeil 2005.

3 Goldstein 2007.

Figure 2.4 China's energy efficiency standards and labelling system

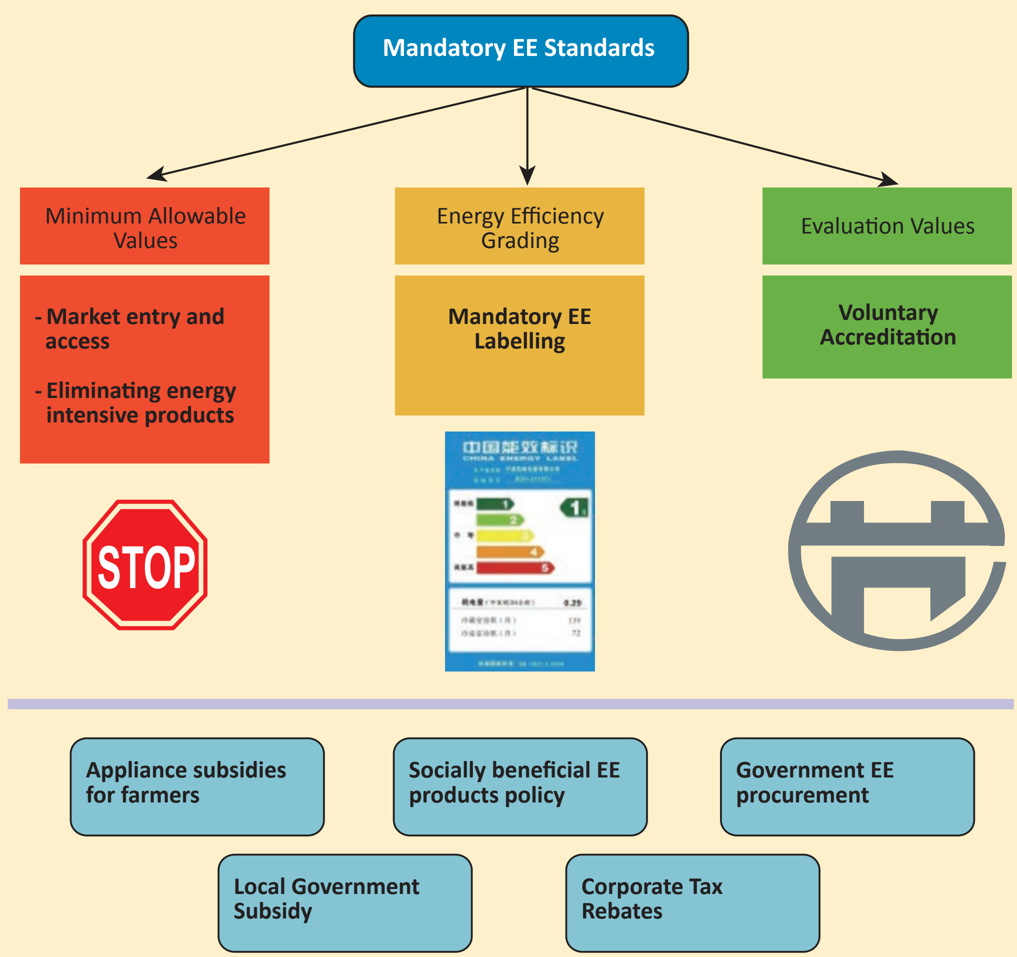


EE standards. China has been following international trends to implement an EE standards system for all end-user products, with a sophisticated and comprehensive coverage of standards. The methodology for determining the various efficiency standards and indicators was based on a range of analyses, including technical, cost benefit, and lifetime analyses, combined with operational and environmental factors.

Today, China has issued 58 EE standards, covering 6 categories of energy-consuming products, including household appliances, lighting, commercial equipment, industry equipment, communication devices, and vehicles. Development of these EE standards in China has gone through four phases since 1987. During Phase I, the implementation of 9 standards for household appliances was launched in 1989. Ten years later, Phase II was implemented for the development of standards for lighting and industrial equipment, relevant at the time due to China's enormous industrial growth. In 2003, Phase III increased the standards to cover commercial products and transport vehicles, while Phase IV in 2008 introduced standards for office equipment.

Mandatory EE standards in China have been implemented through three major channels, as shown in figure 2.5. The Minimum Allowable Values set the minimum EE standard and are used by authorities to hinder market access and eliminate from the market energy-intensive products above those minimum standards. The government has launched a subsidy program to support rural areas to introduce appliance to households to improve lifestyle. The program requires appliances entry into rural households must meet the minimum allowable values to be eligible to receive government subsidies. The second channel, EE Grading, has been implemented in the form of mandatory EE labels that must, by law, be placed on all energy-intensive products and appliances to allow the market to differentiate products by their energy consumption level. Consumer rebate programs are also based on this mandatory labelling. Finally, the Evaluation Values require manufacturers to seek voluntary accreditation, which allows them to be eligible for a wide range of financial incentives such as government's bulk procurement program and tax credits.

Figure 2.5 China's EE standards and labelling program



EE labelling. The EE labelling system, implemented in 2005 by the central government, covers 10 categories with 20 products; the labels are essential for the compliance with the mandatory EE standards and are designed to aid consumers to make informed decisions when purchasing a product. By law, labels are required to be applied to a product to identify its EE level, energy cost, power consumption, and related EE information. The labelling system applies as an overarching requirement for household appliances, office equipment, commercial products, and industrial equipment.

The labelling system has been proven to promote the manufacturing and use of EE goods, saving energy during both the production process and the lifetime of the goods. The grading system used for the labels is similar the system used in the European Union, but with China using a 5 grade system while Europe uses 7 grades. The grading system identifies the EE on a scale of 1 to 5, with grade 1 being the most energy efficient, as shown in figure 2.6.

Level 1 category products are highly advanced and are the most energy efficient, accounting for a small proportion of products of the market. The Level 2 grade generally represents the threshold where products are considered energy efficient, while Level 3 represents the average product available on the market. Level 4 standards are generally designated to below-average products. Lastly, standards established in Level 5 act as a market entry barrier, imposing minimum market access requirements for all products manufactured or sold in China. Any products that fall below the Level 5 categorization are prohibited from being manufactured or sold in China.

Figure 2.6 China's energy efficiency labelling system

Level 1: Advanced and most efficient products; comprising of approximately 5% of the market.

Level 2: Efficient power consumption products; 10-20% of the market.

Level 3: Market average in EE.

Level 4: Below market average for EE.

Level 5: Minimum market acces level; high energy consumption products with 10-15% market share.

Any products rated below 5 are not permitted to be manufactured or sold within China.

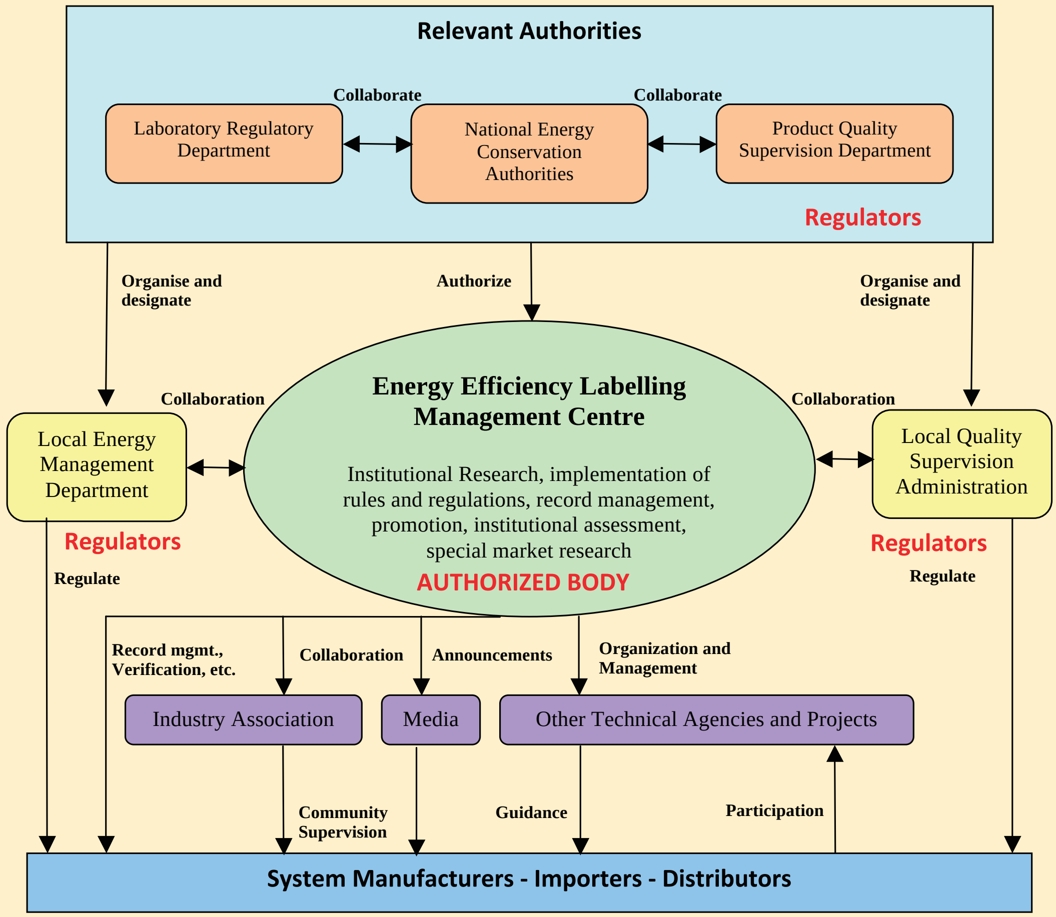
Top runner program. Learning from international experience in Japan and the United States, China started to design a top runner program, which searches for the most efficient model on the market and makes that model's specifications become the standard at a specified date in the future or within a certain number of years. China's top runner program aims to set up examples in market and industries and promote the highly efficient products through a Top Runner catalogue. The program in particular targets energy-consuming products with large demand and high energy-saving potentials.

Institutional framework. The institutional system for EE labelling, shown in figure 2.7, has been established on an official level through the NDRC Quality Supervision department, local energy conservation departments, and the Energy Efficiency Labelling Management Center (EELMC). The National General Administration for Quality and Quarantine and the China Standardization Institute are also responsible for managing and implementing EE product standards and labelling. Applications for EE labelling are conducted through self-declaration, meaning that products are tested within a manufacturer's own laboratory and submitted to the government for record keeping.

The framework structure is based on a top down approach, allowing respective national level authorities—responsible for laboratory regulation, energy conservation, and product supervision—to organize and designate local level authorities for energy management and quality supervision, as well as collaboration with the EELMC. EELMC itself is authorized by the national level authorities to do the necessary work to further develop and implement of China's EE labelling policies, including institutional research, implementation of rules and regulations, EE product records management, promotion of EE within the community, institutional assessments, and special market research.

Local government departments, specifically the local energy management departments and local quality supervision administrations, are responsible for the regulation of manufacturers, importers, and distributors, while the EELMC collaborates closely with industry, industry associations, media, and various other technical agencies to carry out record management, verification of labelling standards, dissemination of public announcements, and organization and management of new projects for industry participants.

Figure 2.7 Institutional framework for energy efficiency standards and labelling



Outcomes of the EE standards and labelling program. Outcomes of the EE standards and labelling system have been impressive. It is expected that the standards program, after further modification of 25 commonly used products, would save 180 TWh of electricity per year by 2015. The energy labelling program has achieved energy savings of 230 TWh (or 750 Mtce) by the end of 2013, since the labelling program was introduced 8 years ago. Since its implementation, 13 key household appliances have significantly improved their efficiency. In particular, efficiency of household air conditioning systems increased by 25 percent, while the percentage of highly efficient air conditioners was raised from 7.8 to 73.6 percent. Similarly, the average efficiency of refrigerators increased by 24 percent with the share of highly efficient refrigerators now reaching 92 percent. The numbers underscore the effectiveness of EE standards and labelling as a policy tool to improve energy efficiency.

2.5 Providing Financial Incentives to EE

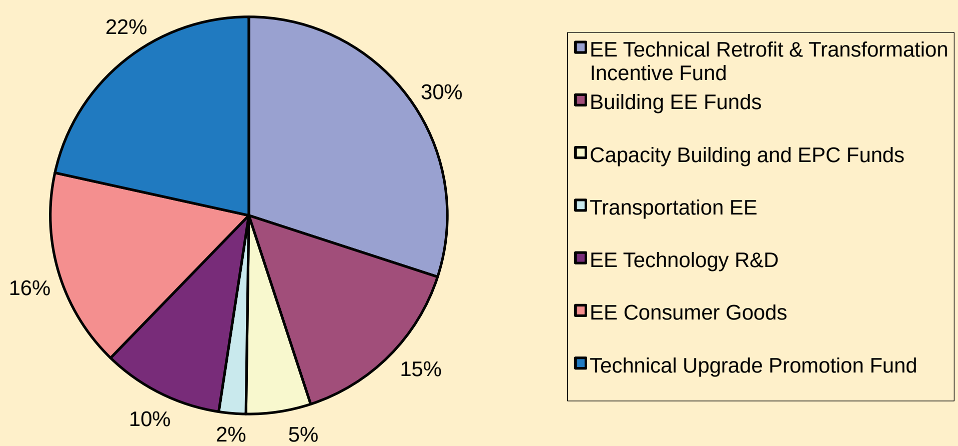
While many EE measures are financially viable, they face substantial market failures and barriers. EE project investments tend to be small and most energy inefficient end users and EE project developers, such as ESCOs, have high credit risks and difficulties accessing financing. EE investments also involve a performance risk because lenders are not sure whether the expected future savings will be realized or captured by the investors. Current practices have shown that many EE projects with feasible technologies and sound financial viability are not implemented well by market force alone, which justifies the use of public funding from the government to nurture and expand the EE market.

To complement the administrative measures and mandatory EE policies, the central government also provided a total of 102 billion Yuan (or US$15 billion) in financial incentives for EE from 2006 to 2010 during the 11th FYP, with additional fiscal support from the local governments. These government funds have leveraged 846.6 billion Yuan (or US$120 billion) for energy efficiency investment from enterprises, ESCOs, and commercial lenders in China during the same time period, 82.3 percent of which was financed by the private sector. The principle of the government incentive programs is that energy conservation shall be implemented mainly by enterprises, participated in by the public, and led by the government. As such, government investment has played the instrumental role of nurturing the market.

The government's fiscal support was allocated to eight programs (see also figure 2.8):

- **EE technical retrofit incentive fund** (30.5 billion Yuan). This output-based fiscal reward program provides incentives for EE investments; the government will provide a subsidy of 240 Yuan (US$40) for each ton of coal equivalent (tce) energy savings delivered from the priority enterprises in eastern China, and 300 Yuan (US$48) per tce for those in mid- and western China.
- **Energy Performance Contracting (EPC) Incentive fund** (1.24 billion Yuan). To strengthen the development of the ESCO industry, the central government provides a subsidy of 240 Yuan/tce (and the provincial governments at least 60 Yuan/tce) to ESCOs undertaking EE investments.
- **Technical upgrades promotion fund** (21.9 billion Yuan). Established for the promotion of technical upgrades to eliminate obsolete and backward capacity production facilities, fund disbursements to companies are made as direct transfer payments to the plants overseeing the upgrades.

Figure 2.8 Breakdown of central government energy efficiency financial support



- **Consumer rebate for energy efficient products** (16.4 billion Yuan until 2010). Since 2009, China's government has implemented policies to subsidize consumers for the purchase and use of energy efficient products, creating an opportunity for these products to occupy a larger market share. Subsidies are generally provided to the manufacturers of EE products, who in turn pass the subsidies on to the end users; a method designed to ensure the efficient transfer of government funds. From 2009 to 2013, the government dedicated 40 billion Yuan in subsidies to consumers for four categories of products (lighting, automobiles, industrial equipment, and household goods). Along with the subsidies, several guidelines and policies were implemented, including some for the promotion of EE products and equipment, subsidies for EE products, and preferential tax incentives. The channels for advocating and encouraging the market of EE products and equipment were also further reinforced through government programs including (i) subsidies to rural households for efficient appliances; (ii) local government subsidies; (iii) government EE bulk procurement mandates; (iv) corporate tax rebates; and (v) the "Energy Saving Consumer Rebate" program.

- **Technology R&D funds** (10 billion Yuan). Funds are used to support R&D of new EE technologies.

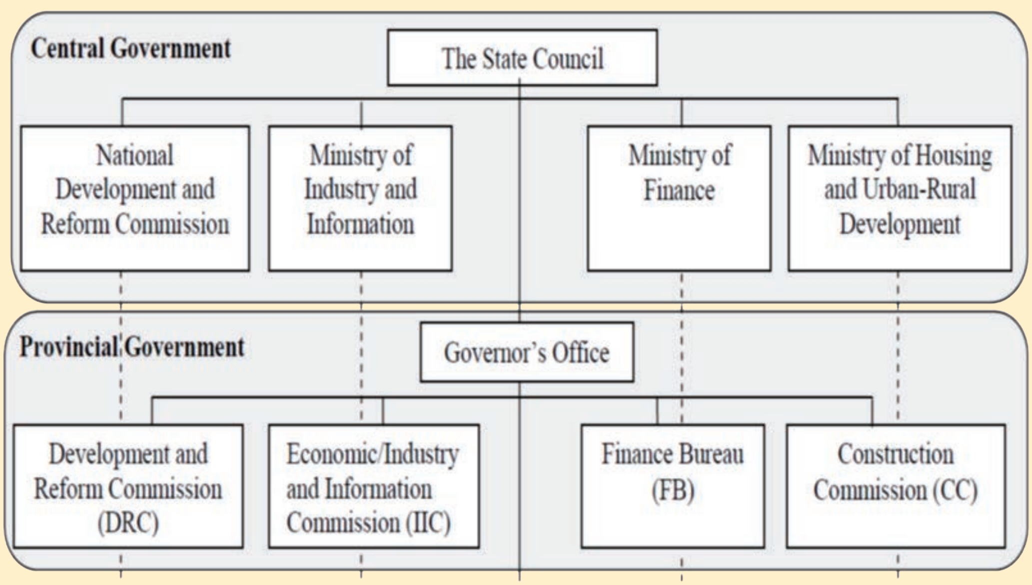
- **Capacity building funds** (5.4 billion Yuan). The capacity building funds are used to support EE supervision.

- **Building energy efficiency funds** (15.2 billion Yuan). This fund is used to carry out EE retrofitting of existing buildings in the North China heating area, and EE retrofit of public buildings and existing residential buildings in the extreme weather climatic zones.
- **Transport energy efficiency funds** (2.2 billion Yuan). The fund subsidizes electric vehicles and demonstrations, fiscal incentive funds for transport EE, and a subsidy for an urban low-carbon transport system pilot.

2.6 Putting in Place Effective Institutional Arrangements

The single biggest impediment for EE is that it is nobody's priority, and a lack of institutional champions given the fragmented nature of EE measures. Successful implementation of EE policy measures requires a strong national champion and effective institutional coordination. China's EE institutional framework (figure 2.9), with the central government as the leading champion, has been vital to China's EE progress and achievements.

Figure 2.9 Institutional framework for energy efficiency implementation in China



National level. In June 2007, the GoC established the National Leading Group on Energy Conservation and Emission Reduction. Headed by the premier and involving 20 ministries and government agencies, the group is responsible for formulating key strategies, policies, and measures to tackle climate change and ensure coordination among agencies. The Secretariat of the Leading Group is housed in the National Development and Reform Commission (NDRC), where also a National Energy Conservation Center (NECC) was established by the NDRC. The NDRC is responsible for developing and implementing the country's FYPs and has the highest authority with a sufficient budget to coordinate key line ministries to address climate change.

Because the leading groups is chaired by China's premier, stakeholders are coordinated by the highest level of authority. Moreover, as the leading group is embedded within the country's highest executive level, it also can be more effective than otherwise would be the case. The Environment Protection and Resource Conservation department under the NDRC is responsible for setting and implementing the targets. This is not conducted by each individual ministry, but carried out by the NDRC as a comprehensive policy making body, with an overarching responsibility over all ministries.

Provincial level. Policy implementation is done on the provincial level. Provinces have also established leading groups, which on this level are chaired by the governors. This set-up facilitates timely and coordinated policy development and decision making for EE program implementation. The State Council has assigned responsibility, accountability, procedures, and evaluation criteria for achieving specific quantified energy intensity reduction targets to all provinces, with provincial government leadership being held accountable for the results of energy intensity reductions. Program development and implementation responsibilities and accountabilities have also been assigned to sector-specific agencies. The provincial governments, in turn, have assigned energy-saving targets and responsibilities to prefectures and departments within their provinces.

Enterprise level. By the end of the day, enterprises have the ultimate responsibility to undertake energy conservation measures, and the top 17,000 energy-intensive enterprises have signed contracts with the government to achieve energy efficiency targets. Enterprises are required to establish energy conservation departments. Large state-owned enterprises (SOEs), in particular, are required to designate a member of management to manage and control the EE practices of an organization.

National Energy Conservation Center and Provincial Energy Supervision and Monitoring Centers. As part of the effort to reinforce the institutional framework for energy conservation, the NECC was established in 2009 under direct leadership of the NDRC, to act as the energy conservation arm of the NDRC. To realize national objectives, the NECC has several functions:

- **Develop and implement major policy initiatives related to EE.** The NECC has been responsible for executing EE research and providing services to the government for EE strategic planning and decision making, as well as the implementation of major energy-saving policies and measures in accordance with government directives. Since the implementation of activities, the NECC has been involved in quarterly analysis of the 10,000tce category companies, including tracking, auditing, and analyzing annual energy savings targets and energy utilization.

- **Implement an energy assessment and review system for green field investments.** Introduced by the Chinese government to analyze and control energy consumption from the source, the program enhances the capacity of leading fixed asset investment projects on a path to new energy efficiency standards. Since the energy rating system was implemented in 2011, the NECC has assessed 161 projects; using energy-saving measures almost 5.71Mtce of energy savings were realized.

- **Develop an online monitoring system for energy conservation data.** The monitoring system will allow real-time collection of energy conservation data to support EE program management, evaluation, and monitoring. Pilot projects for the online energy conservation and record system are underway in Beijing, Henan, and Shanxi; the system is expected to be rolled out nationwide by the end of 2015.

- **Promote energy assessment practices.** To promote energy assessment practices, the NECC, under the guidance of the NDRC, has published an "energy evaluation guide" (a unified energy assessment reporting system), developed as a project evaluation information management system to carry out local assessments. The NECC is currently collaborating with the NDRC to improve the assessment system, speed up its technical support system, and have standardized assessment procedures optimized for evaluation and assessment.

- **Set up a multi-level evaluation system to improve energy efficiency.** Energy efficiency is a major priority for the NECC and its efforts assist the central government in promoting energy conservation to authorities and enterprises. An evaluation system has been devised for technologies, products, and processes, focusing on energy-intensive industries from the enterprise level to city and provincial levels. At the enterprise level, the NECC launched the China Energy Star evaluation program for organizations, which included the development of a comprehensive system for efficiency performance evaluation. This system was designed to guide enterprises to commit to a multi-pronged approach to energy efficiency—using management, technology and behavior—to fully promote energy conservation practices. The first pilot has been completed and benchmarks are established to guide enterprises within their respective industries.

- **Promote collaboration and monitoring of energy conservation programs and standards.** Commissioned by the NDRC, in 2012 the NECC strengthened its institutional capacity to monitor the implementation of energy conservation programs and energy monitoring equipment configuration standards. The NECC leads and guides a nationwide energy conservation monitoring system that includes provincial, municipal, and county levels. With the financial assistance of the central government, the Center's institutional capacity was increased to support more than 1,500 monitoring teams. Currently, China has more than 2,000 energy-efficiency institutions at all levels, to achieve full coverage on provincial and municipal levels.

At the provincial and municipal level, a large cadre of EE monitoring and supervision centers, such as for example the Shandong Energy Conservation Center and the Beijing and Shanghai Energy Efficiency Monitoring and Supervision Centers, assist the local governments in implementing and supervising EE efforts and monitoring results.

3. China's ESCO Industry

3.1 China's ESCO Industry

China's Energy Service Company (ESCO) industry has come a long way from its start-up two decades ago to today's multi-billion dollar market. Using energy performance contracting (EPC), the ESCOs provide a wide range of EE services, such as energy auditing, recommendations on energy saving measures, project design and implementation, and financing to end users, using performance-based contracts under which the end users pay for these services from the energy savings upon demonstration of successful results.

Several World Bank projects have supported the development of the Chinese ESCO industry. In the 1990s, the World Bank/GEF-supported Energy Conservation Project first introduced the ESCO concept to China and established the first three ESCOs. When the ESCO industry started to grow but access to financing became a major bottleneck, a second World Bank/GEF-supported project, the Energy Conservation II Project, provided partial risk guarantees to help ESCOs access financing; the project also helped establish an ESCO Association. However, it was not until the Government of China issued a series of financial incentives to ESCOs that the ESCO industry boomed in 2010. To date, the ESCO industry has grown to nearly 5,000 companies with US$10 billion in energy performance contracts now.

3.1.1 Growth of the ESCO Industry

Launched in 1998, the China Energy Conservation Project used WB/GEF funding to develop the first three pilot ESCOs in Beijing, Liaoning, and Shandong. By its completion in 2006, these demonstration ESCOs had succeeded in the implementation of 475 energy efficiency projects with a total project investment of US$170 million, contributing to an energy conservation of 1.51Mtce per year or a CO_2 emission reduction of 1.45MtCO_2e per year, thus achieving project objectives. Boxes 3.1 and 3.3 each provide more information about recent projects implemented by two of these first three ESCOs.

As the ESCO concept developed roots within the domestic EE market and was ready to expand, financing became the limiting factor. In 2003, responding to the need for financing, the GoC and the World Bank launched Phase II of the Energy Conservation Project with GEF funding to provide loan guarantees to ESCOs, increase access to financing, and establish an industry association. The loan guarantee program was implemented through National Investment and Guaranty Co. Ltd (I&G) to provide partial risk guarantee to ESCOs in their commercial bank loan. The program offered loan guarantee to over 148 projects involving 42 ESCOs. Through the program, many ESCOs received bank loans for the first time. The guarantee program also contributed to the capacity building of commercial banks' energy conservation project appraisal and transactions. At the end of 2003, the Energy Conservation Service Industry Committee of China Energy Conservation Association (EMCA) was founded, also with Energy Conservation Project Phase II support. At the early days of its establishment, EMCA played a key role in information dissemination and training on the new business concept. The United Kingdom's Department for International Development (DfID) also provided key financial support. Since then, EMCA has been acting as the industry champion to promote the ESCO industry, stimulate market development, and provide research support on different issues. When the Energy Conservation Project Phase II completed in 2010, the number of EMCA members had increased to 450.

The EE industry flourished during and after 2010, following the introduction of a series of policies related to energy conservation and the introduction of the general technical rules for EPC. Financial incentives from the Ministry of Finance (MOF), including tax holidays, breaks, and financial subsidies for EE projects, facilitated the drastic growth of the industry within a very short period of time. On June 3, 2010, MOF and NDRC together issued a "Temporary Method for Management of Energy Performance Contracting Project Government-budgeted Award Funds." This regulation sets the procedures, criteria, and amounts for award of investment subsidy payments to ESCOs for qualified completed energy performance contracting investments. For each tce of annual energy savings capacity created by qualified energy performance contract investments, 240 Yuan (US$36) of central government funds will be awarded, with an additional award from local governments of at least 60 Yuan (US$9) per tce (Sun et al. 2011). The regulation requires the ESCOs to register with MOF and NDRC and defines a set of qualifications.

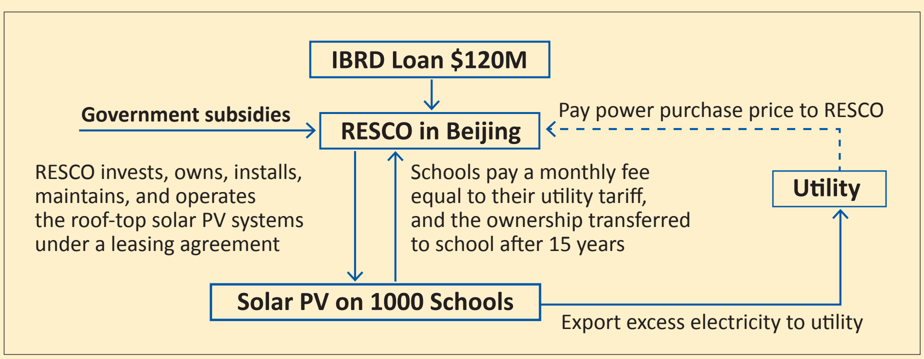
At the local level, under the pressure of meeting energy saving targets, provincial or municipal governments also increase local level incentives. In Beijing, for example, up to 800 Yuan/tce is offered to ESCOs meeting the requirement for energy management projects in the city, while Shenzhen awards eligible EPC project with incentives of 500 Yuan/tce. In addition, to further enhance support, in 2012 a separate scheme of financial award incentives was made available (in parallel to the existing ESCO subsidies) to host companies for their completion of qualified EPC projects. The GoC also implemented tax exemptions for eligible EPC projects. By 2013, over 1,200 ESCOs were benefiting from tax incentives. Accounting rules were also clarified for taking into account energy saving and EPC payments.

Box 3.1 CASE STUDY: Yuanshen Energy Saving Technology Company and the Sunshine Schools Project in Beijing

Yuanshen Energy Saving Technology Company is one of the first three pilot ESCOs set up under the World Bank's China Energy Conservation Project. Since its establishment, Yuanshen has followed the EPC model to implement hundreds of demonstration projects in energy conservation. A recent World Bank loan of US$120 million supported one of Yuanshen's demonstration projects: the Sunshine Schools Project in Beijing.

The Sunshine Schools Project is being implemented within the Beijing municipality, with an objective to promote the EE industry and contribute to the improvement of Beijing's air quality. The project was designed to introduce solar PV to nearly 1,000 primary and secondary schools and universities with a total installed capacity of 100MW. While distributed generation is still novel in China, the project utilizes rooftop areas at educational campuses and institutions to build solar PV power generating systems and integrates these into the Beijing electricity grid to increase the proportion of renewable energy used in Beijing. After completion, the project is expected to generate 120M kWh of electricity a year, saving 48,000 tce and cutting down 120,000 tons of CO_2 emissions each year.

Figure B3.1.1 Overview of the Sunshine Schools project for roof-top solar PV



Some unique project features include:

- **Grid access for distributed generation.** Access to the grid to export excess electricity when schools are off was a major bottleneck, but a recent change in policies now allows grid access for distributed generation and amended feed-in tariff premiums for roof-top solar PV.
- **A real distributed power generation network.** While most EPC projects in China focus primarily on industrial EE retrofitting, the Sunshine School Project was implemented at 1000 schools across the Beijing municipality.
- **Demonstration of a "Renewable ESCO" (RESCO) leasing model to install solar PV.** As shown in figure B3.1.1, the RESCO invests, owns, installs, and maintains the solar PV systems under a leasing agreement with the participating schools. The schools pay a monthly fee equal to their current utility tariffs, with ownership of the solar PV systems transferred to schools in 15 years. Excess electricity is transported to the grid by the RESCO.
- **Use of an integrated remote control monitoring system.** Built into Yuanshen's headquarters, the control center covers a range of functions and options, including monitoring, data inquiry, data alerts, trend analysis, process reporting, process playback, fault statistics, and remote management. Using advanced remote network technology, the center can effectively manage the PV power generation systems, making the project the first in China to implement a PV power generation, dispatch, control, and analysis system under a single dispersed generation model, with dispersed on-grid access and remote management capabilities.
- **A large group of beneficiaries.** The project's beneficiaries include students, parents, and teachers, as well as society at large; through the project, the students, parents, and teachers are learning about the benefits of energy conservation and renewable energy.

3.1.2 Achievements

In line with the industry's momentous growth, the NDRC started registering ESCOs in 2010. Up to now, China's ESCO industry comprises of 4,852 companies, with 500,000 professionals recorded to be employed by the ESCO industry in 2013.Also in 2013, the industry's gross value of ESCOs was recorded at 215 billion Yuan, while investments in EPC exceeded 74 billion Yuan.

A major achievement of the industry has been the positive environmental impact of the EPC projects undertaken by the ESCOs. In 2013, energy saving from EPC projects exceeded 25Mtce, while CO_2 emission reductions were almost 64Mt (table 3.1).

Table 3.1 Status: Energy saving and CO_2 emission reduction from EPC projects

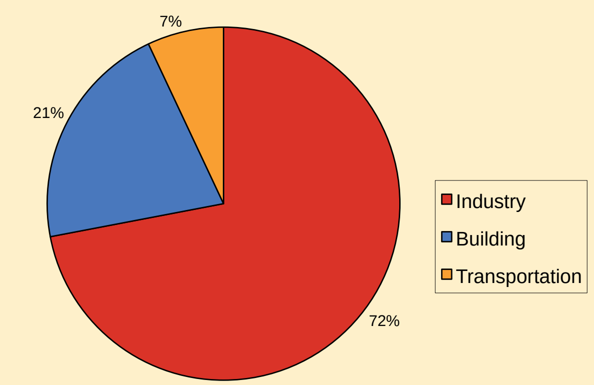
Year	2006	2007	2008	2009	2010	2011	2012	2013
Energy Saving (Mtce)	1.24	3.19	5.69	9.53	10.65	16.48	18.28	25.59
CO_2 Emission Reduction (Mt)	3.11	7.99	14.23	23.82	26.62	41.21	45.71	63.99

3.1.3 Current Status of China's ESCO Industry

In China, the NDRC provides considerable oversight over the ESCO industry, primarily due to the government's financial incentives and the scale of the ESCO industry.

Sector breakdown. China's economic growth over the past three decades has been mostly driven by the industrial sector, which accounts for nearly 60 percent of final energy consumption in China. As such, the industrial sector has become a natural target for ESCOs, comprising of 72 percent of investment into EE projects (generally 5-30 million Yuan in size), as shown in figure 3.1. Within the industrial sector, the major energy intensive industries that have been targeted by the ESCOs have been the iron and steel, cement, and chemical industries.

Figure 3.1 ESCO Project investment breakdown by sector



While industry dominates the energy consumption in China, energy demand for the building and transport sector has been growing very rapidly. Building energy efficiency is also becoming a rather large market for ESCOs, taking up 21 percent of the total projects invested in EE, although the future development of this market segment relies heavily on green building policies, as the building owners usually lack internal driver to invest in building energy efficiency. Within the building sector, major industries that are targets for ESCOs include hospitals and hospitality and commercial properties.

The transportation sector comprises of the smallest 7 percent of total ESCO project investments. Transportation sector EE projects have focused in particular on lighting and illumination of for example roads, highways, bridges, and railroads. The market also extends to shipping, with ports requiring an array of energy conservation measures, as well as to oil and gas stations, although to a lesser extent.

Size breakdown. Although a number of registered ESCOs have reached a considerable operation size (that is, 25 ESCOs out of the total number of registered ESCO companies have reached an annual revenue over 500 million Yuan), 95 percent of ESCOs are small- and medium-sized enterprises (SMEs). A large share of the registered ESCOs has reached considerable operation size. There are currently 2,430 ESCOs operating in China with an annual revenue exceeding CNY5M, 114 enterprises exceeding CNY100M and 25 enterprises with revenues exceeding CNY500M. In terms of investments, 62 EPC investors have a portfolio value of more than 100 million Yuan, while 15 have more than 500 million Yuan in EPC investments.

Ownership breakdown. Ownership structures of ESCOs can be categorized as being either private, publicly-listed, state-owned, foreign joint-ventures, or foreign-invested enterprises. As the majority of ESCOs are SMEs, private companies make up over 90 percent of the participants in the market. However, interest from many publicly-listed companies to engage in EPC business or establish professional ESCO entities has been increasing. A number of major state-owned enterprises with primary interests in steel, coal, chemicals, and electricity generation have established ESCOs for implementing energy conservation on an enterprise level. Foreign joint-venture ESCOs, including organizations such as Carrier and GDF SUEZ, are also present in the market, capitalizing on offshore technological expertise to realize energy savings.

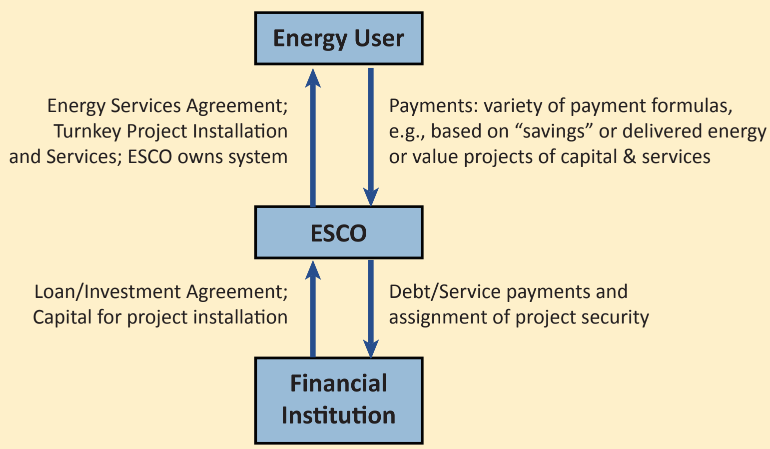
Geographic breakdown. ESCO industry projects have been predominantly located in Eastern China, comprising 55.4 percent of the total project output value, while projects in the Central and Western provinces respectively represent 27.7 and 16.9 percent of the total value of ESCO projects. This is in line with the varying levels of industrial development across provinces.

3.2 ESCO Business Models

In any EPC project, the ESCO typically provides financing to the project in combination with a full package of implementation services. Financing of an EPC project may be done in different ways, depending on the model of the ESCO or the contract arrangement. In China, three major types of ESCO models are applied, which are the shared savings, guaranteed savings, and outsourcing models.

Shared savings model. In the shared savings model (figure 3.2), an EPC contract is signed between the ESCO and the client that requires the ESCO to provide capital, management, and technology to the client. The client then pays the ESCO for the percentage of energy savings as stipulated in the contract, with a monitoring system used to verify the actual savings. During the contractual period, the ESCO owns and operates the project assets, while the client uses the savings to pay the ESCO; the client then keeps the remaining savings. Unlike practices in North America, in China it is common to maintain the payment streams at a stable level, as long as—over a considerably long period within the contract—project performance is monitored and verified to meet the agreed percentage of saving. In North America, shared saving models typically have payments for savings vary over time, as the performance varies. After the conclusion of the contract, ownership of the project assets is transferred to the client, usually at no cost. All energy savings also belong entirely to the client.

Figure 3.2 Overview of the ESCO shared savings model



Source: Unlocking commercial financing for clean energy in East Asia.

The advantage of the shared energy cost saving model is that it demands the minimum amount of capital investment from the client. Meanwhile, the ownership and technical expertise from the ESCO during the contractual period usually ensures a high-quality project and performance. The model reduces risks and lowers the management burden for the client. In China, the model is also the only model recognized by the government for incentive awards. A practical approach of the shared savings model is described in box 3.2.

Box 3.2 CASE STUDY: Shandong Lu Dian—a technology ESCO specialized in power systems

Shandong Lu Dian Energy Saving Co., Ltd (SLES) is a subsidiary company of Shandong (Lu Dian) Leader Electric Group, a leading supplier of power equipment and accessories and a provider of integrated solutions for power systems. SLES specializes in system improvement solutions for power system clients; its client group includes the iron and steel, cement, glass, non-ferrous metals, commercial properties, and hospitality industries.

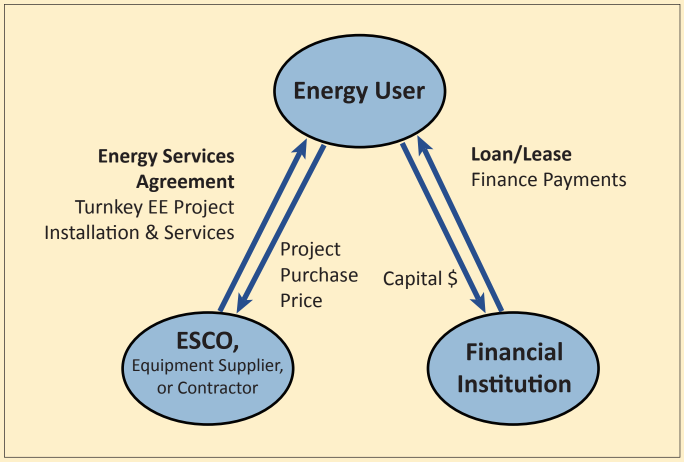
SLES follows the typical Chinese shared savings model. By signing an EPC contract with the client, SLES assumes all investment costs and risks for the EE retrofit contract period. As part of the arrangement, SLES promises a certain ratio of energy savings to the client; when energy savings fall short, the loss is borne by SLES, but when savings are above what is promised, they are shared by both SLES and the client according to the methodology agreed. The contract terminates when SLES's project investment is recovered, at which time the energy conservation equipment is handed over to the client at no charge and the savings go entirely to the client.

Recently, SLES has provided retrofit services to the Shandong State Grid Company, upgrading a 110kV power transmission line in Liaocheng City, Shandong. The transmission line was of a low terminal voltage and had been seeing a gradual increase of its transmission loss ratio up to 5.78 percent during peak load. Under the EPC contract, SLES installed an SVG High/Low Voltage Dynamic Reactive Compensation device (SVG) that resulted in a 6.85 percent increase in daily power supply at the substation, with line loss at the substation dropping by 1.5 percent.

The economic benefit from the line loss reduction amounts to 3.37 million Yuan per year, while the total investment in the SVG and accessories was 2.7 million Yuan. The project realized a payback period of 9.5 months from commencement. Based on the 20 year lifespan of the SVG, the capital expenditure will yield 67.45 million Yuan in economic profits.

Guaranteed savings model. In this model (figure 3.3), the ESCO guarantees the performance parameters and specifies the methods for measurement and verification, while the client is responsible for financing the project. The project is implemented under two separate agreements, one for turnkey project implementation services between the client and the ESCO (energy services agreement) and the other for project financing between the energy user and the lender (financing agreement). The client generally assumes responsibility for equipment maintenance and repair. Provision for equipment operations and maintenance services, warranties, and performance guarantees can be included in the energy services agreement.

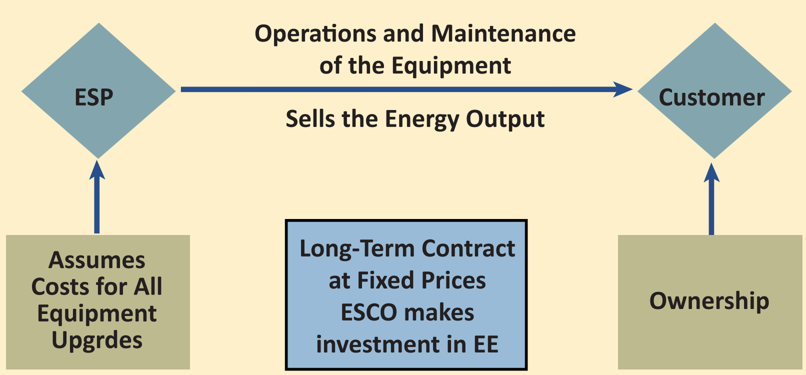
Figure 3.3 Overview of the ESCO guaranteed savings model



Source: Unlocking Commercial Financing for Clean Energy in East Asia

Outsourcing model. In this model (also known as chauffage), ESCOs assume responsibility for operation and maintenance of energy-using equipment and sell the energy output (for example steam, lighting, and heating or cooling) to the customer at an agreed price. The model, shown in figure 3.4, is a form of "outsourcing," in which the costs for all equipment upgrades and repairs, among others, are borne by the ESCO, but ownership remains with the customer. Under the chauffage arrangement, the fee paid by the customer is based on the customer's existing energy bill minus a percentage savings (3-10 percent), or based on a fee per square meter of conditioned space. Under the model, the client is guaranteed an improved level of energy service at a reduced price.

Figure 3.4 Overview of the ESCO outsourcing model



Source: Unlocking Commercial Financing for Clean Energy in East Asia

3.3 Lessons Learned

Based on the experiences with the ESCO industry in China, three key lessons could be identified:

- **Effective policies can create market demand for ESCO services and kick start an ESCO business.** As combined efforts, two critical policy measures have fostered the development of the ESCO industry in China and can be considered prerequisites for success. First, the GoC mandatory performance-based EE targets created a huge demand for EE investments and ESCO services, whereas the absence of such policies in other countries in the region has limited the impact of EE financing initiatives. Second, the provision of fiscal incentives, such as the energy saving investment subsidies and incentive awards, helped market players overcome market failures and barriers that inhibit EE investment.

- **Continuous technical assistance is critical to nurture the growth of an ESCO industry.** A large number of technical assistance (TA) activities, including both extensive training programs and tailored advisory services, were packaged with the publicly funded projects, which has contributed to China's successful ESCO industry development. EMCA served as the industry's information dissemination platform, trainer, and industry champion.

- **ESCOs are a viable and profitable business model.** The ESCO industry in China, growing from three companies in 1997 to nearly 5,000 companies with an industry gross value estimated at US$35 billion to date, has proved its own market viability. That is the flourish of the ESCO industry itself demonstrates that saving energy can also make money.

3.4 Challenges

Despite its unprecedented rapid growth, key challenges remain for the ESCO industry in China:

- **Difficulties accessing financing from commercial banks.** The ESCOs' weak balance sheets and limited physical assets that can be used as collateral, combined with the perceived risks of realizing revenues from energy savings, are making ESCOs difficult to access to commercial financing. Lenders are also not familiar with the EPC concept and project-based financing in general is new to lenders in many developing countries who are not willing to accept the energy savings revenue stream generated by the project as collateral.

- **Client repayment risks.** Many host enterprises that ESCOs do business with are energy-intensive industries, some of which face difficult operational and financial situations. Chinese enterprises are also generally reluctant to pay for only services provided by the ESCOs. Due diligence is essential in evaluating the client's repayment ability.

- **Difficulties establishing credibility with customers.** Because potential clients often cannot determine which ESCOs or EE technologies are best suited for them, they sometimes reject ESCO recommendations for EE retrofits.

- **Lack of standard EE measurement and verification (M&V) methodology and credible third-party verifiers.** As the ESCO business is fundamentally built on the performance of energy saving measurements, the lack of standardized operational guidelines for energy saving M&V methodology and credible third-party verifiers has become a critical barrier to continued growth of the industry.

3.5 Future Trends

As the ESCO industry matures in China, new business models have been emerging to overcome the barriers mentioned above. These include for example the guaranteed savings model mentioned in section 3.2, an equipment leasing model, and the use of "Super ESCOs."

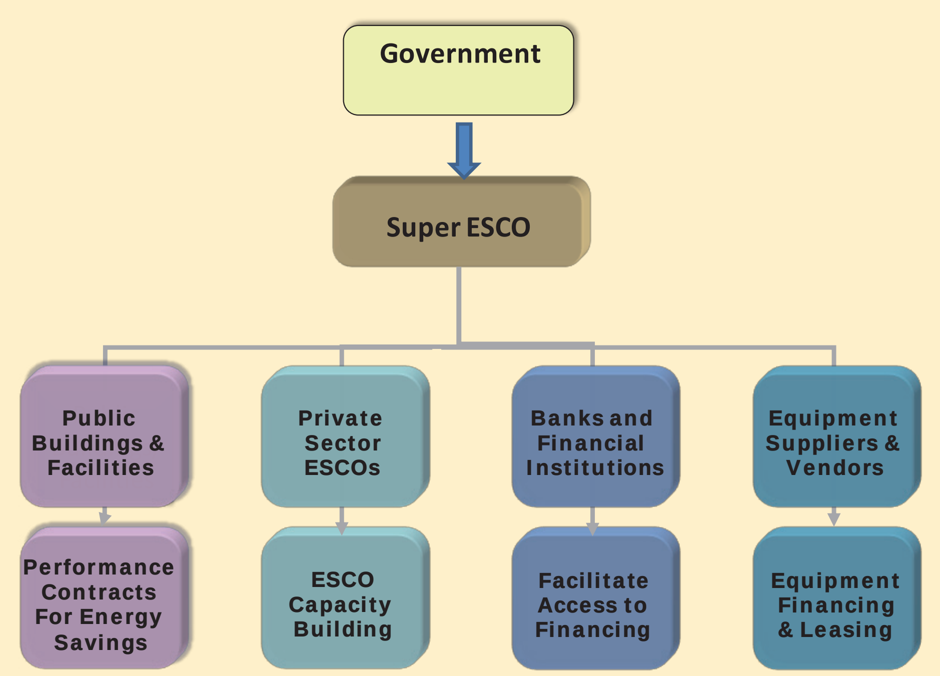
Energy saving equipment leasing. The equipment leasing model is a hybrid model that combines the shared saving model with leasing. With leasing, leasing companies install EE equipment at client facilities. The clients then make monthly payments, matched with the shared energy savings, while the leasing companies retain ownership of the equipment until the clients have made all payments over the lease period. As EE projects generally involve the installation of new equipment, equipment leasing allows clients to avoid having to obtain up-front equity and debt financing and collateral requirements because the equipment is owned by the leasing company. Leasing companies also can play a role in project-bundling. In addition, partnerships between leasing companies and EE equipment companies can facilitate the implementation of EE technology with a financing solution.

In the World Bank-financed Shandong Energy Efficiency Project, which supports financial leasing and energy performance contracting for EE investments in selected industrial enterprises, the IBRD fund is used for on-lending to two leasing companies: Shangdong Rongshihua Leasing Company (see box 3.3) and Guotai Leasing Company Ltd. Both companies have acquired pilot leasing licenses, offering an opportunity to leverage the World Bank loan to accelerate EE investments.

Super ESCO. As shown in figure 3.5, a Super ESCO is an entity set up by the government to function as an ESCO for the public sector market, while also providing capacity development, project development, and project financing services to the private ESCOs. As a public institution, the Super ESCO is in a unique position to access financing and public sector market opportunities. The government could also capitalize the Super ESCO with sufficient funds to leverage commercial financing and international donor funding. Because the Super ESCO is also well-positioned for public sector business opportunities, it can effectively assist smaller, private ESCOs to overcome barriers related to market access, project financing, or capacity building.

The advantage of the Super ESCO model is that the Super ESCO itself can achieve its business objectives while assisting smaller and medium sized ESCOs to grow and gain market share, thus expanding energy conservation efforts.

Figure 3.5 Super ESCO Model



Box 3.3 CASE STUDY: Shandong Rongshihua Leasing Company

Shandong Rongshihua Leasing Co., Ltd (Rongshihua) was one of the first three pilot ESCOs to be created under the World Bank/GEF China Energy Conservation Project; it was also the first ESCO to conduct EPC in China. In 2011, the World Bank provided an IBRD loan to Rongshihua under the Shandong Energy Efficiency Project. The project supports financial leasing and energy performance contracting for EE investments in selected industrial enterprises.

In the case of Rongshihua, its key market is in Shandong province, the largest energy consuming province in China and indeed a province with enormous exploitable potential in terms of energy conservation. In the first 10 years of operation, Rongshihua was mostly involved in projects employing energy shared savings models in the industrial sector.

As the sector grew and the market matured, Rongshihua, as the sector leader, adopted the financial leasing model and, for the first time in China, a Super ESCO model to nurture the development of smaller ESCO companies in the market. As of 2013, Rongshihua reported to have used US$91 million in World Bank loans to carry out 129 energy saving projects for 98 clients, realizing energy savings of 3.06Mtce or 2,300 MWh of electricity and CO_2 emission reductions of 2.07Mt since 1998.

Source: World Bank High-Level International Forum on Market-Based Mechanisms for Energy Conservation in China, November 2013.

4. China's Experience on Energy Efficiency Financing

4.1 Overview

Many EE developers face substantial financing barriers. These include credit risks, performance risks, lack of expertise or interest by the financial institution, and high transaction costs.

Credit risks. Most energy inefficient end users and EE project developers, such as ESCOs, are SMEs. SMEs face unique barriers in access to financing regardless of their sector because of their inherent low creditworthiness resulting from limited collateral. Most local banks usually rely on balance sheet financing, which requires that borrowers either have good credit ratings or high levels of collateral, which, in turn, favors large-scale borrowers. The concept of project-based financing that focuses on the cash flows from energy savings has not yet been widely accepted by financial institutions. The result is that the most creditworthy potential clients do not necessarily need financing for EE, while the customers most in need of financing are typically not creditworthy. Under these circumstances, publicly backed risk guarantee funds can reduce perceived credit risks, while dedicated EE funds can increase access to financing for SMEs.

Performance risks. EE investments also involve a perceived performance risk because lenders are not sure whether the expected future savings will be realized or captured by the investors. In such cases, energy saving guarantees can help lessen perceived performance risks.

Lack of expertise, interest, and confidence in EE financing on the part of the financial institutions. Most local financial institutions lack the required technical expertise to appraise EE investments and generally view EE lending as risky with a strong social cause. Dedicated credit lines have proven to be effective at increasing the confidence of local banks and their capacity for EE lending, while also changing their perceptions to recognize that EE investments are actually a profitable business.

Small deals with high transaction costs. EE investments tend to be small, with high transaction costs. Innovative business models found through the dedicated credit lines and ESCO financing can help aggregate small deals.

Some commonly used financing instruments that can address these barriers are described in the following sections, including the use of dedicated credit lines through local financial institutions (section 4.1.1), risk sharing programs with partial risk guarantees (4.1.2), and innovative project-based financing (4.2).

4.1.1 Dedicated Credit Lines

Under dedicated credit lines, governments and multilateral development banks (MDBs) or donors provide concessional loans to participating financial institutions (PFIs) in developing countries, which in turn on-lend to end beneficiaries at either concessional or market rates. A dedicated credit line is usually most effective at increasing EE financing for traditional bank clients, which are medium and large enterprises. Encouraging commercial banks to support SME EE investments, however, has been a challenge as most banks continue to rely on their traditional underwriting criteria of balance sheet financing. Because the balance sheets of most SMEs are much weaker than those of larger companies, their risk profiles are much higher.

In China, the use of dedicated credit lines through local banks has already demonstrated their effectiveness in increasing participating banks' capacity, interest, and confidence in mainstreaming EE and renewable energy (RE) investments. They also have had a double leverage effect by attracting substantial debt contributions from the participating banks and equity financing from the private sector. To date, this financing source appears to be the one most successful at unlocking commercial financing for EE projects.

To mainstream EE financing at local banks, in 2008 the GoC and the World Bank started the China Energy Efficiency Financing program (CHEEF), providing IBRD loans to three local banks, who then perform on-lending to industrial enterprises and ESCOs for EE investments. A GEF grant was also dedicated to building capacity for participating banks and to provide EE policy support. The CHEEF program has played a significant role in mainstreaming the EE financing business line, increasing the capacity, interests, and confidence of the participating banks, and leading the Chinese banking sector to finance EE. The project also played a catalytic role in leveraging additional EE financing from the KfW Development Bank and the European Investment Bank to participating banks.

During the CHEEF project, the US$178 million World Bank loan leveraged more than US$720 million in investments in industrial energy efficiency from participating Chinese banks and industrial enterprises. These investments resulted in energy savings of 2.1 million tce and reduced CO_2 emissions by 5 million tons. Box 4.1 provides more detail about the program and participating banks.

Box 4.1 CASE STUDY: China Energy Efficiency Financing Program (CHEEF)

The China Energy Efficiency Financing (CHEEF) program consists of three phases, with a total IBRD loan of US$400 million. Approved in 2008, the first phase (CHEEF I) involved the on-lending of a World Bank loan through both the China EXIM Bank and Huaxia Bank, to improve EE of medium and large industrial enterprises in China. Each bank received a US$100 million line of credit from the World Bank, to be repaid after 17.5 years, including a grace period of 5 years. The banks were also required to co-invest at least US$100 million in EE projects. The next, second, phase of CHEEF, approved in 2010, provided a World Bank loan of US$100 million to Mingsheng Bank. In 2011, the World Bank provided an additional US$100 million IBRD loan to China EXIM Bank, with a coverage expansion from industrial enterprises to ESCOs and building energy efficiency investments. Another important part of the CHEEF program is the technical assistance supported by GEF grants. The grants have supported EE policy development at the national level, as well as capacity building in the three participating banks.

China Exim Bank. EXIM Bank, or the Export-Import Bank of China, was founded in 1994 and is wholly owned by the Chinese government. The bank has had considerable experience in on-lending funds from foreign governments and international financial institutions and has the longest history in on-lending of all the banks in China. EXIM has provided medium and long-term credit loans, together with its own funds, including technical consulting services to support EE and renewable energy projects. In terms of lending criteria, projects were limited to retrofitting of existing equipment and systems with a payback period less than 10 years. To date, EXIM has supported more than 20 projects under the CHEEF program, with a total investment cost of US$520 million; the projects are expected to account for energy savings of 1.17 million tons of coal equivalent (tce) per year and reduced CO_2 emissions of 2.85 million tons per year. In parallel, EXIM Bank has also financed US$1.8 billion in renewable energy and energy efficiency projects under KfW, French Development Agency (AFD), European Investment Bank (EIB), and Asian Development Bank (ADB) programs.

Huaxia Bank. Established in 1992 as a national joint-equity commercial bank, Huaxia Bank actively implements on-lending projects and promotes green lending business development. Its focus has been on scaling up its green lending business and by the end of 2013, Huaxia's green lending balance was 35 billion Yuan. Through the CHEEF program, Huaxia bank has disbursed on-lending funds to various projects involving cogeneration, system rehabilitation for energy conservation, waste gas recovery, and renewable energy in cement, iron and steel, coal, glass, and other energy intensive industries, covering 13 provinces. Between 2009 and 2014, Huaxia disbursed US$90.7 million of IBRD funds with US$96 million (590 million Yuan) in co-funding. This contributed to a total energy saving of 0.78 million tce per year and a CO_2 emission reduction of 1.6 Mt per year.

Both EXIM and Huaxia Bank have engaged in significant capacity building programs to enhance their green lending business. EXIM Bank is currently the only bank in China with a dedicated on-lending department. Huaxia Bank has trained over 2,500 of its staff—intermediate as well as high level managers, marketing, and project assessment staff—through 26 training sessions on the energy conservation lending business.

4.1.2 Risk Sharing Programs

Risk-sharing programs, which can either be project- or portfolio-based, are structured to eliminate the perceived risk of loans by providing partial coverage of potential losses. Within a project-based risk sharing program, the public agency can be responsible for approving each individual project or a project portfolio for the lender. For individual project guarantees, the public agency is involved in each transaction, appraising the eligibility of the applicant borrower for the guarantee, in parallel to the lender's due diligence to determine eligibility for the loan. In a portfolio-based guarantee setting, the public agency covers all the loans made by a lender to a class of borrowers that form an EE portfolio.

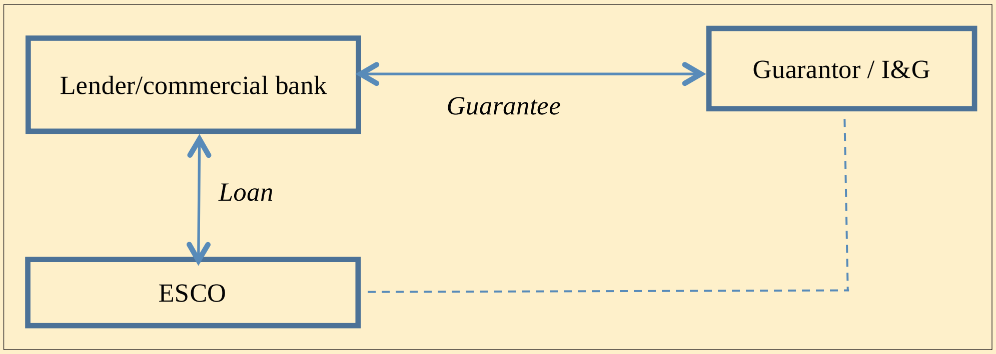
In general, the risk sharing programs are intended to share and mitigate the perceived risks for domestic banks investing in EE projects, particularly those from ESCOs. Partial risk guarantees allow borrowers to access commercial funding that may not have otherwise been available to them due to their credit worthiness. They also enables them to secure lower interest rates or longer maturity terms due to the reduced commercial risks to the lender. Risk sharing programs correct the misconception held by lenders that EE projects are far riskier than traditional investments, which creates a major barrier to commercial financing of EE projects. The risk sharing program provides partial indemnity to the risk involved in lending to EE projects.

The World Bank and IFC have financed two risk sharing programs in China: (i) the World Bank/GEF China Energy Conservation II Project (box 4.2), which provides partial risk guarantees to ESCOs, and (ii) the IFC/GEF China Utility Based Energy Efficiency (CHUEE) program (box 4.3), which provides portfolio risk guarantees to participating banks for EE.

Box 4.2 CASE STUDY: China Second Energy Conservation Project with China National Investment and Guarantee Company (I&G)

The China Energy Conservation Project (1998-2006), which introduced the ESCO concept to China, successfully demonstrated that the ESCO business model is viable in China. In the early years of the industry, however, one of the main barriers that kept the industry from growing was the lack of financing for EE projects. While the commercial banks did not yet have a technical understanding of EE issues, the ESCOs typically were small and medium sized enterprises without a strong balance sheet or sufficient collaterals to be considered creditworthy by the banks. The US$26 million GEF Energy Conservation Project Phase II was implemented in 2003 to help overcome the barriers to rapid and efficient development of the ESCO industry in China. The project objective was to establish an EE loan guarantee program to enhance new and emerging ESCO credit, so they could access commercial financing. In addition, the project aimed to form an ESCO association to provide technical assistance and capacity building for ESCOs.

Figure B4.2.1 Overview of the ESCO Loan Guarantee Program



Guarantor and the banks. China National Investment and Guarantee Company (I&G) was selected by the World Bank and the GoC as the implementing institution for the ESCO Loan Guarantee Program. The guarantee program was open to all banks and a total of 12 Chinese banks with 37 branches participated.

Guarantee coverage and risks. The guarantee program provided a loan guarantee of up to 90 percent of the principal of a single project loan, with the participating banks covering the remaining risks. This risk coverage level had been determined during the project design. If the borrower defaulted, I&G had the recourse right. Although the program's projected loss rate was 2.54 percent, its actual loss rate was only 1.08 percent. Five projects defaulted with subrogation of 23.5 million Yuan, of which 10.4 million Yuan was recovered.

Counter guarantee. Counter guarantees were required, but the stipulations were often less stringent than banks usually demanded and involved ESCO's assets, collateral, and diversified portfolio security; third-party partial counter guarantees; and various methods for using EPC contracts with host enterprises as security.

Guarantee fee. The guarantee fee was about 1.0-1.5 percent of the loan amount, based on project-specific risks and costs.

Deal flow. Deal flow was mainly generated from I&G branches, EMCA members, and partner banks.

Average size, payback period, and type of EE investment. The average loan size was US$3.9 million, with an average payback period between two and four years. Most loans were for industrial projects.

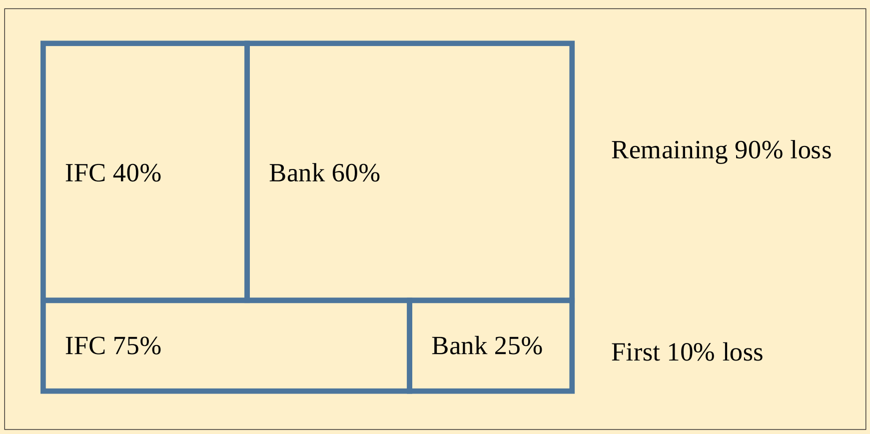
Through the Energy Conservation II project, many ESCOs for the first time received a bank loan. By the end of 2009, the ESCO loan guarantee program had been implemented for 6 years, offering loan guarantees to over 148 projects involving 42 ESCOs. The US$22 million GEF grant leveraged a total investment of US$140 million. The projects are expected to save 589,900tce and reduce 376,800 tons of CO_2 each year.

Box 4.3 CASE STUDY: IFC/GEF China Utility-Based Energy Efficiency Finance Program (CHUEE)

Responding to the GoC request to provide assistance for developing new private sector initiatives in financing renewable energy and EE projects, in 2006 the IFC with the support of GEF funding launched the China Utility-Based Energy Efficiency (CHUEE) program. The program included a guarantee for EE loans, as well as the provision of technical assistance to financial institutions and market partners, including ESCOs, equipment suppliers, vendors, energy end-users.

The CHUEE guarantee program was a risk sharing facility (RSF) for the IFC to provide partial credit guarantees to banks. The objective of this risk-sharing structure, shown in figure B4.3.1, was to give some confidence to the local banks to develop and try different flexible EE financing products, while taking less risk. For the first 10 percent of the loss, IFC covers 75 percent of the risk sharing, with the remainder borne by the participating bank; for the remaining 90 percent of the loss, IFC covers 40 percent and the bank 60 percent. The risk sharing facility was based on the entire portfolio risk of the lenders.

Figure B4.3.1 Overview of the CHUEE risk sharing structure



The CHUEE program also provided technical support to the market partners in developing sound project proposals and help foster relationships with the banks to facilitate access to financing. At the same time, the program also used technical assistance to engage energy end users and enhance their knowledge and awareness of EE opportunities.

The CHUEE program showed good results for both its Phase I and Phase II, during 2006-2012. A large number of projects have been implemented nationwide. A total of 226 loans were disbursed by the partner banks, with a total loan value of US$790 million, leveraging US$1.88 billion in total investment and resulting in an annual GHG emission reduction of 19 million tons of CO_2 (equivalent to Mongolia's total annual emissions per year).

One obstacle for the EE financing business at present is the lack of special products offered by banks to regulate the market. These have now began to be introduced by Shanghai Pudong Development Bank (SPDB) and Bank of Beijing (see also section 4.2). Currently within the EE space, SMEs still have a distinct lack of access to finance. To target the market opportunity presented by SMEs, Phase III of CHUEE (launched in May 2012) has included an RSF with four smaller banks (commercial city banks) to finance smaller projects for which the borrowers must be SMEs.

4.2 Emerging Innovative Financing Products

As EE financing over the last few years has grown into a considerable market segment, a number of commercial banks have started to gain confidence in the EE business and developed the necessary technical capacity. As a result, innovative financing products, in particular project-based financing, are beginning to emerge.

Project-based financing. Project-based financing generally refers to the financing of long-term infrastructure, industrial projects, and public services based on a non-recourse or limited recourse financial structure in which project debt and equity used to finance the project are paid back from the cash flow generated by the project. As opposed to the conventional corporate-based financing, project-based financing relies primarily on the project's cash flow for repayment, with the project's assets, rights, and interests held as secondary security or collateral. The project-based financing model helps to address the financing obstacles faced by the ESCOs. Box 4.4 presents examples of innovative financing products from the Shanghai Pudong Development Bank.

Box 4.4 Shanghai Pudong Development Bank and its innovative financing products

Shanghai Pudong Development Bank (SPD Bank) was established in 1993 in Shanghai and in a relatively short period has become one of the most successful private sector banks in China. The bank initially focused on the business market but later expanded into the retail and SME markets.

The SPD Bank is currently providing on-lending of World Bank loans to the building EE investments in Shanghai with a focus in Channing District under the World Bank/Global Environmental Facility Project Green Energy for Low Carbon City in Shanghai. The SPD Bank has also collaborated with IFC on the CHUEE Program, the Agence Francaise Developpement (AFD) on the EE and Renewable Energy On-lending Programs, and the Asian Development Bank (ADB) on the Building EE Financing Project. Under these projects, more than 4,000 SPD Bank staff have been trained in EE lending business.

The SPD Bank has become one of the leading commercial banks in innovative green financing. First of all, within the institution an integrated institutional framework has been established especially for the green financing services. For instance, for the World Bank building EE dedicated credit line, the SPD Bank headquarter provides policy and technical support and overall guidance; the Shanghai Branch SME Department is responsible for the overall implementation of the project including appraisal and approval of sub-loans and development of special financial products; and SPD Bank Hongqiao sub-branch will be responsible for deal origination, pre-appraisal, and supervision.

SPD Bank has also developed several innovative financing products.

In 2010, SPD Bank issued a loan to an off-shore wind power project, taking the project's revenue from its Clean Development Mechanism (CDM) emission reduction credits as repayment and using the project assets as collateral.

In 2011, SPD Bank expanded the **project-based financing service** to EE projects. The financing model allows existing EPC contracts to be used as collateral to receive financing for new projects, essentially providing an ESCO with the additional flexibility to commence more projects. This loan product currently only covers retrofit projects on existing equipment, but not new equipment investments. Provided the ESCO already has recovered a material portion (typically one year's worth) in revenues, the balance of the revenues receivable for an EPC can be used as a collateral for a new project.

EPC finance factoring. Derived from the trade finance business of SPD Bank, EPC finance factoring is a financial transaction and a type of debtor finance in which a business sells its accounts receivable (that is, invoices) to a third party (called a factor) at a discount. The concept involves factoring the future receivables from the ESCO as a securitized product and transferring the project receivables to the balance sheet of the bank. The bank is then responsible for the repayment of those receivables. The financing product ultimately allows small and medium sized ESCOs to realize their sales and revenues in advance and proceed to the next project. Finance factoring essentially liquidizes companies' funds under EPC terms, minimizing investment by the owner and achieving revenues and profits ahead of time.

4.3 Lessons Learned

Several lessons can be learned from China's Experiences with EE financing. These include:

- **Effective policies are the driver for catalyzing investment in energy efficiency.** Conducive energy efficiency policies are essential for creating an incentive environment that allows public financing to leverage sustainable private investment. Measures designed to help overcome market failures and barriers that inhibit EE investments are a prerequisite for success. For example, the Chinese government's mandatory performance-based EE targets have created huge demand for EE investments and ESCO services, whereas the absence of such policies in other countries in the region has limited the impact of EE financing initiatives. Another policy area that can help facilitate financing for EE investment is financial sector regulation. The banking regulators in many countries use regulation to encourage or discourage lending activities by banks, including what sectors to prioritize or reduce exposure to.

- **Public financing instruments must be tailored to overcome market barriers, meet the needs of targeted segments, and suite the local content.** Financing instruments have to be selected and tailored based on careful diagnoses of the regulatory environment, the maturity of the local financial market, the target market segments, and market and implementation barriers. For example, the balance sheet risks and transaction costs associated with SME lending tend to be much higher than those for larger enterprises; financing mechanisms must reflect these realities.

- **Public financing mechanism should be designed to maximize private financial flows.** The principle of public green funds is to attract but not crowd out private capital by lowering risks for investors and unlocking clean energy project financing. Public funds should therefore be willing to take higher risks and (i) invest in the secondary market in which commercial financing is not interested or willing to invest (such as with SMEs and ESCOs); (ii) provide incentives to investors; (iii) kick start the market; and (iv) demonstrate the viability of new financial products.

- **Technical assistance is critical and has a high payoff.** Technical Assistance (TA) projects help build capacity at the banks, by introducing technical know-how and risk evaluation capacity in project appraisal and by assisting the banks in building human capacity and internal management structures. This subsequently contributes to future increased bank lending.

- **SMEs remain the toughest market segment to finance.** Most of the ESCOs are SMEs and not favored by the commercial banks' traditional risk assessment criteria, which are extremely risk-averse and focus on balance sheet financing. The balance sheets of most SMEs are much weaker than those of larger companies and their risk profiles are generally much higher. Because of this, public funding plays a critical role, with effective governance and management of publicly funded programs critical to success. Public funded programs need to be designed to leverage private sector financing by lowering risks and building technical know-how. Multilateral development banks (MDBs) have been pioneers in innovative clean energy financing mechanisms, while national development banks have the potential to play a significant role.

5. Implementation on the Provincial Level

5.1 Introduction

This chapter focuses on how policies and targets are implemented at the provincial level. China's administrative structure determines that policies and targets are implemented at the provincial level. Provincial governments thus play a critical role in the implementation of the country's energy conservation drive. It is on this level that the government interfaces with large consumers, consolidates resources for specific activities, and organizes implementation on the ground. All provinces have negotiated specific energy intensity reduction targets with the central government as their contributions to the national FYP goals (see also section 2.3) and provincial governors are being held accountable for achievement of these targets. Provincial governments themselves have promulgated new laws and decrees to deepen foundations for implementation, as well as made new institutional arrangements to ensure the relevant agencies focus on the task of achieving energy savings. Provincial programs generally mirror the programmatic themes of national programs, but priorities, specific implementation arrangements, and the provision of financial and human resources vary substantially between provinces.

The provincial governments in particular play an important role in integrating policies across sectors in the implementation process. In Shaanxi Province, for example, the provincial Development and Reform Commission (DRC), which is responsible for economic development and planning and investment approval, is also the responsible agency for the provincial energy conservation program across the industry, building, transport, and public sectors. As a part of the EE Knowledge Exchange event, a study tour was organized to Xi'an, the capital city of Shaanxi Province, from June 18 to 20 2014, to allow participants to also take a close look at the implementation ground of China's energy conservation policies.

Shaanxi Province's target and implementation status. Shaanxi province has been on track to meet its overall target of 17 percent reduction in energy consumption per unit of GDP for the 12^{th} FYP period (2011-2015). The provincial

DRC reported that 6.97 percent reduction had been achieved from 2011 to 2012, or over 41 percent of the overall target. In 2013, the total GDP of the province increased by 11 percent, while energy intensity dropped 3.6 percent, from 0.816tce per 10,000 Yuan to 0.787tce per 10,000 Yuan. During the first three years of the 12^{th} FYP, energy intensity was reduced by 10.27 percent, completing over 60 percent of the required reduction for the 12^{th} FYP.

5.2 Institutional Arrangements

The provincial DRC is responsible for the overall implementation and supervision of the EE targets and is well positioned to coordinate EE improvement in the industry, building, and transport sectors. Supervision and inspection take place every six months, to ensure the enterprises achieve their annual goals for energy consumption. Shaanxi Province has taken measures to improve supervision and enforcement through the introduction of specialized inspections for equipment performance and setting energy consumption limits for 100 key energy consumption enterprises. Project supervision has also been prioritized, with supervision for energy saving technology upgrade projects carried out by ESCOs.

The provincial DRC is assisted by a large cadre of EE monitoring and supervision centers at the provincial and municipal levels, mirroring the National Energy Conservation Center (NECC) under NDRC at the national level, to carry out enforcement and implementation support and supervision functions. The Shaanxi Provincial Government has established 12 city level monitoring and supervision centers and 105 county level centers as a comprehensive supervision and inspection system. Enforcement is done in the form of supervision and inspection via desk review of energy consumption documentations and on-site inspections, including equipment testing. The introduction of weekly progress reports to monitor EE progress has allowed the Shaanxi provincial government to ensure targets are adhered to. Energy consumption assessments also serve as an early warning system for provincial energy consumption levels exceeding upper thresholds.

5.3 Implementation of Energy Efficiency in Shaanxi Province

In Shaanxi province, implementation of measures to meet EE, carbon, and pollution reduction targets has been conducted via a multifaceted approach. Activities have included industrial restructuring, development of renewable capacities, and promotion of EE in industry, as well as activities to increases the consumption of gas and enhance building energy efficiency, energy conservation in transportation, and energy conservation in public institutions.

Adjusting the economic structure towards less energy-intensive sectors. The Shaanxi government has embarked on a path to restructure the province's industrial sector, steering away from high energy intensive industries and conducting measures to nurture new pillar industries (advanced technology industries, including aerospace, electronics, automobiles, and pharmaceuticals). In 2013, growth of new and high technology industries exceeded 3.5 percent among the larger enterprises, while the added value from tertiary industries now occupies 34.95 percent of the total provincial output value, an increase of 0.31 percent. The government has enforced a control of the traditional energy intensive industries, restricting project construction for thermal power, iron and steel, cement, non-ferrous metallurgy, and traditional coal chemicals. Through this gradual shift in the industrial structure, the energy consumption share of the six major high energy consuming industries, accounting for 80.16 percent of total energy consumption, decreased in 2013.

Phasing out old inefficient capacity. In 2013, the provincial government closed down inefficient capacities in industries such as cement, pulp and paper, calcium carbide, ferroalloy, and textile, phasing out 87,000 inefficient and heavy-polluting vehicles and dismantling 1,250 coal-fired boilers. These measures have led to savings of 1.4 million tce, achieving the provincial goal set by the 12th FYP two years ahead of time.

Shifting the energy mix towards clean fuels. Other key measures implemented on the provincial level have been the development of non-fossil fuel energy capacity and a shift from coal to gas. In 2013, the installed capacity of non-fossil fuel energy sources in Shaanxi reached 4.22 GW, with newly added capacity totaling 690 MW, an increase of 20 percent. Non-fossil fuel sources have reached a 13.1 percent share of the total installed capacity, contributing to 8 percent of the province's electricity supply. To increase gas penetration, the cities of Xi'an and Yulin have been selected in the first batch of New Energy Demonstration Cities in China. With the provincial government pursuing a program to see a widespread shift from coal to gas in Shaanxi, the province implemented a considerable expansion of the city's natural gas pipeline network, carried out the gas pilot program in rural areas, commenced the gas project in the transport sector, and promoted the use of LNG stations. As such, provincial natural gas consumption was at 5.25 billion cubic meter, up by 16 percent, while the gas penetration rate has reached 85 percent in urban areas.

Limiting energy-intensive and polluting new green field investments. Shaanxi province also adopted energy efficiency assessment regulations and restrictions on high energy consuming industries. The provincial government revised and refined the "Shaanxi Province Fixed Asset Investment Project Energy Efficiency Assessment and Verification Management Methods (Trial)." Following the management methods, 387 projects were assessed on energy efficiency performance in 2013, with 1.1 million tce of coal equivalent of energy saving. Integrated with the air pollution mitigation works, the provincial government issued Guanzhong Area Smog Prevention and Key Industries' Project Construction Guidance, to suspend approval and filing of new project development in the thermal power, iron and steel, cement, non-ferrous metallurgy, and traditional coal chemical sectors.

Providing fiscal support. Substantial fiscal support was made available to the energy conservation agenda by both the central government and the provincial government. The provincial government identified ten types of key energy efficiency projects, including motor systems EE improvement, green lighting, public agency energy saving, building energy efficiency, energy system optimization, energy saving monitoring systems, and coal-fired boiler retrofit. Eligible projects within the categories could apply for funding support. In 2013, 91 projects in Shaanxi received central government funds for a total of 244 million Yuan, while 101 projects received provincial level funds for 119 million Yuan in total.

Prioritizing actions in key sectors. In the provincial energy conservation campaign, four key sectors were identified by the government, covering the industrial, building, and transport sectors, and public institutions.

- **Industrial sector.** Energy intensity per unit of industrial value added at the provincial level dropped by 5.83 percent in 2013. A number of measures have been taken, including the restriction on project approval and filing in key energy consuming sectors. A major capacity building event was launched to cover 200 key enterprises on energy management and energy efficiency benchmarking. Energy efficiency assessments were conducted in a systematic manner and with stringent enforcement, including the disclosure of results and enforcement of administrative measures for non-compliance enterprises (such as disqualification from government promotional campaigns or expansion approval). The provincial government also issued the Shaanxi Province Electric Motor Energy Efficiency Upgrade Plan (2013-2015), combined with subsidy support.

- **Building sector.** In the building sector, the government issued the Shaanxi Province Green Action and Implementation Plan. A total of 23 projects in Shaanxi received the National Green Building certification in 2013. The government is also promoting heat metering and EE retrofit in existing buildings. In 2013, 2.36 million square meters of existing building areas went through EE retrofit. In the same year, newly constructed buildings between 20,000 and 100,000 square meter were subjected to enhanced energy management criteria and evaluations. The provincial government also started the development of an information platform for building energy consumption; to date, EE data on 160 million square meter of civil construction has been collected.

- **Transport sector.** In the transport sector, the government enforced vehicle fuel consumption testing and restricted under-performing vehicles from entering the service market. Xi'an City, the provincial capital, has started the pilot development of a low-carbon transport system. Non-motorized transport was promoted via the establishment of a public bike network with 375 terminals as its phase I development. A low-carbon transport campaign was launched to involve 1,000 transport and logistics enterprises in the low carbon activities. In 2013, the province received central government funding of almost 30 million Yuan for low carbon transport development.

- **Public sector.** In the public sector, institutions at provincial, city and county levels have also been subjected to increased data collection on energy consumption. A total of 31 demonstration energy efficient institutions have been established, including government offices and higher education campuses. There has been a strong push in the direction of promoting the use of high EE lamps and technologies within buildings and institutions, while the city of XinChen has seen construction of 700kW of solar PV power stations to supplement conventional energy sources for public buildings.

In 2014, the Shaanxi provincial government is conducting a phased implementation of policy objectives, starting with increased inspections on a regular basis for more control in monitoring and early detection of irregularities. The province has prioritized restraint on high energy consuming industries, such as steel, cement, electrolytic aluminum, and glass, by not approving any new capacity increase projects. Moreover, the provincial government will prioritize and accelerate major energy-saving projects, offer incentive based policies and subsidies to encourage technology innovation, and provide financial support for energy saving and resource recycling projects.

Improving Measurement, Reporting and Verification (MRV) and building capacity. In 2013, the provincial government launched a demonstration project for an energy consumption monitoring system, with energy consumption monitoring assessments in 10 enterprises leading the practice. The province also strengthened its supervision and verification capacity by establishing 12 city level monitoring and supervision centers and 105 county level centers. For data collection, management, and disclosure, an online monitoring system is being developed, connecting the power sector, iron and steel, and petrochemical industrials to the network. The online monitoring system plans to include all the key energy consuming enterprises as demonstration pilots. The provincial government has also launched an energy consumption data disclosure scheme in which city (district) level energy consumption reports are published on a quarterly basis and reports for key enterprises on a monthly basis.

5.4 Implementation at the Enterprise Level

Enterprises have the ultimate responsibility to undertake energy conservation efforts. Energy conservation targets require business actions to be realized on the ground. This is particularly critical in China where about 16,000 key energy consuming enterprises account for over 60 percent of national energy consumption. As mentioned in earlier sections, in China institutional arrangements are set up at the provincial level to allocate, supervise, and enforce the implementation of energy conservation targets. Enforcement of targets has been stringent across the country. Depending on the industrial mix and energy consumption profiles, however, enforcement measures vary among provinces. While warnings, exposure, and administrative penalties (for example the suspension of new project approvals) are commonly imposed on enterprises failing to meet their targets, other sanctions ranging from disqualification for favorable tax exemption to compulsory operation suspension are also possible and are typically implemented in the provinces under pressure to meet the overall targets. Stringent enforcement has been a key factor in ensuring enterprises take measures to improve energy efficiency performance. Businesses are also responding to the programs and incentives to improve their operations and productions, effectively realizing cost savings on energy use and, more importantly, obtaining long-term benefits such as strategic upgrades. Without compromising production outputs, the business measures can be generally categorized as either technological upgrades or management improvements.

Technological upgrades. Technological upgrades are responsible for the bulk of energy savings in the industry. Box 5.1 illustrates an example of an iron and steel enterprise in Shaanxi province that was able to realize a considerable energy efficiency improvement through technological solutions.

Box 5.1 CASE STUDY: Shaanxi Iron and Steel Group efficiency enhancement through technological solutions

Shaanxi Iron and Steel Group was founded in August 2009. The Group's iron and steel plant has a production capacity of 10 million tons of crude steel annually. The Group, with 19,000 employees, has expanded business in mining, iron and steel smelting, processing of steel materials, trade, logistics, and transportation.

In general, it has been a challenging time for the iron and steel industry as a result of the recent global economic downturn; the first quarter of 2014 was in fact the worst period for steel manufacturers in China since the turn of the century. At the same time, to address the environmental costs of the industry, new environmental and energy conservation regulations have come into force. These include the "Discharge Standards on Eight Pollutants in the Iron and Steel Industry," issued by China's Ministry of Environmental Protection in 2012, the "Action Plan for the Control of Air Pollution," issued by the State Council in 2013, the "Energy Consumption per Unit Quota in the Major Process of Crude Steel Production," revised in 2013, and the "Environmental Protection Law of the People's Republic of China," revised in 2014.

Enterprises in the iron and steel industry, all facing these economic challenges and changes in environmental laws, can be broadly divided into two groups. The first group are technology oriented enterprises that are able to maintain good development momentum and have technical superiority, advanced products, and existing energy conservation and emission reduction practices; these enterprises also use leading information technology. The second group of enterprises consists of the more standard SMEs that are facing not only economic hardship, but also have to address the capital costs of industrial transformation and upgrades, as well as structural adjustment requirements. These standard SMEs lack sufficient processes and technology to meet environmental protection and energy efficiency regulations and have a less competitive position in the market.

Shaanxi Iron and Steel is in the first category and has taken measures to meet its targets for carbon emissions and energy intensities, also to remain competitive and survive in a difficult market. The technological upgrades take place in two main areas, enhancing energy efficiency both (i) within major processes and (ii) in the overarching management system processes. Among the EE enhancement solutions implemented by Shaanxi Iron and Steel, the most significant undertakings have involved fan energy conservation, energy saving pumps, sintering waste heat recovery power generation technology, dry dust removal of blast furnace and converter gas, blasts furnace top gas recovery turbine units, and gas and turbine power generation in burning blast furnaces. Following the implementation of these EE measures, from 2006 to 2010 Shaanxi Iron and Steel's overall energy consumption per ton steel dropped 16.09 percent and continued to drop to 16.49 percent between 2011 and 2013. Production energy consumption also decreased 4 percent from 2010 to 2012, and then a further 13.4 percent from 2012 to 2013.

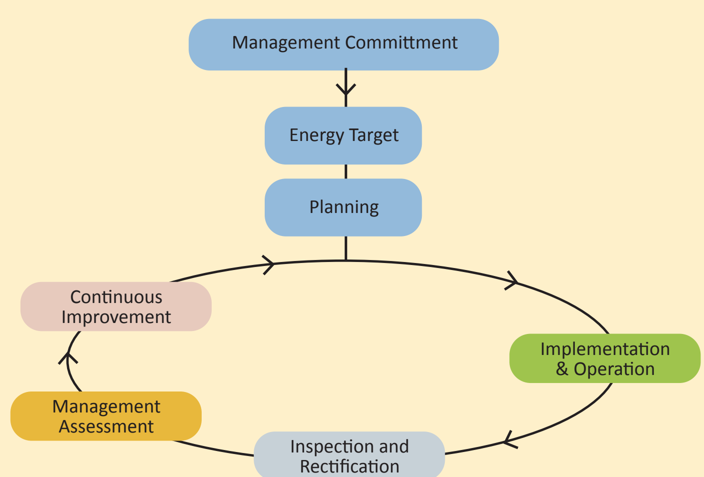
The primary reason for the improvement in energy efficiency was the technological upgrade, fuelled by a stagnant market and weaker steel prices. The experience of Shaanxi Iron and Steel also reinforces the notion that market prices are a fundamental driver of technology innovation.

Management improvements. In addition to the technological upgrades, management improvements are also critical in the overall process as they bring in essential measures for modernizing corporate management, aligning efficiency performance with strategic decision making, and building employee capacity. Management improvements benefit enterprises in the long term and include the implementation of energy conservation target accountability and responsibility systems, energy management systems, centralization of energy control, and designated management of key energy-consuming equipment. Energy efficiency benchmarking and an energy consumption index system are extremely effective in helping an enterprise quantify the results of all EE measures.

To establish the EE management system, a number of tools need to be implemented to collect and monitor the data. These include energy monitoring, conducting energy balance analyses, and energy audits. Many enterprises adopted energy performance contracting (EPC) models to improve their energy efficiency performance.

- **Energy management systems.** Implementing an energy management system is extremely important for key energy-consuming businesses to achieve their targets. Many enterprises set up internal energy efficiency management systems for systematic and comprehensive management of their energy consumption. Government guidance for the enterprises is provided via the Energy Management System Requirements (GB/T23331-2012) publication, which defines the overall process and management framework. Energy management systems incorporate EE targets into a robust system of overarching management control as well as continuous improvement, as illustrated figure 5.1.

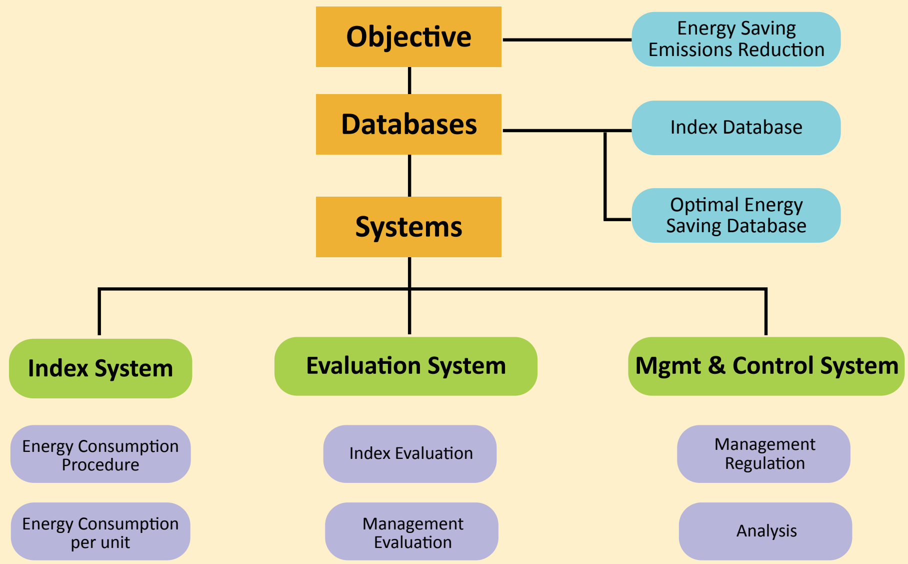
Figure 5.1 Energy management system lifecycle



- **Energy audits.** The key energy-consuming enterprise program requires enterprises to establish sound energy measuring and statistical systems, submit energy utilization status reports on a regular basis, carry out self-conducted energy audits based on the government published standard GB/T17166-1997, submit energy audit reports to provincial governments bi-annually, and develop energy conservation plans. For the EE targets compliance, the enterprises are also required to undergo audits conducted by qualified third-parties. The audit process typically involves testing, inspection, examination, analysis, and evaluation of both the physical and financial processes of energy consumption, after which recommendations and changes are appropriately delivered. This provides a basis for improvement, which is manifested through the identification of benchmarks, establishment of energy management procedures and systems, and the implementation of continuous improvements in the management of enterprise EE.

- **Enterprise EE benchmarks.** EE benchmarks provide a vital point of comparison and analysis on the enterprise level; they are developed in accordance with national standards, with the single objective of energy conservation and emission reduction. Typically enterprises maintain two sets of databases for benchmarking purposes, which are an index database and an optimal energy saving database. Implementation of the benchmark can be represented in a continuous improvement cycle, where an initial situational analysis on the enterprise EE management provides the necessary data to determine suitable benchmarks. Upon identification of the appropriate benchmark, planning is conducted to implement changes accordingly, which sends the process into an index evaluation stage that can then be used to make recommendations on further improvements and analysis. Some management systems need to be set up to implement the benchmark goals, including the index system, evaluation system, and management control system. Figure 5.2 illustrates the structure for EE implementation.

Figure 5.2 Energy efficiency implementation structure diagram



To elaborate further on each stage of the index system implementation cycle, a situational analysis requires enterprises to conduct a comprehensive analysis of total energy consumption to gather data on EE and losses, among others. Based on the energy audit report and a mid- to long-term development strategy, enterprises then determine benchmarks to enhance EE per unit product or reduce energy consumption in production processes. The selection of benchmarks is conducted via established guidelines and support from the industry. There is always the preliminary requirement to select several potential benchmarks and rigorously analyze and study their suitability. Based on the circumstances of a given enterprise, benchmark objectives are then established, generally to achieve advanced level efficiencies in line with domestic and international standards.

Planning is conducted in conjunction with the establishment of benchmarks, with industry support, and using various information available from multiple sources including the internet. During the planning phase, enterprises learn and adapt advanced methods, measures, and best practices in index management. A necessary task during this phase is the comparison and analysis of an enterprises own EE situation compared to a benchmark enterprise, to determine the most effective improvement plans and implementation schedules. Improvement indices can then be applied to work groups and individuals according to what is outlined in the planning phase.

Enterprise-wide awareness of EE improvements are instilled into all staff, from management to junior staff, to ensure the comprehensiveness of the implementation phase. In practice, enterprises must embark on a wide range of projects, including the revision of corporate regulation and policy, improving human resource management, installing energy measurement tools, reinforcing the monitoring and management of energy consuming equipment, and fast-tracking energy-saving technology reform projects.

Following implementation, the EE index must be periodically re-evaluated, to assess its effectiveness and analyze the feasibility for index improvement measures; this re-evaluation must result in an evaluation report that is detailed enough to bring about further change. Enterprises use this information to summarize effective methods, measures, and guidelines on the path to accomplishing benchmark objectives. New benchmarks for the next stage in EE improvement and energy consumption reduction can then be established, with the indices adjusted for further improvement. Box 5.2 summarizes energy efficiency measures at Conch Cement Company, which combined technological solutions with an employee incentive system.

- **Energy Manager Program.** The Energy Conservation Law requires key energy consumption enterprises to appoint an energy manager who then is responsible for the implementation of measures stipulated in the Energy Conservation Law within the enterprise. Internally, the energy manager oversees and coordinates the enterprise's EE measures and ensures an energy management system is in place. Externally, the energy manager liaises with the government. Because of this, an energy manager usually is at the core of an enterprise's senior management team, with a high level of leadership and authority and directly reporting to the legal representative of the enterprise. This arrangement effectively ensures the enterprise's implementation of energy efficiency measures, while accountability for achieving the enterprise EE targets is at the leadership level.

Box 5.2 CASE STUDY: Energy efficiency measures at Conch Cement Company

Conch Cement was established in 2009 and commenced production of cement in 2011. Since then, the group has expanded aggressively in the domestic and international market. Annual production for the Shaanxi plant is 4.4 million tons per annum with annual revenues of 1 billion Yuan. To reduce its energy intensity, the company has focused on technological solutions and an employee incentive system.

Technological solutions. As a modern production facility, the plant has adopted many advanced energy conservation technologies for various stages in the production process. The plant and its associated energy conservation implementations were designed by the Conch Group. In the production facility's design stage, the group-wide energy conservation principles require all new projects to adopt practical measures in terms of energy conservation, emissions reduction, electricity generation, as well as water conservation. State-of-the-art technologies are sourced from Germany and Japan to ensure high production standards and efficiencies. Among the technologies adopted by the plant, the most notable and significant is the waste heat and pressure power plant co-developed by Osaki in Japan and the Conch Group, allowing the facility to generate 0.48kWh of electricity per ton of raw material. The waste heat power plant allows 40 percent of the energy consumption to be offset by power generated through waste heat and pressure. Other advanced technological features that contribute to the energy efficiency of the cement factory include the advanced grinding technology and the low-pressure low-loss five star burning system, both technologies introduced from Japan, as well as the fourth-generation grate coolers imported from Germany.

In terms of basic energy conservation practices, LED lamps and variable frequency motor technology have been adopted throughout the facility. Suitable measures have been implemented to comply with all local and provincial requirements.

Employee incentive system. Building on the management system, the company has also developed an evaluation system for employees and teams at various stages in the production process, assigning energy conservation responsibility to every single employee. Based on pre-defined energy conservation targets, should employees and their teams achieve this goal, they are awarded a 0.5 percent salary increase; if they fail to achieve this target, they are subjected to a 0.5 percent salary deduction. Each production process has a team, with meters on the process side to monitor energy consumption. According to the plant management, the system has been well received and is considered effective in managing energy consumption.

Annex 1. Workshop Agenda

China-ASEAN Energy Efficiency Knowledge Exchange Event
China, June 16-20, 2014
Agenda

June 16: Energy Efficiency Policy, Beijing (Xiyuan Hotel)	
8:30-9:00	Registration
9:00-9:10	Policies for energy service industry in China Feng Liang, Deputy Director General, National Development Reform Commission
9:10-9:20	World Bank introducing market-based mechanisms for energy efficiency to China Marianne Fay, Chief Economist, Climate Change Group, World Bank
9:20-9:30	Introduction of institutional arrangement for energy conservation policies in China Jia Fuxing, Director, National Energy Conservation Center
9:30-10:00	Introduction of the event program and logistics arrangement Event organizer representative
10:00-10:15	Coffee break
10:15–11:00	Chinese energy conservation policies: setting and allocating targets, implementing targets, financial incentive policies Dai Yande, Deputy Director General, Energy Research Institute
11:00–12:00	Chinese energy conservation policies (continued) Q&A
12:00-2:00	Lunch
2:00-2:30	Chinese experience on energy efficiency standards and labelling Li Aixian, Vice President, China National Institute of Standardization
2:30-3:00	Overview of financing instruments: Unlocking Commercial Financing for Clean Energy in East Asia: Xiaodong Wang, World Bank
3:00-3:15	Coffee break
3:15-5:00	ASEAN country energy efficiency programs: • India PAT experience: Bureau of Energy Efficiency, India Energy efficiency • Singapore EE program • Thailand EE and ESCO program • Vietnam EE program
June 17: ESCO and Energy Efficiency Financing, Beijing (Xiyuan Hotel)	
9:00-9:30	China's energy management companies' development China Energy Service Company Association (EMCA)
9:30–10:45	ESCO Business Models • Shared Saving Model and Leasing Model – SUN Hong, Shandong Rongshihua Leasing Co., Ltd. • Guarantee Saving & other Models – Wang Maozhong, Shandong Leader Electric Group • Outsourcing model – CUI Xiaofeng, Beijing Yuanshen Energy Saving Technology Co., Ltd.

10:45–11:00	Coffee break
11:00-12:00	Q&A
12:00-2:00	Lunch
2:00–3:45	Energy Efficiency Financing & Model • Dedicated Credit Line: Li Hao, EXIM Bank and Peng Ling, Huaxia Bank • Innovative project-based financing: Chen Dong, Shanghai Pudong Development Bank • Small enterprises financing: Duan Hongli, Bank of Beijing Partial Risk Guarantee: • China Energy Conservation II Project: Duan Xiumei, I&G • CHUEE: Ying Zhou, IFC
3:45-4:00	Coffee break
4:00-5:00	Q&A
June 18: Site Visit in Beijing and Travel to Xi'an	
Morning	Field visit to Yuansheng RESCO company on rooftop PV site in Beijing
	Lunch in the Xiyuan Hotel
Afternoon	Flight to Xi'an
June 19: Provincial Energy Efficiency Implementation, Xi'an	
9:00-10:00	Provincial Energy Conservation Policies Ma Hongsheng, Deputy Director, Shaanxi DRC
10:00-10:15	Coffee break
10:15-11:00	Implementation of energy conservation policies Zhai Guofu, Deputy Director, Shaanxi Energy Conservation Center
11:00-12:00	Industrial Energy Conservation in key energy-intensive sectors He Ling, Industry Sector Association
12:00-2:00	Lunch
2:00-3:00	Implementation of energy efficiency at industrial enterprises: • Steel sector: Zhang Sujuan, Senior Engineer Shaanxi Iron and Steel Group • Cement sector: He Lixin, Chief Engineer, Shaanxi Qinling Cement Group
3:00-3:15	Coffee break
3:15-5:00	Q&A and roundtable discussions
June 20: Site visit in Xi'an	
Morning	Site visit to industrial enterprise: Conch Cement

The World Bank
Energy and Extractives Global Practice
East Asia and Pacific Region
1818 H. Street, NW
Washington, DC 20433
Telephone: (202) 473-1000
Internet: www.worldbank.org