



## Good Practice and Success Stories on Energy Efficiency in China

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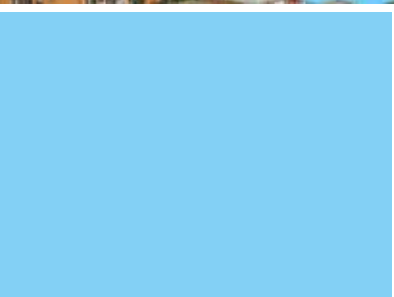
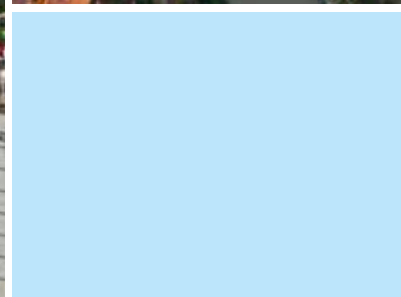
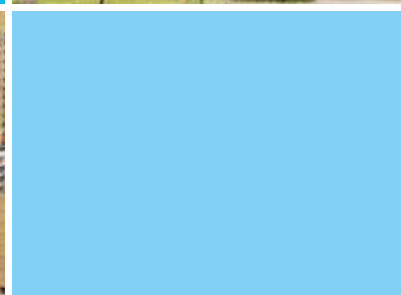
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# GOOD PRACTICE AND SUCCESS STORIES ON ENERGY EFFICIENCY IN CHINA



# **GOOD PRACTICE AND SUCCESS STORIES ON ENERGY EFFICIENCY IN CHINA**

CHINA ENERGY EFFICIENCY SERIES

MARCH 2017

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# LIST OF ABBREVIATIONS

<b>AQSIQ</b>	General Administration of Quality Supervision, Inspection and Quarantine	<b>MOC</b>	Ministry of Commerce
<b>BEPV</b>	Battery electric passenger vehicle	<b>MOF</b>	Ministry of Finance
<b>BEV</b>	Battery electric vehicle	<b>MOHURD</b>	Ministry of Housing and Urban-rural Development
<b>C2E2</b>	Copenhagen Centre on Energy Efficiency	<b>MOST</b>	Ministry of Science and Technology
<b>CAFE</b>	Corporate Average Fuel Efficiency	<b>MOT</b>	Ministry of Transportation
<b>CATARC</b>	China Automotive Technology & Research Center	<b>MRV</b>	Measurable, reportable, and verifiable
<b>CO2</b>	Carbon dioxide	<b>MTCE</b>	Million tonnes of coal equivalent
<b>CPV</b>	Commercial passenger vehicle	<b>NBS</b>	National Bureau of Statistics
<b>DTU</b>	Technical University of Denmark	<b>NDRC</b>	National Development and Reform Commission
<b>EPC</b>	Energy Performance Contracting	<b>NEA</b>	National Energy Agency
<b>ERI</b>	Energy Research Institute of the National Development and Reform Commission of China	<b>NEDC</b>	New European Driving Cycle
<b>ESCO</b>	Energy Service Companies	<b>O&amp;M</b>	operation and maintenance
<b>EV</b>	Electrical vehicle	<b>PHEV</b>	Plug-in hybrid electric vehicle
<b>EVSS</b>	Electric Vehicle Subsidy Scheme	<b>PHEPV</b>	Plug-in hybrid electric passenger vehicle
<b>FCEV</b>	Fuel cell electric vehicle	<b>R&amp;D</b>	Research and development
<b>FEVSS</b>	Fuel-Efficient Vehicle Subsidy Scheme	<b>RMB</b>	Renminbi
<b>FYP</b>	Five-year Plan	<b>SASAC</b>	State-owned Assets Supervision and Administration Commission of the State Council
<b>GDI</b>	Gasoline direct injection	<b>SAT</b>	State Administration of Taxation
<b>GDP</b>	Gross Domestic Product	<b>SEforALL</b>	Sustainable Energy for All
<b>GHG</b>	Greenhouse gas	<b>SOE</b>	State-owned enterprises
<b>HEV</b>	Hybrid electric vehicle	<b>SPM</b>	Subsidy phase-out mechanism
<b>HIO</b>	High Impact Opportunity	<b>TCE</b>	tons of coal-equivalent energy
<b>KWH</b>	Kilowatt-hour	<b>TSINGHUA 3E</b>	Institute of Energy, Environment and Economy at Tsinghua University
<b>LED</b>	Light-emitting diode	<b>UNEP</b>	United Nations Environmental Programme
<b>MEP</b>	Ministry of Environment Protection	<b>US\$</b>	US dollar
<b>MEPS</b>	Minimum energy performance standards	<b>VAT</b>	Value-added tax
<b>MIIT</b>	Ministry of Industrial and Information Technology	<b>VVT</b>	Variable valve timing
<b>MLR</b>	Ministry of Land Resources		



# FOREWORD

Improving energy efficiency is critical to achieving the ambitious goals of the Paris Agreement under the UN Framework Convention on Climate Change. The central aim of the Agreement is to keep the global temperature increase by the end of the century to well below 2°C by the end of the century compared to pre-industrial levels, with an ambition to limit the temperature increase even further to 1.5°C.

Energy efficiency delivers not only reductions in energy consumption and emissions, but also many economy-wide multiple benefits, such as improved health and well-being, cleaner air and more jobs. Nonetheless there are common barriers and market failures that prevent countries from implementing energy efficiency actions. This publication offers some proven solutions from China that can inspire other countries, as the successes presented can be replicated in many parts of the world.

In terms of the future growth of energy and related greenhouse gas emissions, China and India stand out from other countries, due to their rapid economic development, large populations combined with rapid urbanization and growing industrial sectors. Both countries are focused on decoupling both energy use and emissions from economic growth. In their Intended Nationally Determined Contributions submitted under the Paris Agreement, both countries have included strategies to pursue improved energy efficiency across the main sectors of their economies.

The High Impact Opportunities studies that the UNEP DTU Partnership has supported in China and India represent an effort to engage national stakeholders, leading research institutions and practitioners in the identification of good practices and the necessary priorities to enhance energy efficiency further.

From 2000 to 2015, the energy intensity of the Chinese economy declined by thirty per cent, making it one of the countries with the fastest energy efficiency improvements. This *Report on Good Practice and Success Stories on Energy Efficiency in China* assesses the key policies and measures that have been successfully implemented across different sectors. The study concludes that especially three distinct approaches have been effective in stimulating energy efficiency actions in China. These are legislation on energy efficiency standards and products, the regulatory approach that includes mandatory energy efficiency improvement targets set by central government to local governments and mandatory early retirement of inefficient power plants and industrial facilities, as well as providing economic incentives in the form of subsidies, taxes and fees. Further replication and scaling up of these successes will help China realize an early peak in greenhouse gas emissions and a transition to a clean energy future. Moreover, these experiences in China can in many cases be adapted to other developing countries.

I would like to thank the national experts and practitioners who have contributed the eight best practice and success stories included in this publication. I am sure that the publication will be of interest to policy-makers, practitioners and researchers and that will pave the way for further efficiency gains.

*John Christensen*  
Director  
UNEP DTU Partnership

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*Xiliang Zhang*  
*Quan Bai*  
*Xianli Zhu*

# EXECUTIVE SUMMARY

China has made energy conservation and energy efficiency one of its top priorities as a means of guiding its economic and social development. In the past three decades, while China's economy increased eighteen-fold, energy consumption increased only five-fold. The energy intensity of China's GDP declined by about seventy percent during the same period. In the face of resource and environmental constraints, China vowed to make energy conservation a foundation of its economic and social development strategy, as well as its energy and climate change strategy. It is now striving to lead in energy efficiency globally, having been responsible for more than half of the world's entire energy savings in the past thirty years.

Since 2006, the Chinese government has embarked on one of the most aggressive energy conservation campaigns in the world, setting itself a mandatory target to cut energy intensity per unit of GDP by 20 percent in the 11th Five-Year Plan (2006-2010), with annual evaluations and examinations being carried out at the provincial, municipal and county levels, as well as in energy-intensive enterprises. Similar commitments with a targeted sixteen percent reduction in the 12th Five-Year Plan (2011-2015) and fifteen percent in the 13th Five-Year Plan (2016-2020) were also renewed. Strong legal measures, regulatory policies and financial incentives have been put in place to ensure that these targets are met.

Both central and local governments have committed significant resources in the quest to fulfill these national energy-savings goals. New and innovative policy mechanisms and programs have been successfully introduced. Thanks to the great efforts made in promoting energy efficiency, a number of good practices have emerged from different regions and different sectors. This report proposes eight criteria in selecting good practices and stories, including focusing on energy-efficiency policies, being based on sectors, resulting in large energy savings, having clear or quantitative targets, having an implementation process that is measurable, reportable and verifiable (MRV), having been enforced for at least three years, having relatively low costs and high benefits, and being replicable in other regions or sectors.

Based on these criteria, eight good practices and stories from the industrial, building and transportation sectors are identified, including the Top-1,000 Enterprises Energy Efficiency Program, eliminating backward industrial production capacities, the financial rewards of industrial energy-saving technical retrofits, energy-efficiency standards for new buildings, energy-conservation retrofits to existing buildings, promoting energy-efficient appliances, and promoting energy efficiency and new energy vehicles, as well as fuel efficiency standards.

For each good practice and story, the specific background, key elements, implementation process, cost and benefits are discussed, as well as the challenges and barriers to further replication and scaling up. Based on these good practices and stories in respect of energy conservation, the report also discusses the feasibility of improving and rolling out these policies continually, as well as their multiple benefits in ensuring environmental improvements and competitiveness upgrading.

# INTRO

## INTRODUCTION

Xianli Zhu  
Quan Bai

## BACKGROUND

The Copenhagen Centre on Energy Efficiency (C2E2) forms part of the UNEP DTU Partnership, consisting of a collaboration between the Danish Government, the UN Environment (UNEP) and the Technical University of Denmark (DTU). The Copenhagen Centre serves as the Energy Efficiency Hub of the UN Sustainable Energy for All (SEforALL) initiative.

The SEforALL initiative is a multi-stakeholder partnership between governments, the private sector and civil society. It was launched by the United Nations Secretary General in 2011 to achieve three interrelated goals by 2030:

1. Ensure universal access to modern energy services;
2. Double the share of renewable energy in the global energy mix from 18% to 36%; and
3. Double the rate of improvements in energy efficiency from -1.3% to -2.6% annually.

In order to facilitate realization of the SEforALL goal on energy efficiency, the Copenhagen Centre on Energy Efficiency provides capacity-building, analytical and knowledge support to countries in their actions for energy efficiency improvement. With China's and India's high and increasing importance in global energy issues, these two countries have received more emphasis in relation to energy efficiency improvements under the SEforALL initiative.

This report is part of the findings of the project, 'A Study on High Impact Opportunities for Energy Efficiency Improvement in China and India', which was initiated by C2E2 to facilitate and support further and faster energy efficiency improvements in these two big emerging countries. The project in China was implemented by the Institute of Energy, Environment and Economy at Tsinghua University (Tsinghua 3E) and the Energy Research Institute (ERI) of the National Development and Reform Commission. The two institutions' strong expertise in energy efficiency policies and energy-modelling in China, plus their close ties with Chinese ministries as the main think tanks on energy and climate policy-making, provide a strong basis for the study project. The project started in September 2015 and is completed in March 2017.

Apart from this report on 'Best Practice and Success Stories on Energy Efficiency in China', the second output from the project includes an assessment of the energy efficiency improvement potential in the key sectors of industry, building, transportation and power generation. The third output is a report on high-impact opportunities (HIOs) for energy efficiency improvements in China, including some recommendations on how to overcome various barriers and realize the HIOs.

In order for the project's findings to address key issues on the energy policy-makers' agenda, the project included two workshops. The inception workshop, organized in January 2016, was aimed at discussing the main issues and opportunities for energy efficiency improvement in key sectors with various ministries, industries and experts. The final workshop, organized in December 2016, focused on reporting the preliminary findings of the project to government ministries and other key stakeholders for energy efficiency improvements and collecting feedback from them. Apart from these two big workshops, small-scale consultations were carried out during the project implementation process.

Experts from the Copenhagen Centre provided guidance to the study through the overall design of the project, providing templates for each report, and reviewing and commenting on the draft reports. The ERI and Tsinghua 3E use energy models to estimate the potential for energy efficiency improvements in key sectors and to project the role of energy efficiency in fulfilling China's National Determined Contributions for global climate-change mitigation.

## SELECTION OF GOOD PRACTICES AND SUCCESS STORIES

The energy intensity of the Chinese economy declined by thirty per cent from 2000 to 2015, due to technological progress and the long list of policies and measures that China has implemented to improve its energy efficiency. The country started to include energy intensity targets in its five-year economic development plans for the first time in 2005, and national targets were further allocated to each province and each big energy-consuming enterprise. Energy efficiency standards have been set for industrial products, electrical appliances, new buildings and vehicles, and various regulatory and economic schemes have been put into place to stimulate enterprises, consumers and local governments to follow these standards (IEA, 2016').

Moreover, China is further stepping up its efforts to make improvements in energy efficiency. The 13th FYP (2016-20) targets a 15% energy intensity improvement from 2015 levels by 2020 and 560 Mtoe of energy savings annually by that year. In its Nationally Determined Contribution under the Paris Agreement, China pledges to peak its CO<sub>2</sub> emissions by 2030 and reduce its CO<sub>2</sub> emissions per unit of GDP by 60 to 65 percent below 2005 levels. Further and faster energy efficiency improvements are a critical and cost-effective solution to realizing these targets. As such, it is important to review the existing policies and measures the country has taken in the last two decades to achieve energy efficiency improvements and identify some of the most effective ones for further replication and scaling up. This should not only benefit the country's future energy efficiency work, but also provide valuable insights and experiences for other countries that are seeking solutions for harvesting the multiple benefits of energy efficiency improvements. The report consists of ten chapters.

In the first chapter, the general framework of energy efficiency policies in China is presented. The great number and variety of energy efficiency policies are divided into three types: legal measures, economic measures, and administrative measures. The advantages and disadvantages of these three types of measure are also discussed, and the main policies under each type listed. This provides readers with an overview of energy efficiency policies in China.

In the second chapter, eight good-practice selection criteria used in this report are described, as follows: (1) energy efficiency policies, (2) sectoral organization, (3) large energy savings, (4) clear and quantifiable targets, (5) an implementation process that is measurable, reportable and verifiable (MRV), (6) having been enforced for at least three years, (7) relatively low costs and high benefits, and (8) replicable in other regions or sectors. Based on these criteria, eight good practices from the industrial, building and transportation sectors are selected. Appliances are considered part of the building sector in this publication. There is no best practice for the power sector because the sector is similar to heavy industries in terms of big energy consumption, high greenhouse emissions and air pollution. China relies on a similar set of policies and measures to regulate energy efficiency in the power sector and industrial sector, including mandatory maximum energy consumption standards for the generation of each kilowatt hour of electricity, and the mandatory early retirement and closing down of small, inefficient and polluting coal-fired power plants.

Based on these criteria, eight best practices and measures have been selected for presentation in this publication:

- The Top-1,000 Enterprises Energy Efficiency Programme
- Eliminating Backward Industrial Production Capacities
- Financial Rewards for Industrial-Energy Saving Technical Retrofits
- Energy Efficiency Standards for New Buildings
- Energy Conservation Retrofit of Existing Buildings
- Promoting Energy Efficiency Appliances
- Promoting Energy Efficiency and New Energy Vehicles
- Fuel Efficiency Standards

The eight good practices are explained in detail from Chapters 3 to 10. For each good practice, its background in respect of policy development, implementation, its impact of the policy, any challenges experienced, and the potential for it to be replicated and scaled up are discussed.

## STRUCTURE OF THE BEST PRACTICE AND SUCCESS STORIES



Each success story is explained in terms of a short Introduction, followed by why the policy was initiated, what was done, the effects of the policy, the challenges experienced during implementation, and the reliability and scaling-up potential of the policy. The best practice and success stories cover the most effective policies and measures that China has implemented in the last two decades for energy efficiency improvements in industry, buildings, appliances and the transport sector.

# 1

CHAPTER

# ENERGY CONSERVATION POLICY FRAMEWORK IN CHINA

Quan Bai

China started to enforce and implement energy conservation policies and programmes in the early 1980s. At that time, energy conservation was regarded as a temporary and secondary measure to alleviate shortages in energy supply.

With the fast growth in energy demand after 2000, the Chinese government began to attach high importance to promoting energy conservation and energy efficiency. Energy conservation and energy efficiency are regarded as necessary to improve development quality and benefits, rather than to address energy supply shortages.

In 2006, the Chinese government began to treat resource conservation as a fundamental national policy in its overall economic and social development strategy. Since that year, energy conservation has been included as a binding indicator in China's National Economic and Social Development Outline within the Five-Year Plans. A quantitative target to reduce energy intensity, which is measured as total primary energy consumption per 10,000 RMB of Gross Domestic Product (GDP), was put forward in the Five-Year Plans. The energy conservation targets of the last three Five-Year Plans aimed to reduce energy intensity by 20% during the 2006-2010 period, by 16% from 2011 to 2015, and by 15% from 2015 to 2020 respectively.

Under the last two Five-Year Plans periods, after great efforts, the energy conservation targets were successfully achieved. Energy intensity in 2015 was 33.8% lower than in 2005, 1.55 gigatons of coal-equivalent energy (tce) were saved, and 3.3 billion tons of CO<sub>2</sub> emissions avoided.

After great efforts for more than ten years, a general framework for an energy efficiency policy has taken shape, with many good practices and experiences being accumulated in the process.

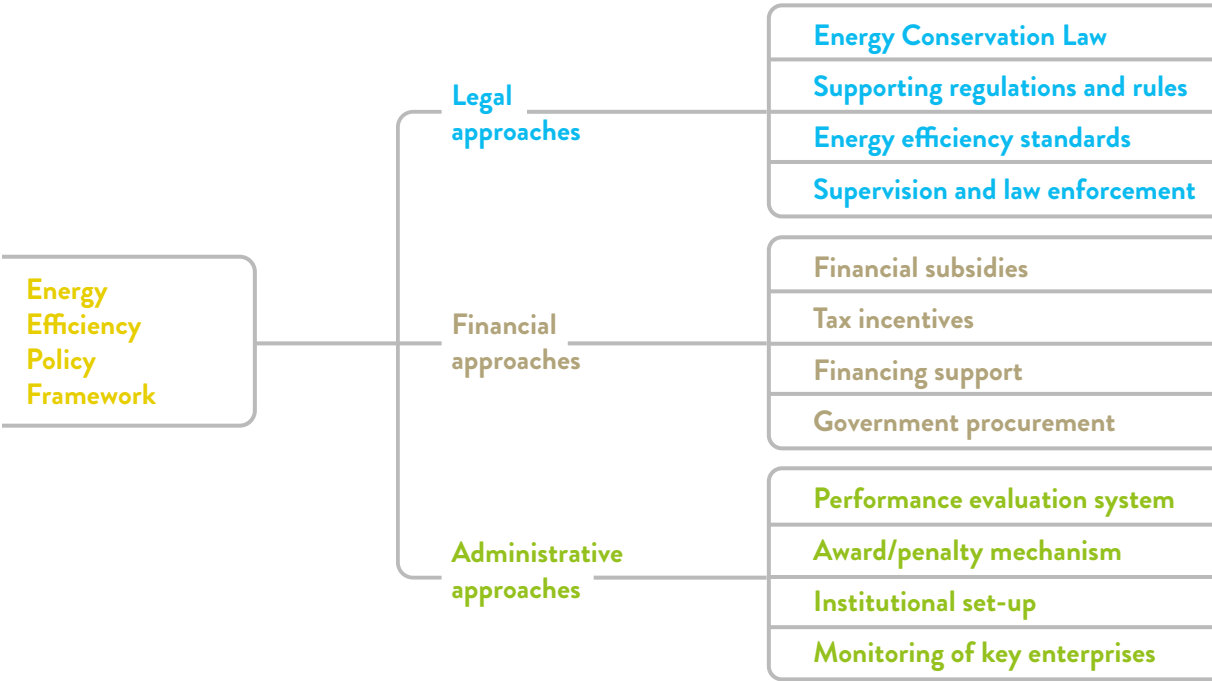
## 1.1 GENERAL FRAMEWORK OF ENERGY EFFICIENCY POLICIES IN CHINA

The Chinese government is striving to mobilize all available resources to drive the whole of society towards realizing the binding target for energy conservation in its Five-Year Plans. The policies and measures adopted by the government can be divided into three types: legal measures, economic incentives, and administrative measures. The legal policies and measures include the Energy Conservation Law, various government regulations, standards and a law enforcement system. The economic policies and measures relate to pricing, taxation, financing, government procurement etc., which use market power to change the energy consumption behaviour of businesses and consumers. The administrative policies and measures are those produced by different levels of government, both high and low.

China has made great progress in its transition from a planned economy to a market economy during the last four decades since the opening up of reform in 1978. During the era of the planned economy, administrative measures were widely used to promote energy efficiency and energy conservation. The National Government sets its energy intensity target in its Five-Year Plans, it then allocates mandatory targets for provincial-level of government and enterprises with high energy consumption. The provincial-level governments in turn set the mandatory target for lower level governments and major energy consuming enterprises in their jurisdiction. Many administrative measures are still in use today. With the continuing transition from a planned economy to market economy, economic policies and measures are increasingly being adopted and implemented to promote energy conservation in China. Currently these three types of policies and measures are being used simultaneously in different fields, all of them being effective in promoting energy conservation in China. The Energy Efficiency Policy Framework is shown in Figure 1.

The energy efficiency policy framework itself is a combination of Chinese characteristics and international experience. Some policies, such as energy efficiency standards and labeling and government procurement, are based on similar policies in developed countries. Some policies, such as target division, allocation and performance evaluation from the upper to lower levels of government, are based on the Chinese administrative system and have strongly Chinese characteristics.

**FIGURE 1. China's Energy Efficiency Policy Framework**



**1.2 LEGAL POLICIES AND MEASURES**

**1.2.1 ADVANTAGES AND SHORTCOMINGS OF LEGAL POLICIES AND MEASURES**

Legal policies and measures are based on the principle that laws and regulations should be developed and enforced to regulate economic activities. Legal policies and measures should effectively safeguard the legal rights and interests of participants in economic activities, as well as adjust social and economic relationships among different market stakeholders and markets in order to ensure the normal operation of the economy. Such legal policies and measures mainly include economic legislation, economic law enforcement and supervision. Legal policies and measures are characterized by being serious, authoritative and formal. They enable normalized, unified and stable activities and prevent governance from being subjective and arbitrary.

The advantages of legal policies and measures in promoting energy conservation include the following:

- 1. They can provide a legal foundation for devising energy conservation policies and enforcing the law.
- 2. A standard toolbox of solutions, including energy efficiency standards, energy efficiency labeling etc., are provided to help regulate energy efficiency in the market.
- 3. The law enforcement system supplements government agencies effectively in solving the problem of labour shortages.

The problems of legal policies and measures in promoting energy conservation include the following:

- 1. Law enforcement needs a large staff, equipment installation and day-to-day operation, as well as heavy fiscal support, which can be a heavy burden, especially on county-level government budgets.
- 2. Energy efficiency law enforcement may not be cost-effective. If the majority of enterprises are able to comply with the energy conservation law, the need to maintain a large team of law enforcement officers will be questioned.
- 3. The weak effectiveness of law enforcement and lack of a transparent system for law enforcement has been a big problem in China for a long time.



## 1.2.2 MAIN CONTENTS OF LEGAL MEASURES FOR ENERGY CONSERVATION IN CHINA

The legal measures for energy conservation include the following:

- The Energy Conservation Law has been amended to enhance energy efficiency incentives and standards, and to strengthen administrative enforcement. More and more industries, as well as buildings, transportation and public institutions, are required to take actions promoting energy conservation.
- Energy efficiency standards for appliances, equipment and vehicle fuel efficiency have been laid down in various regulations, including the Ordinance of Civil-Building Energy Conservation and the Regulations on Energy Conservation for Public Institutions. National efficiency standards have been established for 40 end-use products, 22 energy-intensive products (such as iron and steel) and 11 energy products. Five fuel-economy standards for vehicles have been enacted. Several standards and guidelines on energy measurements, energy consumption calculation methods and energy conservation baseline standards have also been developed.
- Some supporting measures have also been enacted and implemented, such as mandatory energy efficiency assessments of projects involving new investments (those leading to the creation of new fixed assets), the inspection and monitoring of high energy-consuming equipment and mandatory energy-efficiency labeling.
- Energy conservation supervision centres in China are responsible for enforcing the Energy Conservation Law. These centres, also known as “energy conservation policeman”, are responsible for supervising energy use and compliance with both national and local energy efficiency standards.

## 1.3 ECONOMIC MEASURES

### 1.3.1 ADVANTAGES AND SHORTCOMINGS OF ECONOMIC MEASURES

Economic policies and measures refer to the government using economic policies to change and influence the economic interests and economic activities of society. Economic policies include financial policy, monetary policy, industrial policy, credit policy, income distribution policy, price policy, exchange rate policy, tax policy and others. These policies are aimed at altering economic parameters to influence the relationship between market supply and demand and thus achieve national energy-intensity reduction targets. Economic policies and measures have the characteristics of being indirect, compensatory, equal and relevant, that is, are most suitable for managing economic activities.

The advantages of economic measures to promote energy efficiency and energy savings mainly include the following:

1. The cost of promoting energy conservation is mainly paid by enterprises. Thus, the burden on the government budget in promoting energy conservation can be reduced.
2. The energy conservation potential of enterprises can be mobilized and thoroughly explored. Therefore, the “many words, little action” problem can be avoided.
3. The government can avoid the accusation of “excessive interference in the internal affairs of enterprises”. Especially for private enterprises and foreign enterprises, market-based policies and measures are often more effective than administrative measures.

The main problems with economic measures include the following:

1. They are constrained by status of the broader economic system reform. Price reforms and fiscal and tax system reforms have other objectives than energy-saving, such as reforms to the fiscal system, financial system, customs system etc. It is quite difficult to reshape the relationship between different stakeholders in a short period of time.
2. It is very sensitive to energy prices. In areas where the energy price is low (especially in areas with abundant energy resources), the intrinsic motivation to save energy is also very low.
3. The importance of energy saving varies at different stages of product market development. Before the market for a product reaches saturation, enterprises tend to focus on expanding their productive capacity and increasing their market share. They may therefore regard energy conservation as a secondary issue. Once the market reaches saturation, fierce competition among enterprises will force business decision-makers to pay more attention to cost reductions and energy conservation.
4. Fiscal measures and taxation measures could be subject to the impacts of changes in the government’s budget balances. In periods of government deficits, the government may find it more difficult to provide financial subsidies and tax reductions for energy-saving actions.
5. The market itself is not mature. In some areas or regions, the market is not well developed. There are many obstacles to the actual operation of the market, such as the lack of a transparent system, cutthroat competition, regional monopolies etc., which still need to be solved.

### 1.3.2 MAIN CONTENTS OF ECONOMIC MEASURES FOR ENERGY CONSERVATION IN CHINA

The legal measures governing energy conservation in China include the following:

- Government funds for the implementation of various projects to:
  - invest in energy-efficient technologies and retrofit projects,
  - phase out outdated production capacity,
  - adopt heat-metering and retrofit in residential buildings,
  - renovate large public buildings,
  - promote the adoption of energy-efficient end-use equipment and products,
  - promote energy performance contracting,
  - encourage R&D and the commercialization of energy efficiency technologies, and
  - build energy conservation monitoring and evaluation capacity.
- Incentive measures were provided for a range of target groups. Tax reductions were awarded to companies that undertook retrofit projects, consumers who purchased efficient equipment and small-size cars, energy service companies conducting energy performance contracts, and companies importing energy-efficient equipment. On the other hand, VAT refunds were reduced for exports of products considered wasteful in their use of energy and resources, or causing high levels of pollution.
- A series of pricing policies were introduced, such as the promotion of differential power pricing in energy-intensive industries and residential sectors.

## 1.4 ADMINISTRATIVE MEASURES

### 1.4.1 ADVANTAGES AND SHORTCOMINGS OF ADMINISTRATIVE MEASURES

Administrative measures are designed to regulate and manage the economy through administrative institutions, administrative orders, indicators, instructions, provisions, seizures, detentions, inspections, supervision, examination and approval, administrative licensing and other measures. Implementation is mainly conducted through the administrative systems of different levels and different regions. This regulation is characterised by orders and evaluations from a superior authority.

Compared with the economic and legal measures, administrative measures have the following characteristics:

1. Authority. Administrative measures are managed and controlled by the central government, reflecting the country's united will and behaviour. Improving the authority of the leadership will help improve the effectiveness of administrative measures.
2. Mandatory. Administrative compulsion requires that people should obey the unified will, orders, instructions and decisions issued by the superior authority.
3. Vertical. Administrative instructions and commands are communicated in a vertical line at the level of the administrative organization, which emphasizes the vertical membership of the upper and lower levels. Generally, there are no links between lateral structures.
4. Specific. Certain administrative orders and instructions relate only to a specific object at a specific time.
5. No economic benefit. Other than the relationship of administrative governance, there is no economic interest between the administrative subject and object.
6. Closeness. Administrative methods are based on the administrative professional division or regional division, and are compulsory and binding only within the system itself.

The advantages of administrative measures in promoting energy conservation include the following:

1. Rapid decision-making. Administrative measures are decided by small groups of decision-makers, and the procedure for decision-making is brief.
2. Efficient and strong enforcement. The administrative system in China is strong and efficient. Historically, most policies could be carried out from top to bottom, and the impact on economic activity is relatively fast.
3. The central government can mobilize huge resources to solve big problems, especially when local government or enterprises could not do so using their own strengths. This is regarded as a good experience in the past thirty years of development since the opening up of reform in China.

At the same time, the shortcomings of administrative measures in promoting energy conservation include the following:

1. The costs of administration will increase. With the increase in the depth and coverage of energy conservation, more of the government budget should be allocated to energy conservation.
2. Increased numbers of staff will be needed. With the increase in energy conservation administration, more government departments will be established, and more personnel will be hired.
3. Some enterprises do not comply with the government's guidance. In some regions, some companies do not follow the government's guidance in promoting energy efficiency.
4. The "one size fits all" problem. Some policies are developed by central government, such as phasing out old production capacity, energy efficiency standards etc. Sometimes, it is difficult to apply the same standards to all regions and all enterprises in different situations. In some cases, this is not as cost-effective as market-based policies.

#### **1.4.2 MAIN CONTENTS OF ADMINISTRATIVE MEASURES FOR ENERGY CONSERVATION IN CHINA**

The legal measures affecting energy conservation in China include the following:

- Central and local governments at all levels established Energy Conservation and Emission Reduction Leading Groups to be responsible for coordinating energy conservation activities.
- A responsibility and accountability system for mandatory energy conservation targets was established. In this system, energy conservation targets were assigned to local governments and major energy-consuming enterprises, and progress with targets was monitored and assessed annually. These results are one of the key elements used in evaluating the performance of a government or an enterprise.
- Top-1000/Top-10,000 Energy-Consuming Enterprises Programs were initiated to scale up energy conservation efforts.

Legal measures, economic measures and administrative measures all have their own advantages and shortcomings. All three measures were used in China to promote energy conservation. The successful implementation of energy conservation policies in China resulted in great achievements, leading China to step out on to a more sustainable road to development.

In 2012, the Chinese government began to re-start reform of the market economy. With the further transition from a planned economy to a market economy, it is estimated that more economic measures, such as a carbon cap and trade system, will be introduced and widely adopted in China in the future.

# 2

CHAPTER

## CRITERIA IN SELECTING THE BEST PRACTICES/ GOOD STORIES

Quan Bai

Since China has made great efforts in promoting energy efficiency, a number of good practices and good stories have emerged from different regions and different sectors.

In fact, it is quite difficult to select an appropriate Best Practice or Good Story. Some policies are very effective when they are initiated, and they may be regarded as good policies at the beginning. But after many years of implementation, shortcomings may become evident. Some policies are widely adopted by market economy countries, but they may require a relatively long time to take effect, and their contribution to achieving the energy conservation target may be quite small, requiring five years to achieve. Some energy efficiency policies are very effective in the east, where the more developed provinces are located, but are not successful in the west of China, which is less developed but has rich energy sources. Therefore, some criteria should be developed before best practices are selected.

## 2.1 CRITERIA TO SELECT BEST PRACTICE

After thorough discussion, the research team adopted eight criteria for the selection of best practice. They are:

### 2.1.1 FOCUSED ON POLICY

Best practice should be divided into two types, the first being based on good technology, the second on policy.

In China, a lot of best technologies were recommended by government agencies and industrial associations. These advanced energy efficiency technologies contributed greatly in promoting energy efficiency in China.

Based on discussions within the working group, best practices in this report will be based on energy efficiency policy, rather than best technology.

### 2.1.2 BASED ON SECTORS

In China, many policies are focused on the cross-cutting method. In previous years, it was widely accepted that energy efficiency performance evaluations from higher levels of government to lower-level government leaders were regarded as the most important policy promoting energy efficiency in China. This greatly raised the awareness of lower level government, leading the heads of government at this level to use more resources to support energy efficiency efforts. Besides this performance evaluation policy, there are many cross-cutting measures as well.

For purposes of international comparison, best practice in this report will be based on the sector, rather than on cross-cutting policies, even though many experts think that these policies are even more effective and more influential in China.

### 2.1.3 LARGE AMOUNTS OF ENERGY SAVINGS

When choosing best practice, the policy should have resulted in large amounts of energy savings. Given the five-year energy-conservation target, the best practice should have contributed a large share to realizing the target.

Since many policies are issued by central government and enforced nationwide, the influence of this policy will be stronger and its amount of energy savings will be much larger than in the case of an energy policy developed by provincial government or city government. Therefore, most policies will be focused on the national level.

### 2.1.4 THE TARGET SHOULD BE CLEAR EVEN WITH A QUANTIFIED TARGET

When choosing best practice, the policy should have a clear objective with a quantified target. This will help progress with the policy to be evaluated and tests to be made whether the policy has been successful or not.

### 2.1.5 THE IMPLEMENTATION PROCESS SHOULD BE MEASURABLE, REPORTABLE AND VERIFIABLE (MRV)

When choosing best practice, implementation of the policy should be measurable, reportable and verifiable. Historically, objective evaluations of the policy should be conducted. A good methodology or standard of evaluation should be developed and adopted in the evaluation work.

Preferably, the policy results should be made publicly available for external evaluation.

### 2.1.6 ENFORCED FOR MORE THAN THREE YEARS

When talking about the success or failure of a certain policy, a relatively long time is needed for policy enforcement. After discussion, the research team decided that the selected best practice policy should have been enforced for longer than three years.

It would be advantageous for the policy to have a long-term sustainable development mechanism.

### 2.1.7 LOW COST AND HIGH BENEFIT

Cost-effectiveness is an important criterion in selecting best practice. Policies with lower costs and higher rates of energy efficiency are more favoured in the selection process.

Some policies address existing inefficient production lines or facilities, while others address new ones. Energy efficiency standards are widely regarded as a low cost and high benefit measure for improving the energy efficiency of the new ones.

### 2.1.8 REPLICABLE TO OTHER REGIONS OR SECTORS

Best practice should be capable of easy adoption from one region to another, whether in China or in another region in the world, or capable of being introduced from one sector to another. This would make it useful for other regions or sectors wishing to promote energy efficiency in the future.

## 2.2 SELECTED RESULT OF BEST PRACTICES

Based on the criteria for the selection of best practice, eight best practices from three sectors have been selected (see Table 1).

TABLE 1. Selection results of best practices

NO.	BEST PRACTICE	MAIN REASONS	SECTOR
1	Top 1000/10,000 enterprise energy saving activities	Key energy users in China are motivated Large energy-saving contribution to realize the national energy efficiency target	industrial sector (including power generation sector)
2	Phasing-out inefficient production lines and equipment	1. Most cost effective (low-hanging fruit) 2. Large energy-saving contribution to realize the national energy efficiency target	
3	Energy conservation retrofit and subsidies	1. Large energy-saving contribution to realize the national energy efficiency target 2. Clear project target and MRV result	
4	Building energy efficiency standard development and enforcement	1. Large energy-saving contribution in building sector 2. Highly cost-effective	building sector (including appliances)
5	Energy-efficient retrofit of existing buildings	1. Clear project target and MRV result 2. Replicable to other regions	
6	Subsidies for energy efficient appliances	1. Clear project target and MRV result 2. Replicable to other regions	
7	Promoting energy efficient and new energy vehicles	1. Clear project target and MRV result 2. Replicable to other regions	transportation sector
8	Fuel efficiency standard development and enforcement	1. Highly cost effective 2. Replicable to other regions	

The main reasons for selecting these eight best practices are listed in Table 1. These best practices meant large energy savings for China and had a great influence in promoting energy efficiency in existing energy use and future energy demand.

The best practices shown in this report could be applied to other regions or sectors, and they provide strong support to the world's efforts to mitigate GHG emissions.

**3**  
CHAPTER

**GOOD PRACTICE 1**

**TOP-1,000  
ENTERPRISES  
ENERGY  
EFFICIENCY  
PROGRAM**

**Zhiyu Tian  
Quan Bai**



### 3.1 INTRODUCTION

In April 2006, the National Development Reform Commission (NDRC) officially launched the Top-1,000 Enterprises Energy Efficiency Program, which targets

energy efficiency improvements in the 1,000 largest enterprises, which together consume about one-third of all China's primary energy. The program aimed to make a major contribution to China's 20% energy-intensity reduction target from 2005 to 2010 by delivering over 100 Mtce (million tons of coal equivalent) energy savings.

**FIGURE 2. Training Course in Promoting Top 10,000 Energy Conservation and Low Carbon Activity**



*Photo: Courtesy to Guangdong Energy Conservation and Supervision agency*

### 3.2 WHY THE POLICY/ PROGRAM WAS INTRODUCED AND IMPLEMENTED

The industry sector accounts for around 70% of China's primary energy consumption, and therefore plays a pivotal role in tackling China's energy, environmental and ecological challenges. These 1,000 enterprises are all in the industry sector, and they consume around 50% of China's total industrial energy consumption. Energy saving efforts in Top-1,000 enterprises played a key role in realizing China's energy-intensity and pollutant emission reduction goals. Besides, as a developing country shifting from a centrally planned economy to a market-oriented economy, the Chinese government still exerted strict controls over the economy, especially over state-owned enterprises (SOEs) and large enterprises, through administrative and regulation measures. Given

the increasing attention being paid to energy and environmental issues by the whole of society in recent years, energy-intensive enterprises have to comply with the government's orders, as well as increase competitiveness, by improving energy efficiency.

### 3.3 WHAT WAS DONE

#### CONTENTS OF THE POLICY

The program stipulated that the enterprises in the Top-1,000 program should realize total energy savings of 100 Mtce between 2006 and 2010, thus significantly improving their energy efficiency, with the goal that energy intensities (energy used per unit of production) reach the level of advanced domestic production and that some enterprises attain either international or industry-advanced levels of energy intensity.



The essential elements of the program included assessments of the energy efficiency potential at the sub-sector and enterprise levels, target-setting through a negotiated process, policy implementation of incentives and disincentives, annual examination, and progress monitoring, reporting and verification. Key measures undertaken as part of the Top-1,000 Program included the following:

1. Top-1,000 enterprises were required to sign a letter of responsibility for energy conservation targets with local governments. Each enterprise is to create a leading group on energy efficiency, set up energy management positions, and allocate energy conservation targets to workshop sections. Achievements in reaching these goals should be regularly monitored and reviewed.
2. Energy audits should be conducted in each Top-1,000 enterprise, following the Chinese energy audit standard, GB/T 17166-1997, to analyze the situation on the ground, identify current energy utilization status and potentials, and introduce feasible and practical energy-saving measures. The energy audit reports should be submitted to provincial government for examination.
3. Top-1,000 enterprises should formulate an energy conservation plan and submit energy utilization status reports regularly, including details of energy consumption, energy efficiency and the cost-effectiveness of energy savings and energy-efficient measures, having established a sound energy-measuring and statistical system.
4. Participants in the Top-1,000 program were urged to make investments in energy retrofit projects every year, adopting advanced technologies, equipment and materials, and eliminating backward technologies and equipment. Energy efficiency improvements should be leveraged to upgrade production and increase competitiveness.
5. Stick and carrot policies should be implemented in Top-1,000 enterprises. Rewards and grants should be given to staff who have excelled in energy-efficient innovations or renovations. Progress with energy efficiency should be evaluated as a part of key performance indicators. Energy-wasting activities should be penalized. Leaders of state-owned enterprises that fail to reach energy conservation goals should not receive annual evaluation awards.
6. Provincial and local governments are directed to lead and implement the program, including overseeing, tracking, supervision, and management of the energy-saving activities of the enterprises, providing training sessions for Top-1,000 enterprises on energy efficiency measurement, statistics and management, and improving the monitoring of enterprises through audits and sampling.
7. Financial support should be provided by central and local governments to promote the use of new energy-efficient technologies, as well as market-oriented mechanisms such as energy performance contracts. Key pilot projects on energy efficiency and enterprises that reach allocated targets ahead of schedule should be rewarded and supported financially. Soft loans from non-commercial banks and international institutions were also encouraged in support of Top-1,000 enterprises.

8. Online monitoring of energy consumption in key energy-using enterprises was implemented in three pilot cities or provinces, namely Beijing, Henan Province and Shaanxi Province, covering a total of 184 enterprises from the Top-1,000 program. The online-monitoring system tracks real-time energy consumption, energy intensity and electricity consumption in enterprises, thus aiming to increase the transparency and accuracy of energy statistics.

## IMPLEMENTATION SCOPE AND INSTITUTIONAL ARRANGEMENT

The program targeted the largest 1,000 energy-consuming industrial enterprises in the country that each consumed a minimum of 180 Mtce in 2004. According to the National Bureau of Statistics, these Top-1,000 enterprises consumed 670 Mtce in 2004, accounting for 47% of industrial energy consumption and 33% of national primary energy consumption. The enterprise list of names covered 1008 enterprises, including the most energy-intensive sectors such as electricity production, coal mining, iron and steel, cement, chemicals, petroleum, coking, and non-ferrous and textile industries.

## THE GOVERNMENT AGENCIES, INDUSTRIAL ORGANIZATIONS, AND BUSINESSES INVOLVED

The Top-1,000 Energy Efficiency Program was led by NDRC, with collaborations from the Ministry of Industry and Information Technology (MIIT), the National Bureau of Statistics (NBS), the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and the State-owned Assets Supervision and Administration Commission of the State Council (SASAC). The NDRC undertook comprehensive management, supervision and overall coordination, allocating energy conservation targets to the enterprises, providing guidance, and supervising implementation. The NBS was responsible for collecting data on energy consumption and energy efficiency, tracking and verifying the reported data, and annually publicizing the energy utilization status of the Top-1,000 enterprises. AQSIQ was in charge of reinforcing energy measurement work by encouraging Top-1,000 enterprises to improve their energy measurement systems. SASAC was to strengthen energy efficiency supervision in SOEs by incorporating energy efficiency targets into its leaders' annual performance evaluation system. Industrial associations were also involved in implementing the program by helping to upgrade energy efficiency standards, collecting benchmarking information on energy efficiency, building industrial energy-efficiency databases and providing training and consultation.

### 3.4 EFFECTS OF THE POLICY/PROGRAM

#### IN TERMS OF THE COSTS TO GOVERNMENT, BUSINESSES, HOUSEHOLDS ETC.

No estimates or calculations of the implementation costs of the Top-1,000 program were made. As China announced a 20% energy-intensity reduction goal during the 11th FYP, energy savings responsibility contracts were signed between provincial governments and Top-1,000 enterprises. Achievement of the energy saving targets and energy conservation measures became part of provincial government evaluation systems, in which the responsible government officials were evaluated annually on whether or not the targets they had been set had been achieved. Total investments and costs savings results are unclear, since administrative resources, legal means and economic measures were all leveraged across different areas.

#### THE BENEFITS OF ENERGY SAVING, REDUCTION OF LOCAL POLLUTION AND ANY OTHER SOCIAL BENEFITS

According to the NDRC, from 2006 to 2010, total energy savings from the Top-1,000 program amounted to 165.49 Mtce,<sup>127</sup> far exceeding the original targets. 127 enterprises have closed, merged or changed to other forms of production. Of 881 enterprises examined in 2010, 866 enterprises achieved the energy-saving objectives, with only fifteen enterprises failing to do so.<sup>128</sup> The energy performance of these key energy-consuming enterprises improved significantly. Many enterprises in China had even attained international advanced energy performance levels.

### 3.5 CHALLENGES EXPERIENCED

1. The successful implementation of the Top-1,000 program can be partly attributed to command economy. However, as market mechanisms are to play an essential role in the allocation of resources, it has become harder for governments to give orders regarding economic activities at the micro-level, given institutional deficiencies and poor oversight.
2. Like the situation nationally in China, with its wide disparities between rural and urban areas and regional developments, big gaps in energy efficiency levels remain across various enterprises. From a top-down perspective, it was difficult to allocate the energy conservation targets among enterprises in accordance with each enterprise's technical energy-saving potential and cost-effectiveness.
3. Despite improving statistical and supervisory systems, both central and local governments were still lacking in manpower and the technical and financial resources to carry out projects. The monitoring, reporting and verification system remained weak and insufficient in many aspects. Energy efficiency standards and their enforcement in China lagged far behind those in developed countries.

### 3.6 REPLICABILITY AND SCALING UP POTENTIAL

#### WHY IT WORKED (FACTORS OF THE POLICY ITSELF, INCLUDING DESIGN, TARGETING SCOPE, IMPLEMENTATION ARRANGEMENTS ETC.; EXTERNAL FACTORS AND CONDITIONS)

Top-1,000 enterprises were key to sustaining China's economic development and its achieving its environmental targets. As a developing country with immature market mechanisms, the government-led Top-1,000 program partially complemented the inefficient market system, especially in the areas of energy-pricing and environmental supervision. The command and control approach in implementing the Top-1,000 program also stimulated the initiatives of local governments and enterprises, incentivizing them to improve energy efficiency on their own.

#### THE FEASIBILITY OF ROLLING OUT THE POLICY IN OTHER PARTS OF THE COUNTRY OR OTHER SECTORS AND SUB-SECTORS WITH SIMILAR CHALLENGES IN ENERGY EFFICIENCY IMPROVEMENT

The Top-1,000 Energy Efficiency Program motivated China's governments and enterprises to accelerate energy-efficient retrofits, promoting the prevalence of advanced energy-efficient technologies, equipment and products, as well as best practices from both at home and abroad. Under the 11th FYP, the provincial and municipal authorities expanded the program, bringing small and medium enterprises with less energy consumption into the program at local levels. Besides, the Ministry of Transportation also initiated a similar Top-1,000 Energy Efficiency & Low Carbon Program in enterprises such as freight transportation, logistic enterprises, waterborne companies, ports and wharves, thus promoting energy efficiency retrofits and low carbon transformation.

In 2011, China expanded its Top-1,000 Program into a Top-10,000 Program, which accounted for about 60% of total energy consumption in 2010. The new program included industrial enterprises that use more than 10,000 tce per year, public buildings (hotels, restaurants, and schools) that use more than 5000 tce per year, and large transportation enterprises. In total, about 15,000 industrial enterprises will be involved. Taking into account the public buildings and transportation enterprises, around 17,000 entities will be included in the Top 10,000 Program. The Chinese government needed the Top-10,000 Program to save 250 Mtce during the 12th FYP.

# 4

CHAPTER

## GOOD PRACTICE 2

# ELIMINATING BACKWARD INDUSTRIAL PRODUCTION CAPACITIES

Zhiyu Tian

## 4.1 INTRODUCTION

After decades of fast industrialization, China has in effect become the world's factory, the world's largest manufacturer of industrial products. However, for historical, technical and economic reasons, there were still a large number of

inefficient, polluting or outdated production capacities operating in China. Since 2006, the Chinese government has vowed to accelerate the phasing-out of outdated production capacity so as to transform its pattern of economic development, improve energy efficiency in industrial sectors, and encourage competition on an equal footing.

**FIGURE 3. Phasing out a Small Industrial Plant**



*Photo: Courtesy of Zhengjun Chen, China Photo Press*

## 4.2 WHY THE POLICY/ PROGRAM WAS INTRODUCED AND IMPLEMENTED

China's overcapacity problem is by no means a new one, but it is now more pervasive. Due to decades of heavy investment-driven growth, most energy-intensive industries in China experienced an extraordinary boom, accompanied by soaring energy consumption and a

deteriorating environment. The massive fiscal stimulus package of 2008, which aimed to cope with the global financial crisis, further fuelled the irrational expansion of heavy industries. As a result, many industrial sectors in China were weighed down by a lot of small, poorly performing enterprises. Given the fact that China was still in its transition from a centrally planned economy to a market-oriented economy, it might take years before pricing mechanisms for natural resources are rationalized and the enforcement of laws and standards improved.

## 4.3 WHAT WAS DONE

### CONTENTS OF THE POLICY

The Chinese government took the industrial overcapacity problem very seriously, noting that it was not only impeding the transformation of the economic structure, but also imposing negative impacts on promoting energy conservation and environmental protection. A series of actions have taken place since the 11th FYP in an attempt to speed up the elimination of backward industrial production capacities in energy-intensive industries.

1. The central government set five-year targets for production capacity cuts in 2006, allocating them to provincial governments and signing responsibility contracts with officials. Annual targets to phase out out-dated industrial production capacity for each energy-intensive sector were also specified. The provincial governments published a list of plants each year with time frames for their closure according to predefined closure thresholds. The State Council also undertook field inspections and evaluations of actual progress in the provinces. Provinces that did not meet the targets would not be given annual rewards or honorary titles, and officials would not be promoted without meeting the energy conservation targets. In some regions, failure to achieve the phasing-out goals resulted in the suspension of the regions' high-energy consumption projects.
2. Special funds were set aside for less developed regions to achieve the capacity-reduction goals. Discretionary programs of transfer expenditures were established by central government in compensation for earlier retirements or shutdowns of energy-intensive capacities in the western and central provinces. During the 11th FYP, rather than direct subsidies, the national government allocated about 21.91 billion yuan (about US\$ 3.48 billion) in financial rewards for local governments closing down inefficient production capacities. Local governments also had similar funds to handle the unemployment and land property problems incurred during the process.
3. In order to facilitate structural changes to industry, in 2005 the national government publicized an updated guide for industrial structural adjustment. Enterprises and new projects were classified into the encouragement group, the restraint group and the elimination group. For energy-intensive sectors, specific closure targets and closure thresholds are provided by sector. For example, for iron and steel enterprises, iron-making blast furnaces with a volume equal to or less than 400 m<sup>3</sup> were to be closed, as well as steel-making converters and electric arc furnaces with capacities equal to or less than 30 tons. Meanwhile, the added capacity would be strictly controlled so as to avoid a new round of gluts.
4. Mandatory energy efficiency standards for key energy intensive products were developed and upgraded, encouraging enterprises that failed to bring production up to standard to be closed by local government. The national government also called for the strict enforcement of environmental protection standards, pollutant emission standards, product quality standards and health and safety regulations. Enterprises that violated energy efficiency standards or environmental regulations were ordered to cease production or shut down.
5. A progressive electricity-pricing system was introduced, with differentiated energy prices levied based on energy consumption per unit of output in industrial sectors such as aluminium production. In some developed provinces, punitive energy prices were levied if enterprises failed to achieve the annual energy conservation goals. The implementation of differentiated pricing systems also provided extra financial sources to compensate for the elimination of backward capacities.
6. Energy efficiency appraisals were strengthened for new fixed-asset investments. In 2010, China announced the Interim Regulation of Energy Efficiency Assessment and Review on Fixed-Asset Investment Projects. Energy efficiency assessments and reviews, which should be conducted by third-party institutes independently, was a prerequisite for approval and construction. New industrial projects must not only meet the requirements of land assessments and environmental assessments, but also pass the energy-efficiency assessments. Those without an independent energy-efficiency assessment and review will not be approved.
7. Flexible mechanisms were also encouraged for joint implementation. Despite China steadily adapting a market-oriented economy, the government still had a lot of power over project approval, SOE supervision, energy-pricing and electricity dispatch. During the 11th FYP, a program to replace small plants with larger ones was initiated, which encouraged new project applicants in energy-intensive sectors to purchase quotas of production capacity from inefficient plants prior to building new plants, so as to increase average energy efficiency levels and avoid further overcapacity problems. Besides, mergers and acquisitions were also encouraged local governments to improve industrial concentration, reduce subsidies for capacity elimination and deal with unemployment challenges.



## IMPLEMENTATION SCOPE AND INSTITUTIONAL ARRANGEMENT

In 2007, fourteen energy-intensive industries were targeted to accelerate the closure of backward industrial production capacities, including iron, steel, ferrous-alloy, cement, aluminium, coal-fired power, coking, ferrous metal, glass, paper and pulp, ethanol, gourmet powder and citric acid enterprises, according to the Comprehensive Working Plan of Energy Conservation and Emission Reduction released by the State Council. In 2010, the number of targeted industrial sectors was increased to include additional energy-intensive and high-pollution sectors such as calcium carbide, printing and dyeing, and chemical fibre enterprises, with higher targets for each sector regarding the amount of capacity to be closed.

### WHICH GOVERNMENT AGENCIES, INDUSTRIAL ORGANIZATIONS, AND BUSINESSES ARE INVOLVED

Several ministries were involved in the work of phasing out backward industrial production capacities. The five-year and annual targets for industrial sectors were set by MIIT, whereas the target for the coal-fired power sector was set by the National Energy Agency (NEA), with collaborations from the NDRC, Ministry of Environment Protection (MEP), Ministry of Finance (MOF), Ministry of Commerce (MOC), Ministry of Land Resources (MLR), State Administration of Work Safety and State Administration of Coal Mine Safety. Assessments and reviews of the energy-efficiency levels of new investment projects, and of the implementation of differentiated electricity prices for existing capacities, were led and administered by the NDRC. The MLR takes overall charge of promoting multiple uses of land resources after the early retirement of backward industrial production capacities. Provincial and municipal governments were responsible for allocating targets to each enterprise, strengthening regular and periodical monitoring and supervision, and ensuring target were achieved.

## 4.4 EFFECTS OF THE POLICY/ PROGRAM

### IN TERMS OF COSTS TO GOVERNMENT, BUSINESSES, HOUSEHOLDS ETC.

It is difficult to estimate the costs incurred by the elimination of backward capacities for governments, since the measures were regarded as important not only for reducing inefficient energy use and improving environmental quality, but also for changing the economic structure and making room for efficient and high value-added sectors. Despite the fact that government at both the central and local levels combined the legal, financial, technical and administrative measures where necessary, the enforcement and administrative costs involved were still much lower compared to the energy efficiency benefits, let alone the social and environmental co-benefits.

### BENEFITS OF ENERGY SAVING, REDUCTION OF LOCAL POLLUTION AND ANY OTHER SOCIAL BENEFITS

By the end of the 11th FYP, China had successfully achieved its goal to phase out backward industrial production capacity. It closed 76.83 GW of small thermal power-generating capacity and production facilities responsible for 122 million tons of iron, 72 million tons of steel and 370 million tons of cement capacity. In addition, it closed inefficient and highly polluting facilities in the paper, chemical, textile, dye-printing, alcohol, sodium glutamate and citric acid sectors. The elimination of backward industrial production capacities proved important for China in achieving its energy intensity and pollutant emission reduction goals. However, due to a lack of benchmarking information, as well as the utilization rates for each sector, it was difficult to estimate energy savings and pollution reduction benefits accurately. Comparisons between the original goals and their actual achievement are listed in following table.

**TABLE 2. Summaries of eliminating backward industrial production capacities in the 11th FYP**

INDUSTRY	UNIT	TARGET	ACTUAL TOTAL	OVER-FULFILLED BY
Coal-fired power	1,000 kW	5,000	7,682.5	53.7%
Iron	10,000 tons	10,000	12,272	22.7%
Steel	10,000 tons	5,500	7,224	31.3%
Aluminium	10,000 tons	65	84	29.2%
Ferrous-alloy	10,000 tons	400	663	65.8%
Calcium carbide	10,000 tons	200	305	52.5%
Coking	10,000 tons	8,000	10,700	33.8%
Cement	10,000 tons	25,000	37,000	48.0%
Glass	10,000 weight box	3,000	6,000	100.0%
Paper and Pulp	10,000 tons	650	1,130	73.8%

Sources: 1) The State Council, *The Comprehensive Work Plan for Energy Conservation and Emission Reduction for the 12th FYP, 2007*. 2) MIIT, *Industrial Energy Conservation Plan for the 12th FYP, Development Plans for the 12th FYP in sectors including iron and steel, non-ferrous metals, cement, petroleum and chemicals, paper and pulp, 2007*.

## 4.5 CHALLENGES EXPERIENCED

1. It was difficult nationally to shut down obsolete enterprises, as this task fell under the jurisdiction of local governments. However, obstacles remained at most local government levels, where officials were reluctant to give up tax revenues and jobs from local energy-intensive enterprises subject to closure. Despite the fact that more administrative powers were given to NDRC and MEP to strengthen energy conservation and pollution reductions, the enforcement of laws, regulations and standards remained insufficient. Even when small out-dated plants were replaced by larger and more efficient ones, some officials still worried about unemployment problems, as the more modern plants required fewer workers.
2. With its vast area, massive population and diversity of situations, China faced enormous challenges in balancing economic growth with environmental concerns. In light of the increasing downward pressure on economic growth, sustaining investment and economic output were prioritized, rather than improving energy efficiency. A lot of backward capacities were given a cost advantage and kept in business, since they could operate below legal standards or be given subsidies by local government in the form of lower energy prices. The intrinsic weakness of market mechanisms and law enforcement in China contributed significantly to the overcapacity problems, which might take years to resolve.
3. Administrative measures still play a central role in phasing out obsolete capacities currently, together with fiscal and tax support. But in the implementation phase, this usually caused inefficiency, opacity, corruption and unsustainability problems. On one hand, the advantage of Chinese governments in pooling resources to address major problems should be strengthened, but on the other hand, elimination and bankruptcy procedures for backward industrial production capacities based on market rules and environmental standards should be improved.
4. Market-based mechanisms were encouraged and piloted in local governments, such as trading electricity generation quotas among coal-fired power plants. However, in most cases, due to local protectionism and the fragmentation of industries driven by regionalism, local government officials were more willing to boost domestic output, even from zombie companies that need constant bailout to survive. A well-functioning and equitable market should be established, together with carbon trading and environmental taxes.

## 4.6 REPLICABILITY AND SCALING UP POTENTIAL

### WHY IT WORKED (FACTORS OF THE POLICY ITSELF, INCLUDING DESIGN, TARGETING SCOPE, IMPLEMENTATION ARRANGEMENT ETC.; EXTERNAL FACTORS AND CONDITIONS)

China's overcapacity was a problem long before the stimulus package of 2008, with reasons deeply rooted in development history and institutional arrangements. In the past decade, most energy-intensive sectors have been suffering from excessive outdated production capacity while struggling with weak demand and falling prices, pushing their profitability down to dangerously low levels. Intervention from governments to facilitate the elimination of backward capacities in energy-intensive sectors has helped avoid the Prisoners' Dilemma, promoting competition for higher energy efficiency, rather than stimulating a race to the bottom.

### THE FEASIBILITY OF ROLLING OUT THE POLICY IN OTHER PARTS OF THE COUNTRY OR OTHER SECTORS/SUB-SECTORS WITH SIMILAR CHALLENGES IN IMPROVING ENERGY EFFICIENCY

During the 12th FYP, the Chinese government continued the elimination of backward industrial production capacities, allocating targets for eighteen industrial sub-sectors and a total of 2,255 enterprises. Besides, energy-intensive equipment such as boilers and motors, as well as low-efficiency appliances such as incandescent lamps and air-conditioning, was included to speed up retirement and replacement. Since 2016, Chinese governments have emphasized supply-side structural reforms by aiming to reduce industrial overcapacity and form new growth momentum. The policies for eliminating backward production capacity were rolled out together with stricter enforcement of environmental quality and safety standards. With supporting measures for reemploying laid-off workers, the government has striven to cut low-end supply while increasing high-end supply through the new all-round reforms.

CHAPTER  
**5** **GOOD PRACTICE 3**

**FINANCIAL  
REWARDS FOR  
INDUSTRIAL  
ENERGY-SAVING  
TECHNICAL  
RETROFITS**

**Zhiyu Tian**



## 5.1 INTRODUCTION

In spite of continuing improvements in energy efficiency, average energy-efficiency levels in China's industrial sectors still lagged far behind those in developed countries. After the 11th FYP, the Chinese government launched the Ten Key Energy Saving Projects, providing financial rewards for industrial energy-saving technical retrofits, so as to promote energy efficiency and technical levels by a big margin in industrial sectors. The financial rewards and retrofit projects were key elements in supporting the nationally binding goal of reducing energy intensity by 20% from 2005 to 2010.

**FIGURE 4. Energy Conservation Retrofit in a Power Plant**




## 5.2 WHY THE POLICY/ PROGRAM WAS INTRODUCED AND IMPLEMENTED

Chinese governments have been supporting technical retrofits in industries since the period of the centrally planned economy through direct investment subsidies or discount loans. With the soaring energy consumption due to fast industrialization and urbanization, energy efficiency was to be prioritized to meet rapidly increasing energy demand. The policy was introduced in 2007 and aimed to accelerate energy-saving technical renovations in industry through new mechanisms of rewards based on energy savings rather than subsidies based on investments.

## 5.3 WHAT WAS DONE

### CONTENTS OF THE POLICY

1. Targeted to tap energy-saving potentials adequately, from 2007 the Chinese government implemented Ten Key Energy Saving Projects, with financial rewards for enterprises to pursue a wide range of energy-saving projects. The ten key projects included coal-fired industrial boiler (kiln) retrofit projects, District Cogeneration Projects, Waste Heat and Pressure Utilization Projects, Petroleum Saving and Substituting Projects, Motor System Energy Saving Projects, Energy System Optimization Projects, Energy Efficiency Building Projects, Green Lighting Projects, Government Agency Energy Conservation Projects, Monitoring and Evaluation, and Energy Saving Service Projects. Five-year goals and tasks for each of the ten projects were specified, as well as the implementing organizations.
2. Eligible projects under the Ten Key Projects could apply to the central government for financial rewards for making energy savings. For industrial enterprises, in order to receive the rewards, energy-saving projects must have been in the following categories of the Ten Key Projects: coal-fired boiler (furnaces) retrofits, district cogeneration projects, waste heat and waste pressure utilization projects, conservation and substitution of oil, and motor system energy conservation projects, in coordination with the Top-1,000 Enterprises Energy Efficiency Program.
3. During the 11th FYP, financial rewards were paid at a rate of 200 RMB (about 32 US\$) per tce saved in the eastern region and 250 RMB (about 40 US\$) per tce saved in the central and western regions of China, with funds from the central government's budget. To be eligible for the financial reward, each project must have a minimum energy savings of 10,000 tce. Enterprises that carried out energy-saving retrofit projects must have comprehensive energy measurement, accounting and management systems. In some rich provinces, extra rewards were also paid for eligible energy-saving retrofit projects. In addition, projects that are not eligible for rewards were clearly listed, including projects with the aim of increasing production capacity, projects whose main facility was to be phased out and projects run in violation of laws and regulations.
4. A two-step process was established for the payment of financial rewards. Once eligible projects had been approved by provincial governments - or by NDRC and MOF directly in the case of enterprises under the direct administration of central authorities - and validated by NDRC and its validation bodies, MOF would grant 60% of the incentives directly to the enterprises to carry out the program. After the energy-saving retrofit projects had been completed, final payment of 40% of the incentives would be made after the actual energy savings had been examined and verified by third-party validation agencies. Local finance bureaus would grant or deduct the incentives from the surplus or deficit of actual energy savings.



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graph TD; Enterprises[Enterprises] --> Local[Local NDRC and MOF]; Local --> Final[Final Review]; Local --> Grant60[Grant 60%]; Local --> Check[Check and Examination]; Check --> Grant40[Grant 40% or Deduct];
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The flowchart illustrates the NDRC Review Process. It begins with Enterprises, which submit applications to the Local NDRC and MOF. The Local NDRC and MOF then conduct a Check and Examination. Based on the examination, the Local NDRC and MOF can Grant 40% or Deduct. The Local NDRC and MOF also submit applications to the Final Review. The Final Review then grants 60%.

5. Market-based mechanisms such as energy management contracts were encouraged to complement the energy-saving retrofit program, as well as to promote the development of the energy service industry in China. In 2010, an ESCO (Energy Service Companies)-based rewarding program was initiated, aimed at projects with energy savings of between 100 to 10,000 tce in general, and between 500 to 10,000 tce in industrial sectors. The ESCO-based program incentives are targeted at ESCOs, which must advance more than 70% of the capital in the projects and agree to share the energy savings with their clients.
6. Actual energy savings must be validated by independent legal entities. If fraud was found in industrial retrofits projects, the application for rewards would be revoked, with requirements to return the first payment. If fraud was found in government authorities or personnel in charge of the approval, they were to be punished with disciplinary sanctions or criminal charges.

The Rewards for Industrial Energy-Saving Technical Retrofits Program was jointly administered by MOF and NDRC. During the 11th FYP, the financial rewards were granted to support implementation of energy-saving retrofits projects under the Top-1,000 Enterprises Energy Efficiency Program, carrying out the Ten Key Energy Saving Projects, improving energy efficiency performance standards and compensating capacity-building in local governments.

NDRC and MOF were responsible for implementing the rewards program, including technical assessment of projects, energy savings validation and rewards appropriation. Enterprises which applied for rewards for energy-saving retrofits projects had to submit application reports to the local NDRC in the provinces, which were sent to NDRC and MOF after provincial approval, or to NDRC and MOF directly in the case of enterprises under the direct administration of the central authorities. Local NDRC and financial bureaus were in charge of organizing, selecting and helping enterprises in submitting applications for rewards. Some third-party entities, such as Energy Saving Centers affiliated with provincial and municipal governments and independent audit companies, provided energy saving validation services during the process.

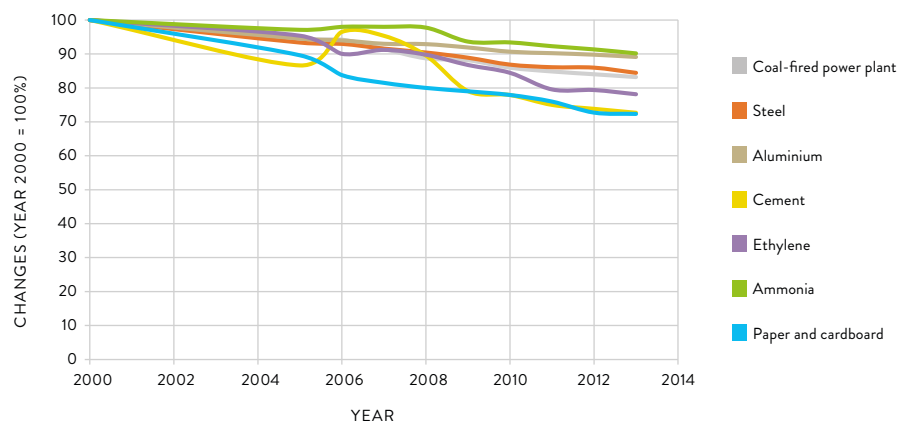
## COSTS TO GOVERNMENT, BUSINESSES, HOUSEHOLDS ETC.

Leveraged by financial rewards from central government, investments in industrial energy-saving retrofit projects increased a lot. By the end of the 11th FYP, the central government had allocated 8.1 billion RMB in the central government budget for rewarding such projects and funded more than 5100 projects from 2006 to 2010. According to incomplete estimates, in 2007 enterprises invested over RMB 50 billion in energy-saving technology innovation, and over RMB 90 billion in 2008. Generally, funding for these projects mainly came from enterprises' own funds, third-party financing and the central government. In general, rewards from central government funding represented about 5% of the total investment for the Ten Key Projects.

## BENEFITS OF ENERGY SAVINGS, REDUCTION OF LOCAL POLLUTION AND ANY OTHER SOCIAL BENEFITS

It was estimated that the cumulative energy savings from the program were about 340 Mtc during the 11th FYP, though some energy savings overlapped with the Top-1,000 Program and the Rewards for Industrial Energy Saving Retrofits Program. More importantly, energy-efficiency levels in energy-intensive sectors were improved remarkably. On average, energy consumption per unit of industrial product was basically reduced by 10%-30% from 2000 to 2013. Large-scale equipment was widely used in energy-intensive sectors.

**FIGURE 6.**  
Changes in Energy  
Consumption per Unit  
of Industrial Products



## 5.5 CHALLENGES EXPERIENCED

1. After years exploring the potential of traditional energy-conservation measures, it became more difficult for energy-intensive enterprises to conduct energy-saving retrofits, as the incremental costs of conserving one unit of energy were rising fast. Some advanced enterprises needed to redesign their production processes or carry out integrative retrofits to further improve energy efficiency, which could involve technical uncertainties and market risks.
2. The effectiveness and efficiency of public spending was always a concern globally, even in energy conservation areas with apparent market failure. In implementing the rewards program, multiple rounds of auditing and verification were carried out by central and local governments in order to strengthening supervision and avoiding inefficient use and corruption. Still, the validation processes for energy savings and money use should be improved, thus reducing administrative costs, as well as increasing the efficiency of public funds.
3. The additionality and co-benefits of retrofits project should be taken into consideration. Concerns were raised that the energy-saving technical retrofits would be implemented automatically by enterprises, even without financial support from government, as most energy-efficiency potential in energy-intensive industries could be tapped in a cost-effective way.
4. During the 11th FYP, energy savings from technical improvements contributed greatly to achieving the energy-intensity reduction goal. However, as China was shifting from energy-intensive sectors to manufacturing and tertiary sectors, structural adjustment and upgrading should be paid more attention, in addition to the energy-efficiency gains from technological innovation.
5. Market-based mechanisms should be enhanced to play a greater role in allocating public funds. Within the current rewards system, central and local governments act as buyers of energy savings from enterprises. As China intends to build a national market in carbon trading, as well as energy quotas, more flexible mechanisms based on market rules should be created.

## 5.6 REPLICABILITY AND SCALING UP POTENTIAL

### WHY IT WORKED (FACTORS OF THE POLICY ITSELF, INCLUDING DESIGN, TARGETING SCOPE, IMPLEMENTATION ARRANGEMENT ETC.; EXTERNAL FACTORS AND CONDITIONS)

Energy-saving retrofits in energy-intensive sectors created multiple benefits, not only for enterprises and governments, but also for social and environmental purposes. Financial support from governments to improve energy efficiency also helped to improve competitiveness in light of global trends to low carbon transformation. As China pledged to build a modern governance system that would permit governments to play a more proactive role, it also helped to resolve the problems of market failure and government failure in pursuing energy-efficient development pathways.

### THE FEASIBILITY OF ROLLING OUT THE POLICY IN OTHER PARTS OF THE COUNTRY OR OTHER SECTORS/SUB-SECTORS WITH SIMILAR CHALLENGES IN ENERGY EFFICIENCY IMPROVEMENTS

The rewards for the energy-saving technical retrofits program have been continued in the 12th FYP, with fiscal rewards increased to 240 RMB (about 38 US\$) per tce energy saved in the eastern region and 300 RMB (about 48 US\$) per tce saved in the central and western regions, and the threshold of energy savings for eligible projects has been reduced to 5000 tce.<sup>iv</sup> Local governments also had similar programs to support small and medium enterprises in implementing energy-saving retrofits. Recently, due to concerns about additionality and corruption issues in such projects, the government has made changes rewards, with more support for pilots of advanced technologies, energy-efficiency innovation and comprehensive retrofits combining energy-efficiency improvements and pollution reductions.

# **CHAPTER 6** **GOOD PRACTICE 4**

## **ENERGY EFFICIENCY STANDARDS FOR NEW BUILDINGS**

**Jianguo Zhang**

## 6.1 INTRODUCTION

Since 1986, China has successively enacted building energy efficiency design standards for different climatic regions and different building types. At present, the mandatory design standards for the energy efficiency of residential buildings in urban areas in China are implemented in severe cold and cold regions, hot-summer and cold-winter regions, and hot-summer and warm-winter regions respectively (see Figure 7). The Design Standard for the Energy Efficiency of Public Buildings is compulsory for public buildings; the design standard for energy efficiency in residential buildings in rural areas was only released in 2013, being a non-mandatory but recommended standard.

**FIGURE 7. Building Climatic Region Division in China**



**FIGURE 8. Design Standard for the Energy Efficiency of Buildings**



## 6.2 WHY THE POLICY/ PROGRAM WAS INTRODUCED AND IMPLEMENTED

China is in a rapid development phase of urbanization, with both the building area and the building energy consumption level increasing rapidly. From 2000 to 2010 the urban building area doubled, and the total building area has increased by nearly 53% accumulatively, at an annual growth rate of approximately 2 billion square metres, while the building stock has reached more than 52 billion square metres. There is still great room to increase the level of urbanization in the future, and the total building area will also be further increased. The rapid growth in total building area has fundamentally driven the continuous rise in building energy consumption. On the other hand, building is a durable product, and building energy consumption has lock-in effect. If no powerful energy-efficiency measures are taken during the construction phase, this will affect energy consumption for decades once the buildings have been constructed. Therefore, there must be mandatory requirements for a design standard for the energy efficiency of new buildings.

## 6.3 WHAT WAS DONE

### CONTENTS OF THE POLICY

China asks that newly constructed, reconstructed and extended urban residential buildings and public buildings must implement the design standards for the energy efficiency of buildings. From the perspective of content, these design standards mainly concern some compulsory requirements regarding the building envelope, which is usually compared with the energy performance of the typical local building at the beginning of 1980s and is expressed by an energy-saving percentage, such as “saving energy by 50%”, “saving energy by 65%”, etc. The Design Standard for the Energy Efficiency of Public Buildings has been implemented since 2005 and was revised in 2014. In making comparisons with the public buildings designed at the beginning of the 1980s, the requirement is to reduce year-round energy consumption by 50%. The Design Standard for the Energy Efficiency of Residential Buildings in Severe Cold and Cold Regions, implemented after revision in 2010, called for energy savings of 65% compared to the energy consumption of the centralized heating of the typical local building at the beginning of 1980s. Both the Design Standard for the Energy Efficiency of Residential Buildings in Summer Hot and Winter Cold Regions implemented after revision in 2010 and the Design Standard for the Energy Efficiency of Residential Buildings in Summer Hot and Warm Winter Regions implemented after revision in 2012 call for energy savings of 50% in each case. That is, while the same indoor thermal environment is guaranteed, through comparison with the situation without taking energy efficiency measures, the total energy consumption of year-round heating and air-conditioning should be reduced by 50%.



## IMPLEMENTATION SCOPE AND INSTITUTIONAL ARRANGEMENT

The Regulation on Energy Conservation in Civil Buildings promulgated in 2008 requires the competent department of building construction in all provinces to incorporate the compulsory standard for the energy efficiency of civil constructions to be implemented for new buildings through the whole-process supervision and management of construction projects. So far, all provinces in China have gradually established the whole-process energy-efficiency supervision mechanism of new buildings from planning, design, construction drawing review, construction and completion acceptance filing to sales and application phases. In the construction drawing review phase, it calls for a special review of building energy efficiency. Through the review, if the building is not compliant with the compulsory standards for the energy efficiency of civil constructions, the competent department of building construction should not issue a construction permit; in the phase of completion acceptance, if the building does not meet the compulsory standards for the energy efficiency of civil constructions, the completion acceptance report will not be issued. The Ministry of Housing and Urban-Rural Development (MOHURD) has organized and conducted special supervision and inspection of energy conservation and emission reductions in the construction field annually since 2005 by focusing on the inspection of new buildings in implementing the compulsory standards for the energy efficiency of buildings in all provinces. Meanwhile, all provinces also conducted periodic inspections of the energy efficiency of buildings accordingly, intensified the efforts on law enforcement, and urged implementation of the compulsory standard for the energy efficiency of buildings.

### WHICH GOVERNMENT AGENCIES, INDUSTRIAL ORGANIZATIONS AND BUSINESSES ARE INVOLVED

The national standards for the energy efficiency of civil constructions are organized, formulated and released by the Ministry of Housing and Urban-Rural Development (MOHURD) according to legal procedures. The design unit, construction unit, construction supervision unit and their registered practitioners are to conduct design, construction and supervision tasks according to the compulsory standards for the energy efficiency of civil constructions.

## 6.4 EFFECTS OF THE POLICY/ PROGRAM

### COSTS TO GOVERNMENT, BUSINESSES, HOUSEHOLDS ETC.

For government, formulating and implementing design standards for the energy efficiency of buildings may increase some administrative costs; for developers, it will increase the costs of investment for appropriately increasing the technical measures for the energy efficiency of buildings; for users, it will reduce the operating costs of the energy efficiency of buildings in the long term. At present, the construction costs of energy-efficient building in China are generally 5-7 percentage points higher than the construction costs of ordinary building projects.

### BENEFITS OF ENERGY SAVING, LOCAL POLLUTION REDUCTION AND ANY OTHER SOCIAL BENEFITS

Significant achievements have been made in the implementation of compulsory standards for the energy efficiency of new buildings in urban areas in China. The implementation rate of standards has been continuously improved. The standard implementation rate during the design and construction phases was only 53% and 21% respectively in 2005, but increased to 100% and 95% respectively in 2010; during 2006-2010, accumulated energy-efficient buildings constructed nationwide reached 4.9 billion square metres.<sup>vi</sup> During the twelfth Five-year Plan period (2011-2015), the design standards for the energy efficiency of buildings has been implemented comprehensively at a higher requirement. As of the end of 2014, the implementation rate of the compulsory standard for energy efficiency during the design and construction phases of new buildings in urban areas reached 100% and 99% respectively; the implementation rate of the compulsory standard for energy efficiency in super-large cities was 100%. The new energy-efficient building area in urban areas during 2011-2014 exceeded 5 billion m<sup>2</sup>; energy-efficient buildings in urban areas nationwide exceeded 10 billion m<sup>2</sup> accumulatively.<sup>vii</sup> According to relevant research, the energy-saving capability generated from the implementation of the design standard for the energy efficiency of new buildings in China reached 13 Mtce, 10 Mtce, 13 Mtce and 11 Mtce in 2011, 2012, 2013 and 2014 respectively;<sup>viii</sup> the energy-saving capability accumulatively generated by new buildings during 2011-2014 was 47 Mtce.

## 6.5 CHALLENGES EXPERIENCED

### WHAT WORKED AND WHAT DID NOT WORK, AND ANY ADJUSTMENT IN THE POLICY-IMPLEMENTING PROCESS

Compulsory design standards for the energy efficiency of buildings are now available for public buildings and urban residential buildings in all climate regions across the country. Through comparisons with the energy efficiency level in developed countries, we can see that there is a big gap in existing standards for the energy efficiency of buildings. For example, the newly revised design standard for the energy efficiency of public buildings (GB50189-2014) is more than 20% stricter than the terminal energy intensity required by the American Energy Standard for Building (ASHRAE90.1-2013). The competent government department conducts inspections of the implementation of energy-saving standards for buildings annually, but the inspection mainly focuses on large and medium-sized cities.

Work in the future: China should formulate and implement more rigid energy efficiency standards for buildings. Such standards should also be periodically updated. China should also build up the overall building energy consumption-based energy-saving standards for buildings, as well as provide more resources to intensify the supervision and inspection of the implementation of energy-saving standards for buildings and expand the inspection range to medium and small-sized cities.

## 6.6 REPLICABILITY AND SCALING-UP POTENTIAL

### WHY IT WORKED (FACTORS OF THE POLICY ITSELF, INCLUDING DESIGN, TARGETING SCOPE, IMPLEMENTATION ARRANGEMENT ETC.; EXTERNAL FACTORS /CONDITIONS)

1. Climate condition is an important factor affecting the performance of building energy. Building energy conservation in China is mainly carried out according to different climates progressively;
2. The design standards for the energy efficiency of buildings in China stemmed from the design standards for the energy efficiency of residential buildings in the northern heating region, which realises the full coverage of the region, including severe cold and cold regions, summer hot and cold winter regions, and summer hot and warm winter regions; the building types should be fully covered, including residential buildings and public buildings;

3. The requirements of design standards for the energy efficiency of buildings have gradually been improved. Now China has put forward “three-step” energy efficiency standards. For example, for residential buildings in regions of severe cold and cold, the first step is that, since 1986, the energy consumption for space heating in new residential buildings should be reduced by 30% on the basis of local general design energy consumption during 1980-1981. The second step is that another 30% should be saved for energy on the basis of having met the requirements for energy conservation in the first step since 1996, i.e., total energy consumption should be reduced by 50%. The third step, since 2005, is that energy consumption should be reduced by 30% on the basis of having met the requirement for energy conservation in the second step, i.e., the total energy consumption reduction should be up to 65%. In this case, in the requirement for energy conservation by 30% each time, the building envelope should contribute approximately 20% and the heating system approximately 10%.

### THE FEASIBILITY OF ROLLING OUT THE POLICY IN OTHER PARTS OF THE COUNTRY OR OTHER SECTORS/SUB-SECTORS WITH SIMILAR CHALLENGES IN ENERGY EFFICIENCY IMPROVEMENTS

It is important for the energy conservation of buildings to be able to formulate and implement compulsory design standards for the energy efficiency of buildings. This can also be used for new buildings in the countries all around the world, but suitable requirements for the design standards for the energy efficiency of buildings should combine with local resource endowments, climate conditions, levels of economic development, etc. All provinces may formulate and implement local design standards for the energy efficiency of buildings that are stricter than the national requirements for different building types according to local conditions.

# **7** CHAPTER **GOOD PRACTICE 5**

## **ENERGY CONSERVATION RETROFIT OF EXISTING BUILDINGS**

**Jianguo Zhang**



## 7.1 INTRODUCTION

The energy conservation retrofit of existing buildings is mainly targeted at existing residential buildings and public buildings (commercial buildings) that do not meet the requirements of the energy conservation standard for buildings. Retrofitting the building envelope, heating supply or air conditioning and refrigeration (heating) building energy consumption system, etc., will enable the thermal performance building envelope and the thermal efficiency of the energy consumption system to meet the requirements of appropriate design standard for the energy

efficiency of buildings. The energy conservation retrofit of existing buildings includes the energy conservation retrofit of urban residential buildings and of large public buildings. In this case, in the northern heating regions, the focus is on the energy conservation retrofit of existing residential buildings. For the government, the envelope, heat-metering and pipe network heat equilibrium retrofit are taken as the key points. The northern heating regions are to actively implement the Energy Conservation and Warm House project. The national finances have a special fund to reward achieving the heat-metering and energy conservation retrofit of the existing residential buildings in this region.

**FIGURE 9. Energy Conservation Retrofit of Existing Buildings**



## 7.2 WHY THE POLICY/ PROGRAM WAS INTRODUCED AND IMPLEMENTED

The stock of existing buildings in China is huge. In 2010 existing buildings reached more than 52 billion m<sup>2</sup>; most of them are non-energy efficient buildings, the proportion of energy-efficient buildings being less than 30%. The energy consumption of urban buildings in the northern region is great, accounting for approximately a quarter of nationwide building energy consumption. In this region, there are approximately 2 billion m<sup>2</sup> of existing buildings that should be reconstructed.<sup>ix</sup> Most residents of old residential houses in the northern region are urban medium- and low-income groups. Because the building envelopes generally lack of insulation measures, the indoor thermal environment is poor in winter. Energy conservation retrofitting of the existing residential buildings can not only promote the energy conservation of buildings, but also improve the living conditions of urban medium and low-income groups.

## 7.3 WHAT WAS DONE

### CONTENTS OF THE POLICY

China has called for efforts in respect of the energy conservation retrofit of existing buildings to be strengthened and has set out specific related objectives and tasks in the relevant energy conservation and emission reduction plan. For example, in 2011-2015, the State Council asked for the energy conservation retrofit of 400 million m<sup>2</sup> of existing residential buildings in the northern heating region to be achieved. The Ministry of Housing and Urban-Rural Development (MOHURD) distributed the retrofit tasks to all provincial governments by annual plan according to the requirements of the objectives and tasks of the planned energy conservation retrofit of existing buildings, and asked for an annual assessment.

From 2008 to 2014, the national finances ran a special fund to reward the heat-metering and energy conservation retrofit of the existing residential buildings in the northern heating region. The standard for the rewards fund of the central finance is 8.73 US\$/m<sup>2</sup> (55 RMB/m<sup>2</sup>) (building area, similarly hereafter) in severe cold regions and 7.14 US\$/m<sup>2</sup> (45 RMB/m<sup>2</sup>) in cold regions.<sup>4</sup> The rewards fund is mainly used to reward the building envelope energy conservation retrofit, indoor heat supply system metering and temperature regulation retrofit, heat supply network and pipe network heat equilibrium retrofit, etc. The energy conservation retrofit of the building envelope is weighted at 60%. On the basis of the central finance reward fund, local government also arranged a local financial support fund to increase investment in the energy conservation retrofit of buildings.

### IMPLEMENTATION SCOPE AND INSTITUTIONAL ARRANGEMENT

The energy conservation retrofit of the existing residential buildings in the northern heating region is mainly targeted at the heat-metering and energy conservation retrofit of the existing residential buildings in fifteen provinces in North China. The retrofit modes are government dominance, heat supply company dominance, energy service company dominance, etc. According to the survey by MOHURD, the dominant mode is government dominance (the proportion exceeds the energy conservation retrofit project by 70%).

Clear objective and responsibility division. The Ministry of Housing and Urban-Rural Development assigns the tasks of the energy conservation retrofit of the existing buildings to each provincial government according to an annual plan, signs target specifications, incorporates the energy conservation retrofit of the existing buildings into the working scope of the national “special review of building energy conservation” and conducts inspections annually. At the provincial level, the work should be led, organized and implemented by the provincial Department of Housing and Urban-Rural Development; at the same time, government departments will further delegate these tasks to lower local government so as to define objectives and responsibilities clearly.

Given fund support. The central finance-arranged special fund to reward the heat-metering and energy conservation retrofit of the existing residential buildings in northern heating region. Local finance departments provided a supporting subsidy fund at the proportion of 1:1 to increase investment in the energy conservation retrofit of buildings. Meanwhile, all provinces are to establish diversified funding mechanisms, with market-based financing as the main form, should actively support the projects of Energy Performance Contracting (EPC), and should direct heat-supply enterprises, residents, units of original property rights and other social funds to invest in retrofit building projects.

### WHICH GOVERNMENT AGENCIES, INDUSTRIAL ORGANIZATIONS AND BUSINESSES ARE INVOLVED

Promotion of energy conservation retrofits of existing buildings involves governmental departments, including the development and reform departments of central government and local government, the department of housing and urban-rural development, the finance department etc., as well as heat-supply enterprises, energy service companies, residents and other stakeholders.

## 7.4 EFFECTS OF THE POLICY/ PROGRAM

### IN TERMS OF COSTS TO GOVERNMENTS, BUSINESSES, HOUSEHOLDS ETC..

In terms of retrofit costs, there are great differences between regions. The energy conservation retrofit cost of the building envelope, heat-metering and pipe network thermal equilibrium is roughly within the range of US\$ 23.6-63.5 (RMB 130 - 400) per square meter of building area. The average cost is above US\$ 34.9 (RMB 220) per square meter of building area.<sup>xii</sup> The costs required may be more than the costs of heat-source retrofits alone.

### BENEFITS OF ENERGY SAVING, LOCAL POLLUTION REDUCTION AND ANY OTHER SOCIAL BENEFITS

During the period 2011-2015, the envelope, heat-metering, and pipe network heat equilibrium retrofit were taken as key points. The northern heating regions have actively implemented the project Energy Conservation and Warm House. According to the estimate by MOHURD, as of the end of 2014, the accumulative area of the heat-metering and energy conservation retrofit of existing residential buildings completed in these four years was 960 million m<sup>2</sup>. According to relevant research, the energy-saving capacity generated from the energy conservation retrofit of existing buildings in the northern urban heating regions reached 1.45 Mtce, 2.42 Mtce, 2.46 Mtce and 1.92 Mtce in 2011, 2012, 2013 and 2014 respectively.<sup>xiii</sup> The energy-saving capacity generated accumulatively from the energy conservation retrofit of the existing buildings in the northern heating region during 2011-2014 was 8.25 Mtce. In addition, according to the practical experience of the Energy Conservation and Warm House project, the energy conservation retrofit of old residential houses has significantly improved the indoor thermal environment, and room temperatures in winter have increased generally by 3-5°C. In addition, the retrofit led to integration with the urban landscape into a whole, and it has driven the construction of the urban landscape and the construction of a liveable city, as well as increasing the value of housing and adding to the appreciation potential of the housing.

## 7.5 CHALLENGES EXPERIENCED

### WHAT WORKED AND WHAT DID NOT WORK, ANY ADJUSTMENT IN THE POLICY IMPLEMENTING PROCESS

Clearly the objectives and tasks of the energy conservation retrofit of existing buildings should be defined so as to arrange a special financial fund with the government leading. Measures are taken to mobilize the enthusiasm of the heat supply unit, property management unit and residents in order to encourage them to participate in the energy conservation retrofit of buildings. Meanwhile, the Energy Conservation and Warm House project should be closely combined with the shanty town retrofit and the construction of affordable housing project, as well as with the urban landscape and the comprehensive improvement of old residential quarters. By way of advancing on the whole, this will practically guarantee that the general population have warm houses to live in and ensure that their energetic support will be forthcoming.

The present mode of the energy conservation retrofit of existing buildings is dominated by the government. The new mode, which is dominated by heat-supply enterprises or energy service companies, should be encouraged, with participation by way of marketization.

## 7.6 REPLICABILITY AND SCALING UP POTENTIAL

### WHY IT WORKED (FACTORS OF THE POLICY ITSELF, INCLUDING DESIGN, TARGETING SCOPE, IMPLEMENTATION ARRANGEMENT ETC.; EXTERNAL FACTORS /CONDITIONS)

1. Government attaches importance and clearly defines the objectives and tasks, intensifies organization and leadership, and clearly defines responsibilities and the division of labour;
2. Energy conservation retrofits of existing buildings can be combined with improvements to people's livelihoods with the support and cooperation of the masses. The key points are highlighted and implemented centrally, and specific retrofit areas are selected by the ways of advancing on the whole;
3. Funds are put in place. Both the central government and local government should arrange special financial funds respectively and support the energy conservation retrofit project of buildings by "substituting subsidies with rewards" and raising the funds necessary to build energy conservation retrofits through a wide variety of channels, including the market approach.
4. The supporting incentives are issued and preferential policies regarding taxes and dues relating to the energy conservation retrofit project of the existing buildings are implemented.

### THE FEASIBILITY OF ROLLING OUT THE POLICY IN OTHER PARTS OF THE COUNTRY OR OTHER SECTORS AND SUB-SECTORS WITH SIMILAR CHALLENGES IN MAKING ENERGY-EFFICIENT IMPROVEMENTS

1. Promoting the energy conservation retrofit of existing buildings can exploit the energy conservation potential of the buildings in stock. This is also suitable for promotion in other countries. In particular, it is necessary to carry out the energy conservation retrofit of the existing buildings in those countries with large quantities of building stock but lower energy utilization rates for buildings.
2. Beyond the northern heating region, the existing urban residential buildings in the summer hot and cold winter regions and summer hot and warm winter regions in China may also be retrofitted. However, the focus here should be on the doors and windows of buildings, external sunshade, natural ventilation, etc., so as to exploit a suitable retrofitted mode and technical route.
3. Currently the energy conservation retrofit of existing buildings in China is mainly dominated by government and needs to arrange a certain financial special fund. The quantity of financial subsidy funds is an important factor that affects the smooth implementation of the energy conservation retrofit of buildings. It has some limitations and needs to further innovate the working mechanism for the energy conservation retrofit of existing buildings, especially marketization mechanisms.



# GOOD PRACTICE 6

## PROMOTING ENERGY EFFICIENT APPLIANCES

Jianguo Zhang

## 8.1 INTRODUCTION

The Chinese government initiated the “Energy Efficient Product Benefitting Resident Project” in May 2009 to promote ten main categories of high-level energy-efficient products through fiscal subsidy, including room air-conditioners, refrigerators, flat-screen televisions, washing machines, TVs, etc. which are above energy efficiency grades 1 or 2. In addition, high-efficiency lighting products, energy efficiency or new energy vehicles that have been issued in 2007 are also being promoted. Fiscal subsidy standards are determined at a certain ratio of the difference between high-level energy efficiency products and similar ordinary products in cost terms. The subsidy beneficiary is the buyer of high-level energy efficiency products, including consumers and users. The buyer purchases high-level energy efficiency products from the market at lower prices after being subsidized, indirect subsidies being adopted. Promotional bid-winning enterprises are determined by way of invitations for bids.

**FIGURE 10. Energy Efficient Air Conditioners and Refrigerators with Energy Efficiency Labeling**



## 8.2 WHY THE POLICY/ PROGRAM WAS INTRODUCED AND IMPLEMENTED

In order to deal with the severe impact of the international financial crisis on the economy since 2008, the “Energy Efficient Product Benefitting Resident Project” has been designed to expand domestic demand and drive economic development; to expand the market share of high-level energy efficiency products to support the promotion and use of high-level energy efficiency products; to enable large numbers of consumers to afford and use high-level energy-efficient products and enjoy the material benefits

of saving electricity and money brought in by such products; and to promote technical advancements and improve the energy efficiency levels of energy-consuming products.

**FIGURE 11. Energy efficiency standards issued**



## 8.3 WHAT WAS DONE

### CONTENTS OF THE POLICY

In May 2009, the Ministry of Finance and the National Development and Reform Commission issued a Notice on Implementing the Project of “Energy Efficient Products Benefitting the Public”, and launched a special fund to support the promotion and use of high-level energy-efficient products with fiscal subsidies. It also decided that high-level energy-efficient products must meet certain conditions to obtain fiscal subsidies.

The mode of indirect subsidy was adopted for high-efficiency household appliances. Manufacturing enterprises sell products at a price after deducting the fiscal subsidy from the normal selling price, while the government grants fiscal subsidies to manufacturing enterprises according to the promotional quantity and subsidy standard of the product. Taking room air-conditioners as an example, the subsidy of US\$ 24-32 (RMB 150-200) per unit is granted to the buyer of the air conditioner at energy efficiency grade 2, and the subsidy of US\$ 32-40 (RMB 200-250) per unit is granted to the buyer of the air conditioner at energy efficiency grade 1.<sup>xiii</sup> For high-efficiency lighting products, the central finance department is planning to grant a subsidy of 50% of the supply price in the bid-winning agreement for each high-efficiency lighting product to urban and rural residents, as well as a subsidy of 30% of the supply price in the bid-winning agreement for each high-efficiency lighting product to bulk users. On the basis of national subsidies, some local governments have formulated supporting subsidy policies. For example, on the basis of the national subsidy of 50%, Beijing municipal and district governments also provide 30% and 10% subsidies respectively, rolling out the so-called policy of “RMB 1 for one energy-efficient bulb”.<sup>xiv</sup>



## IMPLEMENTATION SCOPE AND INSTITUTIONAL ARRANGEMENT

The state incorporates the high-level energy-efficient product with large quantities and wide coverage, energy-consuming intensity and significant energy-saving potential into the range of fiscal subsidy promotions. The energy efficiency products with fiscal subsidies include four main categories of product: high-efficiency household appliance products, including room air conditioners, refrigerators, flat-screen TVs, washing machines, water heaters, etc. and high-efficiency lighting, energy-efficient automobiles and high-efficiency motors, adjusted depending on the actual situation. Specific mechanism arrangements are as follows:

1. Select high-level energy-efficient product and include it in subsidy range. Priority is given to the promotion of the high-level energy efficient product with a lower market share but with greater energy-saving potential, thus driving domestic demand and enjoying high social influence;
2. Formulate detailed rules for product promotion according to the requirements of the Interim Procedures for the Management of the Fiscal Subsidy Fund for the Promotion of high-level energy-efficient products, etc.;
3. Screen high-level energy-efficient products and manufacturing enterprises meeting the requirements of the national standard for energy efficiency and the requirements for the relevant energy-efficiency indicators, as well as determine the specific object of fiscal subsidy promotion;
4. Manufacturing enterprises are asked to report the monthly promotion of energy-efficient products to relevant state departments and submit their applications for fiscal subsidy funding;
5. Conduct inspection of the performance of high-level energy-efficient products and carry out supervision and management.

## WHICH GOVERNMENT AGENCIES, INDUSTRIAL ORGANIZATIONS AND BUSINESSES ARE INVOLVED

The organization and implementation of the “Energy Efficient Product Benefitting Resident Project” involves the National Development and Reform Commission (NDRC), the Ministry of Finance (MOF) and the General Administration of Quality Supervision under the central government, the competent department of energy efficiency and finance department under local governments, and stakeholders including energy-efficiency product manufacturing enterprises, selling enterprises, certification authorities, consumers, etc.

The organizational units include the National Development and Reform Commission, the Ministry of Finance, and the General Administration of Quality Supervision, and the governmental departments of all provinces, including local Development and Reform Commissions, local Committees of Economy and Information Technology, Departments of Finance, etc.

The subjects of implementation include household appliance manufacturing enterprises, industrial general energy-using equipment manufacturing enterprises, mechanical and electrical product-selling enterprises, etc. In addition, the China National Institute of Standardization, certification authorities, etc. are participating agencies.

## 8.4 EFFECTS OF THE POLICY/ PROGRAM

### IN TERMS OF COSTS TO GOVERNMENT, BUSINESSES, HOUSEHOLDS ETC.

Government provides a subsidy of US\$ 48-135 (RMB 300-850) per unit to consumers who buy highly energy-efficient products which are above energy efficiency grades 1 or 2, including room air conditioners, refrigerators, flat-screen TVs, washing machines, etc. During 2009-2010, the central finance department arranged US\$ 1.83 billion (RMB 11.54 billion) of funding to support the promotion of more than 34,000,000 units of highly energy-efficient air conditioners. In May 2012, the central finance department arranged another US\$ 4.21 billion (RMB 26.5 billion) to promote over 77,000,000 units of high-efficiency household appliances, including highly energy-efficient air conditioners, refrigerators, flat-screen TVs, washing machines, water heaters, etc. The central finance department also arranged US\$ 0.35 billion (RMB 2.2 billion) to support the promotion of energy-efficient lamps, including LED lamps.<sup>xv</sup>

### BENEFITS OF ENERGY SAVING, LOCAL POLLUTION REDUCTION AND ANY OTHER SOCIAL BENEFITS

Under the 11th “Five-year Plan”, the “Energy Efficient Product Benefitting Resident Project” supported the promotion of more than 34,000,000 units of high-level energy-efficient air-conditioners, directly drove the consumption of more than US\$ 11.1 billion (RMB 70 billion), and achieved annual electricity savings of 10 billion kWh. The electricity saved during the life cycle of the product is 80-100 billion kWh; the market share of high-level energy-efficient air conditioners has increased from 5% before promotion to more than 70%, and the average energy-efficiency level of the industry has been increased by 24%. The price of high-level energy-efficient air-conditioner has been reduced from US\$ 476-635 (RMB 3,000-4,000) per unit to approximately US\$ 317.5 (RMB 2,000), and accumulatively the cost saved by consumers has been up to US\$ 4.8 billion (RMB 30 billion). Accumulatively sales of 360 million units of low-mercury-level energy-efficient lamps have been promoted, directly driving consumption worth US\$ 0.65 billion (RMB 4.1 billion). The annual electricity saving is 12.5 billion kWh. The electricity saving within the life-cycle of the product is 62.7 billion kWh. The market price of energy-efficient lamps has been reduced by 40%.<sup>xvi</sup>

During 2011-2013, the central finance arranged US\$ 10 billion (RMB 61.7 billion) of funding to support the implementation of the Energy Efficient Benefitting Resident project and accumulatively promoted 96,000,000 units of energy-efficient household appliances, more than 7,300,000 units of energy-efficient vehicles, 24,750,000 kWh of high-efficient motors, 400 million units of high-efficient lighting products and nearly 10,000,000 units of semiconductor lighting products, and drove the consumption of energy-efficient products worth by US\$ 136.5 billion (RMB 860 billion). The annual achievable energy-saving capability is 15.6 Mtce.<sup>xvii</sup>

## 8.5 CHALLENGES EXPERIENCED

### WHAT WORKED AND WHAT DID NOT WORK, ANY ADJUSTMENT IN THE POLICY IMPLEMENTING PROCESS

The “Energy Efficient Product Benefitting the Public” Project has established a mechanism for implementation, including definite organizational units, implementation subjects, fiscal fund support, clear management measures for fiscal subsidy funds, the principles of screening high-level energy-efficient products and manufacturing enterprises, and detailed rules for the implementation of the promotion of energy-efficient products, etc.

The “Energy Efficient Product Benefitting Resident Project” has achieved remarkable effects in improving the market share of high-level energy-efficient products and effectively driving domestic demand, especially consumption demand; however, some problems still exist, such as fewer varieties of energy-efficient products promoted, enhancement of supervision and management, insufficient effort on promotion in the whole society, etc.

Next, we should expand the varieties of energy-efficient products for promotion, adjust and upgrade the requirements of the fiscal subsidy of energy-efficient products, establish a traceability mechanism in promotional information on energy-efficient products and perfect the supervision, inspection and punishment system to impose severe punishment on the producing and selling of nonconforming products and illegal activities.

## 8.6 REPLICABILITY AND SCALING UP POTENTIAL

### WHY IT WORKED (FACTORS OF THE POLICY ITSELF, INCLUDING DESIGN, TARGETING SCOPE, IMPLEMENTATION ARRANGEMENT ETC.; EXTERNAL FACTORS /CONDITIONS)

1. Make clear objectives, fuel domestic demand, and expand the market share of high-level energy-efficient products;
2. Organizational guarantee, with clearly defined governmental department in charge of organization and implementation;
3. Fund guarantee, with the special fund supported by the central finance, and definite measures for the management of financial subsidy funds;
4. Object selection, through the screening of high-level energy-efficient products incorporated into the range of subsidy and manufacturing enterprises;
5. Promotion, by formulating and implementing detailed rules for the promotion of energy-efficient products;
6. Supervision and inspection, through sampling inspections of the performance of energy-efficient products being promoted.

### THE FEASIBILITY OF ROLLING OUT THE POLICY IN OTHER PARTS OF THE COUNTRY OR OTHER SECTORS AND SUB-SECTORS WITH SIMILAR CHALLENGES IN ENERGY EFFICIENCY IMPROVEMENTS

The “Energy Efficient Product Benefitting Resident Project” supports the promotion of high-level energy-efficient products by way of fiscal subsidies. This is a short-term market incentive measure that could also be made available in other countries, especially countries where the market share of energy-efficient products is currently lower, but with the potential for wide applications with obvious energy-saving possibilities. Nevertheless, the conditions for fiscal subsidies should be adjusted along with the change in the market share of energy-efficient products and technical advances. The fiscal subsidy should be gradually reduced until it is finally cancelled.



# 9 CHAPTER GOOD PRACTICE 7

## PROMOTING ENERGY EFFICIENT AND NEW ENERGY VEHICLES

Wenjing Yi

## 9.1 INTRODUCTION

In 2015, China surpassed United States as the first largest new energy vehicle<sup>1</sup> market, with sales more than 330,000 vehicles. The explosive increase in the new energy vehicles can be attributed to the subsidy for them, charger infrastructure construction, R&D, pilot demonstration and other promotional policies. Especially since 2009, policies targeting increasing the penetration rates of new energy vehicles have come into force, pushing the deployment of new energy vehicles tremendously.

<sup>1</sup> Including electric vehicles, hybrid vehicles and natural gas vehicles.

FIGURE 12. Electric Vehicle



## 9.2 WHY THE POLICY/ PROGRAM WAS INTRODUCED AND IMPLEMENTED

The new energy vehicle manufacturing sector is considered to be one of the strategic emerging industries in China. Many developed countries also see the development of new energy vehicles as one element of a third industrial revolution. The Chinese government would therefore like to grasp the opportunity of vigorously developing car manufacturing industry as one of the pillars of the country's economy. Using mainly electricity, the new energy vehicles are also potential replacements for conventional internal combustion engine vehicles, thus reducing oil consumption and oil dependency rates. With the cleaner mix and lower carbon trend of the electricity generating sector, the new energy vehicles could also contribute to air quality improvements and greenhouse gas reductions.

## 9.3 WHAT WAS DONE

### CONTENTS OF THE POLICY

Policies to promote energy saving and new energy vehicles include various kinds of measures and tools. The subsidy on vehicle purchases functions as the main driver for the jump-starting of new energy vehicles, and a portfolio of supporting policies ensures their increase. Targets and strategies are made in the planning stages for new energy vehicle development and in other relating planning. Some implementation and demonstration measures are designed for public institutions, city buses, governments, etc. Other supporting plans, including technological innovation and charging for infrastructure construction, have also been designed for the development of new energy vehicles. However, the most important policy for improving the ownership of these new energy vehicles is the subsidy.

FIGURE 13. Energy saving and new energy vehicle promotion policies since 2009

State Council	Planning on adjustment and revival of automobile industry	Decision on Accelerating the Fostering and Development of Strategic Emerging Industries	12th FYP of Social and Economic Development	Industrial Transition Upgrade Plan		Guidance on Promotion of New Energy Vehicle Development	Guidance on Construction of Charging Infrastructure for EVs
Multi-ministries	Notice of Pilot Demonstration and Development Energy Saving and New Energy Vehicles Interim Subsidy Method on Demonstration and Development of Energy Saving and New Energy Vehicles	Subsidy on Private New Energy Vehicles	Guidance on Strategic Emerging Industry Globalization	Development Planning for Energy Saving and New Energy Vehicles 2012-2020	Fuel Consumption Evaluation Methods for Passenger Cars	Notice of Supporting Demonstration and Development of New Energy Vehicles in Shenyang, Changchun Implementation measures for Purchasing New Energy Vehicles for Governments and Public Institutions	Fiscal support for Promoting New Energy Vehicles 2016-2020
NDRC						Notice of Electric Price for EVs	
MIIT			12th FYP of Industry and Technology Innovation	Batter Electric Passenger Car Specifications			
MOST			12th FYP of Science and Technology Development	12th FYP of Electric Vehicle Technology Development			
SAT				Vehicle and Vessel Tax Law of China			
MOT						Implementation Guidance on Demonstration and Development of New Vehicles	
	2009	2010	2011	2012	2013	2014	2015

Phase I of the Electric Vehicle Subsidy Scheme (EVSS) started in 2009. In the beginning, the subsidy was only available to public procurements, mostly of transit buses and taxis. In 2010, the subsidy was extended to include private purchases. Phase I of the EVSS ended at the end of 2012. After nine months of policy absence, Phase II of the EVSS was announced in September 2013 and continued through 2015. It covered both public and private purchases.

Under Phase I of the EVSS, subsidies for private purchases of PHEPV (plug-in hybrid electric passenger vehicles) and BEPV (battery electric passenger vehicles) are based on the vehicle's battery capacity, with a subsidy intensity of RMB 3,000/kWh. The maximum subsidy amount for PHEPV and BEPV are limited to RMB 50,000 and RMB 60,000 respectively. Phase I of the EVSS requires the battery capacities of qualified PHEPVs and BEPVs to be higher than 10 kWh and 15 kWh. Under Phase II, subsidies for private purchases of PHEPVs and BEPVs are based on the vehicle's electric range. For PHEPVs, the subsidy is fixed at RMB 35,000 for all vehicles with an electric range of 80km or more. For BEPVs, there are three subsidy levels. Vehicles with electric ranges of 250 km or more, 150–250 km and 80–150 km qualify for RMB 60,000, RMB 50,000 and RMB 35,000 subsidies, respectively.

For both phases of the EVSS, there are subsidy phase-out mechanisms (SPM). Under Phase I, SPM is only effective for private purchases. It requires that once the sales of PHEPVs or BEPVs from one vehicle manufacturer exceed 50,000, subsidy for EVs of this manufacture should be reduced. The reduction range is not specified. Actually, as no single vehicle manufacturer has sold more than 50,000 PHEPVs or BEPVs, the SPM was never triggered during Phase I. Under Phase II, the SPM required that the subsidy for all EVs were to be reduced by 10% in 2014 and 20% in 2015, except for plug-in hybrid electric and battery electric transit buses. The SPM reflects the government's expectation of EV cost reductions at a higher level of commercialization.

## **IMPLEMENTATION SCOPE AND INSTITUTIONAL ARRANGEMENT**

Under Phase I of the EVSS, the subsidy for public procurement covers all categories of EVs (Hybrid electric vehicle (HEV), plug-in hybrid electric vehicle (PHEV), battery electric vehicle (BEV), and fuel cell electric vehicle (FCEV)). The subsidy for private purchases covers only PHEVs and BEVs. HEVs are considered fuel-efficient vehicles and are subsidized under the Fuel-Efficient Vehicle Subsidy Scheme (FEVSS). However, the subsidy intensity of FEVSS (RMB 3,000 per vehicle) is far lower than that of EVSS (up to RMB 60,000 per vehicle). Under Phase II of the EVSS, the subsidy covers PHEVs, BEVs and FCEVs. Both public and private purchases of HEVs are excluded from the subsidy scheme. As nearly half of subsidized public vehicles during Phase I are HEVs, the exclusion of HEV in Phase II will greatly curtail the subsidy benefits. There has been great controversy over whether HEVs should be included in EVSS, as many people believe they should be given equal priority to PHEVs and BEVs. This subsidy scope partially reflects China's strategy on EV development, which places more priority on pure electric driving technologies.

The central government provides subsidy for vehicles, and the pilot city also arranges a certain amount of additional budget for subsidies, infrastructure construction, maintenance etc. The public procurement of new energy vehicles was carried out in three phases in different cities and later extended to nationwide availability in late 2012. Phase I of the EVSS for private purchases was implemented in six cities, including Beijing, Shanghai, Hangzhou, Shenzhen, Hefei and Changchun. 28 cities and regions have been included in Phase II, and the scope might be further expanded.

## **WHICH GOVERNMENT AGENCIES, INDUSTRIAL ORGANIZATIONS AND BUSINESSES ARE INVOLVED**

The Ministry of Science and Technology (MOST) and the Ministry of Finance (MOF) are mainly responsible for the verification and allocation of the subsidy, and the Ministry of Industrial and Information Technology (MIIT) and the National Development and Reform Commission (NDRC) also support the promotion process. The State Administration of Taxation is providing tax credit profits for the new energy vehicle manufacturers and consumers. The Ministry of Transportation (MOT), as the management entity for transport, also provides support for the development of new energy vehicles.

Dozens of new energy vehicle manufacturers in China are covered by EVSS, including BYD, CHERY, JAC, BAIC, SAIC, SHANGHAI GM, CHANG'AN, etc.

## 9.4 EFFECTS OF THE POLICY/ PROGRAM

In terms of the costs to governments, businesses, households, etc.

In a study by Hao et al. (2014<sup>xviii</sup>), the costs of owning a conventional passenger vehicle and an electric passenger vehicle are compared by adding vehicle price, fuel costs, non-fuel operation and maintenance (O&M) costs, etc. The results show, assuming a moderate gasoline price and the successful reduction of Li-ion battery costs by 2020, that a subsidy is necessary for BEPVs to be cost-competitive compared with commercial passenger vehicles (CPVs) in the short term. In the medium-term, BEPVs could become less reliant or completely non-reliant on subsidies to maintain cost competitiveness. This can be interpreted as the government having to pay more subsidies for BEPVs if the penetration rate is expected to be raised.

### BENEFITS OF ENERGY SAVING, LOCAL POLLUTION REDUCTION AND ANY OTHER SOCIAL BENEFITS

There is no doubt, that the deployment of EVs would contribute to local pollution, especially pollution within the cities. However, the energy saving and greenhouse gas reduction potential should be based on the electricity generation efficiency and mix. If a high proportion of electricity comes from renewable or other clean forms of energy, the reduction potential would be huge. As one of the emerging strategic industries in China, the widespread new energy vehicles could also cultivate the development and competitiveness of vehicle manufacturers.

## 9.5 CHALLENGES EXPERIENCED

1. Some vehicle manufacturers have counterfeited new energy vehicles in order to obtain the subsidy. Some companies just assemble the parts bought from other manufacturers and call them new energy vehicles just to gain the subsidy, despite their questionable quality.
2. When subsidizing the new energy vehicles, the local government only included locally produced ones within its scope, demonstrating local protectionism. This is really harmful to fair competition in and the development of the vehicle manufacturing industry.
3. One reason for the low popularity of new energy vehicles is their technical immaturity. However, anxiety, safety concerns and charging time issues can be all resolved through technological development.
4. The construction of charging infrastructure still lags behind, although some policies have targeted this problem. The construction of chargers faces many obstacles, including deficiencies in financing, mechanical issues, etc.

## 9.6 REPLICABILITY AND SCALING UP POTENTIAL

### WHY IT WORKED (FACTORS OF THE POLICY ITSELF, INCLUDING DESIGN, TARGETING SCOPE, IMPLEMENTATION ARRANGEMENT ETC.; EXTERNAL FACTORS /CONDITIONS)

1. The government has considered developing the new energy vehicle industry as an important strategic goal and has set out clear aims in different plans.
2. The EVSS mechanism has worked effectively in promoting the production and consumption of new energy vehicles. The subsidy measure can push the development of this targeted industry, though some flaws existed in the mechanism itself.
3. The phasing out mechanism of EVSS also imposed future expectations and encouraged vehicle manufacturers to cut costs.

### THE FEASIBILITY OF ROLLING OUT THE POLICY IN OTHER PARTS OF THE COUNTRY OR OTHER SECTORS AND SUB-SECTORS WITH SIMILAR CHALLENGES IN ENERGY EFFICIENCY IMPROVEMENT

1. This EVSS mechanism and related policies can be extended to non-pilot cities, especially small and medium-size cities. This is because every-day driving distances are shorter, and there is more space to build chargers both at home and in public areas.
2. The subsidy is a mechanism which been criticized a lot. Nonetheless it can be made to function as one of the tools that the government can use to promote a particular technology or industry in a relatively short period of time. It could therefore be used for some major or strategic technology development initially, but be phased out gradually.

# **CHAPTER 10** **GOOD PRACTICE 8**

## **FUEL EFFICIENCY STANDARDS**

**Wenjing Yi**

## 10.1 INTRODUCTION

China is one of the few countries<sup>2</sup> in the world that have fuel consumption limits for both passenger cars and heavy-duty commercial vehicles. The fuel economy standards for passenger vehicles were introduced in four phases: Phase I in 2005-2008, Phase II in 2008-2012, Phase III in 2012-2016, and Phase IV in 2016-2020. Fuel

consumption limits for heavy-duty commercial vehicles were introduced in 2011 and put into practice in 2012. The standards and limits for cars and other vehicles have greatly reduced their fuel consumption, thereby cutting energy use by the transportation sector in China.

<sup>2</sup> Four countries have fuel economy standards for heavy-duty vehicles and they are the United States, Canada, Japan, and China. ICCT, 2014. *THE STATE OF CLEAN TRANSPORT POLICY*.

FIGURE 14. Fuel-efficient labeling for new cars



## 10.2 WHY THE POLICY/ PROGRAM WAS INTRODUCED AND IMPLEMENTED

Transport currently makes up about 10% of energy consumption in China, but rising prosperity means that transport energy use is set to increase if no action is taken. The vehicle stock is also increasing quite rapidly, surpassing 20 million in 2006 and 100 million in 2013. In order to curb the excessive rise of fuel use from the explosive growth of vehicle stock and also reduce the oil dependency rate, fuel consumption per unit vehicle should be reduced. The Chinese government has issued several plans to reduce the average fuel consumption of new vehicles, with targets to achieve 6.9L/100 km on average in 2015, 5.0L/100 km in 2020 and 4.0 L/100 km in 2025. The Fuel Consumption Limits for passenger cars was first introduced in 2004 and implemented in 2005. The limits then evolved into Corporate Average Fuel Efficiency (CAFE) in order to retain the diversity of corporate products while achieving the CAFE targets.

## 10.3 WHAT WAS DONE

### CONTENTS OF THE POLICY

The first national mandatory standard for vehicle fuel efficiency entered into force in 2005. It limits fuel consumption for light-duty vehicles based on their weight. After implementation in the first two phases, a standard for fuel efficiency evaluation methods and targets for passenger cars were proposed for Corporate Average Fuel Efficiency (CAFE) during Phase III. This standard takes into account the fuel efficiency of all the vehicles produced by one company as a whole in assessing its fuel economy. A vehicle manufacturer is not allowed to produce gas-guzzling vehicles unless the average fuel efficiency of all the vehicles it produces meets the required minimum standards. However, these standards are only targeted at domestic companies, and imported vehicles are not regulated. During Phase IV of the standard, manufacturers will be encouraged to produce new energy or alternative fuel vehicles to reduce the CAFE, and imported vehicles will also be regulated. For the heavy-duty vehicles, fuel consumption limits are also based on their weight. These entered into force on July 1st, 2012 (see Table 3).



**TABLE 3. Developing History of National Vehicle Fuel Economy Standards**

SERIAL NO.	NAME OF STANDARD	ENFORCEMENT PERIOD	NOTES
1	GB/T 19578—2004 Limits of fuel consumption for light-duty commercial vehicles	Phase I: July 1st, 2005 Phase II: July 1st, 2008	The first national mandatory standard for vehicles' energy savings
2	GB/T 27999—2011 Fuel consumption evaluation methods and targets for passenger cars	January 1st, 2012	Phase III: CAFE is at least 6.9L/100km in year 2015.
3	GB 19578—2014 Limits of fuel consumption for light-duty commercial vehicles	January 1st, 2016	Phase IV: CAFE is to be reduced to 5L/100km in 2020.
4	Phase V: Limits of fuel consumption for light-duty commercial vehicles and testing methods	Under formulation	Phase V: CAFE is to be further reduced to 4L/100km for vehicles made in China in 2025.
5	Minimum fuel efficiency requirement for heavy-duty commercial vehicles	July 1st, 2012	The first national mandatory standard for HDVs was enacted.

### IMPLEMENTATION SCOPE AND INSTITUTIONAL ARRANGEMENT

All domestic vehicle manufacturers are covered by the standards. After Phase IV, imported vehicles will also be affected, as well as new energy or alternative fuel vehicles.

MIIT, together with NDRC, the Ministry of Commerce, the General Customs Administration and the General Administration of Quality Supervision, calculate and manage the CAFE of manufacturers. MIIT is responsible for construction of the Vehicle Fuel Efficiency Data Management System, in order to collect data and report the information to related administrations. Companies should report fuel consumption data concerning the newly produced and imported vehicles in line with the requirements.

### WHICH GOVERNMENT AGENCIES, INDUSTRIAL ORGANIZATIONS AND BUSINESSES ARE INVOLVED

Targeting improvements to the fuel efficiency of the vehicles and on reducing oil dependency rates, the NDRC first demanded the introduction of this standard. The China Automotive Technology & Research Center (CATARC) was mainly responsible for drafting the standards, as well as for providing technical support for the standard-making process. The Standardization Administration was mainly responsible for issuing and managing the standards. During Phase III of the standards, the MIIT replaced NDRC as the proposing standard verification demand. Dozens of vehicle-producing companies are involved in the standard-making process.

## 10.4 EFFECTS OF THE POLICY/ PROGRAM

### COSTS TO GOVERNMENT, BUSINESSES, HOUSEHOLDS ETC.

According to a study by CATARC, the costs of improving fuel economy vary among different engine sizes. For passenger vehicles with engine sizes under 1.3L, the costs would be 10 thousand RMB per car to reach the standards; for passenger vehicles of engine sizes 1.3L or higher, the costs would be 16 thousand RMB. Thus the standards would impose great challenges for domestic companies in meeting the requirements.

### BENEFITS OF ENERGY SAVING, LOCAL POLLUTION REDUCTION AND ANY OTHER SOCIAL BENEFITS

According to the study, implementation of the standards has reduced fuel use by passenger vehicles and the average fuel economy improved by 10% from 2002 to 2006. The standards have also accelerated technological improvements, including engines, weight reductions, hybrids, diesel engines etc. They also promote collaboration between independently developed vehicles and joint brand vehicles.

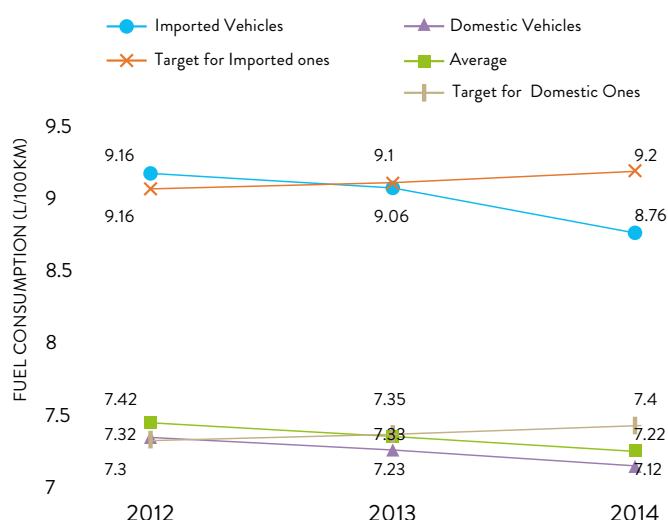
Based on the statistics issued by MIIT, average fuel use was reduced to 7.22 L/100 km in 2014: with domestically made vehicles reduced to 7.12 L/100 km and imported ones to 8.76 L/100 km (see Figure 15). This progress surpassed the targets for 2014, and the figures for imported vehicles reduced more quickly than domestic ones. There is also a trend for the average weight of vehicles to have increased in the past few years because there are more secure facilities in the car and more SUVs in the fleet. In order to meet the Phase III limits, the penetration rates of advanced energy-saving technologies used in passenger



vehicles have been noticeably increased, including variable valve timing (VVT), turbo, gasoline direct injection (GDI), high gear transmission, etc. All these show the stimulation effects of standards and regulations on energy-saving technologies adopted by companies.

If the fuel economy of the fleet reaches the target of 5L/100km in 2020, which is equivalent to 120 g/km, the fuel savings would be 35 million tons and the avoided CO<sub>2</sub> emissions would be 113 million tons.

**FIGURE 15. Fuel consumption of passenger cars in China**



## 10.5 CHALLENGES EXPERIENCED

The methodology used for testing the fuel use of vehicles comes from Europe and is called the New European Driving Cycle (NEDC). This method is based on fuel use under test conditions, which represents a large gap from the actual on-road fuel consumption of the vehicles. Thus the conditions designed for the vehicles' fuel consumption is very different from those that apply to running conditions, creating a blurred and biased view of total energy use and fuel economy levels for China's vehicle fleet. Thus it is strongly suggested that future fuel consumption standards be based on the test running conditions based on the realities of China.

## 10.6 REPLICABILITY AND SCALING UP POTENTIAL

### WHY IT WORKED (FACTORS OF THE POLICY ITSELF, INCLUDING DESIGN, TARGETING SCOPE, IMPLEMENTATION ARRANGEMENT ETC.; EXTERNAL FACTORS /CONDITIONS)

1. The standards are being introduced in four phases, and lessons and experiences are learned for the next phase of standard-making. For example, in the first three phases imported vehicles are not covered, so they influence the average fuel economy of the fleet as a whole. Starting with the fourth phase, imported vehicles are included.
2. The best practices of developed countries have been incorporated into the standards, the CAFE having learned from America's Corporate Average Fuel Economy regime. This provides flexibility to manufacturers, using different portfolios to produce energy-efficient vehicles.
3. The standard management, training and technical support stakeholders are relatively clear, ensuring the smooth implementation of the standards. MIIT is mainly responsible for managing and progress-tracking the standards. MIIT has also created a Vehicle Fuel Consumption Data Management System in order to collect data and report the information to related administrations.
4. CATARC provides professional and strong technical support to the standard-making process and related issues.

### THE FEASIBILITY OF ROLLING OUT THE POLICY IN OTHER PARTS OF THE COUNTRY OR OTHER SECTORS AND SUB-SECTORS WITH SIMILAR CHALLENGES IN ENERGY EFFICIENCY IMPROVEMENT

Limits on fuel consumption for vehicles can be considered to be minimum energy performance standards (MEPS) for the manufacturing companies. One of the successes of the fuel consumption standard lies in the fact that the products of this sub-sector are unitary. It is relatively easy for the management administration to keep track of and calculate energy-efficiency levels. Therefore, this would be suitable for those sub-sectors that have unitary or simplified products, as they are relatively easy to track and to calculate their energy-efficiency levels. This mandatory standard also represents a very good approach to upgrading the energy efficiency of the sub-sector as a whole.

# ENDNOTES

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