

## Shanghai Energy Conservation Information Center

September 2006

### Summary

This is an analysis report on the energy conservation potential, the energy conservation goal decomposition and the policy suggestions in Shanghai.

Focused analysis on Shanghai Municipal industries, buildings and transportations showed that the energy conservation potential could be around 9 million tce in 2010 in comparison with 2005, in which 4 million tce in industries, 3 million tce in commercial and civil areas and 2 million tce in transportations.

The Shanghai Municipal Government has proposal a target of 20% or so reduction of energy consumption per Unit GDP ( $10^4$  RMB Yuan) in the 11<sup>th</sup> five-year plan by the end of year 2010, and the target has been decomposed for realization. Industry is the key with a reduction target of 30%, energy use per unit of industrial output, which will contribute 80.5% to the total energy conservation goal. With the fast economic development, the energy consumption for buildings, commercial and civil activities are increasing very rapidly. So attentions should be paid to these areas as well while the focus is on industrial energy conservation.

This report also analysis the major problems, challenges and opportunities. Seven suggestions are put forward for the energy conservation department in Shanghai Municipal government.

### Preface

According to the requirement of the national Council *the decision on promotion of energy conservation*, the Shanghai People's Congress has made the similar decision and Shanghai Municipal Government published *some opinions on strengthening the energy conservation works in Shanghai*, which proposed a target of 20% or so reduction on

energy consumption per Unit GDP by the end of year 2010 in order to fully implement the scientific outlook on development, build a resource-efficiency society.

## **I. Current Status of Economical and Social Development in Shanghai**

### 1. Economical and Social Developments in the “10<sup>th</sup> Five-Year” period in Shanghai

From the 1990s, Shanghai has been keeping an incredible high speed of economic development. During the “10<sup>th</sup> Five-Year” period, the average annual growth rate of GDP is 11.5% and the total GDP of Shanghai was 914.4 billion Yuan in 2005, which means about 50 thousand per year per capita according to the population of permanent residence. The economic growth structure was further consolidated as the secondary Industry and Tertiary Industry kept as the major source of promoting the economical development during this period. Both service industry and advanced manufacturing industry speed up their development. The structure of industry was optimized greatly, and the modernization of agriculture gains its elementary rewards. The comprehensive economy achieved distinct improvement and the energy efficiency was improved continuously. The energy consumption per unit of GDP in Shanghai decrease by 16.5% during the “Tenth Five-Year” period with the number of 0.88 tce per unit of GDP in 2005.

Table 1 Major economical and social development indices  
of Shanghai in the “Tenth Five-Year” period

<b>Year</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>
GDP (billion Yuan)	495.084	540.876	625.081	745.027	914.395

Population (10 <sup>4</sup> person)	1327.14	1334.23	1341.77	1352.39	1360.26
Energy Consumption (10 <sup>4</sup> tce)	5818.28	6118.53	6650.91	7266.98	8069
Energy consumption per Unit GDP (1tce/10 <sup>4</sup> Yuan)	1.16	1.1	1.07	1.03	0.88
Energy Consumption per Capita (tce)	4.38	4.59	4.96	5.37	5.93

*Shanghai Statistic Book 2002,2003,2004,2005,2006*

## 2. Directions and principles of development in the “Eleventh Five-Year” in Shanghai

The directions of development in the “Eleventh Five-Year” period are: apply the Deng Xiaoping Theory and the “Three Represents” Theory as guidelines, basing on the scientific outlook of development, focusing on the innovation and creation, optimizing the mechanism and systems, enhancing the social harmony. Promoting the sustainable development by realizing the scientific outlook of development, constructing the harmonized society, improving the international competence of Shanghai, taking science and technology development as an important strategy for a prosperous Shanghai.

The development principles of Shanghai in the “Eleventh Five-Year” period

Follow the scientific outlook of development, enhance the good and fast economic development

- ✧ Taking science and technology development as major incentives to improve the innovation strength.
- ✧ Keep on with the transformation of urban development mode, and improve the competitive power of all industries.
- ✧ Keep on the social common wealth development to enhance the social harmony and security.
- ✧ Keep on with the experiments of new policies and governmental systems in Pudong

New Area of Shanghai. kg

- ✧ Take the opportunity of World Expo Shanghai, 2010, upgrade the public service system and the social environment of Shanghai

### 3. Target of development in Shanghai during the “Eleventh Five-Year” period

The Shanghai social economy development goals for 11<sup>th</sup> five-year are: achieve healthy and rapid growth. Hold successfully a wonderful and memorable EXPO Shanghai, 2010. Form the basic structure of four centers, e.g. international economy, finance, trade and ship transportation. Achieve periodical progress in the construction of socialism modern international metropolis. All these will put stable foundations for Shanghai sustainable development between 2011 and 2020.

- Keep healthy and rapid development of the economy. On the basis of optimized structure, increased benefit, and reduced energy consumption, the estimated annual economic growth rate in Shanghai will be over 9%. In 2010, the total output value in Shanghai will reach 15 trillion Yuan. The industrial structure mainly engaged in service economy will gradually come into being. The revenue of the local governments should grow in pace with the national economy.
- Achieve major transition of economic growth mode. The resources consumption ratio will increase significantly. The comprehensive energy consumption per Unit GDP will decrease about 20% of that at the end of the “Tenth Five-Year” period. Overall progress on the construction of ecological city will be achieved then, and the investment on environment will be around 3% of the municipal GDP.
- Make breakthrough on the stratagem of “rejuvenating city with science & education”. The innovation system of the city will be formed basically. The investment on R&D will be more than 2.8% of the whole GDP, and the contribution of science and technology progress will come to 65%, forming a group of dominant enterprises with intellectual property rights, famous brands and strong international competence. The

comprehensive education reform will be further developed with the continuous improved labor quality.

- Markedly improve the urban comprehensive service function. Promote the formation of multiple finance market and financial organization system. Further improve the financial development environment. Make Shanghai one of the international influential financial centers on the basis of further consolidating current status as national financial center. Build up Yangshan deep-water pivotal port and Shanghai air pivotal port. Form a development pattern of integrated domestic and foreign trade, goods trade and service trade going together. Significantly enhance the centralized radiate function of economic central city by mixing together the international financial, shipping and trade center.
- Further improve people's life quality. Keep continuous and stable increase of per capita disposable income of urban and town residents. Control the registered unemployment rate in town around 4.5%. Realize basically full cover of all social securities. The residents enjoy generally convenient basic medical attendance and public health service. Enrich people's cultural life and improve civilians' diathesis and civilization level, with a powerful urban public security.
- Take the lead in forming systematic environment with international convention, more vigorous and more open. Make breakthrough in the comprehensive systematic reform in Pudong. Promote the construction of democratic legislation, service government, responsible government and nomocracy government. Further consummate the modern corporate governance, modern property right system, social credible system and modern market system. Make new progress in the strategic adjustment of state-owned economy. The proportion of value-added in non-public economy in the GDP of the whole city reaches 50%. Increase the quantity and quality of utilization of foreign investment. Attract more regional headquarters of national and multinational corporations and business groups. Form the basic frame of an open economy. Significantly improve the level of urban internationalization, marketization, informatization and legalization.

4. Fully recognize the importance of strengthening energy conservation from the point of view of implementing scientific outlook of development and increasing international competence.

Shanghai has entered a new period of time while outstanding energy restriction appears with its large population, less resource and limited environment capacity. The annual average growth rate of the total energy consumption reached 7.8% in Shanghai during Tenth Five-year Plan. The total energy consumption was 80.69 million tce in 2005. According to the above growth rate of the total energy consumption, the total energy consumption would be over 120 million tce by in Shanghai by 2010. The contradiction between supply and demand of energy and the pressure of environmental protection would be more serious. Strengthening the energy conservation and reducing the energy consumption has become an urgent demand to breakthrough the energy bottleneck and environment constraints. According the “Proposal”, the GDP of Shanghai should increase by an average annual rate of over 10% and the target of 20% energy consumption reduction in the next Five-Year, which means the accumulated energy saved should reach 26 million tec in the five-year period.

Table 2 Estimation on annual energy consumption per unit GDP and accumulated energy conservation of Shanghai in the “Eleventh Five-Year” period

Year	Energy use (tce)/ Unit GDP (10 <sup>4</sup> Yuan)	Energy use reduction (%)	Estimated total energy use	Targeted Energy Saved per Year (10 <sup>4</sup> tecl)	accumulated Energy Saved (10 <sup>4</sup> tec)
2005	0.88		8069		
2006	0.84	4.36	8411	436	436
2007	0.80	8.54	8768	476	912
2008	0.77	12.53	9140	518	1430
2009	0.74	16.35	9528	565	1995
2010	0.70	20.00	9932	616	2611

*Shanghai Statistic Book 2002,2003,2004,2005,2006*

Shanghai is facing a hard task in order to achieve the energy conservation target and to build up its international competence. It should be fully recognized of the importance and urgency of energy conservation works. Comprehensive measures should be taken to expedite the change of economy development mode, to increase the energy efficiency and to reduce the energy consumption. The first step is the have a serious and thorough analysis on the current energy consumption condition in Shanghai before decomposing and fulfilling the energy conservation goal by mobilizing all municipal efforts to promote the energy conservation in the city.

## **II. The Relationship between the Economical and Social Development and the Energy & Environment in Shanghai**

### **1. The Energy Supply and Energy Security issues in the future development of Shanghai**

With the increase of population and rapid industrialization and urbanization, the economical and social development have been facing the serious problem even the crisis of energy shortage and environmental pollution. Supposed that the energy consumption per unit GDP reduces by 20% in the end of the “Eleventh Five-Year period” in Shanghai,

the estimated energy consumption in the year of 2010 will still be increased to 100 million tce.

The energy consumed in Shanghai highly depends on the importing from other provinces or countries. The global energy crisis brings an extremely high pressure to the energy supply security system of Shanghai. At the same time, the domestic energy pricing mechanism is still reforming, any price fluctuation of the international crude oil, natural gas will definitely affects the stable of energy supply and energy price in Shanghai. Energy supply has become the bottleneck of social economy development of Shanghai.

2. The current energy structure, which heavily relies on coal with heavy environment pollution, will not be changed in short time.

Even though Shanghai has been increasing the energy structure adjustment in the “Tenth Five-Year” period and great progress has been achieved, the total consumption of coal is still increasing annually. The consumption of coal in 2005 is about 52.34 million tons, which takes pretty much 52.6% of the total energy consumption of that year. The great utilization of coal as the major combustion fuel together with the emission fume of the vehicles are the major resources of the atmosphere pollution in Shanghai. The total emission of SO<sub>2</sub> in 2004 reaches 470,000 ton. Shanghai is suffering the pollution of both coal and oil, so its capacity of urban environment is quite limited.

In the “Eleventh Five-Year”, Shanghai will host the World Expo 2010. With the development of economy and life quality, citizens will require a higher requirement on environment. The “Eleventh Five-Year Proposal of Shanghai” sets a goal to build up a framework of ecological city. The SO<sub>2</sub> emission will be reduced by 35%, COD emission by 15%, and waste water and municipal wastes treatment ration to 80%, and 90% of standardized drinkable water by the end of 2010. This proposed higher requirement on energy conservation with increasing energy consumption but great reduction of pollutants emission, which is great pressure and also hard task for Shanghai.



### 3. The challenges and problems faced in the energy conservation of Shanghai

During the 11<sup>th</sup> five-year, Shanghai will be facing higher pressure of high quality energy supply, especially the natural gas supply. Energy-intensive industries like iron& steel, petrochemical will develop greatly with more big projects constructed and put into production. The systematic energy utilization rate is lower than international level, especially the comprehensive energy consumption for oil refining and the unit energy consumption for other products still have a large gap with that of international standard.

- 1) Some leaders of energy consumer do not have a strong and clear awareness on the importance and urgency of energy conservation.
- 2) Investment on energy conservation can not meet the demand, and it is difficult to invest and finance in energy conservation. Many enterprises have not become the main responsible body of energy conservation, while some laggard technologies with lower energy efficiency are still in use. Because of the deficient input in energy conservation, it is hard to upgrade the technologies and equipment.
- 3) The long-term market-based energy conservation mechanism has not been established. Energy performance contracting (EPC), demand side management (DSM) and other new mechanisms are still in promotion. The market environment in favor of promoting and applying new energy-saving technologies & products, the technical supporting system for energy conservation information dissemination has not been established. Effective governmental measures to promote energy conservation is still in short. The standardization and infomationization of energy conservation develops very slowly.
- 4) Lack of efficient supervision system for the energy conservation. The current terms and conditions in relative laws of energy conservation are less operational. The supervision on energy conservation is quite weak, and there is no way to manage and supervise the social energy conservation effectively.

### 4. The opportunities in the energy conservation brought by the economical and social development in Shanghai

The advantages for energy conservation in Shanghai include: firstly, both the central government and the Shanghai Municipal government paid great attention to energy conservation. It has been raised to such a high strategic level of scientific outlook of development, the construction of harmony society, and the national security and economy security that great motivation on energy conservation has been formed. Secondary, the urban function of Shanghai is under its transformation. Advanced manufacturing industry and service industry as priority development principal together with the science and technology development strategy have provide sufficient support to upgrading the industrial structure and to promote the energy conservation. Tertiary, Shanghai is implementing a new recycling economy growth mode. Energy planning and reforming the inefficient utilization of energy will considered in advance when centralizing the leading industries, establishing the ecological industrial zones. Thus the new energy utilization mode with higher efficiency and better economy development mode will provide better environment for energy conservation. The fourth, the strengthening energy conservation technology innovation and creation, the forming of encouraging policies and mechanisms, and emerging function of scientific utilization of energy and the economy levers will provide both technical and political support for energy conservation. The fifth, gradually healthy and effective rules and regulations, together with the strengthening of energy management and supervision will provide legal guarantee for energy conservation. The sixth, energy conservation is becoming more and more popular concept, which will receive higher public awareness and is becoming code of urban civilization. This provides strong public foundation for energy conservation in Shanghai.

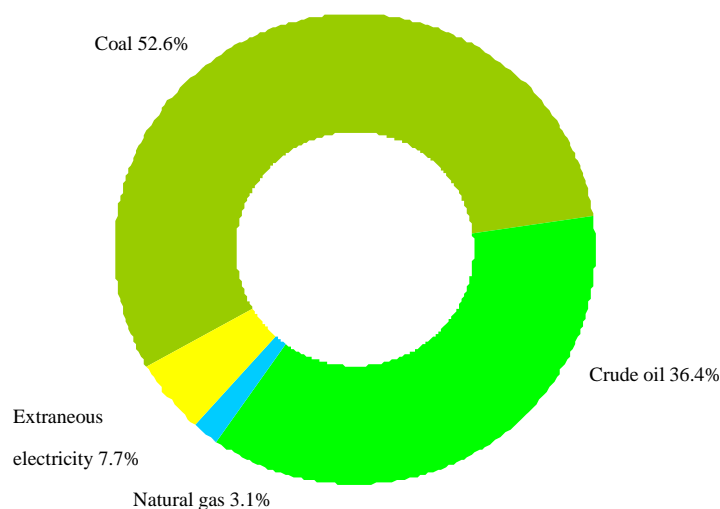
### **III. Analysis on Energy Conservation Potential in Shanghai**

Shanghai's energy consumption per unit GDP is in the lead position in China. However, compared with international advanced level, there still exists considerable gap in the energy consumption per Unit GDP, of which Shanghai is 4.29 times of Japan's, 3.6

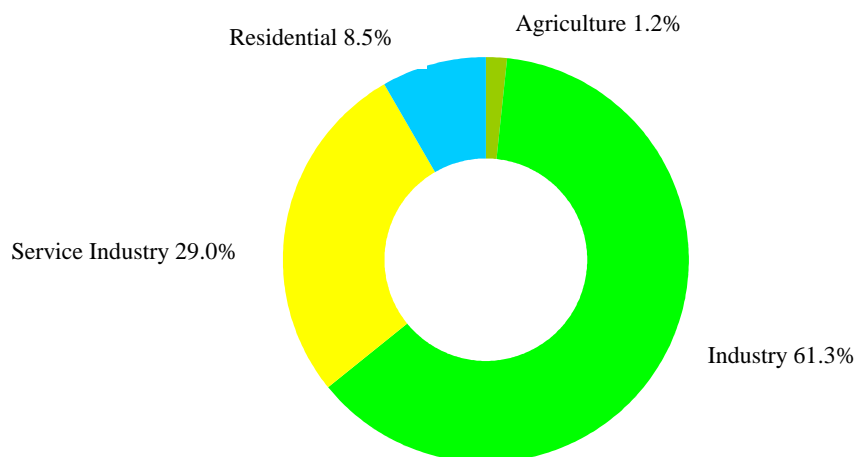
times of Germany's, 2.6 times of France's, 2.4 times of America's and 2.1 times of Australia's. The Energy Comprehensive Utilization was 80% of average level of developed countries. The historical and international experience indicates that to keep the harmonious development of economic society, the traditional way that energy consumption and economic growth increase concurrently must be changed and we should quicken the transform of our economic growth mode, continuously increase our innovative capability and further dig the energy conservation potential.

### 1. The Basic Status Info of Present Energy Consumption in Shanghai

(1) The total amount and structure of energy consumption in Shanghai. In 2005, the total amount of energy consumption in Shanghai was 80.694million tce and the total terminal energy consumption was 76.942million tce. And the structure is as below.



**Shanghai's Primary Energy Consumption Structure in 2005**



**Shanghai's terminal Energy Consumption Structure in 2005 (Classified by Industry)**

*Shanghai Statistic Book 2006*

(2) The energy growth rate and elastic coefficient of energy consumption. In 2005, the energy growth rate was 9.0%, the economic growth rate was 11.1%, and the elastic coefficient of energy consumption was 0.81 nearly in Shanghai.

(3) The urban energy consumption and household energy consumption per capita. In 2000, Shanghai's registered population of was 13.5239 million and its permanent population was about 17.52 million. Counted by registered population, the annual urban energy consumption per capita was 5.97 tce, while counted by permanent population, that number was 4.61tce.

(4) Energy consumption GDP per ten thousands. The energy consumption GDP per ten thousands in Shanghai was 0.88tce in 2005.

## 2. Comparison of Energy Consumption between Shanghai and International Advanced Level

Compared with the developed countries, high economic growth rate in Shanghai follows with high energy consumption for a long time, which high energy consumption

includes high economic growth rate and high pollution emission; Meanwhile, different from other domestic regions, Shanghai has arrived at the development phase that may keep rapid economic growth and is capable of fulfilling decelerating energy consumption increase at the same time, but not the usual opinion that Shanghai is still in the phase of advancing the development of economic society using energy-intensity industries.

(1) The comparison of the energy consumption growth. Although Shanghai's elastic coefficient of energy consumption has been less than 1 steadily since 1990, however, the economic growth and the energy consumption growth are still increasing concurrently generally speaking. Hence, we need to regulate towards the target of increasing the gap between their concurrent growths by increasing the energy utilization rate.

(2) The comparison of the energy consumption per capita. Though the power consumption per capita in Shanghai is far less than the average level in developed countries, it ranks first in China. Besides, the urban energy consumption per capita no matter counted by permanent population or registered population, has already exceeded the average level of the world, even close to some developed countries. Therefore, reverse control must be taken. The information of energy supply and consumption per capita of some countries/regions in 2003 is listed in Table 3.

Table 3. The comparison of Energy Supply and Consumption Per Capita of Some Countries/Regions in 2003

Country	Energy supply per capita (tce/person)	Primary energy supply unit GDP (tce/10,000RMB yuan, constant price in 2003)	Power consumption per capita (kWh/person)
U.S.A.	12.15	0.43	13066
Canada	12.77	0.66	17290

Britain	6.06	0.29	6231
Germany	6.53	0.35	6898
France	6.84	0.39	7624
Russia	6.91	4.05	5525
Australia	8.73	0.50	10642
Japan	6.28	0.21	7816
India	0.81	1.98	435
Indonesia	1.16	1.86	440
Thailand	2.22	1.22	1784
Vietnam	0.84	2.25	433
Philippines	0.81	0.95	565
Malaysia	3.55	1.10	3019
China	1.69	1.98	1379
Hong Kong	3.75	0.17	5642
Shanghai	5.37 ( 4.15 according to permanent population )	1.03	6074

*Shanghai Statistic Book 2002,2003,2004,2005,2006*

(3) The comparison of energy economic structure. The industry is still the key aspect of energy consumption in Shanghai in the near future. However, at the meantime, the energy consumption in construction, commercial and civil activities, and transportation industry is rapid increasing. As a result, with keeping focus on industrial energy

conservation on one hand, to induct the transformation of people's energy consumption model is also considerably significant as well.

### 3. The Energy Conservation Potential Analysis for Industry, Construction and Transportation in Shanghai

After primary analysis, the energy-saving potential of the industry, construction and transportation in Shanghai is about 9 million tce in 2010 in comparison with 2005.

#### (1) Industry

The annual energy-saving potential in industry of Shanghai is about 4 million tce, which mainly lies in the improvement of key energy consumption equipments and reasonable energy utilization, including the renovation of key power equipments, such as motor and driving system, the optimization of plant energy system, waste heat usage, and the application of coal saving technology for boiler and furnace in coal-burning industry, etc.

The industrial motor and driving system account for 70% of the total industrial electricity consumption. By encouraging industrial enterprises to use high efficient motor, high efficient fan and water pump, variable frequency driving device and other control devices, and optimizing the design of motor driving system, more than 12% of the electricity can be saved, and the energy-saving potential is about 3 million tce.

In the energy-intensity industries including petrochemical, chemical and metallurgical industry, the energy conservation potentials in many technical processes of waste heat recovery and usage are comparatively great, Since the blast furnace gas, coke-oven gas and converter gas in Bao Steel has already been recovered and used, it mainly refers to the technologies of waste heat recovery and usage and the condensed water recycling in other industries, and it is expected that the energy saving potential can be 500 thousand tce.

The coal-burning boiler and furnace are key energy consumption devices in industry as well. Decentralized coal-fired boiler and furnace can save energy by improving energy efficiency, expanding the utilization of clean coal technology and high-quality coal, and

clean energy substitution, etc. It is expected that the energy-saving potential will be about 500 thousand tce.

## (2) Construction, business and civil industry

The energy-saving potential in the industries of construction, business and civil of Shanghai is about 3 million tce. With the improvement of people's living standard, the energy consumption in these above three fields goes up quite rapid. We may excavate the energy conservation potential by improving the energy conservation standard, ameliorating the exterior-protection structure in building, using high-efficiency air-conditioning and household electrical appliance device, and promoting green light and distributed energy supply system.

The exterior-protection structure of new building: New dwelling building and public building in town can save energy up to 50% by rigidly carrying out China's Energy Efficiency Design Standard for these buildings. By conducting the Pilot building aiming at 65% energy savings step by step, it is expected that only in the exterior-protection structure, the energy conservation potential is about 1 million tce if it reaches the standard.

The energy conservation renovation for existing buildings: to gradually conduct the energy conservation renovation on existing public buildings including office buildings, supermarkets and hotels and governmental office buildings, to complete and make use of the market mechanism and promote the comprehensive renovation for old dwelling houses by using energy saving technology, it is expected that 10% of the energy-savings could be fulfilled in existing buildings' energy conservation renovation with the energy conservation potential of 400 thousand tce.

The air conditioning system: The energy saving in air conditioning system is a key aspect in construction energy conservation. In Shanghai, the air conditioning takes more than one third of the total electricity consumption at peak load in summer, and that demand is growing up year by year. By advocating energy efficiency identification and promoting high-efficiency air conditioning, the energy saving potential can be more than 10%. By



using high-efficiency air conditioning, heat and cold storage technology, variable air volume and variable flow control system, sun shading, heat insulation and temperature control system in the central air conditioning system, it is expected that the electricity savings could be more than 20% with 700 thousand tce of energy-saving potentials.

Home and office electric appliances: At present, the power consumption in home electric appliances (excluding air conditioning) accounts for 70% of the residential electricity consumption. By carrying out the national standard on energy efficiency and publicizing the knowledge on energy efficiency identification, to encourage residents and units to use refrigerator, washing machine, television, rice cooker of energy-saving kind and office electric appliances of energy saving. It is estimated that the electricity conservation can reach more than 20% with 150 thousand tce of the energy-saving potentials.

The illumination: the electricity consumption in Lighting accounts for more than 10% of the total electricity power. By promoting high-efficiency and electricity-saving lighting system in public building (equipment) and residential, and using green lights such as compact fluorescent lamp, high-efficiency and double-capped fluorescent lamp, high voltage sodium lamp, metal halide lamp, electronic ballast, high-efficiency lamps, dimmable control devices, and natural light utilization, the estimated electricity conservation is about 15% and the energy-saving potential is about 700 thousand tce.

### (3) Transportation

The energy-saving potential of the transportation in Shanghai is about 2 million tce. Shanghai is one of the biggest population densities in the world. Compared with those developed countries, though the proportion of energy consumption in transportation is not that high in the total energy consumption, however, the energy consumption of transportation has increased markedly with the rapid growth of private cars in recent years, and meanwhile, the deterioration of environmental pollution has become more and more serious. According to the experience of the developed countries, to save the energy consumed by transportation, people should expand the transportation burden of mass transit and promote the automobiles with low energy consumption.

To optimize the urban transportation model: to carry out the policy of giving public transportation the priority, speed up the construction of the basic network for rail, complete and expand the mass transportation system, and improve the operational efficiency of public transportation. By 2010, compared with the present 38% of the urban people going-out proportion, the public transportation will take on 50% of that in 2010, among which, the rail transit will take on more than 10%, while at present, the rail transit only takes on 5.7%. Keep the going-out proportion by two-wheelers vehicles to a proper extent, that is, no less than 20%. The energy-saving potential is predicted to be 1.37 million tce by these comprehensive measures.

To decrease the energy consumption of cars: By implementing the standard of “Limits of Fuel Consumption for Passenger Cars” and encouraging the usage of energy-saving, environmental-protection and smaller-emission vehicles, by 2010, the energy-saving potential is expected to be 600 thousand tce.

Developing new type hybrid electric vehicles and fuel battery vehicles: The hybrid electric vehicles can save 30% to 50% gasoline in urban condition, which should be promoted vigorously. As a non-emission automobile, the fuel battery vehicle has won recognition in many countries. The energy-saving potentials can be higher than 100 thousand tce on condition that all the taxi in Shanghai would adopt these new type vehicles.

#### 4. The Energy Conservation Potential Analysis of the Secondary and Tertiary Industry in Shanghai

At present, the terminal energy utilization rate is lower than the average level of developed countries, and the gap of the energy consumption intensity per unit GDP is much bigger between Shanghai and developed countries, which is three times as much as that of the average level in OECD countries and twice the average level of the world. The reason is that compared with developed countries, the products made in Shanghai have a relative lower added value. Most these products lie in a low position of the value chain in

the international production business labor distribution. Besides, there are also effects caused by unreasonable factors, such as industrial structure and variety composition of primary energy, etc. In Shanghai, the secondary industry and tertiary industry account for 49% of the total GDP respectively, while in developed countries, the secondary industry takes around 30% and the tertiary industry takes more than 60% of the GDP. Generally speaking, the energy consumption per unit GDP in the secondary industry is twice as much as that of the tertiary industry. From this point, the energy consumption per unit GDP will decrease 0.7% when the tertiary industry's proportion increases 1%. If the added value of the tertiary industry accounts for 55% of the GDP in Shanghai in 2010, then the achieved energy savings by the added proportion of the tertiary industry will be around 5.04 million tce.

#### 5. The Energy Conservation Potential Analysis by Optimizing the Composition of Energy Consumption

The difference of the composition of energy consumption is a key factor that can influence the energy consumption per unit GDP. In 2005 the coal accounts for 52.6% of energy consumption composition in Shanghai. Generally speaking, in developed countries, the proportion of coal is about 25%, while that of the natural gas is more than 20%. Due to the different quality of these energy resources, the utilization efficiency of petroleum and natural gas is 15% higher than that of the coal. If the proportion of coal could drop to 45% within the 11<sup>th</sup> Five-year Plan, the energy-saving potential would be estimated 4 million tce.

#### 6. The Energy Conservation Potential Evaluation for the Key Energy Consumption Industries, Including Steel, Petrochemical and Chemical, etc.

In 2004, the total comprehensive energy consumption in steel, petrochemical and chemical was 28 million tce in 2004, which accounted for 62% of the industrial energy consumption in Shanghai, the details is as follows:

Table 4

Industry	Comprehensive Energy Consumption (10 thousand tce)	Energy Consumption for Value-added (10,000 Yuan) (ton of equivalent coal)
Total	2800	
Ferrous Metal Melting and Rolling	1320	3.440
Petroleum Processing, Coking and Nuclear Fuel Processing	1102	6.734
Raw Chemicals Materials and Chemical Product Manufacturing	378	1.901

*Shanghai Statistic Book on Industries Energy and Transportation 2005*

Bao Steel plays a leading role in Shanghai's steel industry. In 2005, Bao steel's energy consumption unit GDP per 10,000 RMB was 1.35 tce, which was the historical best level, 53% less than 2001. Among which, Bao steel branch ranks advanced level in the world with 687kg equivalent coal of comprehensive energy consumption per ton of steel and 3.75 tons of new water consumption per ton of steel. Hitherto, Bao steel has owned 49 patent technologies and applied to many new energy-saving technologies, which makes the energy consumption indexes decrease the year by year.

Table 5 Some Indexes of Bao steel in Energy Utilization

Name of Project	Percent (%)
Blast furnace gas recovery rate	Near 100
Converter gas recovery rate	Near 100
Coke-oven gas recovery rate	100
Red coke heat recovery rate	100
Solid waste usage rate	98.1
Water recycle rate rate	97.6

*Shanghai Year Book 2005*

To dramatically reduce the energy consumption index in the 11<sup>th</sup> Five-Year Plan is not easy for Bao steel. Through analysis, the future energy-saving potential for Bao steel mainly lies in the two aspects below:

(1) The comprehensive energy consumption of per ton of steel decreases

In 2005, Bao steel's output of crude steel was 22 million tons, and the comprehensive energy consumption of per ton of steel was 749kg equivalent coal, 62kg more than Bao steel Branch. If Bao steel's comprehensive energy consumption of per ton of steel could drop 30, 40 or 50kg equivalent coal in the "Eleventh Five-Year Plan", accordingly the annual amount of energy savings would be 660 thousand, 880 thousand and 1.1 million tons of equivalent coal, respectively, and the energy saving rate would be 4.0%, 5.3% and 6.6%, respectively.

For the energy conservation rate, there still exists comparatively large gap with the target of comprehensive energy consumption decrease for value-added (10,000 Yuan) in the "Eleventh Five-Year Plan". Similar with most industries, to reduce the comprehensive energy consumption in ten thousands Yuan value-added, one of the main ways is to decrease the energy consumption per unit product, and another way is to regulate the product structure and increase the added value of the products.

(2) Product structure regulation

According to the 11th Five-Year Plan, Shanghai's steel industry should put the emphasis on developing steel with high quality, for example, the steel for marine use and automobile, stainless steel, carbon steel and special steel. The refined steel has a higher value than the plain steel, even several times of the latter.

In recent years, Bao steel has put great emphasis on regulating the product structure. In November 2005, Bao steel-NSC/Arcelor Automotive Steel Sheets Co., Ltd has been put into production, which may manufacture high-quality automotive steel sheets with international advanced level. In June 2005, Stainless Steel Branch of Bao steel has been put into production, which may manufacture hot-rolled stainless steel plate in coils with width of 1600mm. In 2007, Bao steel will accomplish the integral relocation of Pudong

Iron and Steel Co.,Ltd, and establish the product lines of steelmaking continuous casting and heavy plate. This technology will adopt the COREX Smelting Reduction Iron Making Technology with international most advanced level, which meets both the demands of clean and energy saving.

Annual steel output is more than 20 million tons in Shanghai at present. The amount of energy saving would be 20 to 100 thousand tons of equivalent coal when the refined steel output increases 1%. With 10% increase, the energy-saving potential would be expected to 200 thousand to 1 million tons of equivalent coal. With the upper limit, the energy-saving potential equals to the energy-saving potential of the consumption of unit product.

Based on the above analysis, the energy saving rate is about 10%. It's a hard work for Baosteel to drop 20% of the value of comprehensive energy consumption for value-added (10,000 Yuan) in the "Eleventh Five-Year Plan".

In the energy consumption and management practice, Bao steel understands that advanced single unit manufacturing facility and special energy-saving technologies are only the basis of keeping low energy consumption, to realize more energy conservation, systemic analysis and control must be applied. Human's wisdom is needed to achieve 10% energy saving rate on the management of energy systems in the "Eleventh Five-Year Plan". Based on information and the theory of modern management, and further studying on energy cost and product consumption, Bao steel will create another energy-saving miracle.

Shanghai's petrochemical and chemical industries mainly lie in some major enterprise groups, such as Shanghai Petrochemical Co., Ltd., Shanghai Gaoqiao Petrochemical Corporation, Shanghai Huayi (Group) Company, etc. The key product energy consumption of Shanghai's petrochemical and chemical is listed in Table 6:

Table 6:

Name of Product	Unit	2005		2010		International Advanced Level Early in This Century
		Shanghai's	National	Shanghai's	National	
Oil refining unit energy factor consumption	Kg toe • factor	13.3	13	12	12	10
Ethylene comprehensive energy consumption	Kg /toe	685	700	640	650	440
Caustic soda comprehensive energy consumption	Kg /toe	1420	1503	1200	1400	878

*The Energy Conservation Plan for the 11<sup>th</sup> five-year in Shanghai*

Table 6 shows big difference of energy consumption of unit product between Shanghai's petrochemical and chemical and the international advanced level. The unit energy consumption of the three products is 1.33 times, 1.56 times, and 1.62 times of the international advanced level, respectively. Calculated with the international advanced level, the energy-saving potential of Shanghai's petrochemical and chemical should be more than 30%.

According to the "Eleventh Five-Year Plan", the dropping extent of the unit product energy consumption of the three products above in 2010 is 9.8%, 6.6%, 15.5% respectively. There still exists some difference with the aim of dropping 30% of the comprehensive energy consumption for value-added (10,000 Yuan) for Shanghai's petrochemical and chemical in the "Eleventh Five-Year Plan". Similar with Bao steel, regulating the product structure is another important way for Shanghai's petrochemical and chemical to realize the energy-saving goal in the "Eleventh Five-Year Plan".

In recent years, Shanghai Petrochemical Co., Ltd has made great efforts to explore new products with high added value. The output of new products in Shanghai Petrochemical Company Limited was 608 thousand tons in 2005.

For example, the development of flat, V-series Acrylic Fiber by Shanghai Petrochemical Company Limited had new progress in 2005. Generally speaking, the energy consumption of the new products is a little more than the ordinary ones, but the value increases greatly. If the sales price increases 1000 to 2000 Yuan per ton, 608 thousand tons of new products will save energy to the amount of 400 to 800 thousand tons of equivalent coal compared with old products and the energy consumption for value-added (10,000 Yuan) will drop 4% to 8%.

Shanghai Huayi (Group) Company is major in raw chemicals materials and chemicals products. The output value of Huayi Company in the “Tenth Five-Year Plan” increased 77% and the energy consumption unit GDP per 10,000 RMB dropped 28%. According to the statistics of energy consumption of 150 key products in Huayi Group, the energy consumption of unit product contributed 20% to 30% to the decrease of energy consumption per 10,000 RMB of output value in the “Tenth Five-Year Plan”. The main methods of decreasing the energy consumption per 10,000 RMB of output value are to regulate product structure, of which, small scale fertilizer and calcium carbide own comparatively large regulation scale. Only the integral quit of small fertilizer industry contributed 16% of the energy consumption per 10,000 RMB of output value to Huayi Group.

Besides continuously decreasing the energy consumption of unit product, another two ways are also important for Huayi Group to reduce the energy consumption per 10,000 RMB of output value in the “Eleventh Five-Year Plan”. One is to establish large scale process units of modern basic chemical raw material at Wujing industrial zone and Shanghai Chemistry Zone, by independent intellectual property and importing technologies, to further reduce the energy consumption of key products. The energy consumption of new facilities is 10% to 20% less than old ones. The output value of new facilities will be 12 billion RMB Yuan in the “Eleventh Five-Year Plan” and the amount



of energy saving will be 120 to 240 thousand tce. Another way is to expand the production of refined chemical products. The average energy consumption per 10,000 RMB of output value of refined chemical products is about half of the energy consumption per 10,000 RMB of output value of Huayi Company. About 0.4 tce will be saved if 10,000 RMB of output value of refined chemical products is increased. If the refined chemical product could increase 8 billion Yuan of output value in the “Eleventh Five-Year Plan”, the amount of energy saving would be 320 thousand tce.

In summary, the amount of energy saving is 440 to 560 thousand tons of equivalent coal and the energy saving rate is 11% to 14%. Adding the dropped unit consumption of other products of 6% to 10%, the total energy saving rate is 17% to 24%. Take the energy conservation rate of 30% as the goal, the company should make effort to obtain the rest 6% to 13% energy conservation rate by applying to all kinds of energy-saving technologies and reinforcing the management of energy conservation.

#### **IV. The Decomposition of Energy Conservation target in the “Eleventh Five-Year Plan” in Shanghai**

In order to fulfill the target of decreasing 20% energy consumption unit GDP in the 11<sup>th</sup> Five-year Plan, Shanghai allocates it into industry 30% decrease, the tertiary industry (including transportation, tourism and commercial and trade) 15% decrease, building 15% decrease, the energy consumption by governmental agencies 20% decrease, the enterprises in each district and development zone 20% decrease, and the energy consumption index of sanitary system should be decreased as well.

Calculating with the 9%, 10% and 11% annual growth rate for the GDP in the 11<sup>th</sup> Five-year Plan, the accumulated energy savings in these 5 years would be 24.81 million tce, 25.97 million tce and 27.17 million tce respectively and in 2010, the elastic coefficient of the energy consumption would be 0.43, 0.47 and 0.51 respectively. We may see from the Table 7 that the quicker the GDP growth, the bigger the required energy savings, and meanwhile, the elastic coefficient of the energy consumption will increase.

The estimated energy demand and the predicted amount of energy-saving in 2010 in Shanghai is list in Table 7:

Table 7: The Energy Demand and the predicted amount of Energy-saving in 2010 in Shanghai

(The Average Annual GDP Growth Rate Being 9%)

Project	Unit	2005	2010	Growth Rate (%)	Average Annual Growth Rate (%)
Energy Consumption of GDP per 10,000 RMB	tce	0.88	0.704	-20	-4.36
Total Energy Consumption	10 Thousand tons of Equivalent Coal	8069	9925	23	4.24
GDP (Present Price)	100 Million Yuan	9163	14098	54	9.00
Elastic Coefficient of Energy Consumption			0.43		0.47
The Amount of Energy Saving	10 Thousand tons of Equivalent Coal		-2481		-496

(The Average Annual GDP Growth Rate Being 10%)

Project	Unit	2005	2010	Growth Rate (%)	Average Annual Growth Rate (%)
Energy Consumption of GDP per 10,000 RMB	tce	0.88	0.704	-20	-4.36
Total Energy Consumption	10 Thousand tons of Equivalent Coal	8069	10388	29	5.20
GDP (Present Price)	100 Million Yuan	9163	14756	61	10.00
Elastic Coefficient of Energy Consumption			0.47		0.52
The Amount of Energy Saving	10 Thousand tons of Equivalent Coal		-2597		-519

(The Average Annual GDP Growth Rate Being 11%)

Project	Unit	2005	2010	Growth Rate (%)	Average Annual Growth Rate (%)
Energy Consumption of GDP per 10,000 RMB	Tce	0.88	0.704		-4.36
Total Energy Consumption	10 Thousand tons of Equivalent Coal	8069	10869	35	6.16
GDP (Present Price)	100 Million Yuan	9163	15439	69	11.00
Elastic Coefficient of Energy Consumption			0.51		0.56
The Amount of Energy Saving	10 Thousand tons of Equivalent Coal		-2717		-543

### 1. Target Decomposition by Industries

The energy consumption of secondary industry accounts for 65% of the total energy consumption in Shanghai, and if the value-added energy consumption in the industry decreases 30%, it may contribute 80.5% to the overall energy conservation target of Shanghai.

There are 33 categories in Shanghai's industrial industries and the difference of the comprehensive energy consumption for value-added (10,000 Yuan) among each industry is quite large, from 0.016 tce/(10,000 Yuan) in tobacco manufactures to 6.734 tce/(10,000 Yuan) in petroleum processing, coking and nuclear fuel processing. Each industry has a different dropping rate of comprehensive energy consumption for value-added (10,000 Yuan) in the "Eleventh Five-Year Plan", and therefore the goal decomposition of energy saving in the "Eleventh Five-Year" in Shanghai should not be distributed evenly as 30% among these industries. Each industry should constitute the energy saving goal of the "Eleventh Five-Year Plan" according to the specific condition. In these 33 industries, the energy consumption of the following 8 major industries, including Petroleum Processing,

Coking and Nuclear Fuel Processing, Ferrous Metal Melting and Rolling, Raw Chemical Materials, Chemicals Products, Production and Supply of Electric Power and Thermal Power, Textile Industry, General Equipment, Manufacture of Communication Equipment, Computers and Other Electronic Equipment, accounts for 81% of the total energy consumption amount in Shanghai. The related departments should make effort to carry out the energy saving goal of the eight major industries.

To achieve the entire goal of energy conservation, except for the ferrous metal melting and rolling, the other seven major industries must decrease 30% of energy consumption for value-added (10,000 Yuan) in the “Eleventh Five-Year Plan”. If any industry could not meet this standard, other industries would be very difficult to achieve the entire goal.

In the above goal decomposition by industries, the effect of industrial regulation in Shanghai to the entire energy saving goal was not taken into account. This is because the ratio of light industry to heavy industry in Shanghai has changed from 1:1 to 1:3. Most of the industries with priority of development in Shanghai in the “Eleventh Five-Year Plan”, such as manufacturing, automobile industry, equipment industry, shipbuilding, aerospace industry, steel industry and basic petrochemical industry, etc., are heavy industries. It is estimated that in 2010, the ratio of light industry to heavy industry in Shanghai will still be around 1:3.

During the “Eleventh Five-Year Plan”, Shanghai should give priority to biological medicine, new energy resources and new materials industries with high technology and low energy consumption, for abating the pressure from energy supply.

## 2. Goal Decomposition by Industries

According to the energy conservation target regulated in the 11<sup>th</sup> Five-year Plan, the energy conservation in tertiary industry accounts for 15%, which contributes 19.5% to Shanghai energy conservation. Calculated with 50% of the expected proportion of tertiary industry in the total GDP, the accumulated energy savings for the five years of the secondary industry and tertiary industry would be 23.67 million tce and 5.73 million tce respectively. See Table 8:

Table 8

2005	The Primary Industry	The Secondary Industry	The Tertiary Industry
Value-added (100 Million Yuan)	79.7	4475.9	4588.4
Total Energy Consumption (Expected value) (10 Thousand tons of Equivalent Coal)	130	4900	2400
Comprehensive Energy Consumption for Value-added (10,000 Yuan) (tce)	1.73	1.09	0.52
2010	The Primary Industry	The Secondary Industry	The Tertiary Industry
Value-added (100 Million Yuan)	128	7206	7387
Total Energy Consumption (10 Thousand tons of Equivalent Coal)	222	5522	3248
Comprehensive Energy Consumption for Value-added (10,000 Yuan) (tce)	1.73	0.77	0.44
The Amount of Energy Savings (10 Thousand tons of Equivalent Coal)	0	-2367	-573

*Shanghai Statistic Year Book on Industries Energy and Transportation, 2005*

The energy consumption of tertiary industry accounts for comparatively small proportion in Shanghai, which is about 27%, and its value-added energy consumption accounts for 47.7% of which industry. During the 11<sup>th</sup> Five-year Plan, the tertiary industry of Shanghai will focus on developing financial, materials circulation, culture and culture related

industries. The value-added energy consumption per 10 thousand RMB of materials circulation industry is higher than the average value of the tertiary industry, the rapid development of materials circulation brings pressure for fulfilling the energy conservation target of the tertiary industry, however, the development of Shanghai's materials circulation industry will root in information and use modern materials circulation as model, and its value-added energy consumption per ten thousands RMB could reach favorable international level, which has great decrease compared with the 10<sup>th</sup> Five-year Plan and may abate the pressure of fulfilling the energy conservation target of the tertiary industry. The value-added energy consumption per ten thousands RMB of the industries including financial, culture and related industries is lower than the average value of Shanghai's tertiary industry and its development is preferable for completing the energy conservation target of the tertiary industry.

### 3. The decomposition by the energy conservation target in building industry

Energy consumption of Shanghai's building accounts for 25% of the total energy consumption, and in the 11<sup>th</sup> Five-year Plan, the energy consumption of building should arrive at 15%. The main methods of building energy conservation are executing the energy conservation standard in new building and the renovation in existing buildings:

During the 11<sup>th</sup> Five-year Plan, there will be 180 million square meters in new buildings and public buildings, which should all implement energy conservation standard. Of which, there are 130 million square meters of new buildings and 50 million square meters of public buildings. In the 11<sup>th</sup> Five-year Plan, we should finish 30 million square meters energy conservation renovation for existing buildings, of which, 20 million square meters existing public building energy conservation renovation and 10 million square meters existing comprehensive dwelling energy conservation renovation.

The solar photothermic equivalent area of 2.5 million m<sup>2</sup> will be completed during the "Eleventh Five-Year".

Whether the goal of building energy conservation can be realized has great relation with

the accomplishment of energy saving goal of Shanghai's tertiary industry. In most of the tertiary industries, energy cost by construction is the largest part. If the energy conservation in construction is controlled, the most important part of the energy conservation in the tertiary industry is held in hand.

#### 4. The Decomposition by Energy Consumption Enterprises

There are more than 800 key energy consumption enterprises (over 5000 tce of the annual consumption) in Shanghai, which account for 70% of the total energy consumption of the city. Therefore, the energy saving goal for key energy consumption enterprises in the "Eleventh Five-Year Plan" is an important task of the goal decomposition of energy conservation. Since the number of the key energy consumption enterprises is very big, and there are also many industry varieties, to set down the energy saving goals for each unit is quite difficult. Hence, the competent government department or industry association must take part in to help the enterprises with establishing the energy saving goal. Here are only the general principles of goal decomposition of energy conservation, as a reference for the competent authoritative departments of the enterprise, industry associations and energy consumption enterprises.

(1) The industrial energy saving goal that the key energy consumption enterprise belongs should be used as the reference; the goal of the key energy consumption enterprises should not be lower than that of the industry it belongs to;

The Shanghai Municipality has made the energy saving goal for some shared companies and districts and will assess according to the three catalogues.

(2) During the "Eleventh Five-Year Plan", if the industry that the key energy consumption enterprise belongs to experiences significant regulation, and the regulation is in favor of energy saving at the same time, the goal of the key energy consumption enterprise might be a little lower than that of the industry.

## **V. Recommendations**

1. To further strengthen the lead towards energy conservation, enhance the energy conservation dissemination and build up the consciousness of energy conservation

Shanghai has already established the Leading Group of Shanghai Energy Conservation and Emission Reduction to strengthen obligation and fulfillment. The key directors of all level should genuinely attach great importance to energy conservation and bring the fulfillment of each energy conservation and emission reduction index into the comprehensive evaluation system of the development of economic society, and carry out ‘Target Obligation’ system and ‘One Vote Veto’ system; Shanghai should strengthen and advance the energy conservation of all Commissions, adopt variety of types to innovate energy conservation culture and fulfill national energy conservation and emission reduction, three principal energy conservation parts’ obligations including enterprises, government and society should be intensified, and consequently to form the favorable custom of energy conservation and environmental protection of the whole society.

2. To attach importance to cultivate the talents on energy conservation and enhance the trainings for the managers and technicians of the energy conservation sector

Shanghai should encourage the universities and colleges to set specific energy conservation courses at the specialty setting for the sake of cultivating energy conservation talents. The current status is that Shanghai is in a great and urgent demand of energy conservation related professionals. The industrial departments of in charge and associations should actively work with universities and colleges to hold some short-term training courses in energy conservation.

Various energy conservation service companies are also a major force for the professional training. Most of these companies are newly born and just at their very beginning phase. The local government should set policies to promote their development and, especially, in the professional training area.

There are about 800 enterprises which are the intensive energy consuming entities. They



are born to be the best place for energy conservation professional training. The related departments should strengthen the trainings towards the energy conservation managers and technicians of key energy consumption enterprises and stable the team of the key energy consumption enterprises.

3. To strengthen the support and force of governmental finance and stipulate the energy conservation system in incentive and punishment

Shanghai government should keep expanding the financial support and force towards energy conservation, conduct well the special capital for energy conservation, offer allowance and subsidy for energy conservation loan, further study and stipulate the energy conservation systems on incentive and punishment, encourage banks to increase the force for energy conservation financing and encourage energy consumption enterprises to expand the self capital into energy conservation renovation.

On energy supply, the government should solve the reform issue on multiple energy investments by price adjustment and policy incentives. We should reasonably use the lever of energy price, keep implementing differentiating energy price policy, promote the mechanism of energy management, effectively advance the energy conservation behavior of enterprises, and make more energy conservation technologies and measurements feasible economically.

We should establish the energy conservation subjects supported by financial and tax policies and attach importance to supporting the R&D, promotion and appliance of energy conservation new technologies and products.

In order to advance the promotion of energy conservation technologies, we may establish local special energy conservation fund and DSM fund, support the development of ESCO, promote the formation and development of Shanghai's ESCO industry for the sake of relieving the present situation in Shanghai of 'lacking doctors but not medicine'.

In order to further encourage energy conservation in transportation, we should get ready for the coming fuel tax and perfect the operational mechanism of oil market. From the finance, we should actively support the study and development of the transportation oil substitute including ethylene glycol, dimethyl ether, mixed power, and hydrogen energy,

and keep exploring and expanding the new area on transportation energy conservation.

To the energy conservation on residential buildings, the financial departments may grant financial support on energy conservation measurements at the time of renovating and refitting residential buildings.

On industry, we should encourage enterprises to use the products with lower energy consumption and high value-added and give support from finance and tax.

4. To enhance the innovation capacity on energy conservation technologies, increase the renovation on energy conservation technologies, and speed up the promotion, appliance and reservation of new energy conservation technologies and products

Shanghai attaches great importance to strengthening the innovation capacity on energy conservation technologies. In the “Eleventh Five-Year Plan” period, Shanghai will concentrate and put great investments in the research fields which Shanghai have or will have advantages, or the fields of great importance, and by projects’ implementation, to drive the adjustment of Shanghai’s industrial structure and upgrade. Shanghai will also set a series of policies to promote the universities, research facilities and enterprises to participate these researches. The researches will promote the structural transformation and upgrade of the industries in Shanghai. The energy conservation causes will gain great benefits from both the investments for the researches and the transformation, which aim at improving the ability of innovation and technology integration.

To increase the force on energy conservation technology renovation is the key point to existing energy utilization system and equipment renovation. Hence, we should fully attach importance to energy conservation technology renovation, advocate technological innovation, strengthen energy conservation technology, and promote new energy conservation technology, materials and equipments. In Shanghai, we should promote the experience of Bao Steel’s energy conservation technology renovation and energy management.

We should establish a service platform for promoting energy conservation technology, by

which collecting more energy conservation technologies and products of domestic and overseas, establish the channel for information issue and conduct well the energy conservation technology service.

At the same time of vigorously promoting existing energy conservation measurements, Shanghai should conduct well the reservation for energy conservation measurements.

At first, Shanghai should organize, study and develop the clean energy and the clean utilization of traditional fossil energy, improve the key technologies of EE, promote the clean utilization of new energy, energy conservation and energy, the nationality of key energy devices, and the intensity of the energy device soil utilization.

We should deeply research develop coal with high efficiency and clean utilization and gas. Shanghai is planning to apply the Integrated Gasification Combined Cycle (IGCC) system. We could build a demonstration IGCC power plant in Caojing area. We could integrate this with coal-chemical industry, and make the highest efficiency of the current resources and system. On the other hand, we should try to master the manufacture of the relevant equipments and facilities of IGCC. Additionally, we should keep on the researches on Coal-to-Liquids technology and Alternative Fuels (e.g., ethanediol and dimethyl ether). They are the possible substitution of crude oil.

Shanghai should also promote the researches on the new energy (including the renewable energy) and energy clean utilization projects, make new energy (solar energy and wind energy) industrialization in soon.

Natural gas is also a clean and efficient energy which should be wider applied in the “Eleventh Five-Year Plan” period. Shanghai is lack of enough experience, relevant techniques and equipments for this energy. We should import and induce the international advanced techniques, facilities and experiences, and develop our own related technologies and equipments at the mean while, such as natural gas boiler, heating and cooling devices, and dryness devices using natural gas, etc.

5. Speed up the application of new energy saving management system to meet demands of market economy

New systems such as power demand side management (DSM) and energy performance contracting (EPC) have been widely used in foreign countries. The utilization of these systems shall also be generalized in Shanghai in the near future. Practical experiences in demand side management (DSM), especially in PDSM, need to be summarized and the related regulations should be perfected and make them more scientific, normative and practicable. For the state-owned power companies and gas companies, it is important to perform their inner energy conservation as well as to take the social responsibility of energy saving and emission reduction.

It is necessary to bring up intermediary organizations, including institutes, associations and ESCO, to promote the EPC system. Particular policy should be established for ESCO, for instance special rate of tax on fixed assets investment. We should organize and promote the EPC on key energy conservation pilot projects. Energy Audit (energy conservation diagnosis) as well as scientific measurement of energy efficiency shall be strengthened, and the sustainable and healthy development of ESCOs should be promoted as well. We should coordinate with financing and investment companies to increase the financing channels for medium and small ESCOs. Moreover, third-party evaluation, supervision and arbitration system should be established to optimize the management of energy conservation market.

To accelerate the development and utilization of renewable energy. It is predicted that the total renewable energy in Shanghai (such as solar energy, biomass energy, wind energy etc.) will reach about 6.8 million tons of equivalent coal by 2015. However, if relying exclusively on the market-oriented system, it is quite difficult to develop such new energy resources. Therefore, it requires the support from the policies and the promotion by green power system.

## 6. To enhance the supervision and guide to the key energy consumption enterprises

The key energy consumption enterprises cover the fields of industry, commercial and trade, tourism, education, and hospital. To enhance the governmental supervision and guide of these key energy consumption enterprises should be an emphasis for the local government. The Shanghai municipal government should:

1) Promote the energy conservation construction in the key energy consumption enterprises, and enhance the professional training for energy conservation managers;

2) The economical operation of key energy consumption equipments and the energy conservation technology renovation. Related departments should actively regulate the operation and management methods for energy-intensity equipments, including stove, fan, water pump, motor and central air-conditioning, and the mature and efficient measurements on energy conservation technology renovation should be promoted.

3) To attach importance to the unit product consumption. For the key energy consumption product, such as steel, ethane and glass, we may stipulate the limit standard for unit product consumption according to international advanced level, and for these which can not reach the standard, we should ask them to correct within certain term. For other products, the associations should play their role.

5) Accelerate the adjustment of the industrial structure and energy utilization. It is comparatively smaller than the 10<sup>th</sup> Five-year Plan depending on adjusting existing industrial structure to reduce energy consumption. Hence, during the 11<sup>th</sup> Five-year Plan, we should keep increasing the optimization and adjustment of industrial structure, and vigorously develop modern service industry.

## 7. Speed up the establishment and amendment of Shanghai municipal energy conservation law and standard and strengthen the force of energy conservation supervision and execution

The *Regulations of Shanghai Municipality on Energy Conservation* (referred to as *the*

*Regulations* below) came into effect about eight years ago, which has facilitated the energy saving work in Shanghai. However, with the amendment of the national energy conservation law and the establishment of other related regulations, it is necessary for the Shanghai government to amend *the Regulations* correspondingly for the fulfillment of the overall energy conservation target of Shanghai.

Local standards for energy conservation are required to be set up. First of all, it is necessary to specify the local standard for the energy efficiency of energy-using products (EuPs) and for designing of energy-using projects, both of which are the fundamental problems of energy saving. Secondly, local standard of energy consumption quota is required to be set up and rigidly executed, and for these enterprises that violate the energy consumption quota should be punished. In addition, governors need to pay as much as attention on the basic work like measurement, analysis of energy resource and to make rules for related administration.

Moreover, new regulations, standards and their implementing rules for further energy saving of constructions in Shanghai should be soon established and the corresponding plan and incentive mechanism should be carried out gradually.

As for the transportation in Shanghai, rules are required to be established to guarantee the public transportation priority.

Furthermore, appropriate measures need to be adopted to support the development of tertiary industry, such as the incentive policy to encourage the development of ESCO industry.

Law enforcement is as important as law making. The municipal government should strengthen the execution and supervision of the energy conservation regulations as defined in the law. The leadership of related Shanghai municipal administrative department shall be reinforced in the management and coordination of energy conservation affairs. The Shanghai Energy Conservation Supervision Center (SECSC) is the first energy conservation law execution department founded in China. At the time when it was founded, the total energy consumption in Shanghai was only 48 million tons of equivalent coal, while it is predicted to be more than 100 million tons of equivalent coal by 2010. Consequently, the SECSC needs to strengthen its capacity building to meet

the demands of the supervision of energy saving in future.

## **VI Conclusion**

1. The energy conservation potential in Shanghai is quite tremendous. To compare 2010 with 2005, the total energy consumption potentials in Shanghai would be reached around 18 million tce in terms of analysis of energy consumption per product. In which 9 million tce of industry, building and transportation; 5 million tce by the added proportion of the tertiary industry; 4 million tce by optimizing the composition of the energy consumption. Especially with the annual industrial energy conservation potential of 4 million tce, which accounts for 44% of the energy conservation potential of 9 million tce of industry, building and transportation;  
In order to fulfill this target, the task is hard; however it can be realized by efforts. According to calculating the target of Eleventh Five-Year Plan and the growth of GDP 10%, the total energy consumption would be reached around 100 million tce in Shanghai by 2010, and increased 20 million tce than 2005. The accumulated energy conservation would be reached around 26 million tce. The gap would be obtained through reducing energy consumption of adjusting structure and expanding scale.
2. Shanghai proposed its energy conservation target in the 11<sup>th</sup> Five-year Plan has been decomposed. With 30% decrease of the value-added energy consumption in industrial enterprises, its contribution could reach 80.5%, hence, industrial energy conservation is the key point;
3. At the same time of keep maintaining the rapid development of economy in the 11<sup>th</sup> Five-year Plan, the energy consumption in Shanghai's building, transportation and civilian grows fast as well. Hence, we should conduct well the energy conservation on building, transportation and civilian at the same time of emphasizing on industrial energy conservation;
4. Aiming at the existing key issues and obstacles on energy conservation at present in

Shanghai, considering the combination of in the near future and long-term, the combination of macro and micro, the combination of government and market, the combination of management and service, 7 suggestions have been brought forward, which are practicable and feasible, and may promote the energy conservation of Shanghai;

5. Since the lack of related statistic data and the limit time on survey, although there has certain analysis force in this article, however, it is only a preliminary analysis and may only be a reference for the governmental departments in charge of energy conservation and some related energy conservation organizations.