

FINAL REPORT



**STUDY ON THE POTENTIAL OF SUSTAINABLE ENERGY FINANCING FOR SMALL AND
MEDIUM ENTERPRISES IN CHINA**

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ABBREVIATIONS

CETC	= Chinese Economic and Trade Commission
ECI	= Energy Consumption Index (in tons of standard coal equivalence or tce per RMB10, 000 industrial output value)
EE	= Energy Efficiency
EEI	= Energy Efficiency Index (an index of 100 represents average level of the sector)
FYP	= Five Year Plan by the Chinese Government. The period of 12 th FYP refers to 2011-2015
IEAMTs	= Industrial Enterprises Above Minimum Threshold , referring to those with annual revenue of over 5 million RMB from the principal business
IOV	= Industrial Output Value (in RMB)
MIIT	= Ministry of Industry and Information Technology
PER	= Ratio of Power (Electricity) to Total Energy Consumption (kWh/tce) in a given industrial sector or a given province. A higher PER indicates that the sector or the province tends to use more energy in the form of electricity, which is more expensive than the use of primary energy forms, such as coal.
RE	= Renewable Energy
SEUC	= Share of Energy Use Cost in total production cost (%) in a given industrial sector. If the SEUC value of a given industrial sector is 3% or higher, that industrial sector would be considered energy intensive and its business bottom line would be considered likely to be sensitive to energy cost/price.
SME	= Small and Medium Enterprises
tce	= Tons of standard coal equivalence (1 tce = 1,000 kgce = 7,000,000 kCal = 29.31GJ)

List of Indicators

Number	Category	Name	Description	Unit	Source	Present in Section
1	Provincial	Provincial energy consumption of IEAMTs	Energy consumption of industrial enterprises above minimum threshold (which in the context of this Study is the combination of large cooperates and SMEs) of provinces	10k tce	China Statistic Yearbook 2011	2.1
2		Provincial IOV of SMEs	SMEs industrial output value of provinces	100 million RMB	China Industrial Economic Statistic Yearbook 2011	2.1
3		Provincial energy consumption of SMEs	Provincial energy consumption of SMEs	10k tce	Obtained through calculation	2.1
4		Provincial electricity consumption of IEAMTs	Provincial electricity consumption of Industrial enterprises above minimum threshold	100 million kWh	China Statistic Yearbook 2011	2.1
5		Provincial PER	Provincial Ratio of Power (Electricity) to Total Energy Consumption	kWh/tce	Obtained through calculation	2.1
6	Sectoral	Sectoral Energy Consumption of SMEs	Sectoral Energy Consumption of SMEs	10k tce	Obtained through calculation	2.2.1; 2.3
7		Sectoral Energy Consumption of IEAMTs	Sectoral Energy Consumption of industrial enterprises above minimum threshold	10k tce	China Statistic Yearbook 2011	2.2.1
8		Sectoral IOV of SMEs	Sectoral industrial output value of SMEs	100 million RMB	China Industrial Economic Statistic Yearbook 2011	2.2.1

Number	Category	Name	Description	Unit	Source	Present in Section
9		Sectoral Electricity Consumption of IEAMTs	Sectoral Electricity Consumption of Industrial enterprises above minimum threshold	100 million kWh	China Statistic Yearbook 2011	2.2.1
10		Sectoral PER	Sectoral ratio of power to energy consumption of industrial enterprises above minimum threshold (=I/G)	kWh/tce	Obtained through calculation	2.2.1
11		Sectoral IOV of IEAMTs	Sectoral industrial output value of all industrial enterprises above minimum threshold	100 million RMB	China Statistic Yearbook 2011	2.2.1
12		Sectoral Average ECI-IEAMTs	Sectoral average energy consumption index of all industrial enterprises above minimum threshold (=G/K)	tce/10k RMB	Obtained through calculation	2.2.1
13		Sectoral SME ECI in Excess of Average IEAMTs ECI	Sectoral SME energy consumption index in excess of average industrial enterprises above minimum threshold energy consumption index	%	Obtained through calculation	2.2.1
14		IOV Ratio of SMEs/ IEAMTs	Industrial output values ratio of SMEs to industrial enterprises above minimum threshold	%	Obtained through calculation	Appendix B
15		Sectoral Average ECI-Average	Energy consumption index of industrial enterprises above minimum threshold	tce/10k RMB	Obtained through calculation	Appendix B
16		Sectoral Average ECI-SMEs	Energy consumption index of SMEs	tce/10k RMB	Obtained through calculation	Appendix B
17		Sectoral Unit Energy Price	The price of different energy forms by sectors	10k tons, 100 million m3 and 100 million kWh	China Energy Statistic Yearbook 2011	2.2.3
18		Sectoral Energy Cost of IEAMTs	The energy cost by sectors of enterprises above minimum threshold	100 million RMB	Obtained through calculation	2.2.3

Number	Category	Name	Description	Unit	Source	Present in Section
19		Sectoral SEUC/Energy Intensity	Sectoral share energy use cost in total production cost	%	Obtained through calculation	2.2.3
20		Sectoral Principle Business Cost of IEAMTs	Sectoral Principle Business Cost of enterprises above minimum threshold	100 million RMB	China Statistic Yearbook 2011	2.2.3
21		Sectoral Energy Efficiency Improvement Target	Sectoral Targets for Energy Efficiency Improvement in 12 th FYP	%	The 12 th FYP for Industrial Energy Saving by MIIT (2012)	2.3
22		Sectoral Energy Efficiency Improvement Target of SMEs	Sectoral Targets for Energy Efficiency Improvement of SMEs in 12 th FYP	%	Obtained through calculation	2.3
23		Sectoral Energy Saving Potential	Sectoral Energy Saving Potential per year	10k tce	Obtained through calculation	2.3
24		Sectoral Energy Cost Saving Potential	Sectoral Energy Cost Saving Potential per year	100 million RMB	Obtained through calculation	2.3

EXECUTIVE SUMMARY

China has made significant achievements in improving its energy efficiency and reducing its greenhouse gas emissions in recent years, mainly through rolling out regulations with large, state-owned enterprises, which tend to be the country's biggest emitters. Such policy enforcement efforts - although have shown fast and impressive results – have left the majority of the smaller and privately-owned companies unaffected, and thus impeding further major breakthroughs in the country's mitigation efforts. The International Finance Corporation (IFC), the arm the World Bank Group to work specifically with the private sector, has therefore selected facilitating the energy efficiency improvements by Small and Medium Enterprises (SMEs) as one of its priority areas, in order to help China in its next endeavor in further energy efficiency improvements, and to maximize IFC's added value and development impacts.

In April 2012, IFC commissioned ESD China Ltd. (ESD, the Consultant) to undertake a Study on the Potential of Sustainable Energy Financing for in China (the Study). The primary objective of the Study was to identify the priority industrial sectors, in provinces with vibrant SME economies, where significant energy saving potentials lie.

Limited by time and other resource constraints, this Study looked into the issue by pulling together and going through published statistical data scattered throughout various sources. Some of the major sources include China Statistic Yearbook 2011, China Energy Statistic Yearbook 2011, China SMEs Statistic Report 2011, and 2011 Statistic Yearbooks of Guangdong, Zhejiang, Jiangsu, Shandong, Henan, Hebei and Sichuan provinces.

Available energy consumption data have been sparse and scattered for SMEs in China; nonetheless, this Study has been completed with a reasonable level of confidence in estimating SME energy consumptions for the 8 selected priority sectors, largely because most of the selected priority sectors are inherently dominated by SMEs.

The Study concludes that the top six provinces with the highest SME energy consumption costs be Guangdong, Jiangsu, Zhejiang, Shandong, Henan and Hebei, which were selected for further sectoral analysis. In addition, Sichuan province was also selected for sectoral analysis to represent the western region.

The selection of priority sectors began with all 35 industrial sectors at the national level (excluding the energy supply related sectors: petroleum extraction, petroleum processing, power, and gas supply sectors), and was then narrowed down to 18 that are both priority SME sectors and have the highest total aggregated sectoral energy consumptions. Sectoral energy saving potentials would then be calculated mainly based on the energy saving targets (in %) outlined in *The 12th Five Year Plan for Industrial Energy Saving*, thus allowing a selection of provincial priority sectors.

The final list of top 9 energy intensive SME sectors selected from the 7 priority provinces includes:

- Manufacturing of Raw Chemical Materials and Chemical Products
- Smelting and Pressing of Ferrous Metals (also known as Iron and Steel Industry)
- Manufacturing of Non-metallic Mineral Products (primarily Building Material Industry)
- Manufacturing of Metal Products
- Smelting and Pressing of Non-ferrous Metals
- Manufacturing of Textile
- Mining and Washing of Coal
- Manufacturing of Paper and Paper Products
- Mining and Processing of Ferrous Metal Ores

With the exception of Mining and Washing of Coal sectors, there appears to be a total energy saving capacity of approximately 229 million tce/yr that can be achieved by SMEs in the top 8 energy intensive sectors, representing approximately 74% of the total energy saving potentials achievable amongst the 35 industrial sectors during the 12th FYP. This amount of energy saving capacity in the 8 priority sectors, if implemented, is likely to achieve a total energy cost saving of approximately RMB 446 billion per year.

Energy saving potentials for the 7 selected provinces are estimated among the 8 priority sectors based on ratios of provincial sectoral industrial output values. The results from adopting this methodology could be different from results concluded through other methods, should reliable bottom-up statistics become available in these provinces in the future. For the moment, the best estimates by national statistics would conclude that the most significant provincial sectoral SME energy saving potentials concentrate in the following three sectors:

- Manufacturing of Raw Chemical Materials and Chemical Products;
- Smelting and Pressing of Ferrous Metals; and
- Manufacturing of Non-metallic Mineral Products.

The top 3 SME sectors alone would contribute to an energy saving capacity of approximately 174 million tce/yr that may potentially be achieved during the 12th FYP period (2011-2015), representing approximately 56% of the total estimated energy savings potential for the 35 SME sectors combined. Thus the Study has provided some initial insights in priority areas to examine geographically and sectorally, when considering energy efficiency investment in SMEs. Further, more detailed analyses will be required in order to determine specific investment opportunities within those priority areas. The Study also presents 11 real sector case studies, technical solutions, and investment volume typical to SMEs' energy efficiency projects, to facilitate future exploration of actual investment opportunities.

1.0 INTRODUCTION

The SME sector generates over 60% of China's gross domestic products (GDP) and provides around 80% of its urban jobs. However, the majority of SMEs in China are using dated production technologies and equipment with poor performance, low efficiency, and high energy and water consumption in comparison with large, often state-owned, enterprises in the same sector. Thus, SMEs represent a significant share of energy use and greenhouse gas (GHG) emissions in China. The International Finance Corporation (IFC), the private sector arm of the World Bank Group (WBG), focuses on supporting the continued progress of SMEs as an important part of the country's sustainable growth and also the important role they need to play in lowering the intensive energy consumption and GHG emissions, thus contributing to the country's energy efficiency and emission reduction targets set for the 12th Five Year Plan (FYP) period.

In order to achieve this objective, IFC has commissioned ESD China Ltd. (ESD) to undertake a Study on the Potential of Sustainable Energy Financing for Small and Medium Enterprises (SMEs) in China (the Study). This Study aims at identifying the priority industrial sectors in key SME vibrant provinces with significant energy saving potentials. The Study also seeks to illustrate the business case by providing case studies of SMEs that have either implemented or considered implementing energy efficiency (EE) improvements or small renewable energy (RE) projects to overcome challenges or as a success factor.

As indicated in Table 1, the official classification of SMEs in China defers from that of the WBG/IFC; the Chinese definition of SMEs also varies slightly from time to time. According to the Chinese criteria for SMEs published by the Chinese Economic and Trade Commission (CETC) in 2003, SMEs refer to industrial enterprises meeting one or more of the following three criteria: (i) number of employees below 2,000, (ii) total revenue below RMB 300 million per year, or (iii) a total asset of less than RMB 400 million. In 2011, the Ministry of Industry and Information Technology (MIIT) amended the SME criteria by removing the total asset criterion, lowering the upper limit of the number of employees to 1,000 and changing the total revenue limit to RMB 400 million.

Table 1: Definition of SMEs in China

Criteria	Chinese MIIT (2011) (Meeting 1 of the 3 criteria)		Chinese CETC (2003) (Meeting 1 of the 3 criteria)		The World Bank Group (Meeting 2 of the 3 criteria)
	Small	Medium	Small	Medium	
Number of Employees	<300	300~1000	<300	300~2000	<300
Total Asset	NA	NA	< RMB 40 million	RMB 40~400 million	< RMB 100 million
Total Annual Sales Revenue	<RMB 20 million	RMB 20~400 million	< RMB 30 million	RMB 30~300 million	< RMB 100 million

As all the published statistics in China follow the Chinese definitions, a complete break down and re-aggregate of the existing statistics using the WBG criteria will only prove unrealistic. For all practical purposes, the Study is based on the most recently published statistics in 2011 that reflect the country's situation in 2010. As 2010 happens to be the last year of the 11th FYP period (2006-2010), the 2010 data are also the baseline for all published projection for the period of the 12th FYP (2011-2015). Use of year 2010 as the base year would hence allow for easy reference to industrial energy efficiency improvement targets published for 12th FYP and many other Chinese publications.

Although the definitions by Chinese authorities are different from that of the WBG/IFC's, the differences might be getting narrower. The number of employees for medium enterprises has gone down from 2,000 to 1,000 from 2003 to 2011, respectively. Although neither is significantly larger than the WBG definition criteria (under 300), considering that China is a populous country with historically low labor costs, companies of the same scale in China could be more inclined to select a mode of production that is more labor intensive than a similar company elsewhere in the world, thus employing more people.

The 2011 definition dropped total assets as one of the three criteria. Over the past decade, the service sector – typically with light assets – has boomed in China, and now represents a much bigger share in total businesses. Exclusion of total assets as one of the three qualifying criteria may avoid blurring of the picture by mistakenly including large service providers who are light on assets.

On the surface, the upper limit of total annual sales revenue has increased from RMB 300 million to RMB 400 million. However, if inflation is taken into consideration, RMB 300 million back in 2003 actually has a higher purchasing power than RMB 400 million in 2011. Therefore, overall, the Chinese definition of SMEs is “shrinking” in every way.

As described in the following sections, 9 energy intensive sectors are identified as priority SME sectors across 7 key provinces through systematic screening/ranking. Despite the sparse energy consumption data available for SMEs in China, sectoral SME energy consumption reduction and energy saving potentials are quantified for 8 of the 9 priority SME sectors with a reasonable degree of confidence.

2.0 METHODOLOGY

A study to unveil the energy efficiency potential of SMEs can take many forms. This Study, confined by timeframe and resource limitations, has not been able to conduct on-site surveys at the factory level. Instead, it has attempted to paint the picture by pulling a handful of statistical data that are available, compatible, and credible from various official statistical sources, as well as by establishing the nexuses between them to reach the conclusions. The sections below will provide a conceptual description of the thinking process.

2.1 Selection of Priority Provinces

The selection of priority provinces has taken into consideration: (i) the energy consumption by SMEs of the provinces, and (ii) the electricity consumption of the province, as published in China Energy Statistic Yearbook 2011. The latter is expressed through ratio of power (electricity) consumption to total energy consumption, or PER.

Inclusion of the second criterion is due to the cost of power consumption having a disproportionately large influence on the market value of energy when measured in tce and hence is a significant factor to be considered in energy cost saving calculations.

Raw statistics for energy consumptions by SMEs at provincial level are currently not available in China. Quantitative data on SMEs' energy efficiency is also sparse in the literature. Nevertheless, they can be calculated through weighted proportioning, based on a generic assumption that SMEs are on average 36% less energy efficient than the average level of the industrial enterprises in the respective industrial sectors (Xiong and Yu, 2009)¹. The process is depicted in Figure 1 below.

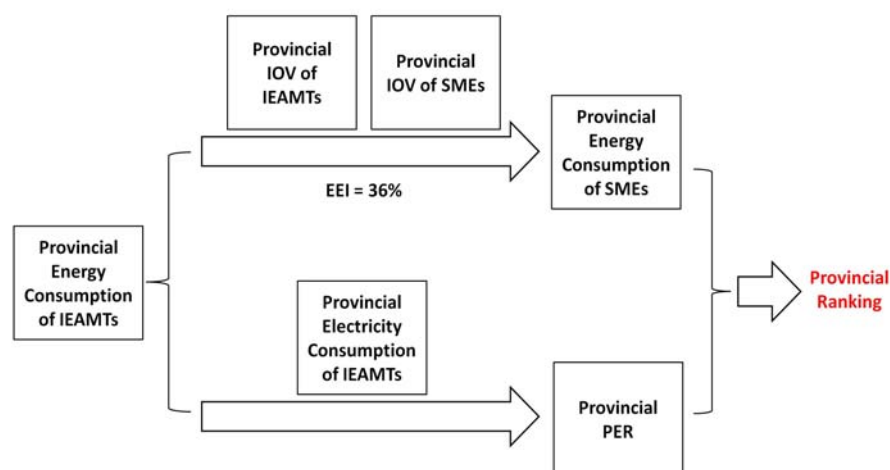


Figure 1: Selecting Priority Provinces

Notes: EEI = Simple average energy efficiency index.

¹ XIONG Hua-wen and YU Cong (2009) *The Energy Efficiency Circumstances of Small and Medium Sized Industrial Enterprises and Their Potential Analysis for Energy Conservation*, Power DSM, Vol.11, No. 6.

Sources:

- Provincial energy consumption of industrial enterprises above minimum threshold (IEAMTs) (in tce), China Statistic Yearbook 2011;
- Provincial industrial output value (IOV) for IEAMTs (in RMB), China Statistic Yearbook 2011;
- Provincial IOV of SMEs (in RMB), China Industrial Economic Statistic Yearbook 2011.

An expanded description of the priority province selection process is provided in Appendix A: Ranking SMEs by Provinces.

2.2 Selection of Priority SME Sectors

The Chinese statistical yearbooks traditionally categorize the entire economy into 39 broad sectors. Among the 39, four are involved in energy and utility supply: Extraction of Petroleum and Natural Gas; Processing of Petroleum, Coking, Processing of Nuclear Fuel; Production and Supply of Electric Power and Heat Power; and Production and Supply of (Flammable) Gas. These primary or secondary energy products producers are known to be dominated by large, state-owned enterprises. They are thus excluded from the sectoral analyses.

The remaining 35 sectors would undergo a series of screening, before a final ranking of the priority SME sectors can be generated, based on joint ranking of the following four factors:

- Sectoral energy consumption of SMEs (in tce);
- Sectoral PER values;
- Regional prevalence counts of priority industrial sectors amongst the selected priority provinces; and
- Sectoral energy intensity, measured in Share of Energy Use Cost (SEUC) as a % of the overall production cost for the respective sector.

The combination of the above four indicators will generate a comprehensive picture of: 1) how large the total SME energy consumption is for the sector, 2) how significant energy cost is for the SMEs for a particular sector, and 3) how important a sector is in the priority province. The remaining task is then to find robust estimations of the indicators, among the scarcity of reliable quantitative data.

2.2.1 Finding Sectoral SME Energy Consumptions and PER Values

Similar to the calculation of provincial SME energy consumption, sectoral SME energy consumption can be calculated through weighted proportioning using the energy consumption index (ECI, in tce per RMB 10,000 of industrial output value) by adopting the generic assumption that SMEs are 36% less efficient than the industrial average for their respective sectors. Such national level calculation can be supported by the following raw statistics for base year 2010:

- Sectoral IEAMTs energy consumption (in tce), in China Statistic Yearbook 2011 and China Energy Statistic Yearbook 2011;
- Sectoral IOV of IEAMTs (in RMB), in China Statistic Yearbook 2011; and
- Sectoral IOV of SMEs (in RMB), in China Industrial Economic Statistic Yearbook 2011.

The calculation process is depicted in Figure 2. The calculation results are preliminary because the generic assumptions do not take into account the sector variations. Nevertheless, the preliminary estimates are considered adequate for the purposes of an initial, semi-quantitative ranking of priority sectors (as further discussed in Appendix B). The uncertainty introduced by the generic assumption would be limited for most of the selected priority SME sectors as the results can be refined with the support of further sector-specific research, if needed.

Similar to the provincial ranking analysis, Sectoral PERs (derived through Sectoral Electricity Consumption data, as published in China Energy Statistic Yearbook of 2011), are also a factor in deciding the sectoral rankings together with the calculated PER values for the respective sectors, expressed in kWh/tce.

The Sectoral Energy Consumption of SMEs and Sectoral PER values will be used to determine the sectoral ranking.

2.2.2 Identifying Regional Prevalent Priority SME Sectors

Provincial statistics in China tend to track somewhat different aspects of the industrial sectors within the provinces. Although the seven selected provinces all have sectoral IEAMT's IOV figures, only Guangdong Province keeps track of sectoral energy consumption of IEAMT's, and only Sichuan Province records provincial IOVs of SMEs.

Thus, the top 6 industrial sectors for each of the priority provinces are identified based on either sectoral IEAMT's IOV, or combined with sectoral energy consumption of IEAMTs or provincial IOVs of SMEs, where data available, while also taking into account the sectoral energy intensity. The industrial presence is then put into context of the sectoral energy intensity (as represented by Sectoral SEUC, which will be explained in greater detail in the next section). A summary of regional prevalence counts of priority industrial sectors is provided in Table 2 below.

Table 2: Regional Prevalence of Energy Intensive SMEs Sectors in 7 Selected Provinces

Item No.	Sector	Energy Intensity (Sectoral SEUC)	Provincial Presence Count	Guangdong	Shandong	Hebei	Zhejiang	Jiangsu	Henan	Sichuan
1	Manufacturing of Raw Chemical Materials and Chemical Products	19.30%	7	•	•	•	•	•	•	•
2	Smelting and Pressing of Ferrous Metals	17.07%	5	•	•	•		•	•	
3	Manufacturing of Non-metallic Mineral Products	16.76%	5	•	•	•			•	•
4	Mining and Washing of Coal	14.34%	4		•	•			•	•
5	Manufacturing of Textile	4.78%	3	•	•		•			
6	Manufacturing of General Purpose Machinery	2.43%	3				•	•		•
7	Manufacturing of Transport Equipment	1.90%	3				•	•		•
8	Smelting and Pressing of Non-ferrous Metals	11.01%	2		•				•	
9	Manufacturing of Paper and Paper Products	8.63%	2	•					•	
10	Manufacturing of Electrical Machinery and Equipment	1.43%	2				•	•		
11	Processing of Food from Agricultural Products	1.73%	2			•				•
12	Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	1.25%	2	•				•		
13	Mining and Processing of Ferrous Metal Ores	7.26%	1			•				
14	Manufacturing of Metal Products	4.90%	1				•			

Energy intensive sectors with energy cost contributing to 3% or more of the total business cost.

2.2.3 Weighting Energy Costs

Sectoral energy mixes, as published in the China Statistic Yearbook of 2011, are provided in 9 basic forms: coal, coke, crude oil, gasoline, kerosene, diesel oil, fuel oil, natural gas and electricity. Their prices have not been included in the national statistic yearbooks, while the Guangdong Statistic Yearbook 2011 did include a complete set of 2010 unit prices for the 9 energy forms. The prices are then correlated to specific energy types, thus the sectoral unit energy price can then be obtained as the weighted average of all 9 energy forms and expressed in RMB/tce. The detailed calculations and results are presented in Appendix C.

Now that the sectoral energy prices (in RMB/tce) have been calculated, the sectoral energy costs can be derived together with the respective sectoral energy consumption (in tce). The sectoral SEUC can then be calculated from the principal business cost of the respective sector, which is also published in the China Statistic Yearbook of 2011. Energy intensive industries commonly refer to those with sectoral SEUC values of 3% or higher.² The Study then sorted the sectors according to their significance of energy costs in their costing structure, and excluded those with Sectoral SEUC values under 3%, who might be rather insensitive to energy costs in daily operations. A detailed list of the average sectoral energy costs is presented in Table D1 in Appendix D.

2.2.4 Integrating Factors

The factors that reflect the sectoral energy consumption of SMEs, sectoral PER values, regional occurrences of priority industrial sectors within the selected priority provinces, and sectoral energy intensity (measured in Share of Energy Use Cost, SEUC as a % of the overall production cost) are now all part of the final ranking of priority sectors. Figure 2 below presents the overall process of selecting priority industries.

² 2006 EU Energy Products Directive.

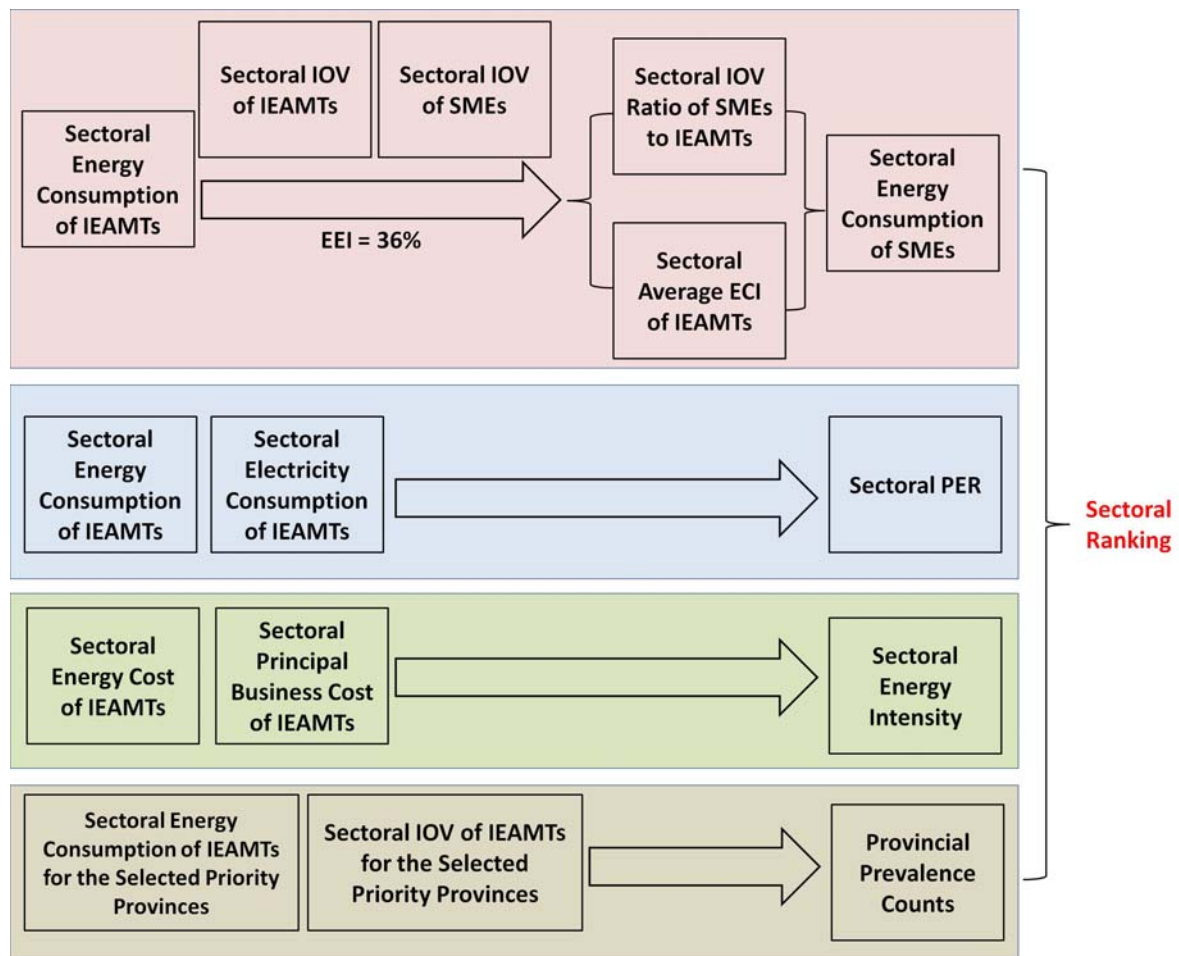


Figure 2: Finding Sectoral Ranking

To avoid premature disqualification of potential priority sectors, 18 out of the 35 sectors with the highest IEAMTs energy consumption are included in the second round screening.

A final, joint ranking has been developed to identify the priority sectors based on individual scores in four factors. For each factor, the highest score will be given to the sector with the highest SME Energy Consumption value, SEUC value, Provincial Prevalence Count numbers, and the lowest sector PER value. For example, the sector with the most SME energy consumption value would be given a score of 18 (out of 18) under that indicator. The sector with highest SEUC value would be given a highest score of 12. Since 6 out of the 18 sectors have a SEUC value less than 3%, which would be given a score of zero, they are hence excluded from further consideration hereafter due to low sectoral energy intensity. The final joint ranking will be based on the total score, which is the sum of the individual scores.

As shown in Table 3 below, once those sectors with SEUC score of zero and/or regional occurrence of zero are truncated, there are only 9 remaining sectors in the final list of priority SME sectors.

Table 3: Summary of Sectoral Ranking for Top 18 Energy Consuming Sectors in China

Sector	SME Energy Consumption		PER		SEUC		Provincial Prevalence Count	Total Score	Final Joint Ranking
	Value	Score	Value	Score	Value	Score			
Smelting and Pressing of Ferrous Metals	29841.75	18	801.55	2	17.07%	11	5	36	2
Manufacturing of Non-metallic Mineral Products	26228.31	17	884.46	3	16.76%	10	5	35	3
Manufacturing of Raw Chemical Materials and Chemical Products	25460.37	16	1059.29	4	19.30%	12	7	39	1
Smelting and Pressing of Non-ferrous Metals	10077.17	15	2436.71	5	11.01%	8	2	30	5
Mining and Washing of Coal	6443.82	14	710.84	1	14.34%	9	4	28	7
Manufacturing of Textile	5446.72	13	2057.75	10	4.78%	3	3	29	6
Manufacturing of Paper and Paper Products	3440.55	12	1351.47	6	8.63%	7	2	27	8
Manufacturing of Metal Products	3412.79	11	2648.25	17	4.90%	4	1	33	4
Manufacturing of General Purpose Machinery	2895.11	10	1898.7	9	<3%	0	3	22	-
Processing of Food from Agricultural Products	2425.28	9	1604.83	7	<3%	0	2	18	-
Manufacturing of Transport Equipment	2258.53	8	2108.09	11	<3%	0	3	22	-
Manufacturing of Plastics	2015.68	7	2541.59	16	4.24%	2	0	25	-

Sector	SME Energy Consumption		PER		SEUC		Provincial Prevalence Count	Total Score	Final Joint Ranking
	Value	Score	Value	Score	Value	Score			
Manufacturing of Electrical Machinery and Equipment	1682.70	6	2395.39	13	<3%	0	2	21	-
Manufacturing of Special Purpose Machinery	1509.14	5	1716.89	8	<3%	0	0	13	-
Manufacturing of Artwork and Other Manufacturing	1450.23	4	2500.86	15	6.57%	5	0	24	-
Mining and Processing of Ferrous Metal Ores	1423.22	3	2296.56	7	7.26%	6	1	17	9
Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	1339.33	2	2656.32	18	<3%	0	2	22	-
Manufacturing of Foods	1326.58	1	1224.31	5	3.30%	1	0	7	-

PER = Ratio of Power (Electricity) to Total Energy Consumption (kWh/tce) in a given industry or province.

SEUC = Share of Energy Use Cost in a given industrial sector vs. total production cost of the sector (%).

2.3 Energy Consumption Reduction and Cost Saving Potentials

MIIT (2012)³ has published the 12th FYP energy saving targets of the nine key industries for 2011-2015 (Table 4), which is considered reflective of the most likely extent of energy efficiency improvements that may be achieved in those industries. Conceivably, the target for SMEs should be higher than the target for the whole sector because the energy saving efforts in the 11th FYP were largely driven by the government and focused on major/large energy consuming enterprises (MIIT, 2010)⁴, leaving much room for SMEs to improve in the 12th FYP. For all practical purposes, it can be assumed that energy efficiency improvement by SMEs may reach 25% on average during the 12th FYP, as suggested by MIIT (2010), 4% more aggressive than the overall industrial energy efficiency improvement target of 21% for 12th FYP as stipulated by MIIT (2012). Based on the above reasoning, sector-specific energy saving targets adjusted for SMEs in the 9 key industrial sectors are also presented in Table 4.

Table 4: Targets for Energy Efficiency Improvement in 12th FYP

Industry	Published Target for Sector Average *	Assumed Target for SME
Steel and Iron	18%	21.42%
Non-ferrous Metals	18%	21.42%
Petroleum and Chemical Industry	18%	21.42%
Chemical Products	20%	23.80%
Building Materials	20%	23.80%
Mechanical Industry	22%	26.18%
Light Industry	20%	23.80%
Manufacturing of Textile	20%	23.80%
Electronics and Information	18%	21.42%
Overall Industrial EE Improvement	21%	25%**

* Data Source: The 12th FYP for Industrial Energy Saving by MIIT (2012)

** Data Source: Guidance for Further Strengthening Energy Saving and Emission Reduction Works of SMEs by MIIT (2010)

Using the energy efficiency improvement targets (in %) from Table 4, the sectoral SME energy saving capacities (in tce/yr) that may have potential for the priority SME sectors in the 12th FYP can be calculated from the sectoral SME energy consumptions. The sectoral SME energy cost saving potentials (in RMB/yr) would then be the products of the sectoral energy saving potentials (in tce/yr) and the respective sectoral energy unit prices (in RMB/tce) obtained in Section 2.2.3.

³ MIIT (2012) *The 12th FYP for Industrial Energy Saving*.

⁴ MIIT (2010) *Guidance for Further Strengthening Energy Saving and Emission Reduction Works of SMEs*.

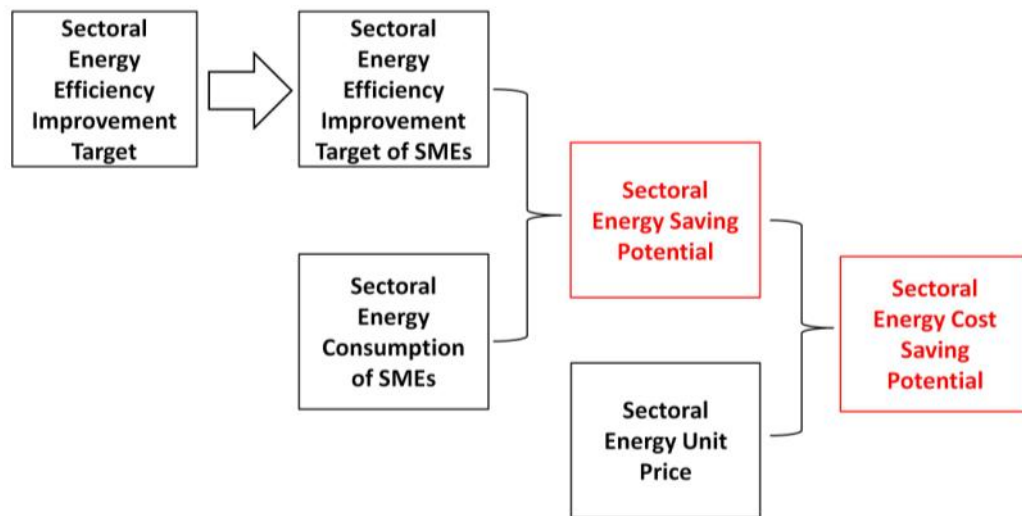


Figure 3: Sectoral Energy Saving Potential and Energy Cost Saving Potential

Figure 3 below presents the overall process of selecting priority industries. A full description of the process and the list of energy saving capacity and energy cost saving potentials are presented in Appendix E.

3.0 FINDINGS AND DISCUSSIONS

3.1 Priority Provinces

Eight provinces have been identified to have the greatest SME energy cost saving potential: Guangdong, Zhejiang, Jiangsu, Shandong, Henan, Hebei, Fujian and Shanghai. Similarly identified are eight provinces with greatest SME energy saving potential: Guangdong, Zhejiang, Jiangsu, Shandong, Henan, Hebei, Liaoning and Sichuan. The six provinces that are ranked top in both charts have been selected as the priority provinces. They are: Guangdong, Zhejiang, Jiangsu, Shandong, Henan and Hebei.

Table 5 Selection of Priority Provinces

No.	Province	Top Provinces with Greatest SME Energy Cost Saving Potentials	Top Provinces with Greatest SME Energy Saving Potentials	Priority Province
1	Shandong	Yes	Yes	Yes
2	Hebei	Yes	Yes	Yes
3	Guangdong	Yes	Yes	Yes
4	Jiangsu	Yes	Yes	Yes
5	Henan	Yes	Yes	Yes
6	Liaoning		Yes	
7	Sichuan		Yes	
8	Zhejiang	Yes	Yes	Yes
9	Shanghai	Yes		
10	Fujian	Yes		

As one of the focuses of this Study is to include at least one western province, Sichuan was selected as the 7th province for further analysis. Therefore, the priority provinces selected for further analysis include Guangdong, Zhejiang, Jiangsu, Shandong, Henan, Hebei and Sichuan as shown in Figure 4.



Figure 4: Map of Selected Priority Provinces

3.2 Priority Sectors

The identified provincial key sectors are summarized in Table 6 below. Those sectors have both a relatively high participation of SMEs (with caveats for Smelting and Pressing of Ferrous Metals and Mining and Washing of Coal) and reasonably significant Shares of Energy Use Cost vs. total production cost (SEUC).

Table 6: Energy Intensive SME Sectors in Seven Priority Provinces

Final Ranking	Sector	SEUC	Sectoral Share of SME Output Value
1	Manufacturing of Raw Chemical Materials and Chemical Products	19.30%	81%
2	Smelting and Pressing of Ferrous Metals	17.07%	37%*
3	Manufacturing of Non-metallic Mineral Products	16.76%	93%
4	Manufacturing of Metal Products	4.90%	92%
5	Smelting and Pressing of Non-ferrous Metals	11.01%	72%
6	Manufacturing of Textile	4.78%	84%
7	Mining and Washing of Coal	14.34%	49%*
8	Manufacturing of Paper and Paper Products	8.63%	83%
9	Mining and Processing of Ferrous Metal Ores	7.26%	87%

SEUC = Share of Energy Use Cost in a given industrial sector vs. total production cost of the sector (%).

3.2.1 Sector Prevalence

The most prevailing sector amongst the seven selected provinces is the Manufacturing of Raw Chemical Materials and Chemical Products industry, which is amongst the top 6 sectors in all provinces, followed by Smelting and Pressing of Ferrous Metals and Manufacturing of Non-metallic Mineral Products (primarily construction materials, such as cement and glass), which are enlisted in five of the seven provinces. Their strong presence can be a useful indication of significant energy saving and energy cost saving potentials.

Table 7: Prevalence of Priority Sectors in 7 Selected Provinces

Sector	Guangdong	Shandong	Hebei	Zhejiang	Jiangsu	Henan	Sichuan
Manufacturing of Raw Chemical Materials and Chemical Products	•	•	•	•	•	•	•
Smelting and Pressing of Ferrous Metals	•	•	•		•	•	
Manufacturing of Non-metallic Mineral Products	•	•	•			•	•
Mining and Washing of Coal		•	•			•	•

Sector	Guangdong	Shandong	Hebei	Zhejiang	Jiangsu	Henan	Sichuan
Manufacturing of Textile	•	•		•			
Manufacturing of General Purpose Machinery				•	•		•
Manufacturing of Transport Equipment				•	•		•
Smelting and Pressing of Non-ferrous Metals		•				•	
Manufacturing of Paper and Paper Products	•					•	
Manufacturing of Electrical Machinery and Equipment				•	•		
Processing of Food from Agricultural Products			•				•
Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	•				•		
Mining and Processing of Ferrous Metal Ores			•				
Manufacturing of Metal Products				•			

3.2.2 Sectoral Concentration of Energy Saving Potential

As shown in Figure 5, the energy saving potential associated with the 8 priority SME sectors represents approximately 74% of the total energy saving potential achievable amongst the 35 industrial sectors (312 million tce/yr) for SMEs, indicating a strong concentration of energy saving potential in sectors.

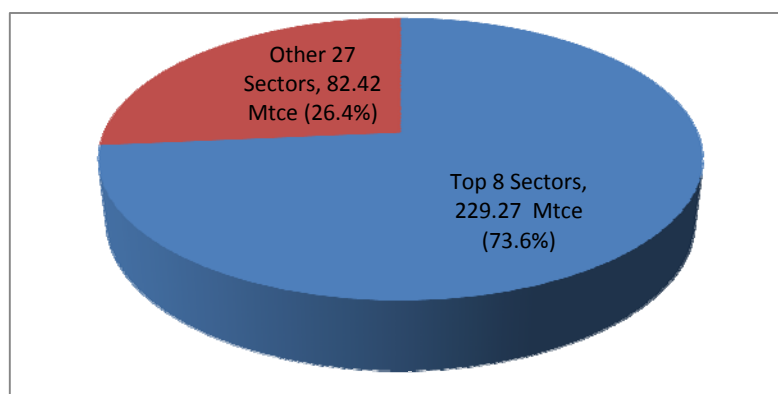


Figure 5: Breakdown of Annual SME Energy Saving Potentials

A breakdown of provincial and sectoral energy savings potential further indicates a greater

concentration of energy savings potentials in Manufacturing of Raw Chemical Materials and Chemical Products for Jiangsu and Shandong provinces, Smelting and Pressing of Ferrous Metals for Jiangsu and Hebei provinces, and Manufacturing of Non-metallic Mineral Products for Guangdong, Shandong, Henan, and Jiangsu provinces.

Table 8: Sectoral SME Energy Saving Potentials in Priority Province

Sector	Guangdong	Zhejiang	Jiangsu	Shandong	Henan	Hebei	Sichuan
Manufacturing of Raw Chemical Materials and Chemical Products	●	●	●	●	●	●	●
Smelting and Pressing of Ferrous Metals	●	●	●	●	●	●	●
Manufacturing of Non-metallic Mineral Products	●	●	●	●	●	●	●
Manufacturing of Metal Products	●	●	●	●	●	●	●
Smelting and Pressing of Non-ferrous Metals	●	●	●	●	●	●	●
Manufacturing of Textile	●	●	●	●	●	●	●
Manufacturing of Paper and Paper Products	●	●	●	●	●	●	●
Mining and Processing of Ferrous Metal Ores	●	●	●	●	●	●	●

Note: Bigger dots indicate higher energy saving potential in that sector/province.

3.2.3 Energy Cost Saving Potentials

The Energy Consumption Reduction and Energy Cost Saving Potentials for the final list of 8 priority SME sectors are presented in Table 9. (SME Energy Saving and Cost Saving Potentials of all 35 sectors are presented in Table E2 of Appendix E). According to Table 9, the total energy saving potential could reach 229 million tce/yr for SMEs in the top 8 energy intensive sectors (excluding Mining and Washing of Coal) during the 12th FYP (2011-2015), which may bring about a total energy cost saving of RMB446 billion/yr.

It is also worth noting that the top 6 occurrences of the top 9 priority sectors listed in Table 6 are consistent with the top 6 sectors with greatest energy cost saving potentials presented in Table 9, albeit not in the exact same order.

Rough breakdown of SME energy savings potential of the 8 priority sectors in 7 selected provinces are presented in Table 8 and Table 10. As indicated in Table 10, the sum of the SME energy savings potential in these priority sectors of the selected provinces make up approximately 60% of the sum of the national total. As evident in Table 8, the most significant provincial sectoral SME energy savings potential appear to concentrate in the following three sectors:

- Manufacturing of Raw Chemical Materials and Chemical Products;
- Smelting and Pressing of Ferrous Metals; and
- Manufacturing of Non-metallic Mineral Products.

Based on the data presented in Table 9, the top 3 SME sectors alone attribute to an energy savings capacity of approximately 174 million tce/yr that may potentially be achieved during 12th FYP, representing approximately 56% of the total calculated energy saving potential for the 35 qualified SME sectors combined.

Table 9: Calculated Energy and Cost Saving Potentials of Top 8 Sectors

Sector	Calculated SME Energy Consumption	SEUC	Sectoral Weight of SME Output Value	12 FYP ECI Reduction Target	12FYP ECI Reduction Target for SME	SME Energy Saving Potential	Sectoral Energy Price	SME Energy Cost Saving Potential
	(10K tce/yr)	(%)	(%)	(%)	(%)	(10K tce/yr)	(RMB/tce)	(RMB100 mil/yr)
Manufacturing of Raw Chemical Materials and Chemical Products	25460.37	19.3%	81%	20%	23.8%	6061.99	2581	1564.86
Smelting and Pressing of Ferrous Metals	23967.34*	17.1%	37%	18%	21.4%	5135.86	1478	758.99
Manufacturing of Non-metallic Mineral Products	26228.31	16.8%	93%	20%	23.8%	6244.84	1565	977.62
Manufacturing of Metal Products	3412.79	4.9%	92%	21%	25.0%	853.20	2275	194.12
Smelting and Pressing of Non-ferrous Metals	10077.17	11.0%	72%	18%	21.4%	2159.39	2239	483.58
Manufacturing of Textile	5446.72	4.8%	84%	20%	23.8%	1296.84	1904	246.95
Mining and Washing of Coal**	6443.82	14.3%	49%	21%	25.0%	1610.96	2277	366.76
Manufacturing of Paper and Paper Products	3440.55	8.6%	83%	20%	23.8%	819.18	1900	155.66
Mining and Processing of Ferrous Metal Ores	1423.22	7.3%	87%	21%	25.0%	355.80	2178	77.51
Total (Top 8 Sectors)**						22,927		4459

ECI = Energy Consumption Index in tce/RMB10,000

SEUC = Share of Energy Use Cost in a given industrial sector vs. total production cost of the sector (%).

*Refined based on the assumption that the ECI of SMEs in the iron & steel sector is 14% higher than the average of the whole sector; in comparison, the preliminary estimate was 29,842tce/yr.

** Exclusive of the sector of Mining and Washing of Coal

Table 10: Summary of Sectoral SME Energy Saving Potentials in Priority Provinces
(Unit: 10K tce/yr)

Sector	National Total	Guangdong	Zhejiang	Jiangsu	Shandong	Henan*	Hebei	Sichuan	Sum of 7 Selected Provinces
Manufacturing of Raw Chemical Materials and Chemical Products	6061.99	517.91	444.13	1160.15	1048.77	234.08	189.12	204.20	3798.35
Smelting and Pressing of Ferrous Metals	5135.86	195.14	188.84	705.27	374.52	190.60	894.83	163.72	2712.92
Manufacturing of Non-metallic Mineral Products	6244.84	595.25	284.48	508.59	915.11	754.10	253.15	327.23	3637.90
Manufacturing of Metal Products	853.20	173.43	83.51	150.17	83.90	27.17	46.69	22.85	587.72
Smelting and Pressing of Non-ferrous Metals	2159.39	177.44	140.97	223.10	213.96	213.61	28.87	44.64	1042.59
Manufacturing of Textile	1296.84	119.76	253.59	271.24	260.15	60.74	44.31	28.36	1038.16
Manufacturing of Paper and Paper Products	819.18	130.04	82.41	87.81	146.69	64.85	27.40	30.26	569.45
Mining and Processing of Ferrous Metal Ores	355.80	10.73	1.01	3.63	25.85	9.04	97.53	15.88	163.68
Sum of Top 8 SME Sectors	22,927	1919.70	1478.95	3109.95	3068.94	1554.19	1581.90	837.15	13550.76

*The provincial SME energy savings potential in a given sector is calculated from the national total of the sector based on the share of the provincial sectoral IOV in the national total IOV of that sector, with the exception of Henan province for whose proportion is based on sectoral principal revenue.

3.2.4 Small is Big

Aggregating and reorganizing the sector-specific data reveal very interesting results. Large industrial enterprises, the traditional “hot-spot” for energy efficiency, are responsible for a small amount (539/13 Mtce), reaching only 16.6% of the total energy consumption, well below non-industrial sectors’ energy consumption (938.38 Mtce) and industrial SMEs’ energy consumption (1333.14Mtce). Industrial SMEs therefore represent a noteworthy – and much more significant – potential area to explore, followed by non-industrial sectors.

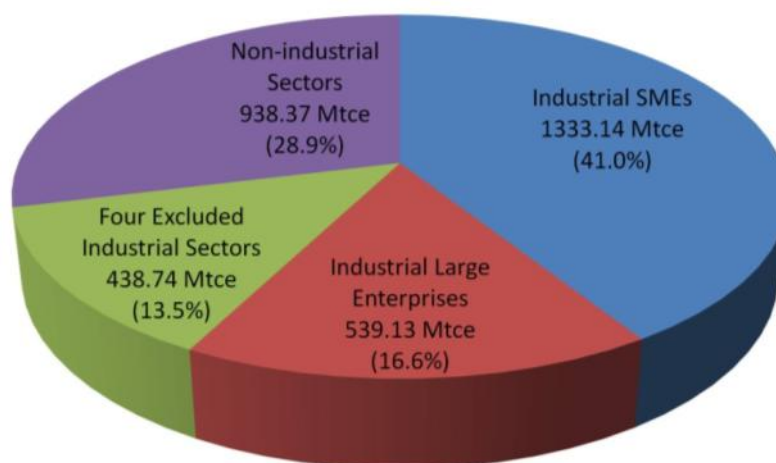


Figure 6: Small, Large, and Non-Industrial Energy Consumptions (2010)

3.3 (Secondary) Opportunities in non-selected sectors

Among the 18 sectors that have undergone a second round of screening, 6 have been found with sectoral SEUC values less than 3% (1.3-2.4%) and hence are not considered energy intensive. They are:

- Manufacturing of General Purpose Machinery
- Manufacturing of Special Purpose Machinery
- Manufacturing of Transport Equipment
- Manufacturing of Electrical Machinery and Equipment
- Manufacturing of Communication Equipment, Computers and Other Electronic Equipment
- Processing of Food from Agricultural Products

The relatively low SEUC values indicate that, although the SMEs’ energy consumption in these sectors are high, business operators in these sectors may find savings from energy efficiency improvement likely to have a limited impact on their business bottom lines. Earlier calculations of energy prices reveal that sectoral energy unit prices could range as wide as RMB 1,478/tce for Smelting and Pressing of Ferrous Metals, which primarily uses coal for fuel, to RMB 2,711/tce for Manufacturing of Furniture, which primarily uses electricity, among the priority sectors. Table 11 below also exhibits

that for some of the priority provinces, not all priority sectors are energy intensive.

However, this does not mean that less-energy-intensive sectors should be overlooked. More attention could be given to the overall efficiency to make comprehensive improvements in the production processes, which tend to bring about much more significant cost savings from various inputs, and not just energy. Given the presence of large energy savings potential in these sectors, a deeper analysis is necessary to translate opportunities into projects.

Table 11: Summary of Top 6 Priority Sectors in 7 Selected Provinces⁵

Order	Guangdong	Shandong	Hebei	Zhejiang	Jiangsu	Henan	Sichuan
1	Manufacturing of Non-metallic Mineral Products	Smelting and Pressing of Ferrous Metals	Smelting and Pressing of Ferrous Metals	Manufacturing of Textile	Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	Smelting and Pressing of Non-ferrous Metals	Processing of Food from Agricultural Products
2	Smelting and Pressing of Ferrous Metals	Manufacturing of Raw Chemical Materials and Chemical Products	Manufacturing of Non-metallic Mineral Products	Manufacturing of Electrical Machinery and Equipment	Manufacturing of Raw Chemical Materials and Chemical Products	Smelting and Pressing of Ferrous Metals	Manufacturing of Non-metallic Mineral Products
3	Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	Manufacturing of Non-metallic Mineral Products	Manufacturing of Raw Chemical Materials and Chemical Products	Manufacturing of General Purpose Machinery	Manufacturing of Electrical Machinery and Equipment	Manufacturing of Non-metallic Mineral Products	Manufacturing of Raw Chemical Materials and Chemical Products
4	Manufacturing of Raw Chemical Materials and Chemical Products	Mining and Washing of Coal	Mining and Washing of Coal	Manufacturing of Transport Equipment	Smelting and Pressing of Ferrous Metals	Manufacturing of Raw Chemical Materials and Chemical Products	Manufacturing of General Purpose Machinery
5	Manufacturing of Paper and Paper Products	Smelting and Pressing of Non-ferrous Metals	Mining and Processing of Ferrous Metal Ores	Manufacturing of Raw Chemical Materials and Chemical Products	Manufacturing of Transport Equipment	Mining and Washing of Coal	Mining and Washing of Coal
6	Manufacturing of Textile	Manufacturing of Textile	Processing of Food from Agricultural Products	Manufacturing of Metal Products	Manufacturing of General Purpose Machinery	Manufacturing of Paper and Paper Products	Manufacturing of Transport Equipment

Energy intensive sectors with energy cost contributing to 3% or more of the total business cost.

⁵ For each of the 7 selected provinces, the top 6 industrial sectors were identified based on the aggregated sectoral IEAMTs outputs as provided in 2011 Statistical Yearbook of the selected provinces, with the exception of Guangdong and Sichuan provinces. For Guangdong, sectoral energy consumption data are available in 2011 Guangdong Statistic Yearbook, which have been used for the selection of top 6 sectors in Guangdong. Sichuan is the only province supported by SMEs data, for which the aggregated industrial output values of SMEs are published in China SMEs Statistic Report 2011; these have been used for the selection of the top 6 sectors.

3.4 Caveats

(1) In the situation where medium and large enterprises accounts for a relatively large share in the sector

For industries with sizable shares of Sector IEAMTs IOVs attributed to large enterprises, sector-specific refinement to estimate SME energy consumption is required prior to the quantification of SME energy saving potential (Appendix E). Amongst the selected 9 priority SME sectors (Table 9), the sectors of Smelting and Pressing of Ferrous Metals and Mining and Washing of Coal, have relatively significant numbers of large enterprises. Sector-specific analyses would be wise for these two sectors.

(2) Refined calculations for the Smelting and Pressing of Ferrous Metals Sector

According to Xiong and Yu (2009), SMEs in Smelting and Pressing of Ferrous Metals (also known as Iron & Steel) are approximately 14% less efficient than the national sectoral average. (By simple proportioning over IOVs, the calculated energy efficiency of large enterprises in the Iron and Steel industry would then be approximately 8% more efficient than the sector average.) This more sector-specific figure can be used to replace the genetic assumption of an EEI=36% across all sectors for a refined calculation of the SME energy saving and energy cost savings potential.

(3) Issues around Mining and Washing of Coal Sector

The Mining and Washing of Coal is a sector widely known to contain a large variety of conflicting data⁶, largely because its primary inputs and outputs are both coal. The 2011 China Statistic Yearbook shows that the coal consumption (alone) of this sector (23,143.94 tons or approximately 16,531 tce) is substantially greater than the total energy consumption of 10,574 tce. Acquiring reliable data about this sector is practically unrealistic at this point; any further calculation for this sector is hence provided for reference only. However, given the significance of this sector in China, its apparent high-energy intensity, and the abundant energy saving opportunities widely known in this industry, it should thus remain on the priority list.

Further, it should be noted that in light of the consolidation of coal mining sector in the most recent years due to heightened work safety enforcement, there would be much fewer SMEs operating in this sector. The published 11th FYP data for this sector are unlikely to be valid indicators for future years in the 12th FYP. The small coalmines that may continue to operate would most likely hold insufficient legitimacy to be considered for IFC financing. It is more likely that legitimate financing opportunities may present in this sector amongst SMEs that provide services to coalmines in areas such as ventilation air methane (VAM) utilization and small-scale coal washing. Further study into these subsectors may prove valuable in the mid-term.

⁶ Guan DB, Liu Z, Geng Y, Lindner S and Hubacek K (2012) *The Gigatonne Gap in China's Carbon Dioxide Inventories*. Natural Climate Change, advance online publication, 12 June 2012.

(4) Data limitation on proportioning for sectoral energy savings potential

Sectoral energy savings potential of the 8 priority sectors at the national level may be distributed to the provinces by simple proportioning over the provincial sectoral IOVs. However, because sectoral SME output values are only available for one province (Sichuan), the proportioning can only be done roughly based on sectoral IOVs for IEAMTs. The resulting crude breakdown of SME energy savings potential of the 8 priority sectors for the 7 selected provinces is presented in Table 9 and Figure 5.

3.5 Relevance to the World Bank Criteria

As indicated in Table 8, in 2010, the average total asset and total annual sales revenue of medium-sized enterprises were well over the RMB 400 million and RMB 300 million thresholds, respectively, whereas the average number of employees of medium-sized enterprises was substantially lower than the threshold (2,000). This would suggest that medium-sized enterprises were classified as such in 2010 most likely just because the number of employees per enterprise was below 2,000 and that they are most likely not to be classified as SMEs under the WBG criterion (300). The portion of medium-sized enterprises with a total asset and total annual sales revenue lower than the WBG threshold (US\$15 million or RMB 100 million) was likely to be negligible, the total IOV of SMEs by WBG criteria would be close to that of Small Enterprises, representing approximately 56% of the combined IOV of Small and Medium-sized Enterprises reported for 2010.

Table 12: Key Indicators of Industrial Enterprises in 2010*

Category of Enterprises	No. of Enterprises	Total IOV	Total Assets	Principal Business Revenue	Unit IOV	Unit Total Assets	Unit Principal Revenue	No. of Employee per Unit
		(RMB 100 mil)			(mil RMB/Unit)			
Large	3742	229947	236257	238017	6145	6314	6361	6167
Medium-Sized	42906	203925	191195	200997	475	446	468	718
Small	406224	264719	165430	258730	65	41	64	102
CETC Criteria (2003)						400	300	2000
WBG Criteria						100	100	300

Notes: *Including industrial enterprises above minimum threshold with an annual revenue from principal business over RMB 5 million.

4.0 SME ENERGY SAVING CASE SUMMARIES

The Study also included a total of 11 energy efficiency and renewable energy projects, which have either been implemented or considered for implementation by SMEs. These cases demonstrate the typical sectors and typical technical solutions often employed by SMEs when conducting energy efficiency projects; thus, they are representative of energy efficiency investment potentials.

The details of each case can be found in Appendix F, and a summary table is presented below to capture the key characteristics that indicate the potential for bankable energy efficiency and renewable energy opportunities.

Table 13: Characteristics of SMEs and Bankable Projects

Project Name/Sector	Province	Key Project Contents	SME Characteristics			Project Characteristics			
			Revenue	No. of Employees	Total Energy Consumption	Energy Saving		Project Investment	SPB
			(mil RMB/Yr)		(tce/Yr)	(tce/Yr)	(%)	(RMB mil)	(Yr)
Ningbo A Food Co / Processing of Food from Agricultural Products	Zhejiang	Condensate Recovery + Co-gen	180	300	14,317	1010	7.1%	8.7	1
Julu B Textile Co / Manufacturing of Textile	Hebei	Boiler Refurnish + Steam and Condensate Recovery + VFD	200	800	28300	8793	31.1%	2.2	2.25
Dezhou C Plastic Co / Manufacturing of Raw Chemical Materials & Chemical Products	Shandong	Compound Pulverized Coal Combustion	36.9	100	3269.5	948.5	29.0%	0.36	0.33
Zouping D Paper Co / Manufacturing of Paper and Paper Products	Shandong	KD-DCS Energy-saving Control System for Industrial Furnaces	120	130	5718.4	607.9	10.6%	0.36	0.5
Cangzhou E Chemical Industry Co / Manufacturing of Raw Chemical Materials & Chemical Products	Hebei	Water Source Heat Pump	89.8	157	295	240	81%	7.28	4
Guangdong F Golf Club Co. / Manufacturing of Metal Products	Guangdong	Furnace sintering flow modification, cooling tower upgrade, compressed air leak prevention, and VFD etc.	290	5000	15,845	3634	23%	14.4	1.25

Project Name/Sector	Province	Key Project Contents	SME Characteristics			Project Characteristics			
			Revenue	No. of Employees	Total Energy Consumption	Energy Saving		Project Investment	SPB
			(mil RMB/Yr)		(tce/Yr)	(tce/Yr)	(%)	(RMB mil)	(Yr)
Hebei Langfang G Glass Co/ Manufacturing of Non-metallic Mineral Products	Hebei	Waste Heat Recovery + Update of Water Pumps and Water Tower	819	439	133,000	14798	11.1%	52.16	1.85
Shijiazhuang H Chemical Co/ Manufacturing of Raw Chemical Materials & Chemical Products	Hebei	Heat Recovery + VFD	745	650	NA*	6551	NA*	7.3	1
Dezhou I Food Co/ Processing of Food from Agricultural Products	Shandong	VFDs	5-10	100	13719.1	1689.5	12.3%	1.62	0.45
Shandong J Building Materials Co/ Manufacturing of Non-metallic Mineral Products	Shandong	Airflow Design Renovation + VFD	5.44	250	616.2	146	23.7%	0.185	0.15
Henan K Industrial Co/ Mining and Washing of Coal	Henan	Utilization of coal mine VAM with low methane concentrations to generate steam/power/hot water and achieve GHG emission reduction.	54.5	<300	14,710	13,700	93%	111	7

SPB = Simple Payback Period (yr)

5.0 CONCLUSIONS

SMEs are probably more important than we had previously thought before embarking on the Study in contributing to achieving energy efficiency improvements. The data collected and analyses in this Study suggest that SMEs consume about 2.5 times the amount of energy in total as compared to the large enterprises, while the latter have historically attracted a disproportionately large amount of attention from both policy makers and practitioners in this area.

The Study has also revealed significant amounts of energy saving and energy cost savings potential in SMEs. For the selected top 8 sectors only, an estimated energy savings potential for SMEs amounts to 229.27 million tce/yr, and an Energy Cost Saving Potential for SME to RMB 446 billion/yr for the duration of the 12th FYP (2011-2015).

The Study results indicate a possible clustering of investment opportunities in a limited number of industrial sectors. The eight selected priority industries alone represent approximately 74% of the total energy savings potential achievable amongst the 35 industrial sectors. Further, the most significant SME energy savings potential appears to concentrate in the following three sectors: Manufacturing of Raw Chemical Materials and Chemical Products; Smelting and Pressing of Ferrous Metals; and Manufacturing of Non-metallic Mineral Products. These top 3 SME sectors alone could contribute to an energy saving potential of approximately 174 million tce/yr for the 12th FYP period, representing approximately 56% of the total calculated energy savings potential for the 35 sectors combined.

This possible clustering of opportunity presents a good omen for exploring the relatively new territory of SMEs industrial energy efficiency improvement as well as for initial scaling up. Past experiences in other sections of the market has proved the importance of igniting the market and keeping the market practitioners' momentum for establishing and sustaining the deal flows. Prompt demonstration and transformation of market potential into real-life (pipeline) projects would be key. The clustering of market opportunities in a handful of sectors would allow market practitioners to employ a rather focused effort in the priority areas to avoid pervasive search, which might present much higher initial costs and only produce significant results over a longer period of time. Therefore, one of the conclusive recommendations the Study will provide for IFC's future engagements with other financiers, market products, or service providers is to begin with identifying the niche market priority areas and sectors for specific business partners.

Although the Study has provided some insights into the SMEs' energy efficiency market potential, much of this area remains to be known. The results of this Study are solely based on official statistics, which tend to provide a good overview but can prove limited in interpreting specifics. As we move on, deeper and deeper into the market, knowledge at more specific levels will become a necessity to observe the SMEs' energy efficiency market space with higher resolutions.

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APPENDIX A

RANKING SMES BY PROVINCES

APPENDIX A: RANKING SMEs BY PROVINCES

Selection of priority provinces for this Study is based on a combination of the national rankings of:

- Provincial energy consumption of IEAMTs (IEAMTs = industrial enterprises above minimum threshold, which in the context of this Study is the combination of large corporate and SMEs) (in tce);
- Provincial industrial output value (IOV) of SMEs (in RMB);
- Provincial energy consumption of SMEs (in tce); and
- Provincial electricity consumption of IEAMTs (in kWh).

A summary of the above statistics is provided in Table A1, where total energy consumption and electricity consumption for IEAMTs for individual provinces in 2010 are extracted from the China Statistic Yearbook 2011 and the China Energy Statistic Yearbook 2011 while total IOV of SMEs for each province is obtained from the China Industrial Economy Statistic Yearbook 2011. The electricity consumption of the province is also factored in because the cost of power consumption has a disproportionately large influence on the market value of energy when measured in tce and hence is a significant factor to be considered in energy cost saving calculations.

Statistics for energy consumptions by SMEs are currently not available in China and the literature on SMEs energy efficiency is sparse. Nevertheless, total energy consumption of SMEs for a given province can be estimated via simple proportioning of the aggregated SME's industrial output value as part of the overall output value for IEAMTs, for which the corresponding total industrial energy consumption data is available amongst the national statistics yearbooks.

The proportioning can be weighed more toward SMEs to account for the fact that SMEs in general may tend to be less energy efficient than large industrial enterprises. According to Xiong and Yu of NDRC Energy Research Institute (2009)¹, the simple average energy efficiency index (EEI) for SMEs is 36% higher (i.e. less efficient) than the average level of all industrial enterprises in the 8 surveyed energy intensive sectors: iron sintering (an iron & steel subsector), iron casting (an iron & steel subsector), steel pressing (an iron & steel subsector), cement (a building material subsector), coking, ammonia (a chemical subsector), pulp and paper, thread manufacturing (a textile subsector) and clothing manufacturing (a textile subsector). Note that MIIT (2010)² suggested that the energy efficiency of SMEs in general may be over 20% lower than that of their sector averages.

Assuming that the SMEs energy consumption level on average is 36% higher than the average of all IEAMTs, then the energy consumption level of large enterprises would then be calculated to be approximately 24% better than the overall average industrial energy consumption using the ratio between the national total industrial output value of large enterprises versus the national overall industrial output value of all corporations, i.e. IEAMTs. Subsequently, the total energy consumption

¹ XIONG Hua-wen and YU Cong (2009) *The Energy Efficiency Circumstances of Small and Medium Sized Industrial Enterprises and Their Potential Analysis for Energy Conservation*, Power DSM, Vol.11, No. 6.

² MIIT (2010) *Guidance for Further Strengthening Energy Saving and Emission Reduction Works of SMEs*.

by SMEs for each province is calculated by subtracting the calculated energy consumption of large enterprises in the provinces from the total industrial energy consumption of the province. The adoption of this assumption is considered reasonable as sectoral variation between industrial sectors would be less of a concern for the comparison of “average” industries between provinces.

Also considered in provincial ranking is electricity consumption by provinces, as published in the China Energy Statistic Yearbook 2011, because the cost of power consumption has a disproportionately large influence on the market value of energy when measured in tce and hence is a significant factor to be considered in energy cost saving calculations. The ratio of power consumption versus total energy consumption (PER), expressed in kWh/tce, are also included in Table A1 for all provinces.

As indicated in Table A1, the top 16 provinces with the highest aggregated SME energy consumptions happen to be the provinces with highest total industrial energy consumptions for IEAMTs as well. Final provincial priority ranking is hence derived for the top 16 provinces based on the sum of the provincial rankings of total SME energy consumption and overall industrial PER, as shown in Table A2. As indicated in Table A2, the top 8 provinces that have greatest SME energy cost saving potential (based on final, joint ranking with PER) include Guangdong, Zhejiang, Jiangsu, Shandong, Henan, Hebei, Fujian and Shanghai while the provinces with greatest energy saving potentials at SMEs include Guangdong, Zhejiang, Jiangsu, Shandong, Henan, Hebei, Liaoning and Sichuan. The provinces that are ranked top 6 in both lists include Guangdong, Zhejiang, Jiangsu, Shandong, Henan and Hebei. As one of the focuses of this Study is to include at least one western province, Sichuan was selected as the 7th province for further analysis. Therefore, the priority provinces selected for further analysis include Guangdong, Zhejiang, Jiangsu, Shandong, Henan, Hebei and Sichuan.

Table A1: Provincial Industrial Energy Consumptions in China (2010)

No.	Province	Provincial Energy Consumption of IEAMTs	Provincial IOV of SMEs	Provincial Electricity Consumption of IEAMTs	Provincial Energy Consumption of SMEs	Provincial PER
		(10k tce)	(100 mil RMB)	(100 mil kWh)	(10k tce)	(kWh/tce)
1	Shandong	34808	57679	3298	26567	947.62
2	Hebei	27531	18956	2692	19359	977.63
3	Guangdong	26908	57178	4060	20096	1508.89
4	Jiangsu	25774	63381	3864	19684	1499.35
5	Henan	21438	24948	2464	16769	1149.16
6	Liaoning	20947	25038	1715	16042	818.88
7	Sichuan	17892	17136	1549	14368	865.78
8	Zhejiang	16865	41911	2821	14505	1672.62
9	Inner Mongolia	16820	9764	1537	13354	913.68
10	Shanxi	16808	6352	1460	10552	868.66
11	Hubei	15138	13010	1418	10564	936.63
12	Hunan	14880	14258	1353	12059	909.50
13	Heilongjiang	11234	4816	763	7016	678.90
14	Shanghai	11201	17250	1296	7572	1156.91
15	Fujian	9809	16951	1315	8127	1340.75
16	Anhui	9707	12314	1078	7184	1110.50
17	Shaanxi	8882	5868	859	5675	967.36
18	Yunnan	8674	4194	1004	6363	1157.54
19	Jilin	8297	7201	577	5464	695.37
20	Xinjiang	8290	2395	662	4822	798.48
21	Guizhou	8175	2683	836	5930	1021.99
22	Guangxi	7919	7019	993	6284	1254.25
23	Chongqing	7856	6056	625	5844	795.67
24	Beijing	6954	7168	831	4439	1194.85
25	Tianjin	6818	9445	675	4562	990.56
26	Jiangxi	6355	10593	701	5212	1102.32
27	Gansu	5923	1931	804	3207	1358.12
28	Ningxia	3681	1162	547	2575	1485.34
29	Qinghai	2568	722	465	1569	1811.25
30	Hainan	1359	1211	158	1232	1164.29
31	Tibet	-	54	-	-	

PER = Ratio of Power (Electricity) to Total Energy Consumption (kWh/tce) in a given industrial sector or a province. A higher PER indicates that the sector tends to use more energy in the form of electricity which is more expensive than the use of coal.

IOV = Industrial Output Value (in RMB)

IEAMTs = Industrial enterprises above designated size are those with annual revenue of over 5 million RMB from principal business.

* Highlighted sections represent calculated values from known statistics.

Table A2: Summary of Rankings for Top 16 Energy Consumption Provinces

No.	Province	Ranking of Provincial Energy Consumption of SMEs	Provincial PER Ranking	Combined Score	Final Ranking
1	Shandong	1	9	10	4
2	Hebei	4	8	12	6
3	Guangdong	2	2	4	1
4	Jiangsu	3	3	6	2
5	Henan	5	6	11	5
6	Liaoning	6	15	21	10
7	Sichuan	8	14	22	13
8	Zhejiang	7	1	8	3
9	Inner Mongolia	9	11	20	9
10	Shanxi	12	13	25	15
11	Hubei	11	10	21	11
12	Hunan	10	12	22	12
13	Heilongjiang	16	16	32	16
14	Shanghai	14	5	19	8
15	Fujian	13	4	17	7
16	Anhui	15	7	22	14

PER = Ratio of Power (Electricity) to Total Energy Consumption (kWh/tce) in a given industrial sector. A higher PER indicates that the sector tends to use more energy in the form of electricity which is more expensive than the use of coal.

IOV = Industrial Output Value (in RMB)

IEAMTs = Industrial enterprises above designated size are those with annual revenue of over 5 million RMB from principal business.

* Yellow highlights indicator selected provinces.

APPENDIX B

RANKING SMES BY INDUSTRIAL SECTORS

APPENDIX B: RANKING SMEs BY INDUSTRIAL SECTORS

The national sectoral data for aggregated energy consumptions, aggregated industrial output values, and aggregated power consumptions for 39 industrial sectors are published in the China Statistic Yearbook 2011 and China Energy Statistic Yearbook 2011 while the IOVs for SMEs are published in China SMEs Statistic Report 2011.

Sector-specific average number of employees, assets and annual sales revenue for individual enterprises are firstly calculated and compared with the CETC (2003) SME criteria. As indicated in Table B1, the average values of Extraction of Petroleum and Natural Gas Sector are well over the three criteria for SMEs. This sector is hence excluded from further data analysis. Also excluded from are the sectors of Processing of Petroleum, Coking, Processing of Nuclear Fuel; Production and Supply of Electric Power and Heat Power; and Production and Supply of (Flammable) Gas. These three sectors primarily use fossil fuels to produce primary or secondary energy products, and as utility suppliers, are known to be dominated by state-owned large enterprises.

For the remainder of the 35 SME sectors, the national aggregated energy consumption for SMEs in a particular sector can be calculated through weighed proportioning over the aggregated industrial output values of SMEs versus large enterprises in the same sectors. The process of sectoral SME energy consumption calculation through weighted proportioning is presented in Table B2. If SME energy consumption level on average is 36% higher than the overall sector average of all 39 industrial categories (Xiong and Yu, 2009)¹, the calculated energy consumption level for large enterprises would be 24.2% better than the overall average using the ratio of SME industrial output value of RMB 46864.36 billion versus total combined industrial output value of RMB 69859.06 billion across all 39 industrial sectors. This would appear to be a reasonable and stable assumption that can be used to calculate sector-specific ECI values for SMEs. As indicated in Table B2, in industrial sectors that are dominated by SMEs, the calculated SME ECI values are, inherently, only slightly higher than the average ECI values of the respective sectors and hence insensitive to the generic assumption used in the calculation.

However, for those industrial sectors with substantial share of large enterprises in terms of IOVs, the preliminary estimate of SME energy consumption would be sensitive to the initial generic assumption and hence warrant further refinement to reflect the actual sector-specific situation. As discussed in Appendix E, further refinement can be made for a specific sector based on the sector-specific information available in the literature, once/if that sector is selected as a priority sector for further quantification of sectoral energy saving potential.

Table B3 presents the initial list of the top 18 SME priority sectors. The list is extended to include the top 18 sectors to ensure that it also captures the sectors with the highest IEAMT energy consumptions. This will help ensure that no potential priority SME sectors will drop out of the initial priority sector list prematurely, although the exact ranking of a particular sector will vary slightly once sector-specific

¹ XIONG Hua-wen and YU Cong (2009) *The Energy Efficiency Circumstances of Small and Medium Sized Industrial Enterprises and Their Potential Analysis for Energy Conservation*, Power DSM, Vol.11, No. 6.

SME energy efficiency is taken into account. The ranking of the priority SME sectors would then be based on the joint rankings of the following four indicators:

- Sectoral SME energy consumption (in tce);
- Regional prevalence counts of priority industrial sectors;
- Sectoral energy intensity measured in share of energy use cost (SEUC) as % of the overall production cost for the respective sectors; and
- Sectoral PER values (in kWh/tce)

The detailed discussion on sectoral SEUC calculation is presented in Appendices C and D. Given the significant implication of electricity in energy cost saving calculation, the PER values, expressed in kWh/tce, are also taken into consideration in sectoral ranking.

Final selection of the priority SME sectors can be made based on joint ranking of the total sectoral scores as the sum of the sectoral scores of national SMEs energy consumptions, PER values, SEUC values and regional prevalence counts. As indicated in Table 3, the sector with the most favorable ranking of SME energy consumption or PER value would be given the highest score (18 out of 18) under that indicator. The sector with highest SEUC value would be given a high score of 12, while a total of 6 out of 18 initial priority sectors with a SEUC value less than 3% would be given a score of zero and excluded from further consideration, as they are not considered energy intensive. As shown in Table B3, once those sectors with SEUC score of zero and/or regional occurrence of zero are truncated, only 9 sectors remain as priority sectors. The final list of top 9 energy intensive SME sectors amongst the 7 selected provinces includes:

- Manufacturing of Raw Chemical Materials and Chemical Products
- Smelting and Pressing of Ferrous Metals (aka Iron and Steel Industry)
- Manufacturing of Non-metallic Mineral Products (primarily Building Material Industry)
- Manufacturing of Metal Products
- Smelting and Pressing of Non-ferrous Metals
- Manufacturing of Textile
- Mining and Washing of Coal
- Manufacturing of Paper and Paper Products
- Mining and Processing of Ferrous Metal Ores

Table B1: Summary of Sectoral Industrial Energy Consumptions in China (2010)

Sector	Sectoral Energy Consumption of SMEs	Sectoral Energy Consumption of IEAMTs	Sectoral IOV of SMEs	Sectoral Electricity Consumption of IEAMTs	Sectoral PER
	(10k tce)	(10k tce)	(100 mil RMB)	(100 mil kWh)	(kW h/tce)
Smelting and Pressing of Ferrous Metals	29841.75	57533.71	18941.7	4611.60	801.55
Manufacturing of Non-metallic Mineral Products	26228.31	27683.25	29836.0	2448.48	884.46
Manufacturing of Raw Chemical Materials and Chemical Products	25460.37	29688.93	38921.7	3144.92	1059.29
Smelting and Pressing of Non-ferrous Metals	10077.17	12841.45	20138.8	3129.09	2436.71
Mining and Washing of Coal	6443.82	10574.43	10723.1	751.67	710.84
Manufacturing of Textile	5446.72	6204.53	23917.4	1276.74	2057.75
Manufacturing of Paper and Paper Products	3440.55	3961.92	8623.8	535.44	1351.47
Manufacturing of Metal Products	3412.79	3627.75	18561.7	960.72	2648.25
Manufacturing of General Purpose Machinery	2895.11	3270.81	29812.4	621.03	1898.70
Processing of Food from Agricultural Products	2425.28	2644.27	31114.4	424.36	1604.83
Manufacturing of Transport Equipment	2258.53	3748.85	26389.0	790.29	2108.09
Manufacturing of Plastics	2015.68	2097.51	13158.7	533.10	2541.59
Manufacturing of Electrical Machinery and Equipment	1682.70	2121.53	31524.3	508.19	2395.39
Manufacturing of Special Purpose Machinery	1509.14	1851.20	16309.1	317.83	1716.89
Manufacturing of Artwork and Other Manufacturing	1450.23	1505.08	5390.6	376.40	2500.86
Mining and Processing of Ferrous Metal Ores	1423.22	1573.35	5244.6	361.33	2296.56
Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	1339.33	2525.15	20937.0	670.76	2656.32

Sector	Sectoral Energy Consumption of SMEs	Sectoral Energy Consumption of IEAMTs	Sectoral IOV of SMEs	Sectoral Electricity Consumption of IEAMTs	Sectoral PER
	(10k tce)	(10k tce)	(100 mil RMB)	(100 mil kWh)	(kW h/tce)
Manufacturing of Foods	1326.58	1508.52	9545.8	184.69	1224.31
Manufacturing of Medicines	1182.46	1427.68	9082.5	222.58	1559.03
Manufacturing of Chemical Fibers	1108.20	1440.91	3445.9	298.86	2074.11
Manufacturing of Rubber	1083.52	1461.17	3894.0	329.89	2257.71
Processing of Timber, Manufacturing of Wood, Bamboo, Rattan, Palm and Straw Products	1009.89	1035.62	7151.0	212.21	2049.11
Mining and Processing of Nonmetal Ores	998.13	1026.38	2981.3	155.26	1512.70
Manufacturing of Beverages	934.42	1130.42	7060.4	132.34	1170.72
Production and Supply of Water	882.14	970.36	1000.8	291.00	2998.89
Mining and Processing of Non-Ferrous Metal Ores	848.44	954.16	3244.4	258.71	2711.39
Manufacturing of Textile Wearing Apparel, Footwear and Caps	672.22	748.42	10676.1	151.58	2025.33
Printing, Reproduction of Recording Media	380.04	390.97	3431.6	95.45	2441.36
Manufacturing of Leather, Fur, Feather and Related Products	346.83	392.19	6693.3	89.72	2287.67
Manufacturing of Measuring Instruments and Machinery for Cultural Activity and Office Work	283.33	346.47	4861.6	85.83	2477.27
Mining of Other Ores	213.47	213.52	31.3	65.52	3068.57
Manufacturing of Articles For Culture, Education and Sport Activities	198.43	210.84	2892.2	48.09	2280.88
Manufacturing of Furniture	197.35	209.66	4073.2	44.49	2122.01

Sector	Sectoral Energy Consumption of SMEs	Sectoral Energy Consumption of IEAMTs	Sectoral IOV of SMEs	Sectoral Electricity Consumption of IEAMTs	Sectoral PER
	(10k tce)	(10k tce)	(100 mil RMB)	(100 mil kWh)	(kW h/tce)
Manufacturing of Tobacco	96.07	228.89	1372.8	45.88	2004.46
Recycling and Disposal of Waste	76.55	77.49	2269.1	14.10	1819.59

PER = Ratio of Power (Electricity) to Total Energy Consumption (kWh/tce) in a given industrial sector. A higher PER indicates that the sector tends to use more energy in the form of electricity which is more expensive than the use of coal.

IOV = Industrial Output Value (in RMB)

IEAMTs = Industrial enterprises above minimum threshold are those with annual revenue of over 5 million RMB from principal business.

Table B2: Calculation of Sectoral SME Energy Consumptions (2010)*

Item	Sector	Total Energy Consumption by All IEAMTs	Total IOV of All IEAMTs	Total IOV of SMEs	IOV Ratio of SMEs/IEAMTs	Average ECI of All IEAMTs	SME ECI in Excess of Average IEAMTs ECI	Calculated Energy Consumption of SMEs
		(10,000 tce)	(100 mil RMB)	(100 mil RMB)	(%)	(tce/10,000RMB)	(%)*	(10,000 tce)
		(A)	(B)	(C)	D=C/B	E=A/B	F=0.242*(1/D-1)	G=C*E*(1+F)
1	Smelting and Pressing of Ferrous Metals	57533.71	51833.6	18941.7	37%	1.110	42%	29841.75
2	Manufacturing of Non-metallic Mineral Products	27683.25	32057.3	29836.0	93%	0.864	2%	26228.31
3	Manufacturing of Raw Chemical Materials and Chemical Products	29688.93	47920.0	38921.7	81%	0.620	6%	25460.37
5	Smelting and Pressing of Non-ferrous Metals	12841.45	28119.0	20138.8	72%	0.557	10%	10077.17
7	Mining and Washing of Coal	10574.43	22109.3	10723.1	49%	0.457	26%	6443.82
8	Manufacturing of Textile	6204.53	28507.9	23917.4	84%	0.567	5%	5446.72
9	Manufacturing of Paper and Paper Products	3961.92	10434.1	8623.8	83%	0.478	5%	3440.55
10	Manufacturing of Metal Products	3627.75	20134.6	18561.7	92%	0.218	2%	3412.79
11	Manufacturing of General Purpose Machinery	3270.81	35132.7	29812.4	85%	0.380	4%	2895.11
12	Processing of Food from Agricultural Products	2644.27	34928.1	31114.4	89%	0.180	3%	2425.28
13	Manufacturing of Transport Equipment	3748.85	55452.6	26389.0	48%	0.093	27%	2258.53
14	Manufacturing of Plastics	2097.51	13872.2	13158.7	95%	0.076	1%	2015.68
15	Manufacturing of Electrical Machinery and Equipment	2121.53	43344.4	31524.3	73%	0.068	9%	1682.70
16	Manufacturing of Special Purpose Machinery	1851.20	21561.8	16309.1	76%	0.151	8%	1509.14
17	Manufacturing of Artwork and Other Manufacturing	1505.08	5662.7	5390.6	95%	0.049	1%	1450.23
18	Mining and Processing of Ferrous Metal Ores	1573.35	5999.3	5244.6	87%	0.086	3%	1423.22
20	Manufacturing of Communication Equipment,	2525.15	54970.7	20937.0	38%	0.266	39%	1339.33

Item	Sector	Total Energy Consumption by All IEAMTs	Total IOV of All IEAMTs	Total IOV of SMEs	IOV Ratio of SMEs/IEAMTs	Average ECI of All IEAMTs	SME ECI in Excess of Average IEAMTs ECI	Calculated Energy Consumption of SMEs
		(10,000 tce)	(100 mil RMB))	(100 mil RMB)	(%)	(tce/10,000RMB)	(%)*	(10,000 tce)
	Computers and Other Electronic Equipment							
21	Manufacturing of Foods	1508.52	11350.6	9545.8	84%	0.262	5%	1326.58

Sectors highlighted yellow are sensitive to the generic assumption below; refinement using sector-specific data would be required prior to quantification of sectoral SME energy saving potentials.

*Assuming that SME energy consumption level on average is 36% higher than the sector average (Xiong and Yu, 2009), the calculated energy consumption level for large enterprises would be 24.2% better than the overall average using the ratio of SME industrial output value of RMB46864.36 billion versus total combined industrial output value of RMB69859.06 billion across a;; 39 industrial sectors.

ECI = Energy Consumption Index (in tce per RMB10,000)

IOV = Industrial Output Value (in RMB)

IEAMT = Industrial enterprises above minimum threshold are those with annual revenue of over 5 million RMB from principal business.

Table B3: Summary of Sectoral Ranking for Top 18 Energy Consuming Sectors in China

Sector Code	Sector	Score of SMEs Energy Consumption	PER Scoring	SEUC Scoring	SEUC Value	Provincial Prevalence Count	Joint Ranking
32	Smelting and Pressing of Ferrous Metals	18	2	11	17.07%	5	2
31	Manufacturing of Non-metallic Mineral Products	17	3	10	16.76%	5	3
26	Manufacturing of Raw Chemical Materials and Chemical Products	16	4	12	19.30%	7	1
33	Smelting and Pressing of Non-ferrous Metals	15	5	8	11.01%	2	5
06	Mining and Washing of Coal	14	1	9	14.34%	4	7
17	Manufacturing of Textile	13	10	3	4.78%	3	6
22	Manufacturing of Paper and Paper Products	12	6	7	8.63%	2	8
34	Manufacturing of Metal Products	11	17	4	4.90%	1	4
35	Manufacturing of General Purpose Machinery	10	9	0	<3%	3	-
13	Processing of Food from Agricultural Products	9	7	0	<3%	2	-
37	Manufacturing of Transport Equipment	8	11	0	<3%	3	-
30	Manufacturing of Plastics	7	16	2	4.24%	0	-
39	Manufacturing of Electrical Machinery and Equipment	6	13	0	<3%	2	-
36	Manufacturing of Special Purpose Machinery	5	8	0	<3%	0	-
42	Manufacturing of Artwork and Other Manufacturing	4	15	5	6.57%	0	-
08	Mining and Processing of Ferrous Metal Ores	3	7	6	7.26%	1	9
40	Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	2	18	0	<3%	2	-
14	Manufacturing of Foods	1	5	1	3.30%	0	-

SEUC = Share of Energy Use Cost in total production cost (%) in a given industrial sector. If the SEUC value of a given industrial sector is 3% or higher, that industrial sector would be considered energy intensive and its business bottom line would be considered likely to be sensitive to energy cost/price.

APPENDIX C

SECTORAL ENERGY MIX AND ENERGY PRICE

Table C1: Consumption of Different Energy Forms by Sectors (2010)

Sector	Energy Consumption	Coal	Coke	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Natural Gas	Electricity	Calculated Sectoral Energy Price
	10k tce	10k tons	10k tons	10k tons	10k tons	10k tons	10k tons	10k tons	100 million m ³	100 million kWh	
Reference price of energy forms	740 1000 8000 9750 9000 8458 8500 6 0.7										
(2011 Guangdong Statistic Yearbook)	RMB/t RMB/t RMB/t RMB/t RMB/t RMB/t RMB/t RMB/m ³ RMB/kWh										RMB/tce
Mining and Washing of Coal	10574.43	23143.94	25.05		20.11	2.53	141.23	2.32	3.80	751.67	2277
Mining and Processing of Ferrous Metal Ores	1573.35	222.10	125.73		7.70	0.35	62.36	0.07	0.03	361.33	2178
Mining and Processing of Non-Ferrous Metal Ores	954.16	99.19	15.75		7.59	0.67	20.82	0.01	0.09	258.71	2266
Mining and Processing of Nonmetal Ores	1026.38	607.79	13.28		6.40	0.24	89.42	0.18	0.66	155.26	2350
Mining of Other Ores	213.52	2.56			0.32	0.62	0.54		0.01	65.52	2222
Processing of Food from Agricultural Products	2644.27	1699.66	9.50	0.11	38.93	0.51	56.78	9.79	0.88	424.36	1981
Manufacturing of Foods	1508.52	1210.93	3.01	0.01	15.74	0.20	30.47	13.76	2.76	184.69	1914
Manufacturing of Beverages	1130.42	792.40	0.68		9.55	0.13	15.91	8.26	1.70	132.34	1694
Manufacturing of Tobacco	228.89	80.06			0.72		4.50	1.06	0.62	45.88	2061
Manufacturing of Textile	6204.53	2618.04	5.10	0.02	26.96	0.50	44.63	22.45	1.66	1276.74	1904
Manufacturing of Textile Wearing Apparel, Footware and Caps	748.42	233.77	3.76	0.03	17.83	0.25	34.34	5.31	0.32	151.58	2364
Manufacturing of Leather, Fur, Feather and Related Products	392.19	75.11	0.22	0.05	8.40	0.24	13.70	5.87	0.04	89.72	2388

Sector	Energy Consumption	Coal	Coke	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Natural Gas	Electricity	Calculated Sectoral Energy Price
	10k tce	10k tons	10k tons	10k tons	10k tons	10k tons	10k tons	10k tons	100 million m ³	100 million kWh	
Processing of Timber, Manufacturing of Wood, Bamboo, Rattan, Palm and Straw Products	1035.62	432.64	1.78	0.22	9.29	0.17	18.06	0.25	0.30	212.21	2003
Manufacturing of Furniture	209.66	33.79	1.51	0.01	8.23	0.08	14.53	0.58	0.36	44.49	2711
Manufacturing of Paper and Paper Products	3961.92	4281.61	2.19	0.12	11.32	0.22	28.43	19.58	1.49	535.44	1900
Printing, Reproduction of Recording Media	390.97	44.70	0.27	0.01	8.33	0.10	13.57	2.05	0.77	95.45	2461
Manufacturing of Articles For Culture, Education and Sport Activities	210.84	17.74	3.82	0.06	4.08	0.11	16.39	1.73	0.32	48.09	2691
Manufacturing of Raw Chemical Materials and Chemical Products	29688.93	14703.88	1743.01	3062.50	48.20	5.02	162.69	514.56	187.28	3144.92	2581
Manufacturing of Medicines	1427.68	716.35	0.87	0.02	12.16	0.34	17.15	6.69	2.92	222.58	1813
Manufacturing of Chemical Fibers	1440.91	589.10	3.88		1.55	0.01	7.95	15.24	0.44	298.86	1923
Manufacturing of Rubber	1461.17	508.10	2.93	0.02	10.81	0.09	10.26	9.16	0.99	329.89	2066
Manufacturing of Plastics	2097.51	377.96	4.04	0.10	23.21	0.28	56.61	13.67	1.61	533.10	2354
Manufacturing of Non-metallic Mineral Products	27683.25	23508.83	385.72	2.45	37.47	1.16	289.94	353.57	42.72	2448.48	1565
Smelting and Pressing of Ferrous Metals	57533.71	28221.59	29448.47	0.33	13.40	0.47	99.88	23.90	20.42	4611.60	1478
Smelting and Pressing of Non-ferrous Metals	12841.45	5714.93	591.98	0.71	10.35	1.78	63.98	97.12	9.06	3129.09	2239
Manufacturing of Metal Products	3627.75	316.00	75.56	0.12	32.95	1.40	66.29	12.47	3.63	960.72	2275
Manufacturing of General Purpose Machinery	3270.81	432.85	657.06	0.09	54.03	4.47	74.65	7.75	6.66	621.03	2137

Sector	Energy Consumption	Coal	Coke	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Natural Gas	Electricity	Calculated Sectoral Energy Price
	10k tce	10k tons	10k tons	10k tons	10k tons	10k tons	10k tons	10k tons	100 million m ³	100 million kWh	
Manufacturing of Special Purpose Machinery	1851.20	627.83	125.61	0.06	29.51	0.64	47.63	3.75	5.95	317.83	2107
Manufacturing of Transport Equipment	3748.85	853.95	168.87	0.17	49.21	10.18	110.55	12.50	12.97	790.29	2327
Manufacturing of Electrical Machinery and Equipment	2121.53	253.54	26.63	0.15	36.48	0.66	71.92	7.81	4.63	508.19	2398
Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	2525.15	185.11	2.61	0.27	20.31	0.36	71.22	13.67	6.27	670.76	2429
Manufacturing of Measuring Instruments and Machinery for Cultural Activity and Office Work	346.47	25.46	5.73		7.26	0.61	14.22	0.40	0.54	85.83	2476
Manufacturing of Artwork and Other Manufacturing	1505.08	471.78	2.13		7.73	0.10	14.35	2.38	0.34	376.40	2142
Recycling and Disposal of Waste	77.49	12.95	10.63		0.73	0.03	4.20	1.80	0.01	14.10	2294
Production and Supply of Water	970.36	66.68	0.14		4.38		4.61	0.18	0.19	291.00	2248

APPENDIX D

SHARE OF ENERGY USE COST

Table D1: Calculation of Sectoral Energy Prices and Share of Energy Use Costs (2010)*

Sector	Coal	Coke	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Natural Gas	Electricity	Overall Energy Cost	Principal Business Cost	Sectoral Energy Price	SEUC*
	Cost 100 million RMB											RMB/tce	
Mining and Washing of Coal	1712.65	2.51	0.00	19.61	2.28	119.45	1.97	22.80	526.17	2407.43	16788.74	2277	14.3%
Mining and Processing of Ferrous Metal Ores	16.44	12.57	0.00	7.51	0.32	52.74	0.06	0.18	252.93	342.75	4722.34	2178	7.3%
Mining and Processing of Non-Ferrous Metal Ores	7.34	1.58	0.00	7.40	0.60	17.61	0.01	0.54	181.10	216.17	2921.12	2266	7.4%
Mining and Processing of Nonmetal Ores	44.98	1.33	0.00	6.24	0.22	75.63	0.15	3.96	108.68	241.19	2360.56	2350	10.2%
Mining of Other Ores	0.19	0.00	0.00	0.31	0.56	0.46	0.00	0.06	45.86	47.44	24.78	2222	191.4%
Processing of Food from Agricultural Products	125.77	0.95	0.09	37.96	0.46	48.02	8.32	5.28	297.05	523.91	30338.53	1981	1.7%
Manufacturing of Foods	89.61	0.30	0.01	15.35	0.18	25.77	11.70	16.56	129.28	288.75	8760.31	1914	3.3%
Manufacturing of Beverages	58.64	0.07	0.00	9.31	0.12	13.46	7.02	10.20	92.64	191.45	6669.36	1694	2.9%
Manufacturing of Tobacco	5.92	0.00	0.00	0.70	0.00	3.81	0.90	3.72	32.12	47.17	1737.77	2061	2.7%
Manufacturing of Textile	193.73	0.51	0.02	26.29	0.45	37.75	19.08	9.96	893.72	1181.51	24709.88	1904	4.8%
Manufacturing of Textile Wearing Apparel, Footwear and Caps	17.30	0.38	0.02	17.38	0.23	29.04	4.51	1.92	106.11	176.89	10067.38	2364	1.8%
Manufacturing of Leather, Fur, Feather and Related Products	5.56	0.02	0.04	8.19	0.22	11.59	4.99	0.24	62.80	93.65	6547.29	2388	1.4%

Sector	Coal	Coke	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Natural Gas	Electricity	Overall Energy Cost	Principal Business Cost	Sectoral Energy Price	SEUC*
	Cost 100 million RMB											RMB/tce	
Processing of Timber, Manufacturing of Wood, Bamboo, Rattan, Palm and Straw Products	32.02	0.18	0.18	9.06	0.15	15.28	0.21	1.80	148.55	207.41	6110.61	2003	3.4%
Manufacturing of Furniture	2.50	0.15	0.01	8.02	0.07	12.29	0.49	2.16	31.14	56.84	3625.31	2711	1.6%
Manufacturing of Paper and Paper Products	316.84	0.22	0.10	11.04	0.20	24.05	16.64	8.94	374.81	752.83	8727.67	1900	8.6%
Printing, Reproduction of Recording Media	3.31	0.03	0.01	8.12	0.09	11.48	1.74	4.62	66.82	96.21	2835.04	2461	3.4%
Manufacturing of Articles For Culture, Education and Sport Activities	1.31	0.38	0.05	3.98	0.10	13.86	1.47	1.92	33.66	56.74	2637.34	2691	2.2%
Manufacturing of Raw Chemical Materials and Chemical Products	1088.09	174.30	2450.00	47.00	4.52	137.60	437.38	1123.68	2201.44	7664.00	39710.50	2581	19.3%
Manufacturing of Medicines	53.01	0.09	0.02	11.86	0.31	14.51	5.69	17.52	155.81	258.79	7902.42	1813	3.3%
Manufacturing of Chemical Fibers	43.59	0.39	0.00	1.51	0.01	6.72	12.95	2.64	209.20	277.02	4456.75	1923	6.2%
Manufacturing of Rubber	37.60	0.29	0.02	10.54	0.08	8.68	7.79	5.94	230.92	301.86	4986.42	2066	6.1%
Manufacturing of Plastics	27.97	0.40	0.08	22.63	0.25	47.88	11.62	9.66	373.17	493.67	11653.68	2354	4.2%
Manufacturing of	1739.65	38.57	1.96	36.53	1.04	245.23	300.53	256.32	1713.94	4333.78	25862.07	1565	16.8%

Sector	Coal	Coke	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Natural Gas	Electricity	Overall Energy Cost	Principal Business Cost	Sectoral Energy Price	SEUC*
	Cost 100 million RMB											RMB/tce	
Non-metallic Mineral Products													
Smelting and Pressing of Ferrous Metals	2088.40	2944.85	0.26	13.07	0.42	84.48	20.32	122.52	3228.12	8502.43	49814.60	1478	17.1%
Smelting and Pressing of Non-ferrous Metals	422.90	59.20	0.57	10.09	1.60	54.11	82.55	54.36	2190.36	2875.75	26124.85	2239	11.0%
Manufacturing of Metal Products	23.38	7.56	0.10	32.13	1.26	56.07	10.60	21.78	672.50	825.37	16835.48	2275	4.9%
Manufacturing of General Purpose Machinery	32.03	65.71	0.07	52.68	4.02	63.14	6.59	39.96	434.72	698.92	28726.15	2137	2.4%
Manufacturing of Special Purpose Machinery	46.46	12.56	0.05	28.77	0.58	40.29	3.19	35.70	222.48	390.07	17475.24	2107	2.2%
Manufacturing of Transport Equipment	63.19	16.89	0.14	47.98	9.16	93.50	10.63	77.82	553.20	872.51	45872.97	2327	1.9%
Manufacturing of Electrical Machinery and Equipment	18.76	2.66	0.12	35.57	0.59	60.83	6.64	27.78	355.73	508.69	35494.98	2398	1.4%
Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	13.70	0.26	0.22	19.80	0.32	60.24	11.62	37.62	469.53	613.31	48920.84	2429	1.3%
Manufacturing of Measuring Instruments and Machinery	1.88	0.57	0.00	7.08	0.55	12.03	0.34	3.24	60.08	85.77	5209.71	2476	1.6%

Sector	Coal	Coke	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Natural Gas	Electricity	Overall Energy Cost	Principal Business Cost	Sectoral Energy Price	SEUC*
	Cost 100 million RMB											RMB/tce	
for Cultural Activity and Office Work													
Manufacturing of Artwork and Other Manufacturing	34.91	0.21	0.00	7.54	0.09	12.14	2.02	2.04	263.48	322.43	4909.37	2142	6.6%
Recycling and Disposal of Waste	0.96	1.06	0.00	0.71	0.03	3.55	1.53	0.06	9.87	17.77	2132.27	2294	0.8%
Production and Supply of Water	4.93	0.01	0.00	4.27	0.00	3.90	0.15	1.14	203.70	218.11	853.38	2248	25.6%

*Sectoral Energy Use Cost (SEUC) is expressed as % of energy cost in total production cost based on 2010 statistics; according to 2006 EU Energy Products Directive, energy extensive industries are commonly referred to the ones with SEUC values of 3% or higher.

APPENDIX E

ENERGY CONSUMPTION REDUCTION AND COST SAVING POTENTIALS

APPENDIX E: CALCULATION OF ENERGY CONSUMPTION REDUCTION AND ENERGY COST SAVING POTENTIALS

E1. Energy Saving Targets for 12th FYP

With the most recent trend of rapid improvement of Chinese energy efficiency projects and the increasingly stringent compulsory phase-out of obsolete technologies, the gap between China's industrial energy efficiency and the international best practices is narrowing. Simple comparison of literature indices, without detailed analyses of the difference in the data source's subsector boundaries and base years can easily result in misleading conclusions or unrealistic estimates. Therefore, rather than comparing with international best practices with non-current published data, the sector targets set out by MIIT (2012)¹ for the 12th FYP will be adopted as the realistic targets for the calculation of energy savings potentials.

The 12th FYP energy savings targets for 9 key industries are stipulated by MIIT (2012) as listed in Table F1. The 9 industries listed in Table 2 include most of the priority sectors selected in Table B3 of Appendix B and are considered reflective of the most likely extent of energy efficiency improvement that may be achieved in those sectors in the period of 2011-2015. Conceivably, the targets for SMEs should be higher than the sectoral targets because the energy saving efforts in the 11th FYP were largely driven by the government and focused on major/large energy consuming enterprises (MIIT, 2010)², leaving much room for SMEs to improve in the 12th FYP. MIIT (2010) suggested that the energy efficiency of SMEs in general may be over 20% lower than that of their respective sector averages, and proposed that energy efficiency improvements by SME sector as a whole may reach 25% during 12th FYP. This is only 4% more aggressive than the overall industrial energy efficiency improvement target of 21% for 12th FYP as stipulated by MIIT (2012). Based on the above, the sector-specific SME energy savings targets may be calculated for the 9 industrial sectors through direct proportional adjustment, as presented in Table F1.

Table E1: Targets for Energy Efficiency Improvement in 12th FYP

Industry	Published Target for Sector Average	Assumed Target for SME
Steel and Iron	18%	21.42%
Non-ferrous Metals	18%	21.42%
Petroleum and Chemical Industry	18%	21.42%
Chemical Products	20%	23.80%
Building Materials	20%	23.80%
Mechanical Industry	22%	26.18%
Light Industry	20%	23.80%
Manufacturing of Textile	20%	23.80%
Electronics and Information	18%	21.42%
Overall Industrial EE Improvement	21%	25%**

¹ MIIT (2012) *The 12th FYP for Industrial Energy Saving*.

² MIIT (2010) *Guidance for Further Strengthening Energy Saving and Emission Reduction Works of SMEs*.

E2. Quantification of Sectoral SME Energy Saving Potentials

With the energy efficiency improvement targets (in %) listed in Table F1 for SMEs, the sectoral SME energy saving capacity (in tce/yr) that have potential for the priority SME sectors in 12th FYP can be deduced from the aggregated sectoral SME energy consumptions calculated for the 2010 base year. The energy cost saving potentials (in RMB/yr) can be further derived from the above-calculated energy saving potentials (in tce/yr) and the sectoral energy unit cost (in RMB/tce). The results of the energy saving potential and cost saving potential calculation are presented in Table F2.

As indicated in Table B3, most of the top 18 sectors of SME energy consumptions are dominated by SMEs with sectoral SME IOVs being over 80% of the total IOVs of their respective sectors. For these sectors, the uncertainty in the calculated SME consumptions that may be introduced by the generic assumption made for the energy efficiency of large enterprises would be very limited. For examples, according to the published statistic data, SMEs comprised 81% of overall IOV of IEAMTs in the Manufacturing of Raw Chemical Materials and Chemical Products sector. As shown below in Exhibit F1, assuming large enterprises are 10% to 40% more energy efficient than SMEs in the same sector (with an average of 24%), the resulted variation of ECI calculated for SMEs would range from 0.634 tce/RMB10,000 to 0.677 tce/RMB10,000 with a deviation of less than 3.5% from the calculated average value of 0.654 tce/RMB10,000. With this limited range of deviation in ECI, the resulting uncertainty in energy cost saving estimate would be equally limited.

EXHIBIT F1 ECI Uncertainty Analysis for the Sector of Manufacturing of Raw Chemical Materials and Chemical Products (Sector Average Energy Efficiency = 0.620 tce/RMB10,000)				
Parameter	"Discount" Rate for Large Enterprises	Assumed ECI of Large Enterprises	Calculated ECI of SMEs	Resulted Deviation from Mid Value
Unit	(%)	(tce/RMB10,000)	(tce/RMB10,000)	(%)
Upper Limit	90%	0.558	0.634	-3.5%
Mid Value	75.8%	0.470	0.654	-
Lower Limit	60%	0.372	0.677	+3.0%
ECI = Energy Consumption Index (in tons of standard coal equivalence or tce per RMB10,000 industrial output value)				

On the other hand, the SME ECI calculation can be mathematically sensitive to the use of generic assumptions made in sectors that are dominated by large enterprises. As indicated in Table 4, amongst the final selection of 9 sectors of priority SMEs energy consumption priority, 2 sectors, including Smelting and Pressing of Ferrous Metals and Mining and Washing of Coal, are not dominated by SMEs. For these two sectors, sector-specific refinements based on actual industrial survey should be done prior to quantification.

According to Xiong and Yu (2009)³, SMEs in Smelting and Pressing of Ferrous Metals (aka Iron & Steel) are approximately 14% less efficient than the national sectoral average. (By proportionating, the calculated energy efficiency of large enterprises in the Iron and Steel industry would then be approximately 8% more efficient than

³ XIONG Hua-wen and YU Cong (2009) *The Energy Efficiency Circumstances of Small and Medium Sized Industrial Enterprises and Their Potential Analysis for Energy Conservation*, Power DSM, Vol.11, No. 6.

the sector average.) This figure has been used to refine the SME energy consumption calculation, prior to further quantification of the energy saving and energy cost saving potentials presented in Table F2.

Mining and Washing of Coal is a sector widely known to contain a large variety of conflicting data⁴, largely because both the primary inputs and primary outputs of coal mining and coal washing are coal. It is self-evident from the published statistics in 2011 China Statistic Yearbook that the coal consumption of this sector alone (23,143.94 tons or approximately 16,531 tce) is substantially greater than the total energy consumption of 10,574 tce. Acquiring reliable data in this sector is essentially unrealistic at this point; any further calculation for this sector is hence provided for reference only. However, given the significance of this sector in China, apparent high energy intensity, and the abundance of energy saving opportunities widely known in this industry, this sector is retained in the priority list.

It should be noted that in light of the consolidation of coal mining sector in the most recent years due to heightened work safety requirements, there would be much fewer SMEs operating in this sector. The published 11th FYP data for this sector are unlikely to be valid indicators for the future in the 12th FYP. Those small coalmines that may continue to operate would most likely have insufficient legitimacy to be considered for IFC financing. It is more likely that legitimate financing opportunities may present in this sector amongst SMEs that provide services to coalmines in areas such as ventilation air methane (VAM) utilization and small-scale coal washing. Further study into these subsectors may prove valuable in the mid-term.

⁴ Guan DB, Liu Z, Geng Y, Lindner S and Hubacek K (2012) *The Gigatonne Gap in China's Carbon Dioxide Inventories*. Natural Climate Change, advance online publication, 12 June 2012.

Table E2: Calculation of Energy Saving and Energy Cost Saving Potentials

Sector	Calculated SME Energy Consumption	Aggregated IEAMTs Energy Consumption	IOV Ratio of SMEs/ IEAMTs	ECI-Average	ECI-SMEs	12 FYP ECI Reduction Target	12 FYP SME ECI Reduction Target	SME Energy Saving Capacity	Sectoral Energy Price	SME Energy Cost Saving Potential
(Unit)	(10k tce/yr)	(10k tce/yr)	(%)	(tce/RMB10k)	(tce/RMB10k)	(%)	(%)	(10K tce/yr)	(RMB/tce)	(RMB100 Mil/yr)
Smelting and Pressing of Ferrous Metals	23967.34 ⁵	57533.71	37%	1.110	1.265	18%	21.4%	5135.86	1478	758.99
Manufacturing of Non-metallic Mineral Products	26228.31	27683.25	93%	0.864	0.879	20%	23.8%	6244.84	1565	977.62
Manufacturing of Raw Chemical Materials and Chemical Products	25460.37	29688.93	81%	0.620	0.654	20%	23.8%	6061.99	2581	1564.86
Smelting and Pressing of Non-ferrous Metals	10077.17	12841.45	72%	0.457	0.500	18%	21.4%	2159.39	2239	483.58
Mining and Washing of Coal	6443.82	10574.43	49%	0.478	0.601	21%	25.0%	1610.96	2277	366.76
Manufacturing of Textile	5446.72	6204.53	84%	0.218	0.228	20%	23.8%	1296.84	1904	246.95
Manufacturing of Paper and Paper Products	3440.55	3961.92	83%	0.380	0.399	20%	23.8%	819.18	1900	155.66
Manufacturing of Metal Products	3412.79	3627.75	92%	0.180	0.184	21%	25.0%	853.20	2275	194.12
Manufacturing of General Purpose Machinery	2895.11	3270.81	85%	0.093	0.097	22%	26.2%	758.24	2137	162.02
Processing of Food from Agricultural Products	2425.28	2644.27	89%	0.076	0.078	20%	23.8%	577.45	1981	114.41
Manufacturing of Transport Equipment	2258.53	3748.85	48%	0.068	0.086	21%	25.0%	564.63	2327	131.41
Manufacturing of Plastics	2015.68	2097.51	95%	0.151	0.153	20%	23.8%	479.92	2354	112.95
Manufacturing of Electrical Machinery and Equipment	1682.70	2121.53	73%	0.049	0.053	21%	25.0%	420.68	2398	100.87
Manufacturing of Special Purpose Machinery	1509.14	1851.20	76%	0.086	0.093	21%	25.0%	377.28	2107	79.50
Manufacturing of Artwork and Other Manufacturing	1450.23	1505.08	95%	0.266	0.269	20%	23.8%	345.29	2142	73.97
Mining and Processing of Ferrous	1423.22	1573.35	87%	0.262	0.271	21%	25.0%	355.80	2178	77.51

⁵ The calculated SME energy consumption of the sector Smelting and Pressing of Ferrous Metals (aka Iron & Steel) has been refined based on sector-specific assumption that SMEs in the Iron and Steel industry are approximately 14% less efficient than the national sectoral average or that energy efficiency of large enterprises in this sector are approximately 8% more efficient than the sector average. Without the sector-specific refinement, the preliminary estimate of SME energy consumption of the Iron and Steel industry would be 29841.75 (10k tce/yr), as presented in Table B2 in Appendix B.

For all other 34 sectors listed in this table, SME energy consumptions are calculated based on the generic assumption that SMEs as a whole are in general approximately 36% less efficient than average industrial enterprises in the country or that energy efficiency of large enterprises in a generic sector is approximately 24% more efficient than the average of the respective sector.

Sector	Calculated SME Energy Consumption	Aggregated IEAMTs Energy Consumption	IOV Ratio of SMEs/ IEAMTs	ECI-Average	ECI-SMEs	12 FYP ECI Reduction Target	12 FYP SME ECI Reduction Target	SME Energy Saving Capacity	Sectoral Energy Price	SME Energy Cost Saving Potential
(Unit)	(10k tce/yr)	(10k tce/yr)	(%)	(tce/RMB10k)	(tce/RMB10k)	(%)	(%)	(10K tce/yr)	(RMB/tce)	(RMB100 Mil/yr)
Metal Ores										
Manufacturing of Communication Equipment, Computers and Other Electronic Equipment	1339.33	2525.15	38%	0.046	0.064	18%	21.4%	287.00	2429	69.71
Manufacturing of Foods	1326.58	1508.52	84%	0.133	0.139	20%	23.8%	315.85	1914	60.46
Manufacturing of Medicines	1182.46	1427.68	77%	0.122	0.130	20%	23.8%	281.54	1813	51.03
Manufacturing of Chemical Fibers	1108.20	1440.91	70%	0.291	0.322	20%	23.8%	263.86	1923	50.73
Manufacturing of Rubber	1083.52	1461.17	66%	0.247	0.278	20%	23.8%	257.98	2066	53.30
Processing of Timber, Manufacturing of Wood, Bamboo, Rattan, Palm and Straw Products	1009.89	1035.62	97%	0.140	0.141	20%	23.8%	240.45	2003	48.16
Mining and Processing of Nonmetal Ores	998.13	1026.38	96%	0.332	0.335	21%	25.0%	249.53	2350	58.64
Manufacturing of Beverages	934.42	1130.42	77%	0.124	0.132	20%	23.8%	222.48	1694	37.68
Production and Supply of Water	882.14	970.36	88%	0.853	0.881	21%	25.0%	220.53	2248	49.57
Mining and Processing of Non-Ferrous Metal Ores	848.44	954.16	85%	0.251	0.262	21%	25.0%	212.11	2266	48.06
Manufacturing of Textile Wearing Apparel, Footwear and Caps	672.22	748.42	87%	0.061	0.063	20%	23.8%	160.05	2364	37.83
Printing, Reproduction of Recording Media	380.04	390.97	96%	0.110	0.111	20%	23.8%	90.49	2461	22.27
Manufacturing of Leather, Fur, Feather and Related Products	346.83	392.19	85%	0.050	0.052	20%	23.8%	82.58	2388	19.72
Manufacturing of Measuring Instruments and Machinery for Cultural Activity and Office Work	283.33	346.47	76%	0.054	0.058	20%	23.8%	67.46	2476	16.70
Mining of Other Ores	213.47	213.52	100%	6.820	6.820	21%	25.0%	53.37	2222	11.86
Manufacturing of Articles For Culture, Education and Sport Activities	198.43	210.84	92%	0.067	0.069	20%	23.8%	47.25	2691	12.71
Manufacturing of Furniture	197.35	209.66	92%	0.047	0.048	20%	23.8%	46.99	2711	12.74
Manufacturing of Tobacco	96.07	228.89	23%	0.039	0.070	20%	23.8%	22.87	2061	4.71
Recycling and Disposal of Waste	76.55	77.49	98%	0.034	0.034	21%	25.0%	19.14	2294	4.39
Total 35 Qualified Sectors**								31,203		6271
Total 8 Priority SME Sectors*								22,927		4559

Sector	Calculated SME Energy Consumption	Aggregated IEAMTs Energy Consumption	IOV Ratio of SMEs/ IEAMTs	ECI-Average	ECI-SMEs	12 FYP ECI Reduction Target	12 FYP SME ECI Reduction Target	SME Energy Saving Capacity	Sectoral Energy Price	SME Energy Cost Saving Potential
(Unit)	(10k tce/yr)	(10k tce/yr)	(%)	(tce/RMB10k)	(tce/RMB10k)	(%)	(%)	(10K tce/yr)	(RMB/tce)	(RMB100 Mil/yr)

The shaded sectors are dominated by large enterprises; the SME energy consumptions calculated for these sectors based on the generic assumptions may contain material uncertainties, of which the aggregated impact on the estimate of total SME energy consumptions for all 35 sectors combined is likely to be substantially less than 5%.

IEAMTs = Industrial Enterprises Above Minimum Threshold are those with annual revenue of over 5 million RMB from principal business.

ECI = Energy Consumption Index (in tce per RMB10,000); IOV = Industrial Output Value (in RMB)

* Exclusive the sector of Mining and Washing of Coal.

** Four of the 39 industrial categories published in China Statistic Yearbook 2011 are excluded as they represent large energy resources exploration/extraction and primary/secondary energy production/distribution industries and do not contain material presence of SMEs.

APPENDIX F

SUMMARY OF SMES CASE STUDY

Company	Ningbo A Food Co.				
Location	Ningbo Free Trade Zone, Ningbo, Zhejiang China				
Sector	Food				
Turnover	18,000,000 CNY/yr	Asset	150,000,000 CNY		
Headcount	300	Size of Factory	10,620 m2 (floor area)		
Energy Consumption	Coal : 0 t/a		Steam: 50,000 ton/yr		
	Electricity: 7000MWh/yr		Heavy Fuel Oil: 3000 ton		
	Natural Gas/Other: -		Total: 14,317 tce/a.		
Production Description	<p>The company is an industrial leader in specialty soy proteins and soy Isoflavones and started it's operation in Ningbo in 2005.</p> <p>Soy protein concentrate is produced by immobilizing the soy globulin proteins while allowing the soluble carbohydrates, soy whey proteins, and salts to be leached from the defatted flakes or flour. The protein is retained by one or more of several treatments: leaching with 20-80% aqueous alcohol/solvent, leaching with aqueous acids in the isoelectric zone of minimum protein solubility, pH 4-5; leaching with chilled water (which may involve calcium or magnesium cations), and leaching with hot water of heat-treated defatted soy meal/flour.</p> <p>The processes are energy intensive because of the extensive drying and hot water required.</p>				
Key Energy Saving Measures	Description of Energy Saving Measures		Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	Condensate recovery The spray dryer is consuming 7 MW of steam with temperature 200° at a pressure of 1.5 MPa. The condensate leaves the steam trap at a temperature above 80 ° and is drained (not returned to the power station). Recovery of the heat from the condensate will save 6 % on the steam consumption.		275	1.2	0.5
	Economizer The fuel/gas boiler produces thermal oil at a temperature of 280 °C, consequently the exhaust gases of the boiler are at +- 330° C. Using natural gas as fuel, the exhaust gases may be cooled to dew point as no acids can be formed due to absence of sulfur in the fuel. Heat recovery from the exhaust gases to hot water or steam that, can be utilized in heating the drying air or for hot water production, will save another 7 % of steam consumption.		320	1.5	0.5
	Cogeneration Instead of burning natural gas in the boiler just for heat, this gas can be combusted in an engine generating power next to the waste heat. The power can be absorbed in the factory and the waste heat can be used for hot water, steam and hot thermal oil. Due to this combined heat and power generation, 9 % of actual steam consumption can be saved.		415	6	1.5
	Total		1010	8.7	1
Remarks	The project is to be self-financed.				

*SPB=Simple Payback Period (yr)

Company	Julu B Textile Co.			
Location	Julu County, Xingtai City, Hebei			
Sector	Textile			
Turnover	200 000 000 CNY/y	Asset	140 000 000 CNY	
Headcount	800	Size of factory:	18,723 m2 (Optional)	
Energy Consumption	Coal : 31,550 t/yr		Steam: 140,000 ton (included in coal)	
	Electricity: 16,000MWh/yr		Diesel/Gasoline: -	
	Natural Gas: -		Total : 28,300 tce/a	
Production Description	<p>Julu Country Changsheng Textile Co. Ltd was established in February 2000. The total capital of the company is 140 million Yuan.</p> <p>Main production of the company include different kinds and qualities of Jeans and similar products. Annual capacity is 18 million meters. The production quality meets national standard and the production has been exported abroad and passed ISO9001 certification. Its main production line comprises 200 high speed shuttles-less rapier looms, producing 15 million m² per year top grade denim fabric.</p> <p style="text-align: center;">Figure 1 Progress of the production line</p> <pre>graph LR subgraph Warp W_spinning[spinning] --> W_clearing[Yarn clearing] W_clearing --> W_knitting[knitting] W_knitting --> W_sizing[Sizing] end subgraph Weft Wt_spinning[spinning] --> Wt_clearing[Yarn clearing] end W_sizing --> Weaving[Weaving] Wt_clearing --> Weaving Weaving --> Repair[Repair] Repair --> Pre_shrinking[Pre shrinking] Pre_shrinking --> Inspection[Inspection] Inspection --> Coiling[Coiling] Coiling --> Warehousing[Warehousing] Boiler[Boiler]</pre>			
Key Energy Saving Measures	Description of Energy Saving Measures	Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	Boiler refurbish – 3x8t/h old boiler will be refurbished	5958	12.6	3
	Steam/condensate recovery – condensate from steam room would be collected and used as feed water for the boilers	1508	4.8	1
	VFD – 30 motors will be installed with VFD drives, saving 3950 MWh/yr electricity	1427	4.6	1.5
	Total	8793	22.0	2.25
Remarks	<p>Also result in CO2 emission reduction by 19,300t/yr, SO2 emission reduction by 27.5 t/yr, NOx emission reduction by 71 t/yr.</p> <p>The project has applied for low-interest policy loan.</p>			

*SPB=Simple Payback Period (yr)

Company	Dezhou C Plastic Co			
Location	Dezhou Economic Development Zone, Shandong			
Sector	Chemical Industry			
Turnover	37 million CNY	Asset	32 million CNY	
Headcount	100	Size of Factory	200 mu	
Energy Consumption	Coal: 3780 t/yr	Total: 3269.5 tce/yr		
	Electricity:240 MWh/yr			
Production Description	<ul style="list-style-type: none">• Pretreatment of the discarded PET, the main equipments include grinder, dryer, etc.• Decomposition and purification of the discarded PET, the main equipments included conveyer, decomposition reactor, plate filter press, decoloring reactor, bag style fine filter, evaporator, conveying pipes, etc.• Synthesis of polyester resin, the main equipments include conveyer, reactor, fractionating tower, cooler, vaccum pump, storage tank for raw materials, cable crane, water storage pool, cooling tower, etc.• Products packaging, the main equipments includes products high-temperature storage tank, tablet-pressing machine, automatic measuring equipment , packaging machine, etc.			
Key Energy Saving Measures	Description of Energy Saving Measures	Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	Add a compound pulverized coal combustion system to furnace combustion. The lower part of the furnace was still traditional layer burning of fire bed over chain grate. At the upper part, part of the pulverized coal was newly added for suspension chamber combustion, which not only strengthens the combustion process in the furnace but also increases the furnace combustion efficiency and the adaptability of coals. In the process of the reformation, the boiler grate and accessory devices are kept unchanged while milling, distributed air and PLC controlling system are newly added; pulverized coal burners were installed on both sides of the furnace. The construction was completed in 10-15 days during furance's downtime.	948.5	36	0.33
	Total	948.5	36	0.33
Remarks	While reducing coal consumption, the adoption of the pulverized coal compound combustion system also reduce pollutant emission and labor intensity. The project has been financed through an energy performance contract on a benefit sharing basis.			

*SPB=Simple Payback Period (yr)

Company	Zouping D Paper Co.				
Location	Weiqiao Industrial Park, Zouping County, Shandong, China				
Sector	Paper and Paper Products				
Turnover	120 million CNY/yr	Asset	150 million CNY		
Headcount	130	Size of Factory	100,000 m ²		
Energy Consumption	Coal : 7921 t/a		Steam: -		
	Electricity: 491,700 kWh/yr		Heavy Fuel Oil: -		
	Natural Gas/Other: -		Total: 5718.4 tce/a.		
Production Description	The company is equipped with advanced high-speed paper machines (models 1575 & 2400), mainly producing high/medium/low level board paper of various weights, including board paper, CE, coating and high-strength corrugated paper. The company also has a large paper tube workshop, producing various types of paper tubes for the use by cotton/ textile manufacturers..				
Key Energy Saving Measures	Description of Energy Saving Measures		Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	A KD-DCS energy-saving control system for industrial furnaces was established to solve the lag problem of the heating load of the furnaces due to the mismatching between the demand and supply of steam. The steam supply was previously either too much or too little, neither of them could meet the instantaneous variation of heating demands of the production; the quality of steam supply was poor. In order to ensure stable and reliable operation of combustion process, the advanced computer control system and variable frequency speed regulation technology were adopted. Artificial intelligence system was introduced to the control scheme by installing an intelligent computer manipulation system on the chain grate, allowing for fully intelligentized auto-control. Through computerized frequency variation, the scheme controls the blowers, the induced draft fans, and water and coal supply by monitoring physical operational parameters, such as the water pressure, temperature, and the furnace negative pressure.		607.9	0.36	0.5
	The project implementation mainly involved installation of different measurable feedback devices, PLC automatic controlling system and variable frequency devices to upgrade the existing furnace. With the intellectual control scheme, the furnace negative pressure, and the drum water level and temperature are controlled within predetermined ranges to ensure the optimal combustion conditions in the furnace under the most energy efficient conditions.				
	Total		607.9	0.36	0.5
Remarks	By comparing the results before and after the project implementation, it was found that the project saves coal by 9.73% and electricity by 32.87%. The project has been implemented via self-financing.				

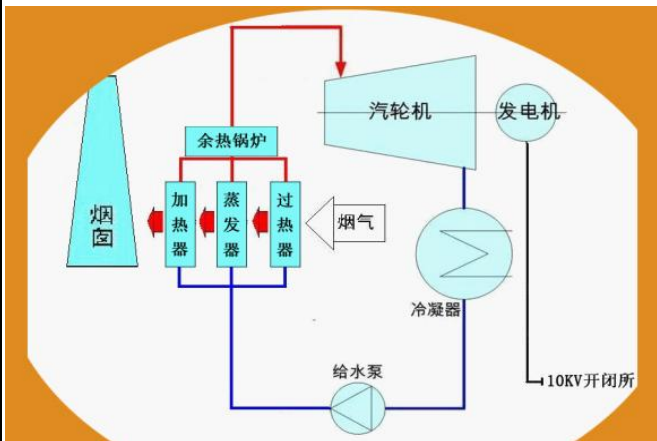
*SPB=Simple Payback Period (yr)

Company	Cangzhou E Chemical Industry Co				
Location	Qingzhou Town, Qing County, Cangzhou, Hebei, China				
Sector	Chemical Industry/Renwable Energy				
Turnover	89,765,000 CNY/yr	Asset	56,828,000 CNY		
Headcount	157	Size of Factory	1000 m ²		
Energy Consumption	Coal: 126.2 t/yr		Steam: -		
	Electricity: 468MWh/yr		Heavy Fuel Oil: -		
	Natural gas: -		Total: 295 tce/yr		
Production Description	Established in 2003, the company is a joint venture with universities, aiming at developing and producing water treatment agents and reverse osmosis devices. It is a primary agent of chemical distribution and technology services for reverse osmosis systems of K1 USA and Betzdearbohn Co. Its production capacity is 10,000 ton water purification agents per year. The geothermal project below, however, is for building heating, unrelated to production.				
Key Energy Saving Measures	Descprition of Energy Saving Measures		Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	Application of High Energy Efficiency Water Source Heat Pump Technology		240	7.28	4
	The project mainly involves in shallow geothermal energy for heating in the winter. The system installation comprises two sets of water source heat pumps with a electric power of 176kW, two water supply wells and four recharge wells, to meet the winter heat demands for 1564kW heating load of six dormitory buildings of the chemical company with a total floor area of 32,420 m2. The process mainly consists of: 1. Geothermal wells: The 50℃ hot water from geothermal wells 1# and 2# flowed into a heat exchanger through a desander. The 40℃ hot water after heat extraction flowed through a water source heat pump and then recharged back into the recharge wells. 2. Circulation water: the 40℃ circulation water flowed into the heat exchanger through a circulation pump. After heat exchange, the 50℃ water was used for heating.				
	Total		240	72.8	4
Remarks	Implemented as an Energy Performance Contract (EPC), supported with DSM subsidy.				

*SPB=Simple Payback Period (yr)

9Company	Guangdong F Golf Clubs Co. Ltd.			
Location	Dongguang Free Trade Zone, Dongguang, Guangdong, China			
Sector	Manufacturing of Metal Products			
Turnover	290,000,000 CNY/yr	Asset	350,000,000 CNY	
Headcount	5000 (approximate)	Size of Factory	30,000 m ²	
Energy Consumption	Coal : 0 t/a		Steam: -	
	Electricity: 36,060 MWh/yr		Diesel: 2,280 M ³ /yr	
	Natural Gas/Other: -		Total: 15,845 tce/a.	
Production Description	<p>The company produces golf clubs, including heads and shafts, primarily by smelting and casting of iron and steel. The main production process flowchart is as follows:</p> <div><div>模具 Molding</div><div>射蜡、浸浆、蒸气脱蜡 Wax Ejector, Dipping, Steam Wax Curing</div><div>铸造 Casting</div><div>加工、毛胚 Processing, Rough</div><div>钻孔、磨光/打亮、清洗 Stiletto, Grinding, Cleaning</div><div>喷漆、喷砂、烘干 Painting Mixture, Painting Sand, Drying</div><div>出球头成品 Finished Golf Head</div><div>制杆 Golf Shaft Process</div><div>组立 Assembling</div></div>			
Key Energy Saving Measures	Description of Energy Saving Measures	Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	Continuous furnace sintering moulds (saving 1,289M ³ /yr diesel)	1598	10	1.3
	Waste heat recovery boiler (saving 50M ³ /yr diesel)	62	0.65	2.2
	Streamlining ventilation (saving electricity by 280MWh/yr)	100	0.1	<1
	Improving cooling tower (saving electricity by 450MWh/yr)	162	0.24	< 1
	Leak avoidance of compressed air and installation of new VFD compressors (saving electricity by 3400MWh/yr)	1227	2.34	1.1
	Installation of VFD on water pumps(saving electricity by 880MWh/yr)	318	0.2	< 1
	Replacing grinding motors with high efficiency (saving electricity by 280MWh/yr)	101	0.5	2.2
	Replacing lights with high efficiency (saving electricity by 150MWh/yr)	54	0.35	2.9
	Replacing cookers in kitchen (saving diesel by 10 M ³ /yr)	12	0.07	1.11
	Total	3634	14.4	1.25
Remarks	Energy cost is approximately RMB42.5 million/yr. Energy saving measures have been implemented in phases by self-financing.			

*SPB=Simple Payback Period (yr)

Company	Hebei Langfang G Glass Co			
Location	Youngqing County, Langfang, Hebei			
Sector	Building Materials			
Turnover	818,610,000 CNY/yr	Asset	844,310,000 CNY	
Headcount	439	Size of Factory	80,000 m ²	
Energy	Coal: 0		Steam:-	
Consumption	Electricity: 40,000 MWh/yr		Heavy Fuel Oil: 0	
	Natural gas: 89,250,000 Nm ³ /yr		Total: 133,000 tce/yr	
Production Description	Established in 2007, the company mainly produces special float glass. The two production lines (600t/d and 900t/d) release flue gas of 450℃at a rate of 200,000 Nm ³ /h, which can be used as low level thermal energy for steam/power generation. Meanwhile, the company is equipped with large water pumps for the colling of the main condensers, primary heaters and, nitrogen & hydrogen generation staions (16 units in total), to provide the cooling water for the furnaces associated with the two production lines and nitrogen and hydrogen stations, while require optimization.			
Key Energy Saving Measures	Description of Energy Saving Measures	Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	Waste Heat Recovery for Power Generator. Two waste heat boilers and a 6MW condensing steam turbine generator unit were installed. The installation included the main workshop, the cooling tower, high and low pressure generators, recycling cooling water system, and automatic control system. The flow chart of the main waste heat recovery for power generation process is shown below: 	14,000	51.28	3
	Energy Saving Upgrade of Water Pumps and Water Towers, including installation of 8 sets of high-efficiency water pumps and upgrade of 2 security water towers. The pressure of the furnace recycling water for the furnace was reduced from 0.41 MPa to and stablized at 0.35 Mpa, resulting in electricity saving by 30%- 32%.	798	0.88	0.7
	Total	14,798	52.16	2.9
Remarks	The project has been implemented via self-financing with subsidies fromt he government.			

*SPB=Simple Payback Period (yr)

Company	Shijiazhuang H Chemical Co			
Location	Shijiazhuang, Hebei			
Sector	Chemical Industry			
Turnover	745,400,000 CNY/yr	Asset	279,120,000 CNY	
Headcount	650	Size of Factory	20,000 m ²	
Energy Consumption	Coal: 73,420,000 t/yr	Steam: -		
	Electricity: 21,660 MWh/yr	Heavy Fuel Oil: -		
	Natural Gas: -	Total: NA (coal constituents form part of products)		
Production Description	<p>Established in 1959 as a state-owned company and reformed into a shareholdeing company in 1997, this old enterprise mainly produces phthalic anhydride. The main products include phthalic anhydride 60,000 t/yr, maleic anhydride 35,000 t/yr, phthalic anhydride plasticizer 60,000 t/yr, unsaturated polyester 3000t/yr and fumaric acid 3,000 t/yr, playing an important role in the domestic industry. The process flow chart of phthalic anhydride production is as follows:</p> <div><div><div>Air</div><div>↓</div><div>Fan</div></div><div><div>O-xylene</div><div>↓</div><div>Oxidation Reactor</div></div><div><div>Hot Melt Condense</div></div><div><div>Distillation Tower</div></div><div><div>Dry Flaking Machine</div><div>↓</div><div>Phthalic Anhydride</div></div><div><div>Waste Heat Steam Driving Turbine Blower/Power Generator</div></div></div> <p>Using matured technology of turbine fan to the newly-introduced phthalic anhydride production technology, the reaction waste heat under high load capacity was fully recovered/resued to lower the unit power by 300 kWh per ton product.</p>			
Key Energy Saving Measures	Description of Energy Saving Measures	Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	Electricity Saving by Technical Upgrade of Phthalic Anhydride Production Installation – The technical upgrade was based on the existing matured phthalic anhydride producing technology. As the oxidation in phthalic anhydride production is a strong exothermic reaction, the oxidation heat was used to produce superheated steam, which was utilized to driving a turbine blower to replace the existing 1900 kW electric-powered blower. It meets the safety and stability requirement of the main production process while lowering the power consumption by 300 kWh per ton product, saving electricity by 13.68 million kWh/yr.	4788	5.3	1
	VFD Applications, VFD were installed at 30 electric powered equipments associated with the production processes of phthalic anhydride and maleic anhydride, including axial flow pumps, circulating water pumps, oil pumps and refining warm water pumps with a combined capacity of 1886 kW.	1823	2.0	1
	Total	6551	7.3	1
Remarks	The project has been self-financed with subsidy from DSM center.			

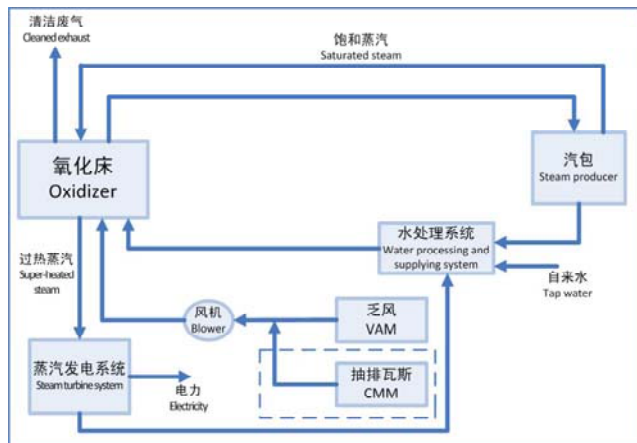
*SPB=Simple Payback Period (yr)

Company	Dezhou I Food Co.			
Location	Dezhou Economic Development Zone, Dezhou, Shandong			
Sector	Food			
Turnover	10-20 million CNY/yr	Assets	50.50 million CNY	
Headcount	100	Size of Factory	132,000m ² (200 mu)	
Energy	Coal: 15 000 t/yr	Water: 500,000 m3/yr		
Consumption	Power: 24,350 MWh /yr	Total :13,719 tce/yr		
Production Description	<p>The protein production line processes dehulled soybean meal to produce 10,000 tons of soy protein. The low temperature dehulled meal of soybeans is placed into the protein extraction vessel for preprotein extraction by injecting fresh alcohol into the vessel; the meal is washed continuously to remove the soluble sugars, ash and trace constituents as well as some alcohol soluble protein.</p> <p>The extracted wet protein is sent into the flash desolventization to strip off alcohol solvent and dry. The dried soy bean protein is then sent to the protein functionalization system to increase its PSI, followed by pulverization to form soybean protein concentrate products. The spent alcohol solution after extraction is collected to a storage tank and then pumped through two stages of vacuum evaporators to recover alcohol, followed by distillation prior to reuse. vacuum evaporate in first-effect and second-effect evaporators by pump. (The liquid residue from the 2nd stage evaporator containing soy oligosaccharides concentrates will further be processed to extract soy bean isoflavones.)</p>			
Key Energy Saving Measures	Description of Energy Saving Measures	Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	The process uses a large variety of blowers and pumps, which were upgraded with installation of variable frequency drives (VFDs). The project was implemented by an ESCO on a benefit sharing basis and achieved power saving of 4841 MWh/yr.	1689.5	1.62	0.45
	Total	1689.5	1.62	0.45
Remarks	<p>In addition to the benefit of power saving, the project also result in avoidance of emissions of PM by 1284 t/yr, CO2 by 4707 t/yr, SO2 by 142 t/yr and Nox by 71 t/yr.</p> <p>The project has been financed through an energy performance contract on a benefit sharing basis.</p>			

*SPB=Simple Payback Period (yr)

Company	Shandong J Building Materials Co.			
Location	Zhaoguan Town, Qihe County, Dezhou City, Shandong			
Sector	Building Materials			
Turnover	5.44 million CNY	Assets	98 million CNY	
Headcount	250	Size of Factory	60,720 m2	
Energy Consumption	Water: 21,800 ton/yr		Total: 616 tce/yr	
	Electricity: 5,014 MWh/yr			
Production Description	<pre>graph TD; Gangue --> HammerCrushing[Hammer Crushing]; HammerCrushing --> Screening[Screening]; Screening --> Aging[Aging]; Screening --> Rejects[Rejects]; Rejects --> HammerCrushing; Aging --> VacuumHardPlasticExtruder[Vacuum Hard Plastic Extruder]; VacuumHardPlasticExtruder --> Adobe[Adobe]; VacuumHardPlasticExtruder --> OffSpecAdobe[Off-spec Adobe]; OffSpecAdobe --> VacuumHardPlasticExtruder; Adobe --> Baking[Baking]; Baking --> FinalProduct[Final Product];</pre>			
Key Energy Saving Measures	Description of Energy Saving Measures	Energy Saving (tce/yr)	Investment (RMB)	SPB* (yr)
	The facility resue gangue waste generated in the coal production process to make bricks. The original design of the flue gas exhaust system in the baking workshop had two competing airflows from two kilns converged at the entrance into the desulfurization tower, which lowered fan efficiency as well as the kiln throughput. Borrowing the ceoncept from coal mine venting design, flow adjustment gates were installed at the two venting duct branches and an 18D centrifugal fan with a 220kW VFD was installed on the main duct to combine the airflows into one prior to entering the desulfurization tower. The design greatly increases the kilns' producvtivity, increasing the production of KP1 bricks by the two kilns from 120 thousand pieces to 160 thousand per day.	146	185,000	0.15
	Total	146	185,000	0.15
Remarks	In addition to the energy saving achieved, the upgrade of venting system greatly improved kiln productivity, resulting in an economic benefits of approximately RMB1.2 million yuan/yr. The project has been implemented through self-fiancing.			

*SPB=Simple Payback Period (yr)

Company	Henan K Industrial Co.			
Location	Shangqiu, Henan, China			
Sector	Mining and Washing of Coal			
Turnover	54,500,000 CNY/yr	Asset	1 7,700,000 CNY	
Headcount	<500	Size of Factory:	2000 m ² (per project site)	
Energy Consumption (by host mine)	Coal : -		Steam: 100,480 ton/yr	
	Electricity: 12,243 MWh/yr		Diesel/Gasoline: -	
	Natural Gas: -		Total : 14,710 tce/yr	
Production Description	Henan K Industrial Co., Ltd. is a private engineering and trading company established in 2004 in Shangqiu City, Henan, China with RMB 10 million of registered capital. Its major businesses are sales of goods, consulting and investment for technologies, especially active in methane utilization.			
Key Energy Saving Measures	Description of Energy Saving Measures	Energy Saving (tce/yr)	Investment (RMB mil)	SPB* (yr)
	<p>The coal mine methane-to-power project is developed at host coal mines in Henan.</p> <p>The project is to utilize coal mine gas to produce steam and hot water for electrical power generation and for heating purposes, by passing the outcoming ventilation air, which contains methane at low concentrations (VAM – ventilation air methane), mixed with drainage gas from the coal seams (coal mine methane – CMM), through 14 parallel VAM oxidizers with the processing capacity of 60000Nm³/h. In addition, the process will reduce methane emissions from underground coal mines. The VAM is oxidized to carbon dioxide, which is a far less potent greenhouse gas than methane. The respective greenhouse gas emission reduction would amount to a massive 0.4 Mt CO₂e/yr.</p> 	13,700	111	7
	Total	13,700	111	7
Remarks	The project has been supported by CER credit trade under CDM; without the income from the CER credit trade, the SPB may be over 14 years. The Promoter also seeks low-interest policy loan to support the project and expand additional projects to more coal mines.			

*SPB=Simple Payback Period (yr)