4th U.S.-China Energy Efficiency Forum September 25, 2013

Compiled Presentations from Track 2, Breakout Session 1/Morning

Energy Management in Energy-Intensive Facilities

4th U.S.-China Energy Efficiency Forum

Energy Management in Energy-Intensive Facilities

Moderators:

Lynn Price, Lawrence Berkeley National Laboratory

Gao Dongsheng, Ministry of Industry and Information Technology

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Session 1:
Energy Intensive Facilities and System-Level Energy Auditing
Elaine Wang, Institute for Sustainable Communities
Zhang Ruiqin, Zhengzhou University

Session 2:
Bringing the Systems Approach to Scale in China:
National Plans on Boiler System Efficiency and Motors
Che Defu, Xi'an Jiaotong University
TBD, Shanghai Electric Research Institute

Application of the U.S. Systems Approach in China
Michaela Martin, ICF International

4th U.S.-China Energy Efficiency Forum

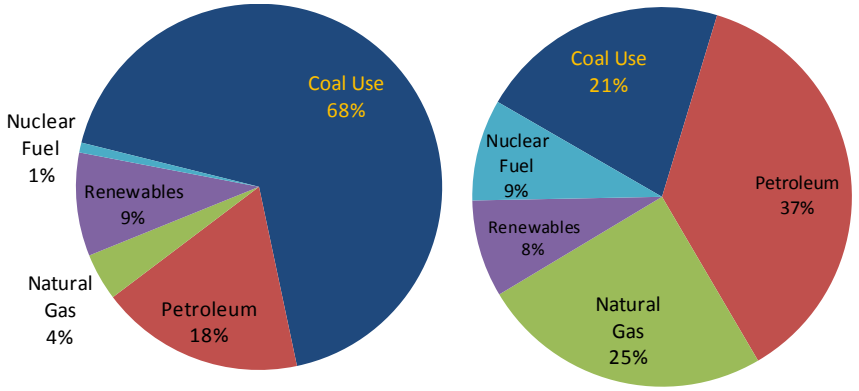
Background

- The U.S. DOE Office of Energy Efficiency and Renewable Energy engages in a variety of international initiatives, partnerships, and events that promote greater understanding and utilization of renewable energy and energy efficiency worldwide.

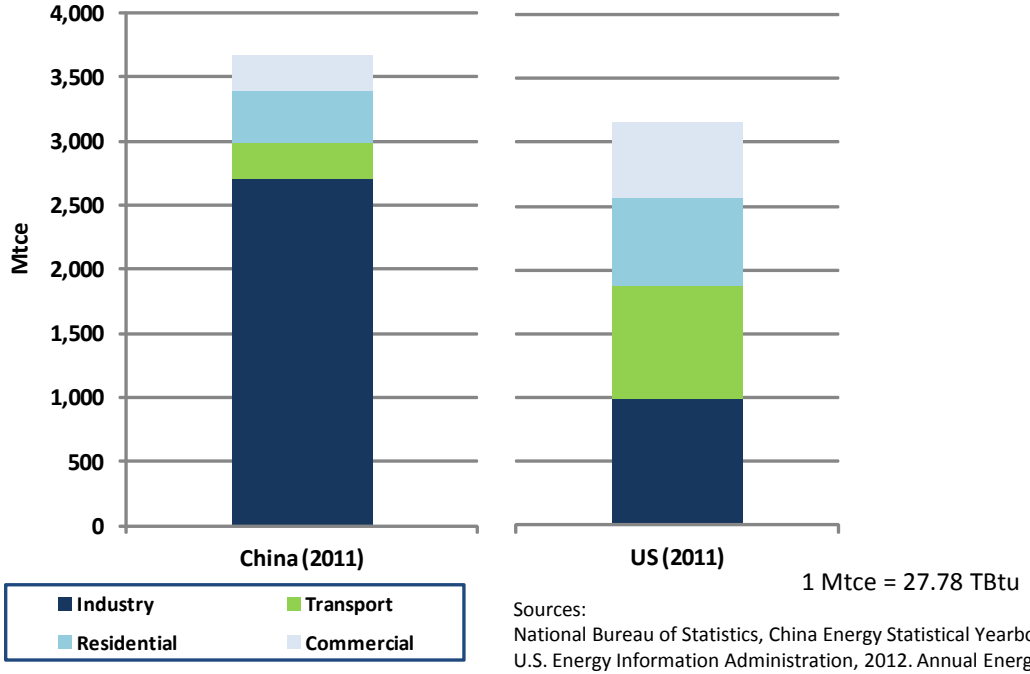
- U.S.-China Energy Efficiency Action Plan of 2009
- MOUs between:
  - Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, and the University Alliance for Industrial Energy Efficiency (2010)
  - Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, and the National Energy Conservation Center (2011)
- U.S. DOE project on International Industrial Energy Efficiency Training and Deployment
  - Introduction of US Assessment Methods and Systems Assessment Approach

Total Energy Use in China and the US

Energy Use by Source



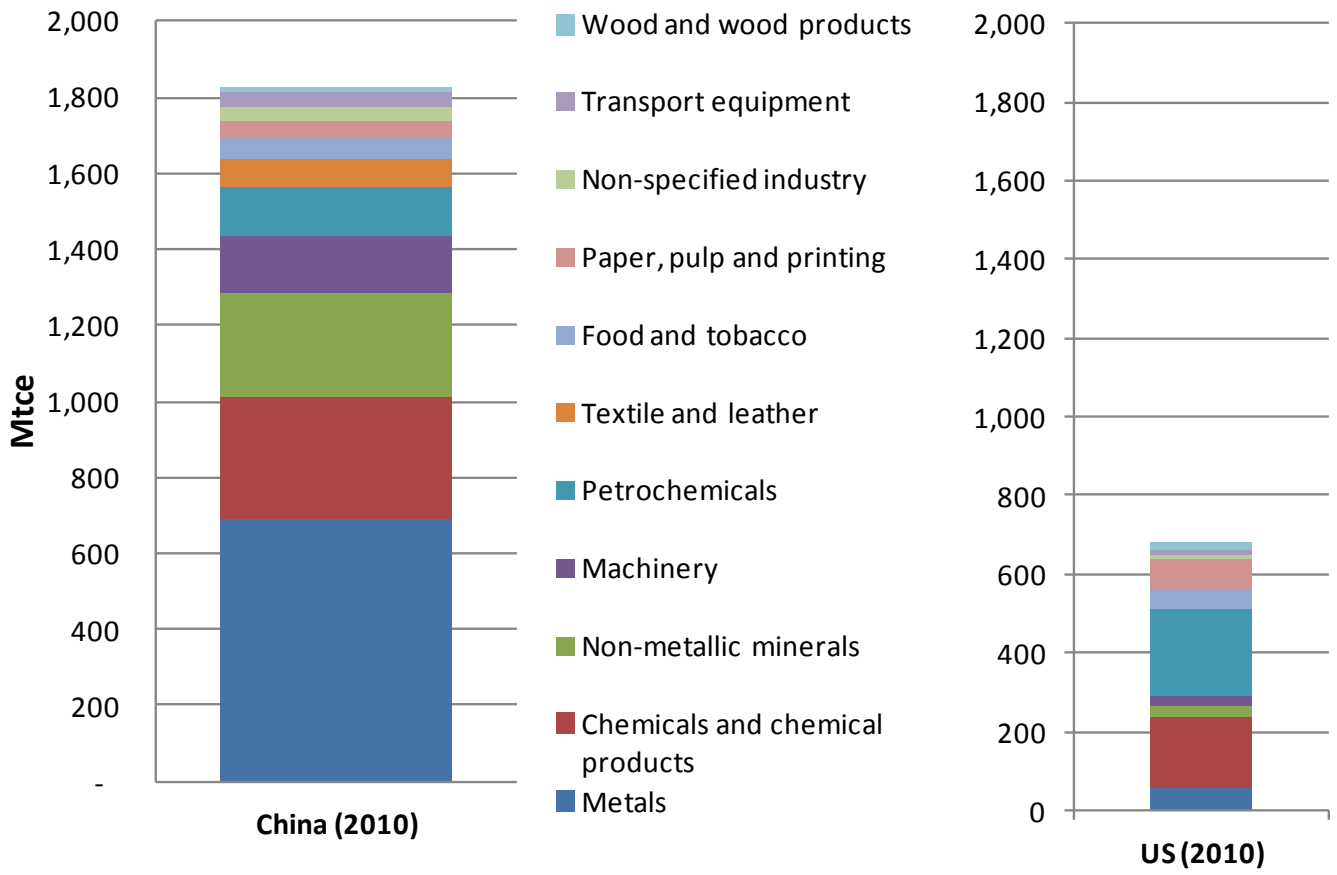
Energy Use by Sector



1 Mtce = 27.78 TBtu

Sources:
National Bureau of Statistics, China Energy Statistical Yearbook.
U.S. Energy Information Administration, 2012. Annual Energy

Manufacturing Energy Use in China and the US: Sectors



Sources:
National Bureau of Statistics, China Energy Statistical Yearbook.
U.S. Energy Information Administration, 2012. Annual Energy Review.

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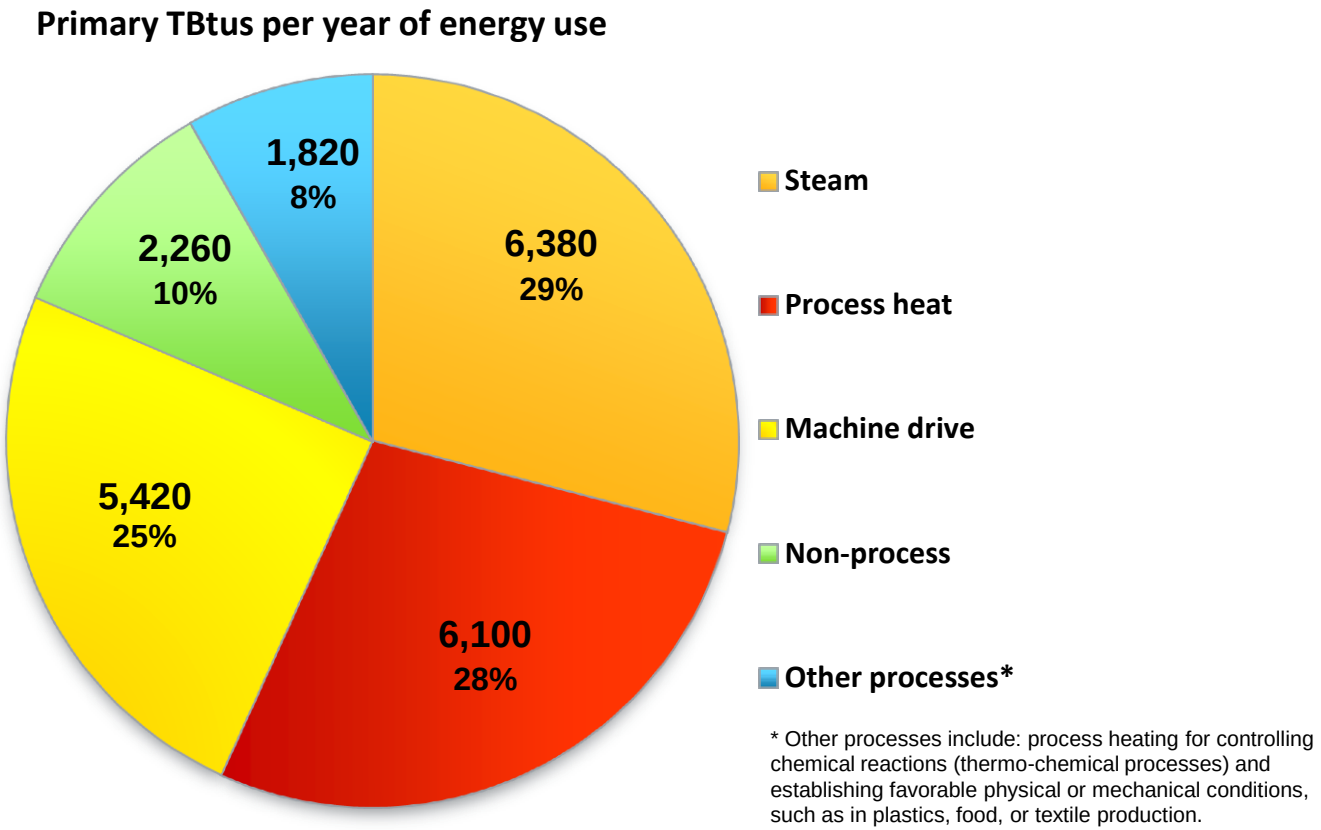
Manufacturing Energy Use the US: Systems



* Other processes include: process heating for controlling chemical reactions (thermo-chemical processes) and establishing favorable physical or mechanical conditions, such as in plastics, food, or textile production.

1 Tbtu = 0.036 Mtce

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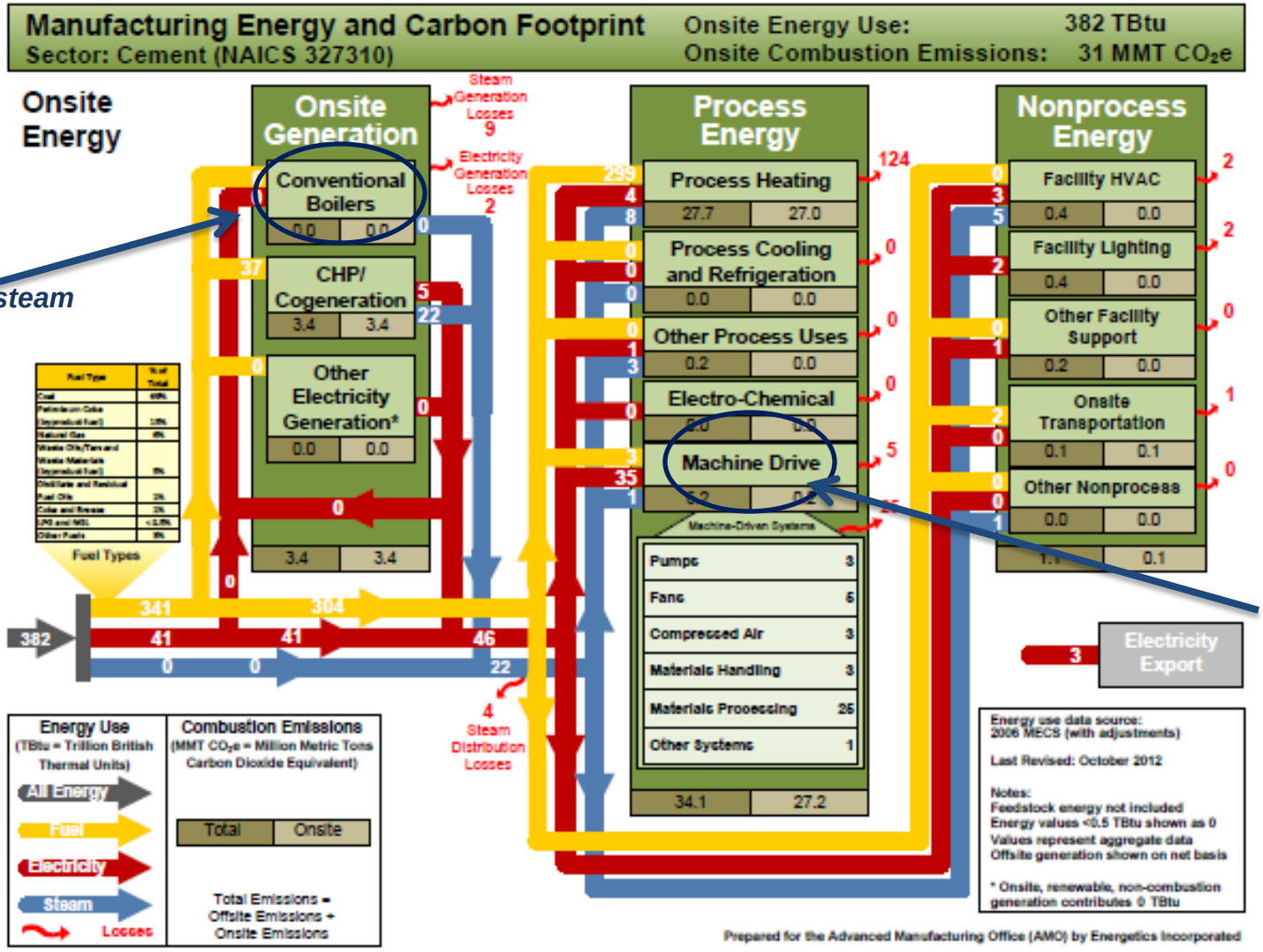

Boilers – for steam generation

Machine Drive System

Source: Manufacturing Energy and Carbon Footprint.
http://www1.eere.energy.gov/manufacturing/pdfs/cement_footprint_2012.pdf

1 Tbtu = 0.036 Mtce

4th U.S.-China Energy Efficiency Forum

Session Overview

- Industry is important in both countries
  - ~ 70% of total energy use in China
  - Almost 1/3 of energy use in the U.S.
- DOE-funded 2-year project to introduce energy auditing and the systems assessment approach in China
  - Participation by 15 US companies
  - Collaboration with China's University Alliance for Industrial Energy Efficiency
  - Training of trainers
  - Translation and demonstration of DOE tools
  - Introduction of DOE's systems approach through hands-on training and webinars
  - Demonstration of the key components of a robust energy auditing program
- Many follow-on opportunities that will drive the market for industrial energy efficiency in China, benefitting both Chinese and US companies

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Deploying System Tools for Energy Efficiency in China

September 2013

Elaine Wang, ISC

Needs: Energy Auditing in China

- LBNL studied China's energy auditing practices
- Found potential for improvement based on international experience

Needs:

Tools	• Limited technical scope of current audits • Need to include economic feasibility analysis • Lack of effective energy assessment tools
Capacity	• Insufficient training for energy audits
Institutional	• Need for long-term and concerted policy mechanisms to promote energy auditing • Need for a national-level organization for implementation of energy audits • Need for systematic standardization of energy assessments • Motivation for enterprises to conduct audits

Resource:

U.S. DEPARTMENT OF ENERGY

- U.S. DOE's Advanced Manufacturing Program (AMO) has a global reputation for its industrial energy efficiency resources.
- DOE's energy management tools, publications and trainings provide best practices for reducing energy consumption in industrial facilities. They include state-of-the-art U.S. technologies and methodologies highly applicable to the Chinese market.
- DOE has trained thousands of U.S. energy practitioners in energy efficiency interventions, resulting in meaningful and lasting reductions in industrial energy use.
- DOE partners closely with national laboratories, universities, industry practitioners, and technical experts.

Resource:

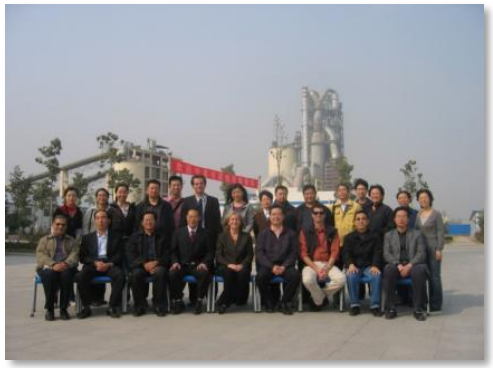
- R&D and Technology Delivery Activities for Industry
  - Materials and Process-Related R&D with US Industry Partners
  - Specialists in development and management of energy-intensive systems
  - Develop software tools
  - Develop and deliver training
  - Deliver technical assistance to industry partners

- Integrated Contractor for US DOE's Better Plants Initiative

- Deliver International Activities in China, India, Turkey, Kazakhstan, Brazil

Resource:

- LBNL's China Energy Group works collaboratively with groups in China and elsewhere to:
  - Understand the dynamics of energy use in China
  - Strengthen Chinese capabilities in energy efficiency by sharing best practice experiences from around the world
  - Enhance relationships on energy efficiency among Chinese, U.S., and international institutions
- Focused on End-Use Energy Efficiency
  - ~ 75 Current Projects
  - Collaborations with ~100 Institutions



Resource:

INSTITUTE FOR Sustainable Communities

- ISC brings stakeholders together across sectors to address sustainability challenges
- Work with municipalities, communities and factories
- In Asia, focus on energy efficiency, GHG management, low carbon development, EHS

- Established industrial training centers in Guangdong and Jiangsu in partnership Sun Yat-sen University and Nanjing University. These have trained over 3,000 factory managers and worked with 150 factories on energy management

Project: International Industrial Energy Efficiency Deployment

- 2-year project funded by DOE
- Team: ISC, LBNL, ORNL
- Goal to advance energy auditing and energy efficiency in India and China
- Target following needs from LBNL report:

Tools	• **Limited technical scope of current audits** • **Need to include economic feasibility analysis** • **Lack of effective energy assessment tools**
Capacity	• **Insufficient training for energy audits**
Institutional	• Need for long-term and concerted policy mechanisms to promote energy auditing • Need for national-level organization for implementation of energy audits • Need for systematic standardization of energy assessments • Motivation for enterprises to conduct audits

Approach: Training Targets

- Factories in Energy-Intensive Industrial Sectors
  - Chemicals
  - Cement
  - Iron & steel
  - Aluminum
  - Pulp and paper

- Trainers
  - Energy Conservation Centers
  - Universities in University Alliance for Industrial Energy Efficiency

- Energy Service Companies

Approach: Chinese collaborators

- Energy Foundation
- University Alliance for Industrial Energy Efficiency
- University hosts
  - Zhengzhou University
  - Beijing University of Science and Technology
  - Shandong University
  - EHS Academy at Lingnan College in Sun Yat-sen University
  - EHS Academy at Nanjing University's School of the Environment
- Energy Conservation Centers
  - Suzhou Energy Conservation Center
  - Shandong Energy Conservation Office

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Approach: Systems

Target Common Industrial Processes

- System-specific DOE energy assessment tools and trainings offered greatest potential for energy savings and the greatest breadth of U.S. technologies, services, tools and products that could add value in the Chinese market
- Process heating and steam system-specific industrial processes

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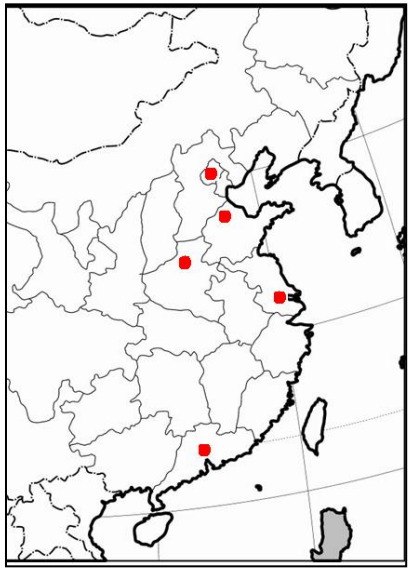
Approach: Engage U.S. Companies

3M
DOW
GE
ALCOA
ICF INTERNATIONAL
Honeywell
Bloomengineering
ECLIPSE®
MAXON™
ARC PACIFIC

Activities

- **Tools**: Tailor/develop energy assessment and management software, resources



- **Capacity building**: Trainings, webinars

- **Institutionalization**: Integrate material into ongoing training programs, identify candidates to become DOE Qualified Process Specialists

Activities: Tools

- Process Heating Assessment and Survey Tool
- Steam System Tools
- Guidebooks

美国能源部 PHAST - 中文Excel版本

美国橡树岭国家实验室委托E3M公司开发

PHAST介绍

控制页面

PHAST_For Excel v1.02

序号	项目	部件数目	
1	企业基本信息		输入数据
2	窑炉数据		输入数据
3.1	入炉料 - 固体(干或湿) (如果没有输入0)	3	输入数据
3.2	入炉料 - 液体 (如果没有输入0)	3	输入数据
3.3	入炉料 - 气体或蒸汽 (如果没有输入0)	3	输入数据
4	夹具、炉盘、输送带等 (如果没有输入0)	6	输入数据
5	炉壁表面热损失	10	输入数据
6	水冷与气冷(内部) (如果没有输入0)	6	输入数据
7	大气或补充空气 (如果没有输入0)	3	输入数据
8	烟气		输入数据
9	开口热辐射损失 (如果没有输入0)	6	输入数据
10	电机或其他设备用电	10	输入数据
11	其他热损失或热生产 (如果没有输入0)	2	输入数据

查看PHAST汇总报告 — 生成报告

查看PHAST能源利用分布 — 查看能源利用分布

打印工作簿

Activities: Trainings

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Stakeholder meetings	Team visits to training host and plant host	Training day 1: Classroom workshop	Training day 2: Classroom workshop, on-site demonstration	Training day 3: Classroom workshop, US company cases	Training day 4: Training of Trainers

Results

- Established foundation for more robust energy auditing program that can drive the market for energy efficiency and energy-efficient technologies in China
- Brought world-class experts to China, directly served 360 trainers, ESCO staff, and factory energy engineers
- Trainers and ESCOs are influencing hundreds more
- Facilitated connections between US companies and Chinese factories
- Demonstrated demand
- Saved energy in factories

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Limitations

- **Scale**: 5 workshops vs. scale of the challenge

- **Institutionalization:** Many original needs still exist, related to need for national energy auditing program
  - long-term and concerted policy mechanisms to promote energy auditing
  - national-level organization for implementation of energy audits
  - standardization of energy assessments
  - training for auditors

Future Opportunities

- High demand for system-specific assessment ToT workshops
  - Chongqing Energy Conservation Center
  - Hebei Energy Conservation Center
  - UAIEE members
  - Beijing University of Chemical Technology
  - Guangdong Energy and Information Commission
  - US-China Energy Cooperation Program, Energy Foundation, IIP
- Support U.S. vendor-Chinese client interactions
- Support Chinese accreditation effort

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Acknowledgements

- DOE EERE/International
- National Development and Reform Commission
- National Energy Conservation Center
- Energy Foundation China
- Organizing partners
  - University Alliance for Industrial Energy Efficiency
  - U.S.-China Energy Cooperation Program
  - Suzhou Energy Conservation Center
  - Shandong Energy Conservation Office
- University partners
  - Zhengzhou University
  - Beijing University of Science and Technology
  - Shandong University
  - EHS Academy at Lingnan College in Sun Yat-sen University
  - EHS Academy at Nanjing University's School of the Environment
- Chinese factory partners
  - Henan Zhongmei Aluminum Company, Zhengzhou
  - China Century Cement, Guangzhou
  - Jigang Steel, Jinan
  - Yanshan Petrochemical Plant, Bejing
  - Gold Huasheng Paper plant, Suzhou

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4th U.S.-China Energy Efficiency Forum

China's Top 10,000 Enterprises Program and System-Level Energy Auditing

Ruiqin Zhang

Research Institute of Environmental Sciences
Zhengzhou University

2013/09/25

Outline

- Henan's Top 10,000 Enterprises Program
- Programs by LBNL and ISC
  - ✓ PHAST Training
  - ✓ DOE Qualified Specialist training and exam
  - ✓ Webinar of PHAST Training
  - ✓ Webinar of STEAM Training
- Policy Research on Energy Saving in Henan Helped by LBNL
- Progress and Future work at ZZU

Henan's Top 10,000 Enterprises Program

- There are 1032 Top 10,000 Enterprises in Henan Province, included 981 industrial enterprises, 41 transportation companies and 10 schools.
- In 2010, Total energy consumption of Henan's Top 10,000 Enterprises and of Henan is 129.84Mtce and 214.38Mtce respectively. It takes about 60.6% in total energy consumption in Henan.
- The 12th FYS, the target task of energy saving of Top 10000 Enterprises is 17.88Mtce.

Progress of Program of Henan's Top 10000 Enterprises

Item of Plan	Documents	contents	Status of progress
1、responsibility assessment of energy-saving target	HDRCEnvi. [2012]48#	1、Report the annual energy saving inspection report;	Finished about 70% of assessment task in 2011 and 2012
		2、To Assess by the classification,	
		3、Report the assessment resulots	
2、Report the annual reports on their utilization of energy	HDRCEnvi. [2012]48#、HDRCEnvi. [2012]69	1、Report the annual reports on their utilization of energy annually	Finished about 80% of the reports in 2011 and 2012
		2、Organize the assessment	
		3、Reassessment and report resuts	
3、Energy Audit and Energy Saving Plan	HDRCEnvi. [2012]1644#	Energ Audit and Energy Saving Plan of Top 10000 enterprises	Slow progress
4、Name list of top 1000 enterprises in local cities and their energy saving target in the 12th FYS	HDRCEnvi. [2012]1125#	Local governments confirm the name list and set their energy saving target	Good progress and done 90%
5、Enhance construction of System of Energy Management of Top 10000 Enterprises	HDRCEnvi.〔2013〕558#	Establish the energy management system	In process

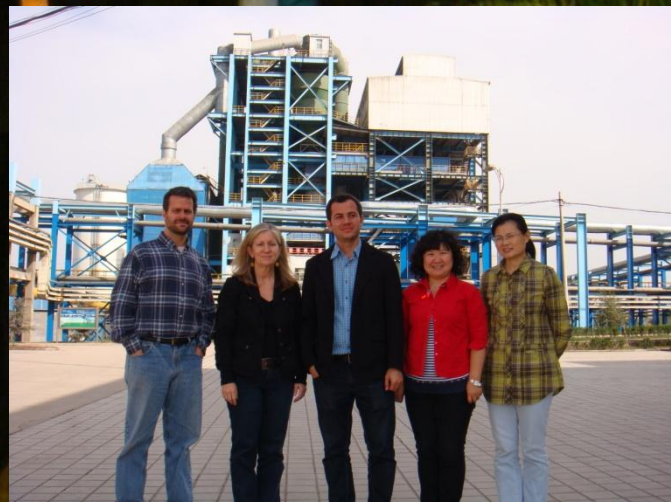
Programs by LBNL and ISC

- Efficiency evaluation of training of PHAST (Processing Heat Assessment System Tool)
- Zhengzhou Oct.11-14, 2011
- For Henan province's energy conservation and emissions reduction work ability construction, "Efficiency evaluation training of PHAST" was held in Zhengzhou University by LBNL, ORNL and ISC under the support of the national energy conservation center, Henan province development and reform commission, and the Energy foundation.
- More than 70 persons from local energy conservation supervision and management departments, universities, international institutions and enterprises and related industry associations attended.
- The US instructors taught the scientific method of evaluation of energy efficiency heating process technology, draw lessons from international experience, the introduction of advanced technology and energy efficiency assessment tools, explain the application of process heating assessment system tool (PHAST).
- The trainees mastered the technology of PHAST, and learn the advanced method of energy management in the United States. It has played a positive role to carry out the evaluation of energy efficiency and energy management in Henan province during the period of the 12th FYS.


工艺加热系统能效评估培训会
Process Heating Assessment Workshop


Lynn Price


艺加热系统能效
ocess H ating Assessm nt Work
主办:



- **DOE Qualified Specialist training and exam**

- ✓ During our visiting China Energy Group, LBNL in May, 2012, we attended PHAST DOE Qualified Specialist training and exam under the support of Ms.Lynn Price
- ✓ Unique experience and well trained
- ✓ Passed the exam and got the certificate

Ruiqin Zhang, Hongyou Lu and Xiaoge Hou

Webiniar of PHAST Training

- PHAST training has been held 3 times of 3 days in Zhengzhou, Guangzhou and Jinan by ISC, ORNL, LBNL under the support of DOE, EF, National Energy Saving Center.
- 190 participants and popular.
- For better training result and more people got trained, ISC hold webiniar of PHAST in 2012.

Webinar of STEAM Training

- **STEAM training has been held 2 times of 6 days by ISC, ORNL, LBNL under the support of DOE and EF in Jan. 2013.**
- **More than 150 trainees and very popular.**
- **For more people get benefit from the training, “Webinar of STEAM training held by ISC, LBNL and ORNL under the support of DOE on Aug. 28, 2013.**

Policy Research on Energy Saving in Henan Helped by LBNL

During the research development, Lynn's team, China energy group, LBNL, supported us for building the methodology and learning international advance experiences.

- Study of Energy Saving Potential of Thermal Power Sector in Henan
- Allocation targets of the 12th FYP Energy saving of Henan
- Energy management system platform construction in henan province
- Allocation of energy consumption cap in Henan
- Inventory of GHG emission of energy activities of Henan
- Forecast and warning system of energy-saving target in Henan （in process）

Allocation targets of the 12th FYP Energy saving of Henan

- **To set more reasonable targets for 12th FYP, this study is devote to analyze energy potential for 12th FYP on provincial and municipal level respectively in scientific method, and assess energy-saving characteristics of responsibility, capability and difficulty of 18 cities and modify targets allocation according to the assessment.**

✓ **Setting Henan's energy-saving target for 12th FYP**

✓ **City-level target allocation in Henan for 12th FYP**

✓ **Carbon emission reduction potential analysis of Henan for 12th FYP**

Allocation of energy consumption cap in Henan

- **Research Background:**

  For 11th FYP, Henan Province has met energy saving target (energy intensity dropped by 20%) issued by national government, but its energy consumption increased by 7.9% annually. It is necessary for Henan province to set and allocate energy consumption cap.

- **Research Target:**

  Reasonable and scientific caps for Henan province are set and allocated, city-level and high energy consumption industries.

- **Research Content:**
- ✓ Provincial cap: Henan's energy consumption for 2015 was forecasted by three methods: ARIMA; Energy Consumption Elasticity Coefficient Method; and Inverse Method based on energy saving target
- ✓ City-level cap: A comprehensive evaluation system was used to evaluate and classified cities. Primary caps were assigned by categories, and adjusted by city-level differentiation.
- ✓ Industrial caps: LEAP model and benchmarking were used to analyze the change of Henan province, and different scenarios were established in analyzing.

Forecast and warning system of Energy-saving target in Henan

- **Research Background:**
  During 11th FYP, because of the lack of scientific and efficient management in the implementation process of energy saving target, there were no warning s and adjustment measures for the situations which fell behind targets. As a result, some unconventional measures such as production ration and power ration were implemented for achieving energy saving target, and caused undesirable economic and social impacts.
- **Research Target:**
  The energy saving forecast and warning system which are able to assess and analyze the progresses of provincial and city-level targets.

- **Research content:**
  - ✓ Macroscopic forecast and warning: The time series analysis of energy intensity was made for comparing energy intensity in 2015 with the targets and evaluating progresses of the targets.
  - ✓ Energy saving target forecast and analysis: LEAP model was used in sector-level analysis, forecast and warning. Especially, energy saving progresses of high energy consumption industries were analyzed and evaluated.

Support and confirmation of Henan goverment

- **On May 7, 2013, Governor Xie fuzhan met Mr. Colburn S. Wilbur, chairman of the committee of China's senior policy adviser of the United States energy foundation.**
- **The Governor highly affirmed that the Energy foundation carried out the productive projects in Henan province, promoted energy conservation and emissions reduction work in Henan, provided technical and financial support for the sustainable development of Henan.**
- **Hope EF continues to support Henan to improve energy efficiency, improve the environment, and helps in the aspect of urban development and business cooperation with the United States.**

Progress and Future Work

- **Capability building**
  - ✓**Policy Research capability**
  - ✓**Training curriculum of PHAST and STEAM**
  - ✓**10 students of MS graduated, 8 students of MS and 1 PH.D student in school,**
  - ✓ **750 administrators and engineers got trained from local governments and enterprises**
- **Capability building**
  - ✓**Environmental sciences**
  - ✓**Environmental Engineering**
  - ✓**Energy And Environment Interdisciplinary Science**

- **Improve training curriculum based on Energy Saving Audit tools and Methodology of System level of Energy Audit of DOE US**
- **Information Platform of Technologies of Energy Saving of US**
- **Information of Technology needed of Energy Saving in Henan**
- **Policy Research of Henan industrial transformation and upgrading**

Thank You !

Status, Problems and Solutions of Industrial Boilers in China

Prof. Dr. Defu CHE

Dept. of Thermal Eng. · Boiler Research Institute

Xi'an Jiaotong University

China, a great power of boiler production and use, huge amount of coal, oil, natural gas are being consumed, leading to serious pollution.

Industrial boilers (inclusive of domestic), in particular coal fired, ranking only second to utility boilers, are the major sources of coal soot style pollution.

As of 2012, industrial boilers in China amounts to $62.4x10^4$, greater than 95% of total boilers of whole country, equivalent to $290x10^4$ t/h of steam boiler, consuming $6.4x10^8$ tce, 18% of total energy consumption of whole country.

By capacity, 80% of total industrial boilers are coal fired, 15% are oil- or gas-fired, the rest are biomass fired.

In China, boiler manufacture licence system is implemented as well as other countries. Currently, 1175 boiler manufacturers can provide various boilers. If boiler installation, retrofit, maintainence licence enterprises are counted, China has 4633 boiler related enterprises, ranking No.1 in the world.

The average operational thermal efficiency of coal fired boilers is about 65-70%, 10-20 percentage points below the advanced level in the world, the pollutants released to the environment have been at high level.

Dust: 410×10^4 tons annually, 40% of total
SO_2: 570×10^4 tons annually, 27% of total
NO_x: 200×10^4 tons annually, 9% of total

Causes：

- **Coal boilers are mainly grate fired, leading low thermal efficiency;**
- **End users are too decentralized and single unit capacity is too small. For majority of the boilers of smaller than 2 t/h, there are no smoke and dust abatement devices, no desulfurization and denitrification devices;**
- **The raw coal without washing , with high sulfur and ash contents, produces the flue gases with high acid dew point, leading to high exhaust gas temperature;**
- **Small capacity coal fired boilers are usually not equipped with water treatment devices, incrustation scale will be given rise to on the heating surfaces, leading to high exhaust gas temperature;**
- **It is difficult to attain the operational mechanization and automatization of the grate fired boilers fully mechanic;**
- **Some small size boiler manufacturers are short in professionals, inspection devices are simple and crude, leading to poor quality of products.**

Summary：

1. National conditions requires that coal should be the main fuel of boilers, the proportion of oil- and gas-fired boilers is too small;

2. Coal fired industrial boilers have a too small single unit capacity and too low efficiency. The average single unit capacity is 5.2 t/h, and the boilers with smaller that 2 t/h amount to 63%;

3. Old boilers are too large in number. The boilers with service time of greater than 15 years account for 55% by capacity, only 10% of the boilers are satisfied with the target values of the state energy efficiency, 65% of the coal fired industrial boilers are still grate travelling chain stoker boilers.

4. The supporting equipment for the boiler system is at low level, the average operational load of majority of boilers is about 50% of rated value;

5. Weak technical innovative capability, backward burning equipment, low level automatic control, the burners for oil and gas fired boilers are mainly imported.

6. Imperfect energy saving supervision and administration system, imperfect energy efficiency standard system, short of incentive policy for energy saving, the skill of boiler operator is to be improved.

The potentials for efficiency promotion and emission relief of industrial boilers in China are very huge, and there is still long way to go.

If the average operational thermal efficiency of coal fired industrial boilers is raised by 10-15 percentage points, (4000-6000)x10^4 tce can be saved annually, pollutant emission can be greatly reduced and the haze weather mainly due to PM2.5 can be relieved.

Possible Measures：

To raise the permission threshold for boiler manufacture

- **Not only hardware, but also personnel and software must meet the standard;**
- **Licenced boiler manufacturer must have sufficient qualified design professionals;**
- **Boiler is not a universal machinery, a great number of professionals are needed, to training the in-service staff is one choice, but the trainees must obtain high standard professional certifictate.**

To raise the market admission threshold of boiler

- After the boiler manufacture is completed and before entering the market, stringent product evaluation program must be gone through to ensure the manufacture quality and thermal efficiency.
- Moreover, the guarantee period for the performance indice shall be effective in sufficient time length.

To implement boiler retrofit from coal to clean fuel

- On the basis of region feature and resource endowment, coal fired industrial boilers shall be retrofitted or replaced by clean fuel fired (oil or gas fired).
- The boilers of smaller than 2t/h shall mainly utilize clean fuels;
- The in-use boilers of 2-20t/h shall have the priority of using clean fuels;
- In the regions with secure natural gas supply or in the developed regions, coal (or heavy oil) fired boilers shall be replaced by gas fired boilers;
- For the regions without secure natural gas supply, the fire coals shall be classified and graded in order to ensure the consistency of coal to be fired with the design coal;
- In rural region, biomass shall be used.

To reinforce energy saving technical retrofit of boiler system

- Retrofit boiler proper, firing equipment, automatic control system, using advanced techniques;
- Encourage to use pulverized coal fired small size burners, energy-saving furnace arc, stratified combustion technique, optimized air distributing devices, etc;
- As for oil and gas boilers, the waste heat recovery technologies for the exhaust gas shall be utilized;
- Automatic control level shall be enhanced by improving control system, upgrading control software.

To promote centralized heating and cogeneration

- In steel and iron industry, nonferrous metal industry, chemical industry, light industry, etc, cogeneration shall be chosen positively;
- In industrial parks, centralized heating or cogeneration shall be promoted to replace the small size coal fired boilers with low efficiency and high emission;
- Northern regions with heating provision and the enterpises in large and medium size cities shall realize centralized heating;
- In the industrial parks with sufficient natural gas supply, cogeneration of heating, cooling and power shall be utilized.

To establish and perfect boiler energy-saving evaluation institutions, clean out the high energy consumption boilers

- Issue “Product Catalog of Energy Saving Boilers”;
- Assess boilers biennially and update the catalog;
- Clean out the small size coal fired boilers of ≤1 t/h;
- Encourage the users to discard the coal fired boilers with service time over 20 years, and the oil or gas fired boilers with service time over 10 years;
- Clean out the boilers below the energy efficiency standard GB 24500-2009.

To establish production, study and research alliance, boost energy saving technology research and development

Dominant institutions, including boiler manufacturers, research institutes, universities, should be organized to set up an alliance or a research center, to carry out collaborative innovative research on relevant indice for attain the expected efficiency and pollutant emission , and new technologies.

Targets：

Before 2020

- **The averaged operational thermal efficiency for grate fired boilers attains 75%;**
- **For industrial pulverized coal fired boilers, 91%**
- **For CFB boilers, 90%**
- **For oil fired boilers, 94%**
- **For gas fired boilers, 96%（LHV）**
- **For steam pipelines, 95%**

Thanks !

Applications of the U.S. Systems Approach in China: Delivering Energy Efficiency and Energy Management Services to Chinese Industry

Michaela Martin
ICF International

About ICF International

- **4,500 employees**
- **Leveraging foundational expertise to serve global clients in public and private/commercial sectors**
- **Global markets including: Energy, Environment, Sustainability, Climate, Industry, International Development, Aviation, Transportation**
- **Offices in 13 countries outside the U.S./Canada**
  - **Asia**: Beijing, Hong Kong, Singapore, New Delhi, Bangkok, Manila, Kazakhstan
  - **Europe**: UK (London, Manchester), Brussels, Warsaw, Moscow
  - **South America**: Sao Paolo, Rio de Janeiro
  - **Africa**: Nairobi

ICF Delivers Energy Efficiency to Global Clients

- **Our Markets**: **Public, Private, International**. While very well-established in the US public and utility Demand Side Management markets, ICF has grown its private sector and international markets rapidly.

- **Public**: Supporting high-profile energy efficiency (EE) programs for governments and utilities:
  - US EPA ENERGY STAR® program (industrial, buildings, products)
  - US DOE Better Buildings, Combined Heat & Power, US-China Clean Energy Research Center (CERC-BEE)
  - UK DEFRA Market Transformation Programme
  - US/Canadian Utilities (implementation of 130+ programs for residential, commercial and industrial end-users)

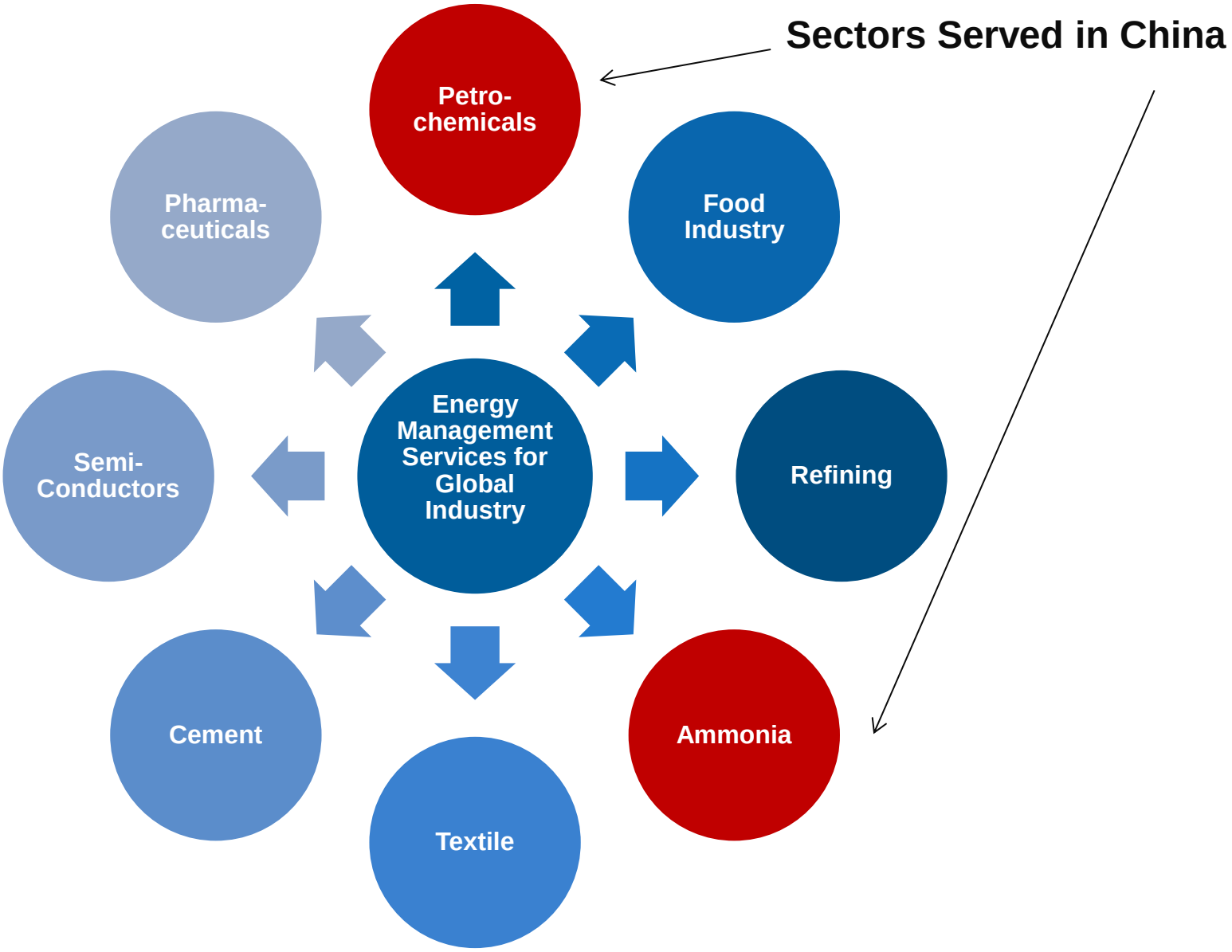
- **Private/Commercial**: Fast-developing market segments:
  - Private Equity "provider of choice" for implementing EE/cost savings across held assets in US and international markets.
  - Direct support to global industrial and commercial firms (petrochemicals, manufacturing, hotel chains, IT/tech), on energy efficiency, GHG emissions, and sustainability.

Policy & Planning
- EE program design
- Stakeholder recruitment

Implementation
- On-the-ground staffing
- Local market engagement

Technical Consulting
- Assessments
- Technical Training
- Energy Management Systems

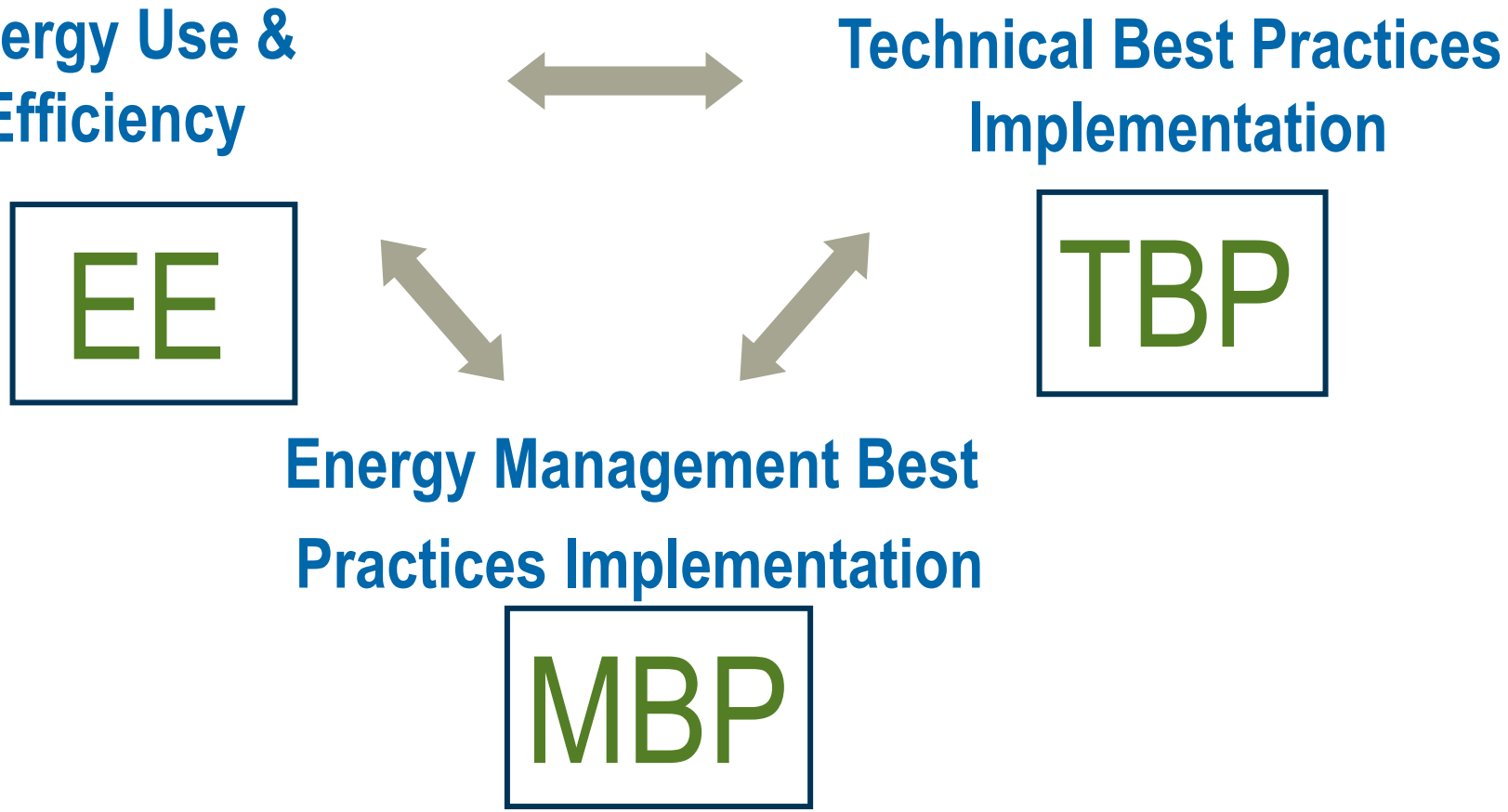
Industry Sectors Served Globally



ICF's Energy Management Framework for Industry

Developing a Framework for Assessment and Action

ICF's approach is based on our ***comprehensive libraries of energy saving opportunities*** in technologies, industrial technical practices, and management practices:



Technical and Management Best Practice Assessment

Use of ***Technical and Management Best Practice Assessment Indicators***

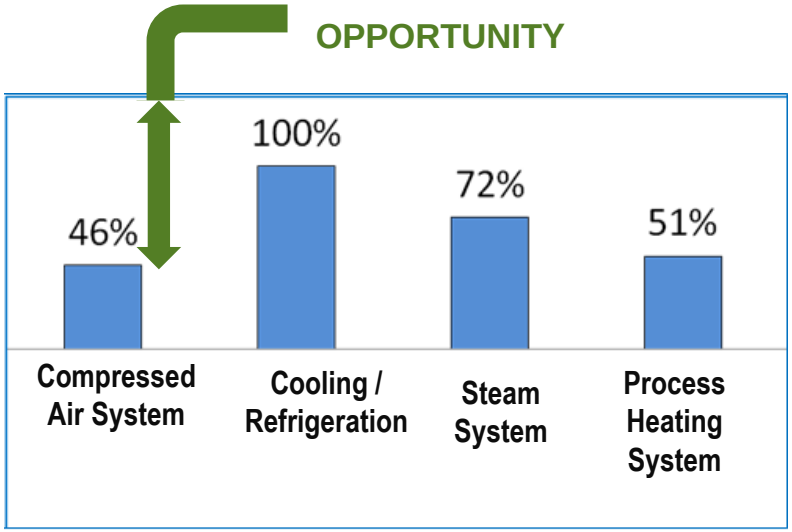
- Define baseline of practices implemented
- Track progress over time when compared to baseline
- Define magnitude of opportunity.
- Standardized method to compare plants with each other

Technical Best Practice:

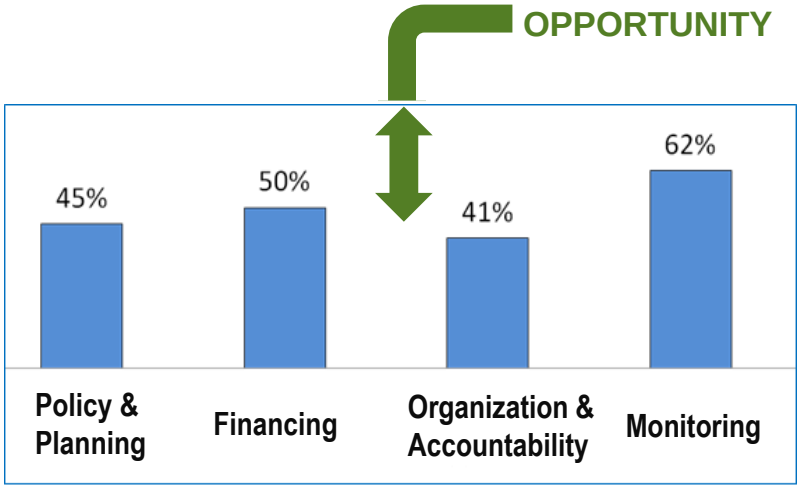
An energy performance improvement best practice that relies on a technology or equipment change

Management Best Practice:

A best practice that relies on people and management activities executed by people



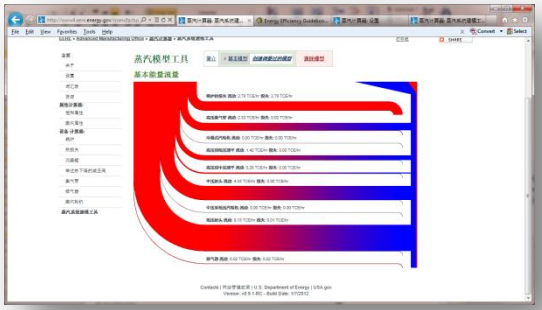
Example baseline technical implementation



Example baseline management implementation

ICF's Global Assessment Services Leverage DOE Tools and Training Resources

- Libraries of opportunities include DOE best practices for crosscutting systems (steam, compressed air, process heating, pumps) -- validated by ICF field experience at over 400 industrial sites globally
- Application of DOE assessment tools including process heating and steam tools
- Assessment of energy management best practices, aligned with the key elements of ISO 50001
- ICF's Beijing staff trained by DOE energy experts in steam and process heating at Beijing and Suzhou workshops



Delivering Energy-Intensive System Best Practices in China

- ICF's assessment models and tools have adopted DOE Best Practices for energy-intensive systems including steam, compressed air, pumping and process heating.

Energy Savings Measure Profile				90
Date Updated:	Jul-2010		Relative Implementation Cost	Medium
Profile Type	Technology		Relative Implementation Difficulty	Low
Measure Profile:	Compressor heat recovery			
Level 1 - Plant Region:	Process			
Level 2 - Plant Area:	Processing			
Level 3 - System:	Compressor Systems			
Level 4 - End-use:	Compressor for Pneumatic Systems			
Level 5 - Group:	Auxiliary			
Applicable industry sector	All			
Applicable Baseline Technology				

Energy Type	Source (yes / no)	% Savings (range or average)	Summary Description and Energy Savings
Natural Gas[1]	Yes	calculated	Compressor heat recovery: savings as a % of comfort heating energy use and compressor energy use.
Electricity	No		
Refined Petroleum Products (RPP)	No		
Coal[1]	Yes	calculated	
Other Fuel (specify)	No		
Measure Life (years)[1]		20	

Description

Air cooled compressors exhaust heated air. Recovering the heat from this air can be used, for example, as comfort heat during winter. In most cases a simple duct system can direct the heated air to inside the building during winter and to outside the building during summer.

Energy savings can be approximated as follows:[3]

Energy Savings (GJ/yr) = 0.80 x Compressor [kW] x .0036 [GJ/kWh] x hours of operation

Cost Savings ($/yr) = ((Energy Savings in GJ/yr)/(GJ/unit of fuel) x ($/unit fuel))/ Primary Heater Efficiency

Reference Sources

1. US Department of Energy. 2003. *Improving Compressed Air System Performance, a Sourcebook for Industry.* Date accessed: July 2010

节能措施信息介绍				90
更新日期:	Nov-2011		相对实施成本	中
类别	技术		相对实施难度	低
方法介绍:	压缩机热回收			
第一级 - 工厂区域:	工序			
第二级 - 装置区域:	加工			
第三级 - 系统:	空气压缩系统			
第四级 - 最终用途:	空气压缩系统			
第五级 - 组:	辅助			
适用工业部门	所有			
适用基础技术				

能源类型	适用性 (是 / 否)	节约百分比 (%)	概要说明和节能
天然气[1]	是	计算出的	压缩机热回收: 节约能源占舒适供暖能耗和压缩机能耗的%.
电	否		
精炼石油产品(RPP)	否		
煤[1]	是	计算出的	
其它燃料(请说明)	否		
措施年限(年)[2]		20	

说明

空冷压缩机排气热空气。从此气体中回收的热量可以用作，例如,冬季的舒适供暖。在大多数情况下，一个简单的导管系统便可在冬季将热气导入楼内,在夏季将热气导出楼外。

能源节约近似如下：[3]

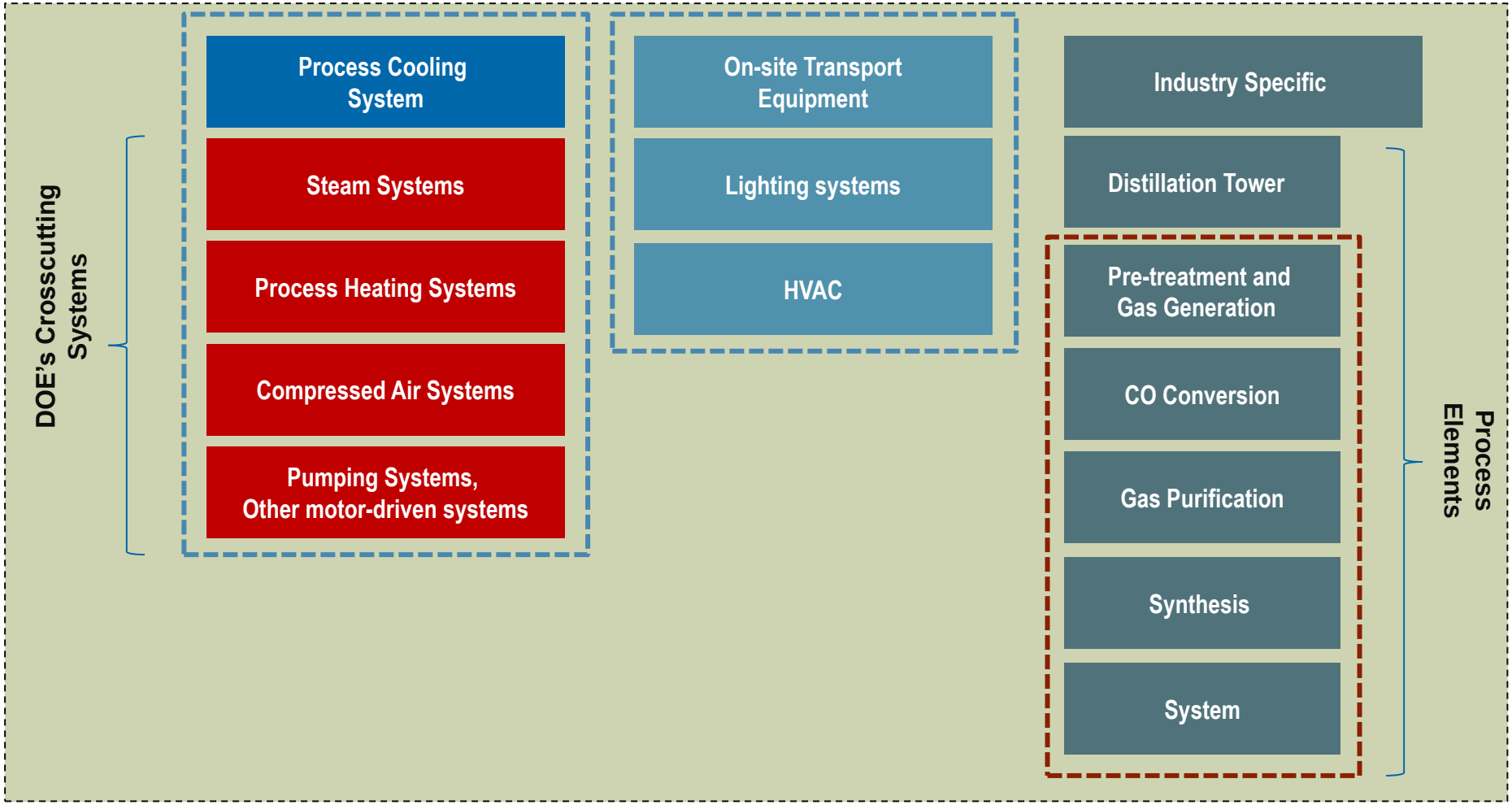
节能（吉焦/年）= 0.80 x压缩机[千瓦] × 0.0036 [吉焦/千瓦时] x工作小时数

成本节约（美元/年）=（（节能以吉焦/年为单位）/（吉焦/燃料单位）×（美元/单位燃料））/主加热器效率

参考来源

1. US Department of Energy. 2003. Improving Compressed Air System Performance, a Sourcebook for Industry. Date accessed: July 2010

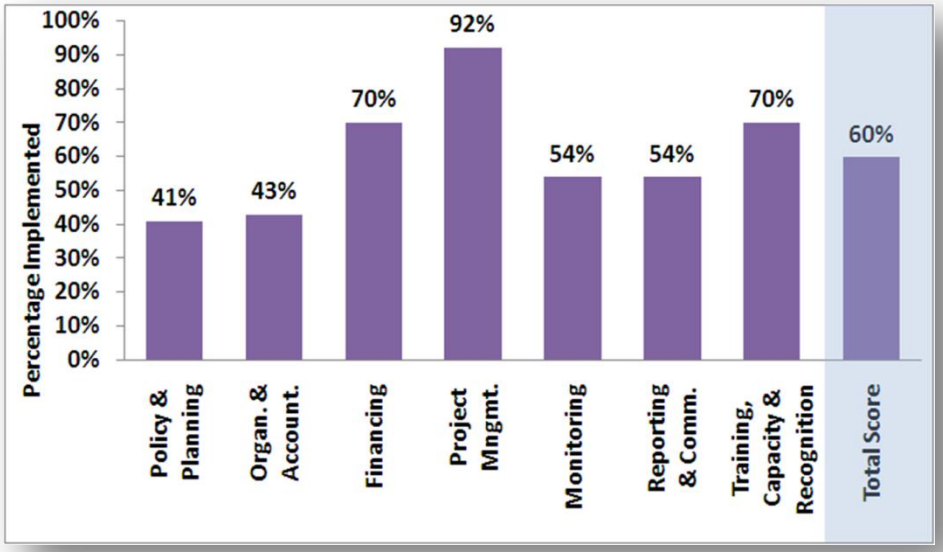
ICF's Comprehensive Industrial Assessments Address Crosscutting Energy Systems and Process Elements…

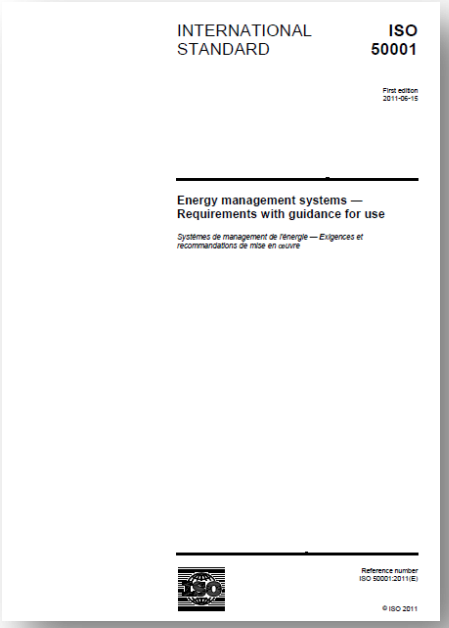


… As Well As Energy Management Systems

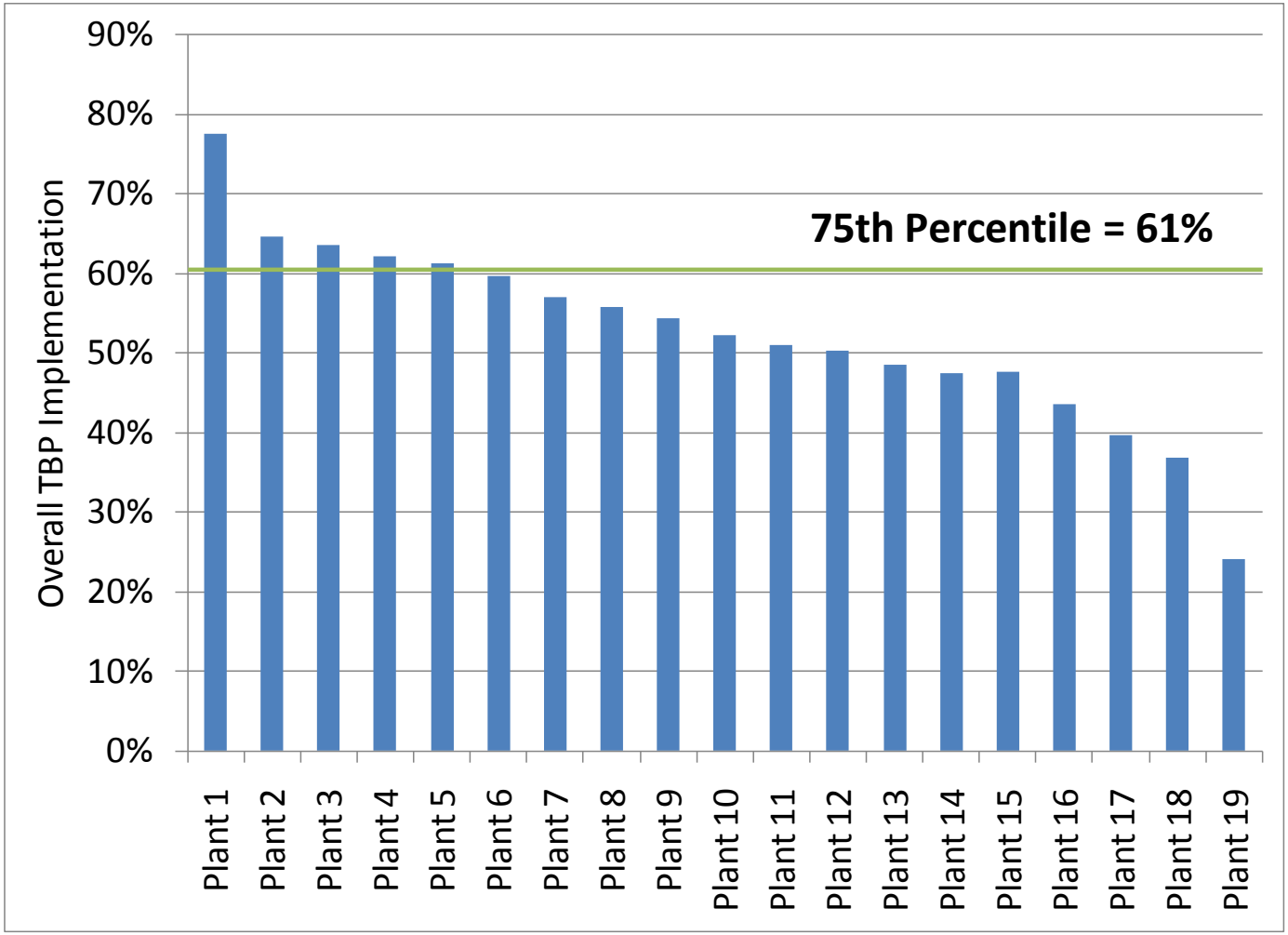
- Preparing our clients for ISO 50001 / EnMS certification
- Ensuring continuous energy performance improvement

Policy & Planning	Organization & Accountability	Financing	Project Management	Monitoring	Reporting & Communication	Training & Capacity Building

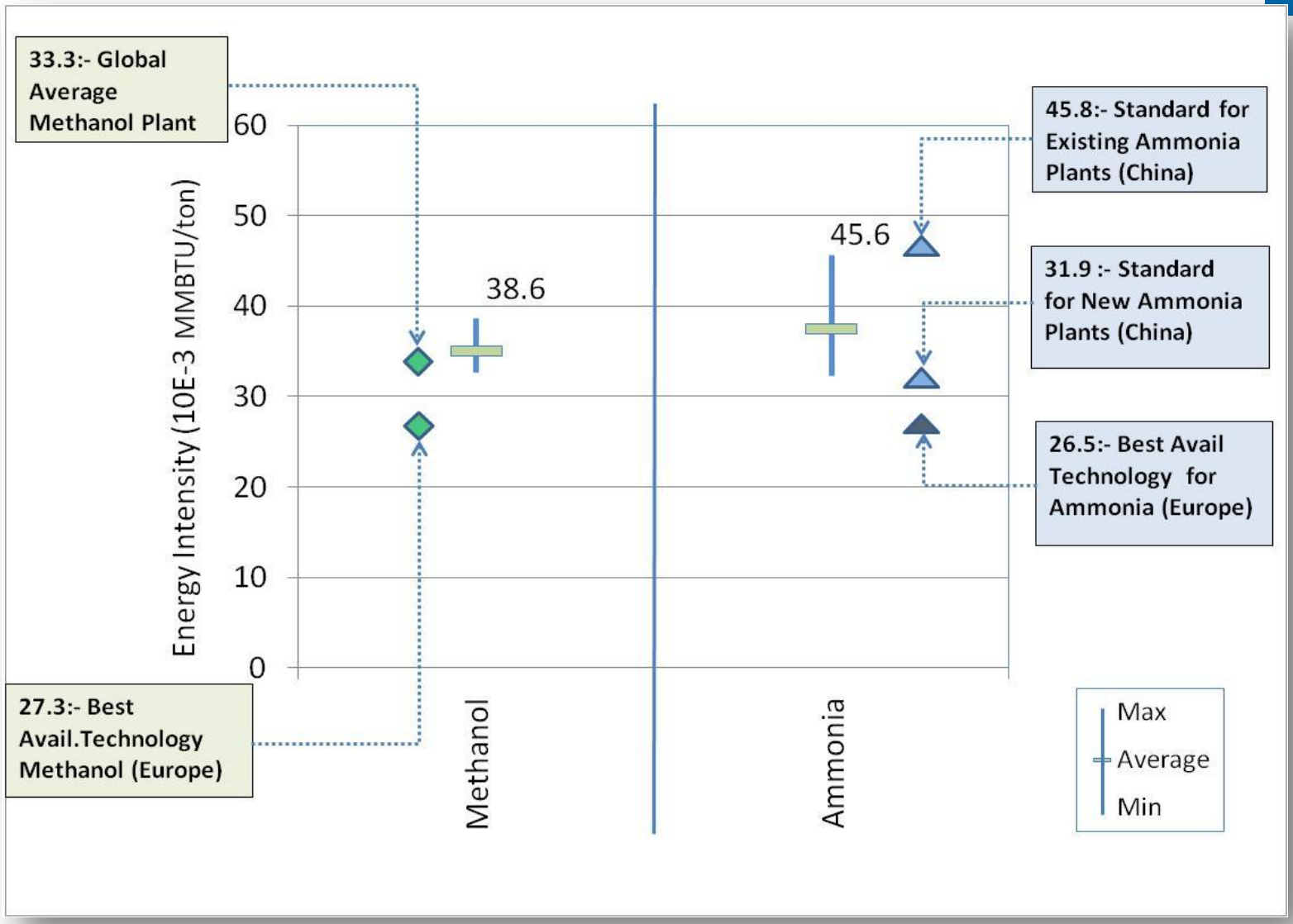




Benchmarking Best Practices to Develop Company-Wide Strategies



Energy Intensity Benchmarking to Evaluate Performance on Global Scale



China Project #1 – System Optimization Opportunity Identification and Benchmarking Assessment

Background & Needs

- **One of the largest fertilizer production facilities** in China (Ammonia and Methanol plants), owned by Chinese **SOE.**
- The management would like to know how their facility **energy performance compared to other** similar plants in the world
- Prefer to have **a portfolio of opportunities**, and rather than energy saving identification project-by-project,
- **Mid-range and long-term (2015 and 2020) energy plan**

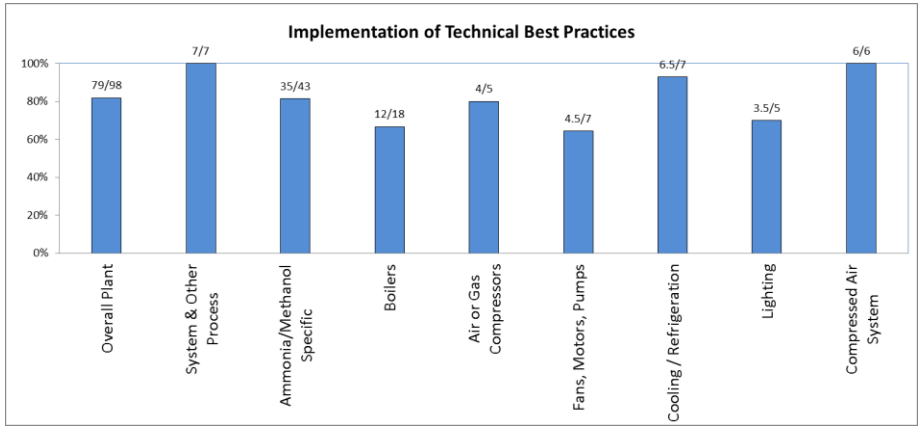
ICF offers

- Assessment indicators for energy use, GHG emissions, water use
- **Technical** measures' implementation assessment
- **Management** practices implementation assessment
- **Energy Intensity Benchmark** with other similar plants in the world (EU, US, Central America, India, etc)
- Development of the **Action Plan**
- **Model the saving scenarios** through 2015 and 2020, in technical saving potential and achievable saving potentials compared to the reference case
- Develop the in-depth technical trainings on the top 10 technical opportunities

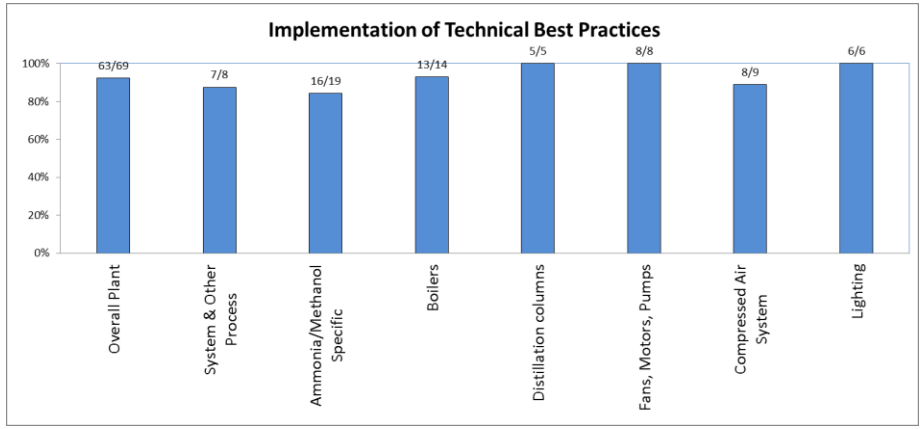
Impacts

- Although the ammonia and methanol plants are relative new and high efficiency in China, ICF identified **14.9% (ammonia plant)** and **7.9% (methanol plant)** in saving potential.
- Energy management assessment results and management gaps were used for further corporate Energy Management System (GBT-23331) development
- The plants began implementation of top 10 measures immediately following the assessment

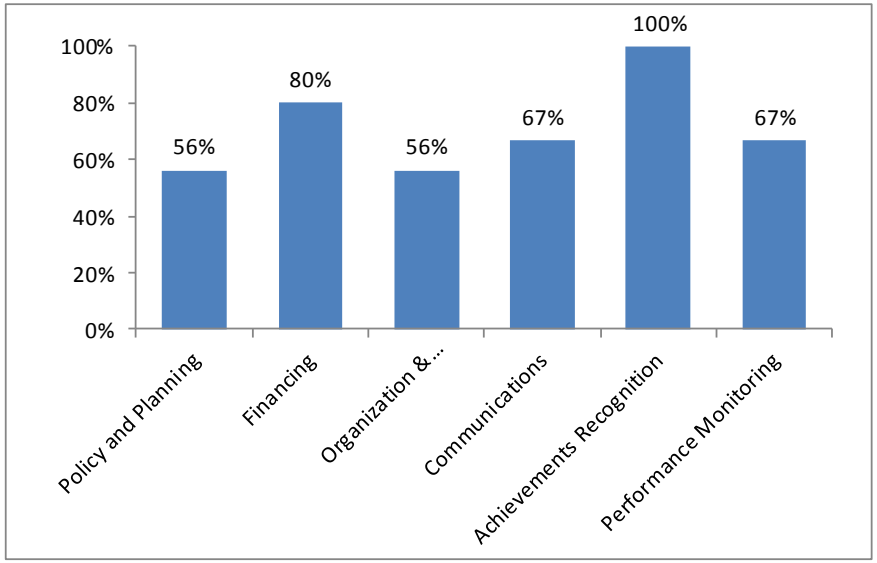
China Project #1 Results



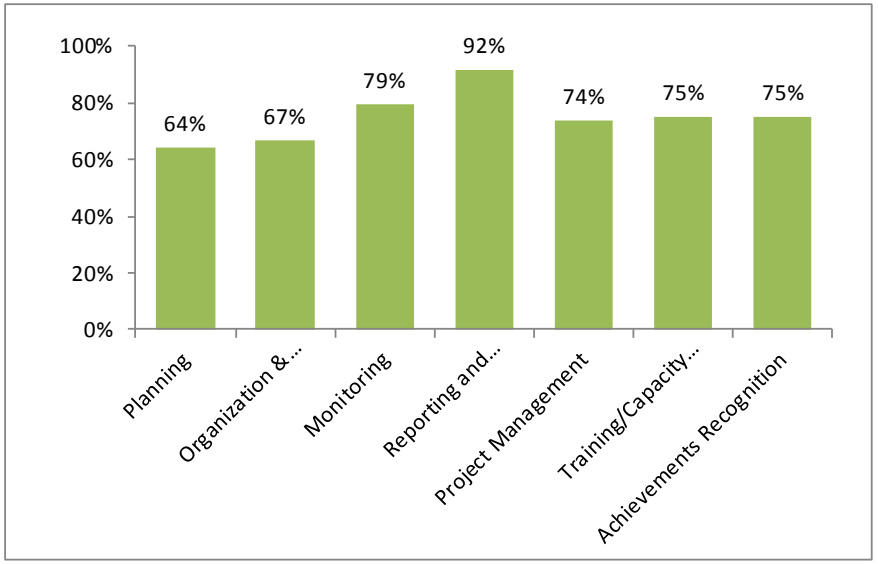
Ammonia plant technical assessment



Methanol plant technical assessment

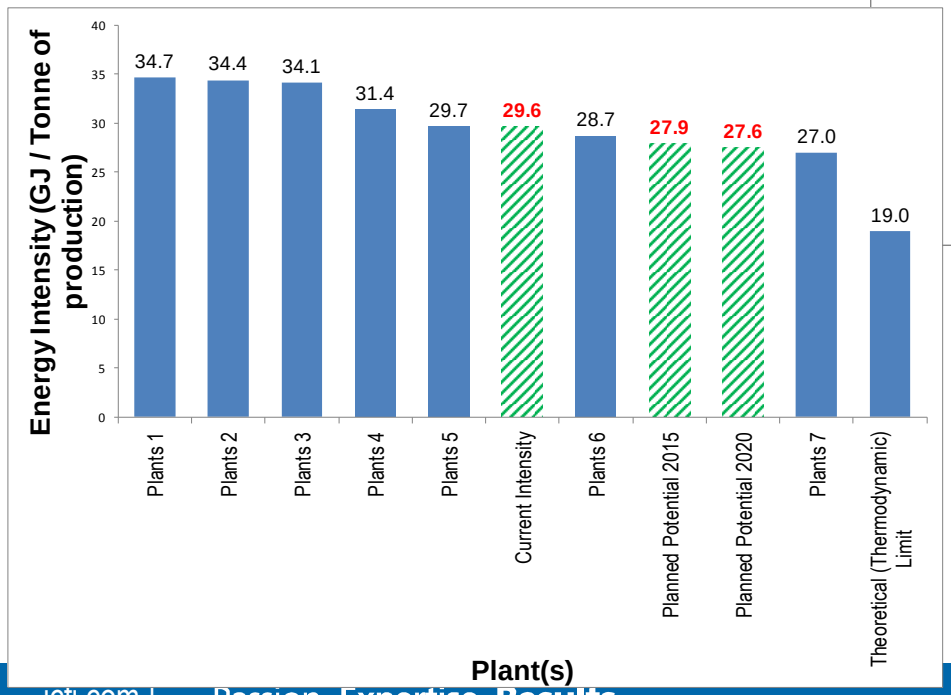


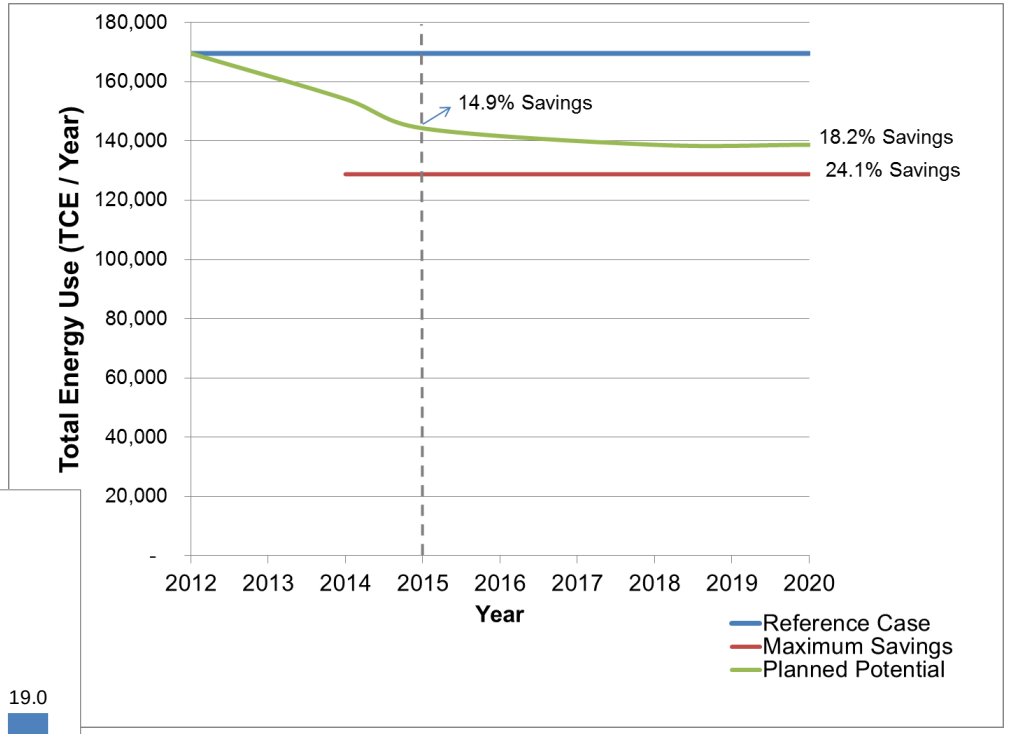
Corporate Level-Management assessment



Facility Level-Management assessment

China Project #1 Technical Savings Potentials





China Project #2 – Corporate energy baseline assessment, capacity building, management tool development

Background & Needs

- **One of the largest petrochemical production facility** in China (ethylene and ethylene derivatives)
- Enterprise is subject to both national (FYP) and corporate global energy efficiency improvement targets
- New management team and plant team were formed, **no working framework** on energy saving and GHG reduction, **no specific capacity and tool** to development plans for 2015, 2020 and 2025 goals

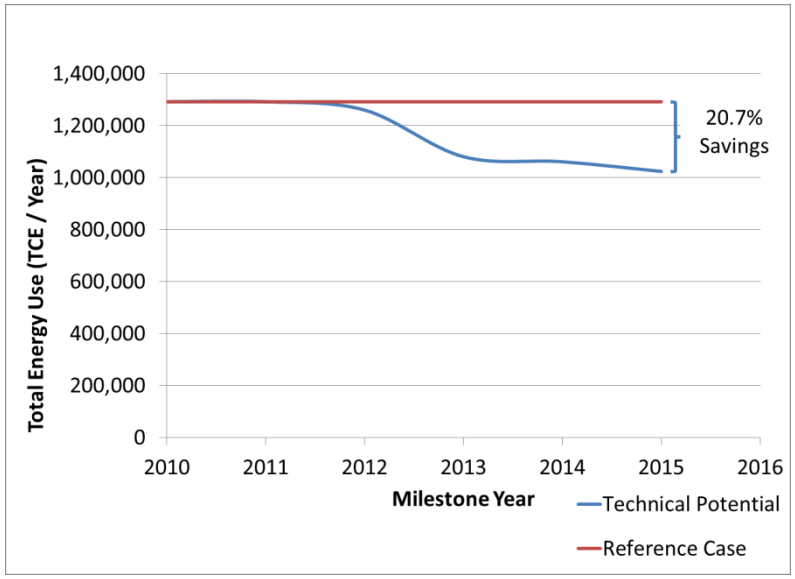
ICF offers

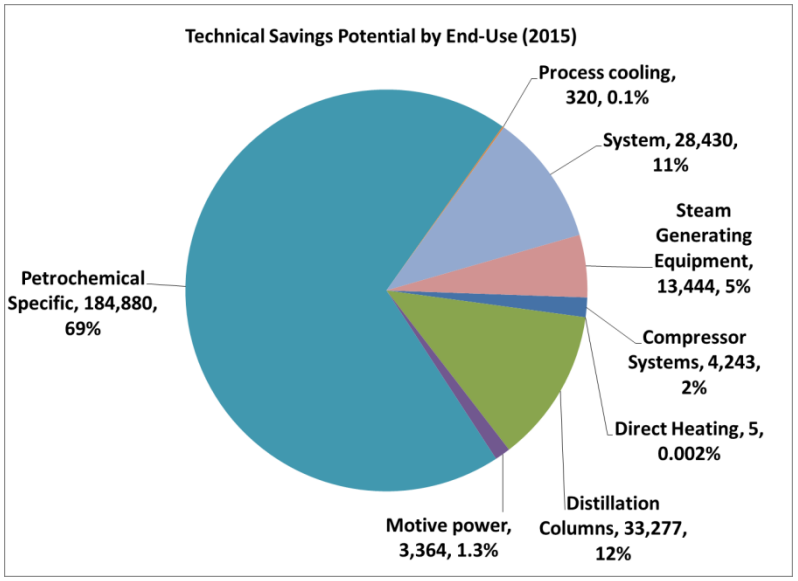
- Development of key performance indicators (KPIs) for energy use, GHG emissions, water use and waste generation;
- Development of the customized KPI assessment and management toolkits, including over 300 technical best practices from ICF's measure library
- Development the KPI assessment training for the management team and floor team
- Conduct the initial assessment with the team, develop the 2010 baseline profiles
- Brainstorming the opportunity prioritization options with the team
- Development of the initial l Action Plan, fit into the corporation planning structure
- Model the saving scenarios through 2015, 2020 and 2025

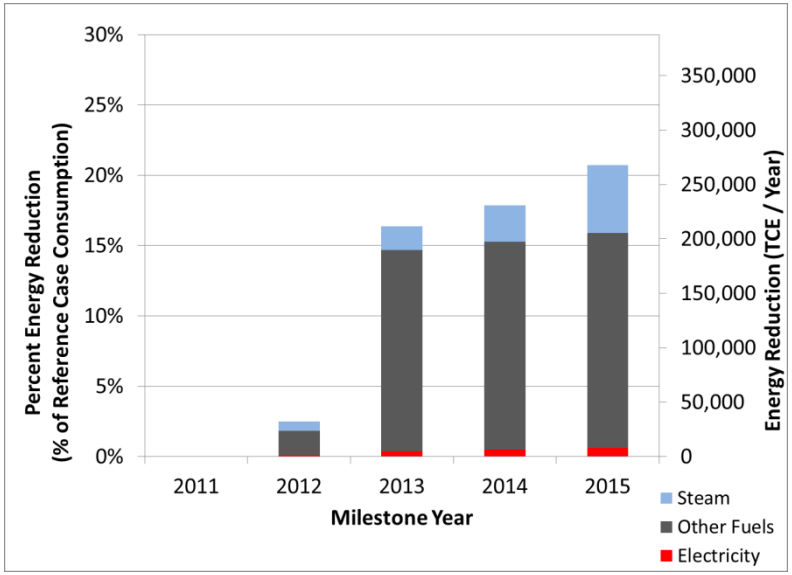
Impacts

- Built the energy and other KPI management capability for the production department
- Identified initial energy and GHG saving potentials 13.1 – 15% (by 2015) and 14.4- 18.3% (by 2020)
- The facility **has achieved about 15% of energy and GHG intensity reduction, and over 50% waste reduction (2010 baseline)** far (as of mid-2013)

China Project #2 Energy Use – Savings Potential







End-Use	Measure	Savings in 2015 (TCE/yr)	Savings (% of 2015 Energy Use)
Petrochemical Specific	Waste gas recovery	144,564	11.19%
	Waste heat recovery	12,046	0.93%
	Installing side re-boiler to primary extraction refinery tower	8,614	0.67%
	Optimized facility water flow	6,656	0.52%
	Long-cycle running technology	6,500	0.50%
	Water treatment operational flexibility	6,083	0.47%
	Install a roof over areas of potential contamination	419	0.03%
Petrochemical Specific Total		**184,880**	**14.31%**

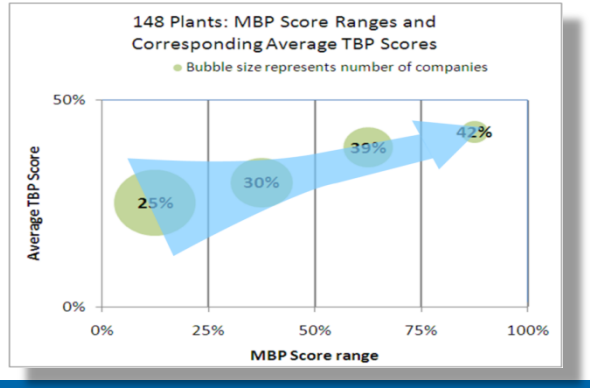
Plant-, Facility-, Portfolio-, Sector-, and Region-wide Studies

Project Name	Scope of Projects	Results
Ammonia and Methanol Facility EE optimization and benchmarking Assessment	Plant-level	Potential energy savings of **14.9%** in the achievable technical saving scenario; at 2% saving operational improvement with about **3.5 million RMB value**
Petrochemical Facility in China for KPI* Assessment	Facility -level	Potential energy and GHG savings of **~8%** identified, along with potential water savings of **~20%**, and waste reductions of **~9.5%**.
Ammonia Sector in China for Institute for Industrial Productivity (IIP)	Sector-wide	Potential energy savings of **15% to 23%** were identified in Chinese pilot plants; annual cost savings per plant of **5,000,000 to 14,000,000 RMB**.
Asian Development Bank: Thailand Cleaner Production for Industrial Efficiency (CPIE) Project	Industrial park	Reported Total Annual Reductions of **1,243,000 m3 water/wastewater** per year; **1,152 TCE electricity** per year; **7,000,000 litres diesel** per year; and annual cost savings of **27,000,000 RMB**.
Private Equity Company Sustainability Assessment	Portfolio-wide	Initial assessment of four facilities identified potential energy cost reduction of **~16%**, indicating potential portfolio energy cost savings of **~22,000,000 RMB**.

*Key Performance Indicators (KPIs) assessed in this study were energy, water, waste and greenhouse gases (GHGs).

In Summary

- Comprehensive assessments evaluate both technical and management practices
- Systems-focused assessments recognize the balance between loads and capacity; delivering the optimal levels of energy efficiency
- ICF has embraced DOE's tools and technical resources for system-based energy efficiency to deliver energy savings for our global clients, including those in China's petrochemical and ammonia sectors
- Assessments are turned into action through action plans, local capacity building and localization of tools to support continuous performance improvement



Thank you!

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