Environmental Energy Technologies Division   Lawrence Berkeley National Laboratory

Energy Assessments under China's Top 10,000 Program: A Case Study for a Steel Mill

Presentation for eceee 2014 Industrial Summer Study

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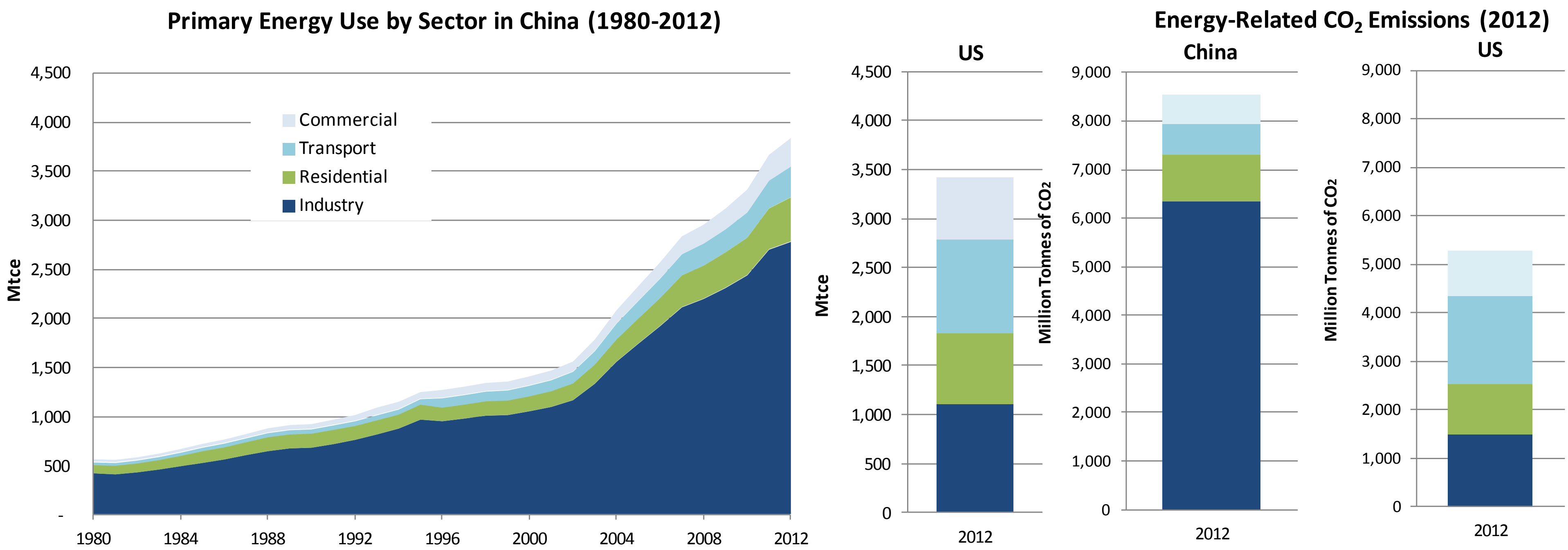
Industrial Sector in China



CO_2 emissions from China's industrial sector > total US CO_2

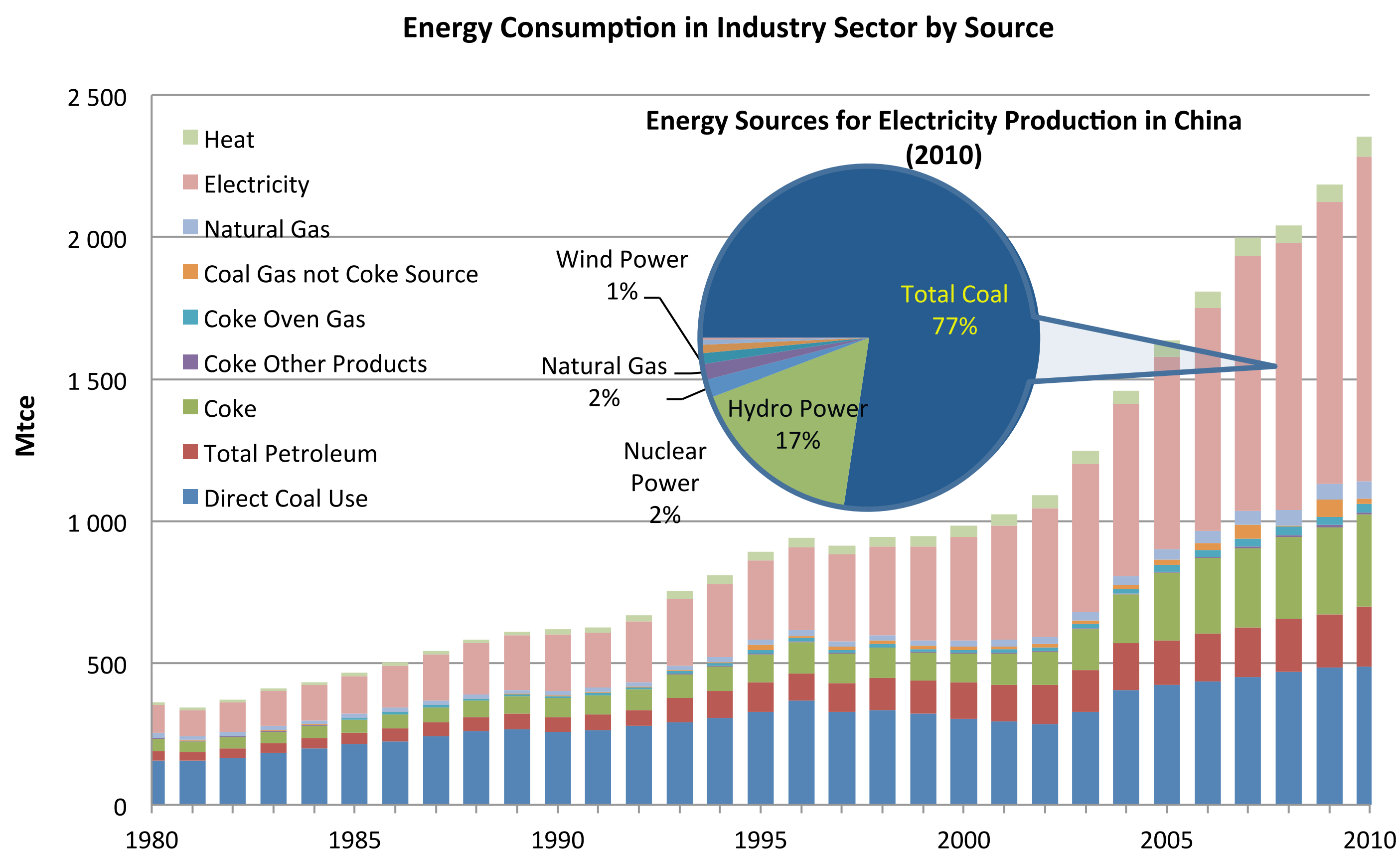
> total EU CO_2

= 5 times Japan's total CO_2

Source: NBS, 2013

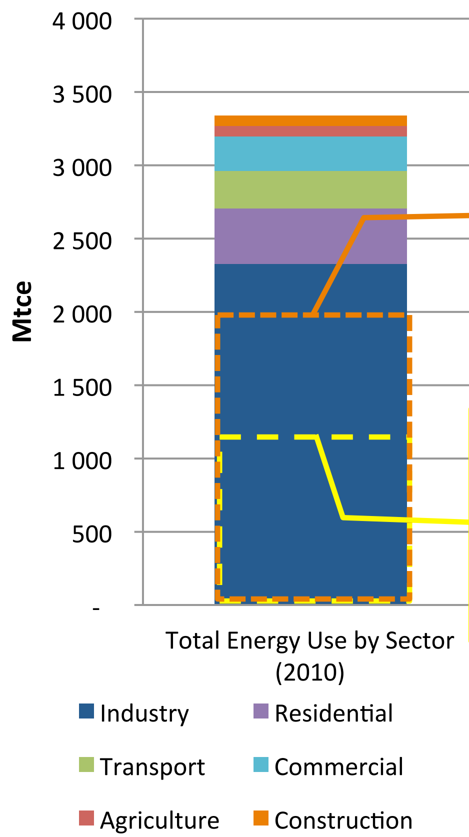
Note: Mtce >> EJ = 0.0293; EJ >> Quads = 0.9478

Coal-based industry



China's Top 1,000 and Top-10,000 Programs

2006-2010: China's Top-1,000 Energy Consuming Enterprises Program
2011-2015: China's Top-10,000 Energy Consuming Enterprises Program



Top -10,000 Program
* covers more than 2/3 of the national total energy use, or 85% of total industrial energy use
* includes more than 15,000 industrial enterprises, and about 2,000 large buildings and transport enterprises
* total energy-saving target during 2011-2015 is 250 Mtce

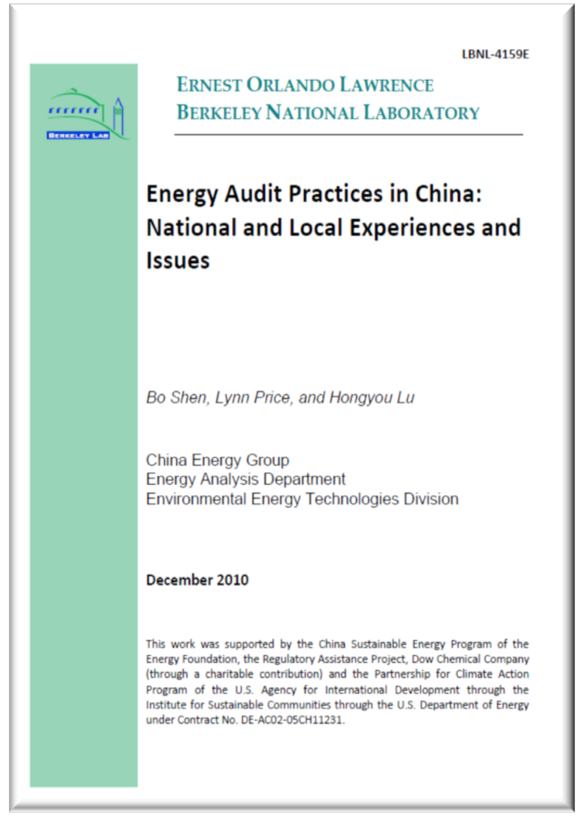
Top -1,000 Program
* covered more than 1/3 of the national total energy use
* included the largest 1,000 industrial enterprises
* achieved its energy-saving target of 100 Mtce during 2006-2010, and exceeded the target by 50%

- Program components:
  - Energy benchmarking
  - Energy audits
  - Technical retrofits projects
  - Energy management
  - Energy reporting
- Supporting policies:
  - Incentives
  - Government evaluations

Source: NBS, 2013.
Note: Mtce >> EJ = 0.0293; EJ >> Quads = 0.9478

Current Results and Challenges

- Top-10,000 Program results:
  - Based on a government evaluation of more than 16,000 industrial enterprises
  - Saved 170 Mtce as of 2012, or 68% of the total target
- LBNL Study on Energy Auditing in China
  - Assessed China's energy auditing practices based on researches on national policies and a series of in-person interviews in 6 provinces/cities.
  - Key findings were identified to further improve the practices of industrial energy auditing in China, such as the need for:
    - Effective assessment tools
    - Capacity and proper training for energy audits


LBNL-4159E

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Energy Audit Practices in China: National and Local Experiences and Issues

Bo Shen, Lynn Price, and Hongyou Lu

China Energy Group
Energy Analysis Department
Environmental Energy Technologies Division

December 2010

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International Industrial Energy Efficiency Training and Deployment (IIEETD)

- Project objectives
  - Localize and introduce the proven plant energy assessment tools and techniques to China's energy-intensive industrial sectors
  - Collaborate with Chinese universities, local energy conservation centers, and research organizations to improve energy-efficiency practices in China's industrial plants

- Project components
  - Tool development and localization for China
    - Process heating assessment tool
    - Steam system tool suite
  - Train the trainers
  - Onsite industrial energy assessment demonstration
  - Introduce energy-efficient technologies

U.S. Collaborators
- Lawrence Berkeley National Laboratory
- Institute for Sustainable Communities
- Oak Ridge National Laboratory

Chinese Collaborators
- National Energy Conservation Center
- University Alliance for Industrial Energy Efficiency
- Zhengzhou University
- University of Science and Technology – Beijing
- EHS Academy Jiangsu
- EHS Academy Guangzhou
- Suzhou Energy Conservation Center
- Shandong Energy Conservation Office
- Shandong University
- Sun Yat-sen University

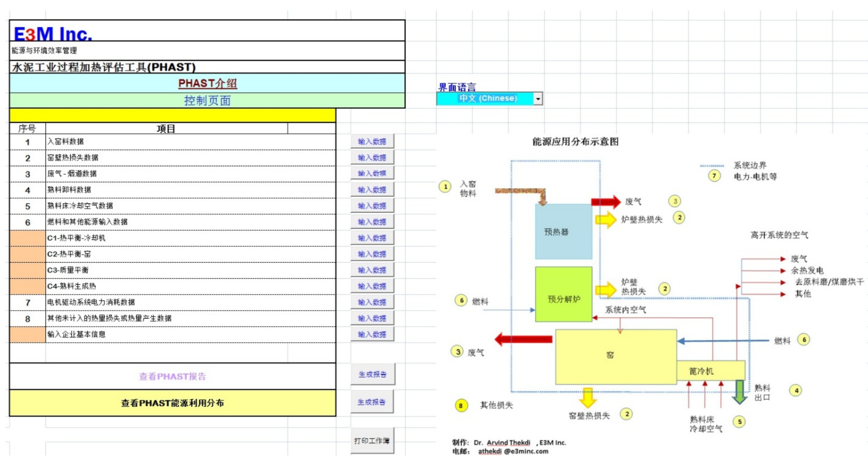
Energy Assessment Workshops in China

- Industry-focus:
  - Process-heating system assessment workshops were held at:
    - An aluminum plant
    - A cement plant
    - A steel plant
  - Steam system assessment workshops where held at:
    - A petrochemical plant
    - A pulp and paper plant

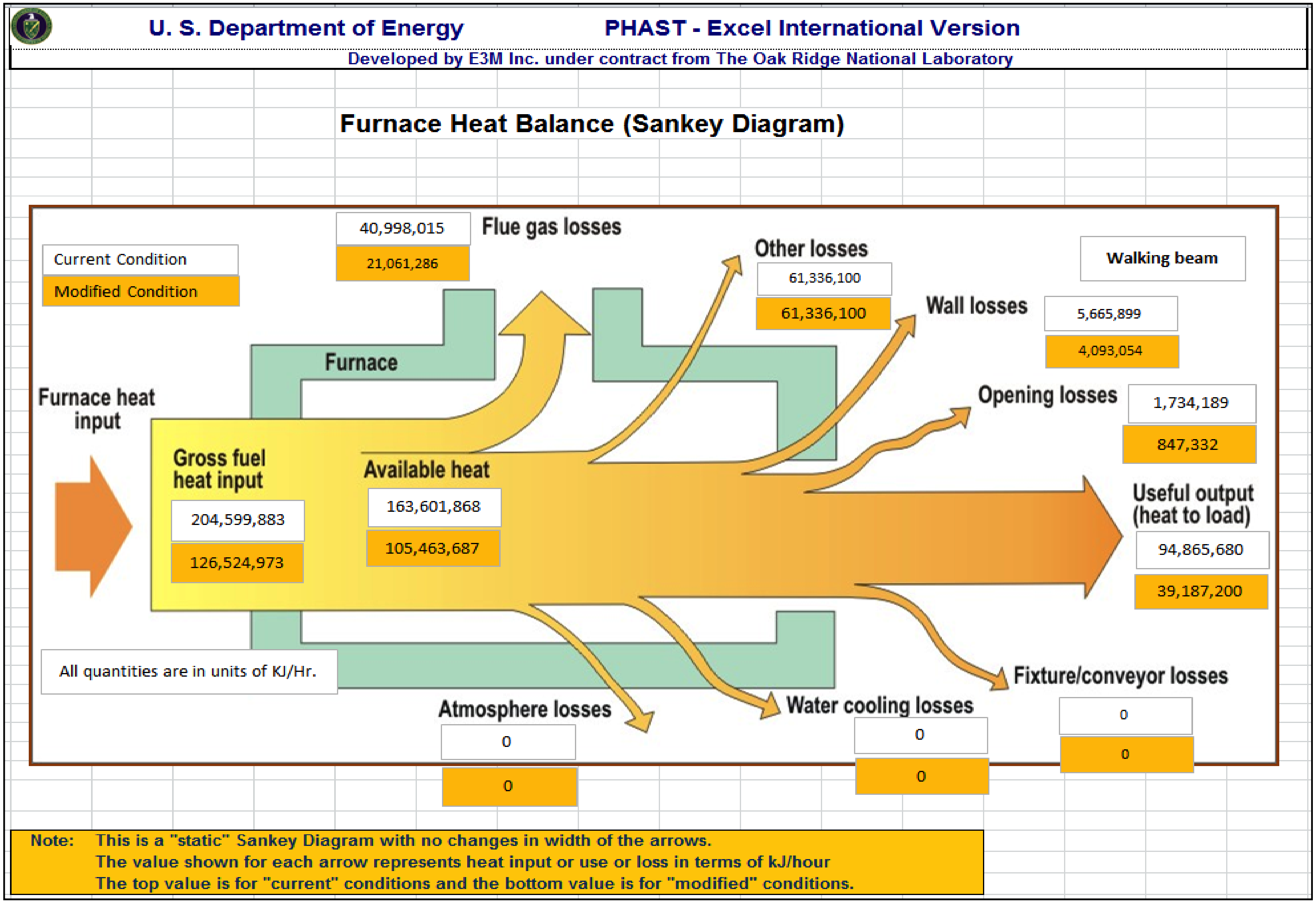
- More than 70 people attended each workshop:
    - Central and local governments
    - Local enterprises
    - Energy conservation centers
    - Research institutions
    - Energy service companies
    - U.S. companies

Process heating assessment tool

- Process Heating Assessment and Survey Tool (PHAST)
  - Conduct an energy assessment of industrial heating equipment (e.g., boilers, kilns, furnaces)
  - Understand energy use distribution
  - Identify and prioritize areas of major heat losses
  - Estimate cost-savings
- Localization
  - Localized for China's industry sector
  - Based on Chinese industrial heat balance standards (JCT 730-2007, JCT 733-2007)
  - Changes were made in data collection, detailed analysis of exhaust gas, clinker cooling and heat recovery system, etc.
  - English and Chinese, SI and Chinese units



Case study results: a steel reheating furnace



Case study results: energy-savings by areas

Energy use or loss category	Energy use - loss (Current)		Energy use - loss (Modified)		Energy Savings [a] (Current - Modified)				Coal Reduction	Cost Savings
	kJ/hour	kgCE/hour [b]	kJ/hour	kgCE/hour	kJ/hour	GJ/Year	TCE/Year [c]	% of Savings	Tonnes [e]	RMB [f]
Charge material	94,865,680	3,238	39,187,200	1,337	55,678,480	467,699	15,962	71%	18,618	9,308,925
Fixtures, trays, conveyor etc.	0	0	0	0	0	0	0	0%	0	0
Wall surface heat losses	5,665,899	193	4,093,054	140	1,572,845	13,212	451	2%	526	262,967
Water or air cooling (internal)	0	0	0	0	0	0	0	0%	0	0
Atmosphere or makeup air	0	0	0	0	0	0	0	0%	0	0
Radiation losses from openings	1,734,189	59	847,332	29	886,857	7,450	254	1%	297	148,282
Other heat loss or heat addition	61,336,100	2,093	61,336,100	2,093	0	0	0	0%	0	0
Flue gas loss	40,998,015	1,399	21,061,286	719	19,936,729	167,469	5,716	26%	6,666	3,333,247
Exothermic heat from process	0	0	0	0	0	0	0	0%	0	0
Total gross heat input required	**204,599,883**	**6,983**	**126,524,973**	**4,318**	**78,074,911 (38.2%)[d]**	**480,461 (38.2%)[d]**	**22,383 (38.2%)[d]**	**100%**	**26,107**	**13,053,421**

[a] Assuming plant's operating hours per year are equal to 8,400 hours.
[b] 1 kgCE= 29,300 kJ or 29.3 MJ net heating value.
[c] 1 Metric ton of "standard" coal equivalent tce = 29.3 GJ.
[d] The percent energy savings is the ratio between saved energy and current level of total gross heat input for the process heating system. Actual energy savings are less than the sum of all energy savings from each individual measures. Actual energy savings depend on implementation rates of recommended measures, as well as the changes in gross heat input.
[e] Coal reduction is estimated based on the coal heating value of 6,000 kcal/kg, or 25,121 kJ/kg, as reported by the steel mill.
[f] Cost saving is estimated based on purchased coal cost of 500 RMB per tonne, as reported by the steel mill.

Conclusions

- At the enterprises level:
  - Significant energy-savings opportunities exist
  - Potentially very large energy, environment, and economical impacts

- Policy opportunities to improve Top-10,000 program
  - Strong local demand for qualified energy auditors and technical energy assessments
  - Needs for capacity building in terms of technical know-how and standardized practices
  - Needs for incentives to conduct non-project based energy-saving activities, such as energy assessments, energy management

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Questions?

Thank you!

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