2016 Integration of District Heating in a Sustainable Energy System

2016中丹可再生能源系统区域供热研讨会

– Technologies, Markets and Policies

—技术、市场与政策

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High Impact Opportunities for District Energy in China

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Copenhagen Centre on Energy Efficiency

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SDC Seminar "Integration of District Heating in a Sustainable Energy System – Technologies, Markets and Policies"

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SUSTAINABLE ENERGY FOR ALL

Outline

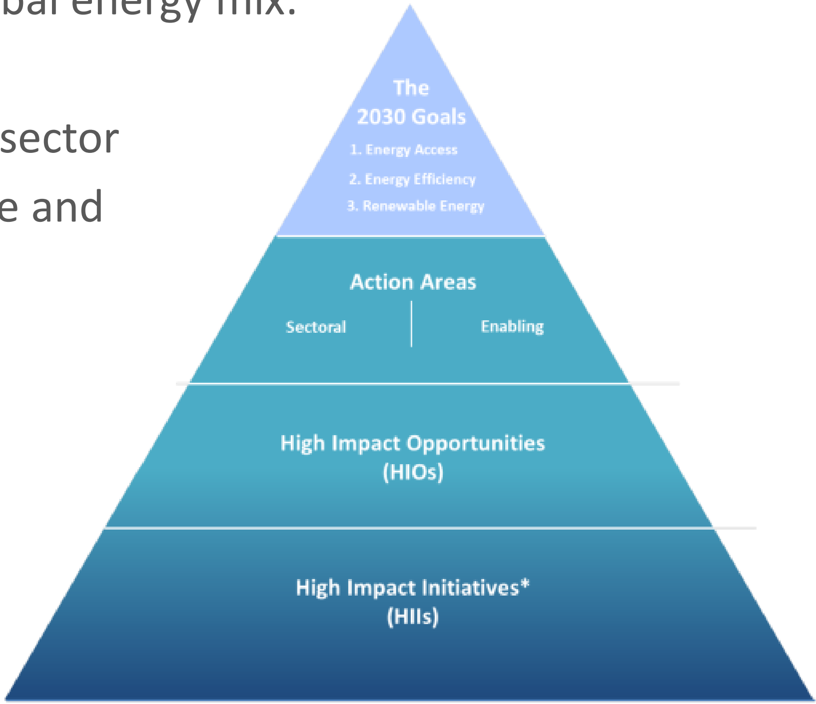
- The High Impact Opportunity of using industrial waste heat for distict heating under the China HIO Study project
- C2E2 roles in the GEF-funded UNEP District Energy in Cities Initative project

What is High Impact Opportunity?

A primary way the UN Initative Sustainable Energy for All (SEforALL) uses to drive the realisation of its three objectives:

- Ensure universal access to modern energy services.
- Double the global rate of improvement in energy efficiency.
- Double the share of renewable energy in the global energy mix.

SEforALL identified over 50 HIOs globally, some are sector based, while others are enabling factors, like finance and policies



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Value of High Impact Opportunities (HIOs)

HIOs provide a platform for stakeholders from the private sector, public sector, and civil society to work together on specific actions that advance sustainable energy within the framework of the larger global initiative. HIOs enable partners to:

- Collaborate with other organizations on similar objectives
- Track and mobilize resources and investment
- Overcome barriers that are difficult to tackle individually
- Share best practices and coordinate activities
- Develop and promote international standards
- Broker new partnerships
- Access global decision-making on sustainable energy (e.g. through forums such as the World Economic Forum, Green Growth Action Alliance, etc.)
- Acquire recognition through Sustainable Energy for All's reporting and events

Background

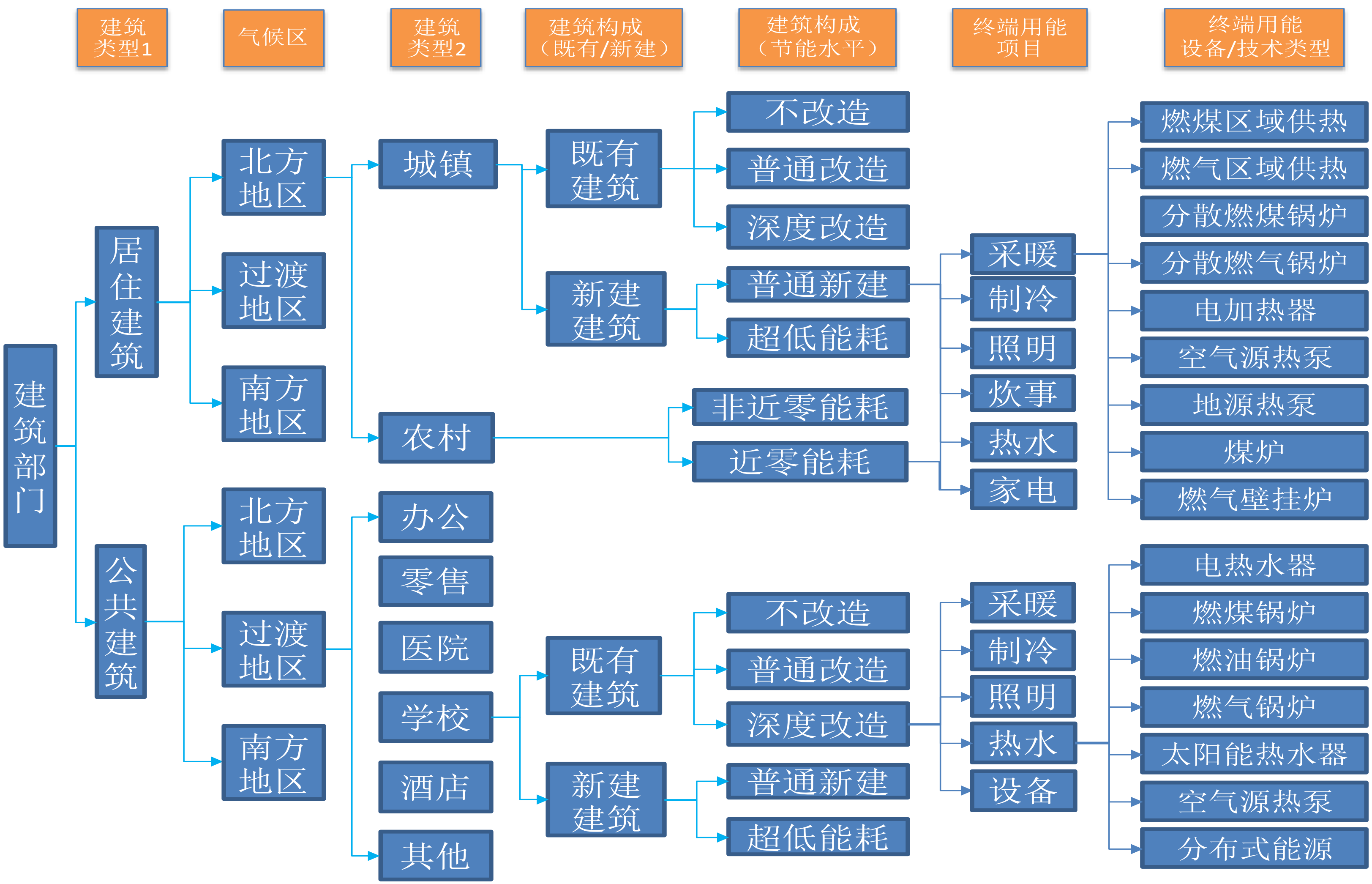
- The HIO study is conducted in parallel in China and India and conducted by leading national think-tanks on energy efficiency
- The national partners were selected through tendering
- In China, the research team include: Institute of Energy, Environment and Economy (3E) of Tsinghua University (Tsinghua 3E), Energy Research Institute (ERI) of NDRC, and Centre of Science and Technology for Construction under the Ministry of Housing, Urban-Rural Development
- Duration: 1 year, final workshop to be held in December 2016
- Objective: provide analytical support for energy efficiency policy making and implementation in China; to support further and faster energy efficiency improvement in the country

Expected Outputs and progress

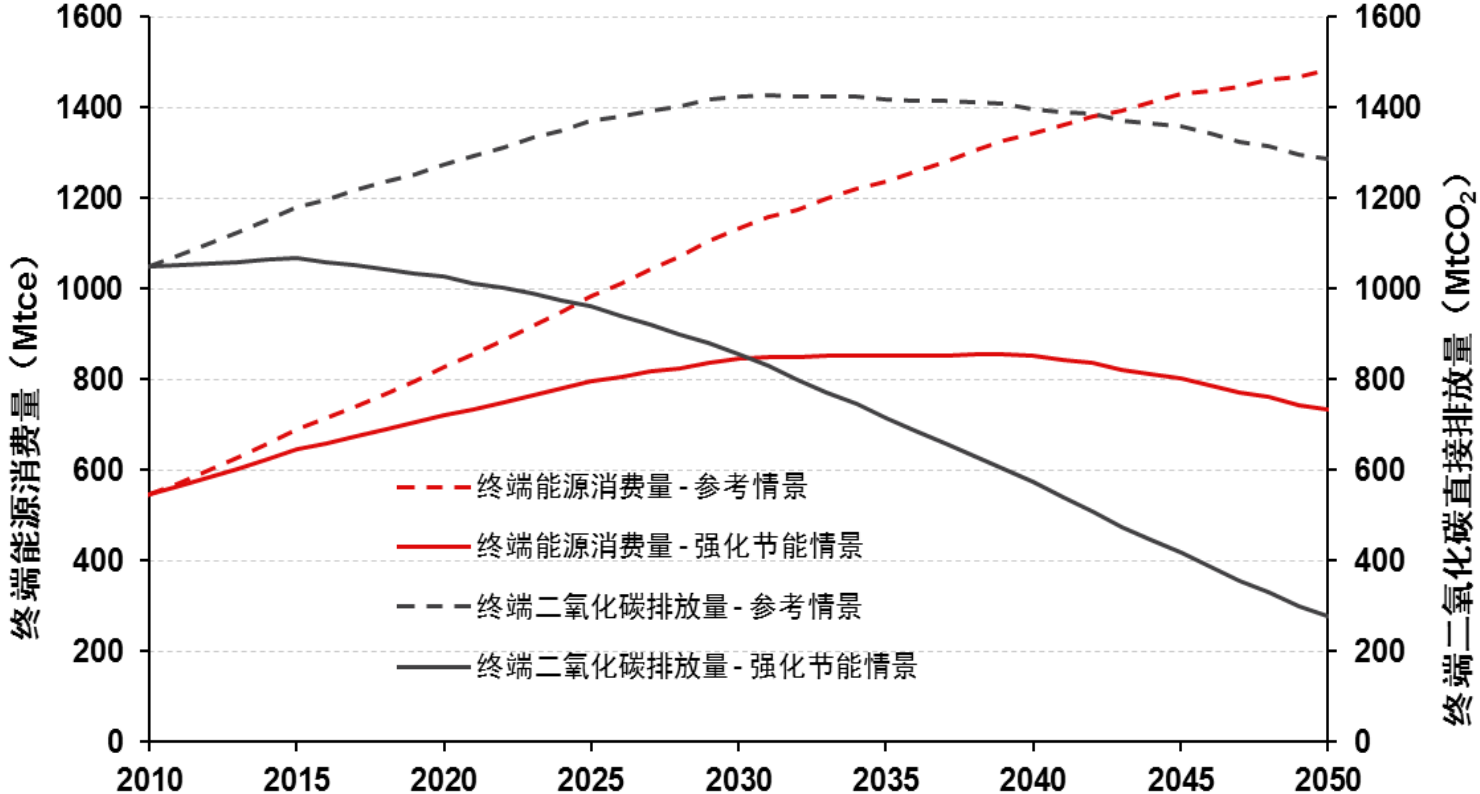
No.	Deliverables	Description of Task	Progress
a	Inception Report	The inception report include the detailed work plan, methodology for assessment and stakeholder engagement plan	Completed
b	Policy database	An excel sheet on each policy or initiative of government	Completed
c	Report on Good Practice and Success Stories	A report covers 3 to 5 good practices and/or success stories for energy efficiency improvement in the country	Completed
d	Report on Energy Efficiency options in industrial, building, transportation and power sector	Partial report: covering Task 2-5 and the presentation to stakeholders during first workshop	Under going
		Full report	Under going
e	Reports on the HIOs	Comprehensive reports documenting the HIOs and policies/technologies/actions needed to tap the energy efficiency improvement potential of the HIOs in the prioritized sub sectors.	Under going
f	Project Concept Note PCN	2 PCNs developed for international & domestic funding to realize the energy efficiency improvement potential identified associated with the HIOs	Under going
g	Final report	Project activity report, including funding uses	Under going

Project period extended to Jan 2017, final workshop scheduled in Decemeber 2016, and all deliverables under the project finalised by 15 Jan 2017

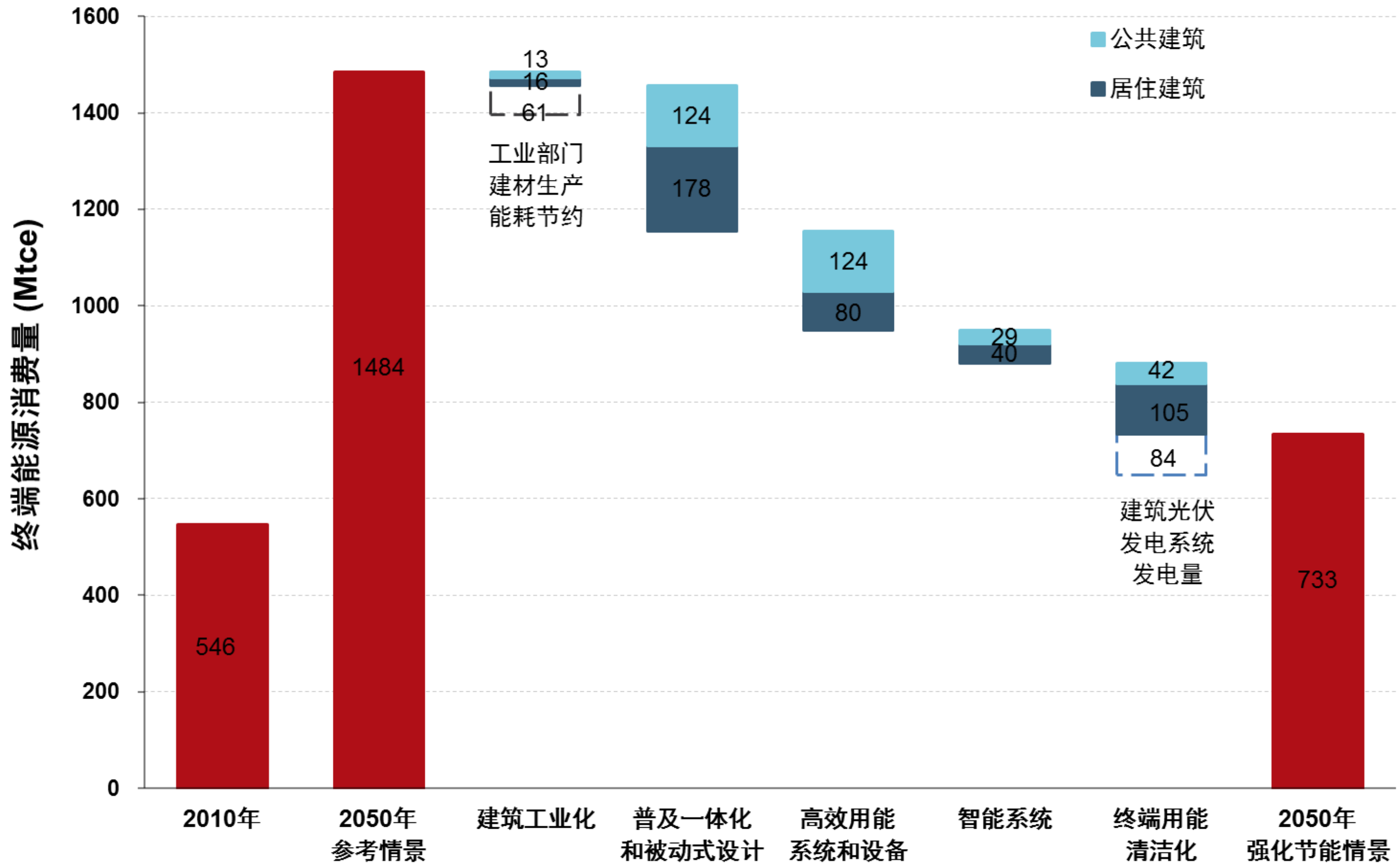
Building energy use and supply under the LEAP model



Future building sector energy use and CO2 emission scenarios



Energy efficiency potential of the Chinese building sector



Heated North Urban: the most potential sector for energy saving

- Energy intensity can reduce from 15kgCe/m2 a. to 6.5 kgCe/m2.a
- Approaches:
  - Further improvement in insulation
  - Adjustments by end users - avoid overheating
  - Alternative clean heat sources
  - Connect existing heating networks to build the 'energy internet'

Where are the sources of waste heat?

Thermal Power Plants

Installed capacity 340GW

Waste heat 400GW

Usable for DHC per winter 130 MtCe

Co-Generation Plants

Installed capacity 140 GW

Waste heat 200GW

Usable for DHC per winter 60 MtCe

Other industries

Waste heat 1000GW

Usable for DHC per winter 120 MtCe

Total potential: Waste heat 1600 GW (310 MtCe/winter)>>space heating depand in North China 750 GW (200 MtCe/winter), total floor area 15 bn m2

HIO - using low-grade industrial waste heat for district heating

- Low-grade industrial waste heat: heat contained in smoke, gas, and steams below 200℃ or liquid below 100℃.
- Low-grade Industrial Waste Heat, due to their low energy grade, is often difficult to used for industrial process or power and currently only a small part of it is used.
- Mainly concentrate in thermal power, iron and steel, petrochemical industries.
- The current use of industrial waste heat is mainly for residential hot water supply, internal space heating for the industrial facilities and the use mainly concentrate in winter
- Space heating for urban buildings in Northern China is an important part of building energy use. In 2013, the total urban building floor area in Northern China is 12 billion m2 and the total energy consumption for space heating is 181 MtCe, 24% of the total building energy use in China.
- Source of space heating: 42% co-generation, coal-fired boilers 48%, gas-fired power plant 8%, other 2%.

HIO - using low-grade industrial waste heat for district heating

- Coal-fired boils for space heating is one main reason of high energy use and heavy pollution in winter in cities in Northern China;
- Meanwhile, it is estimated that there are around 100 MtCe of industrial waste heat during the heating season (4 months)
- This could be an importance source of clean energy for space heating, and could contribute to energy use reduction and air pollution control
- China 2020 target for low-grade waste heat recovery and use for space heating: by 2020, at least replace 2 bn m2 of floor area heated with coal-fired boilers, and replace the 50 MtCe of coal use

Technical and economic feasiblities

- Major industrial facilities, hence sources of waste industrial heat, are often far away from downtown areas. The economic feasibility of long distance heat transmission is a key factor for industrial waste heat use
- Based on advanced technologies for heat loss reduction and economy of scale, for heat transmission systems with a capacity of 5000 MW (sufficient for 100 million m2 of floor space heating), if the cost of industrial waste heat is lower than 15RMB/GJ, then 300 km of long-distance transmission, the district heating supply can be still lower than natural-gas based boilers; if the heat supply distance is below 100 km, then the district heating supply cost will be lower than that of coal-fired industrial boilers. Generally waste industrial heat within 100 km from a city is efficiency to meeting the city's need for space heating

HIO - low-grade industrial waste heat for district heating - Costs and Benefits

The Beijing-Tianjin-Hebei region: total industrial waste heat resource is 95 GW. If a big district heating network is built for the region based on waste heat from power plants and industries, plus natural gas-based heat supply during peak hours, this could supply space heating for 2.5 billion m2 of floor area, enough to meeting the space heating needs of cities at county or higher levels, plus a large part of the neighbouring towns and rural areas. For this, the total investment needs is 180 billion RMB.

- Benefits: replace 30 MtCe of coal use per year, and 200 Mt of water that is released into the air in the form of steam, and the cost only half the cost of natural-gas based heat supply.
- If the entire Northern China switches to district heating based on industrial waste heat, a huge inter-province district heating system can be built. The investment needs will be 800-1000 bn RMB.
- Benefit: meeting space heating needs for 10 bn m2 of floor area, replacing 150 MtCe of coal and save 1 bn m3 of water. Compared with 100% heat supply with natural gas, this could replace 100 bn m3 of natural gas use per year.

Barriers

- Institutional barriers: it requires inter-provincial and inter-government department coordination and high upfront investment, and involve a long list of stakeholders and interest groups; strong high-level leadership and coordination is needed;
- It requires changes to the traditional heat supply model for urban buildings and innovative business models, but currently there lack of district heat planning based on industrial waste heat and related supportive mechanisms, such as a heat pricing system that can reflect the heat costs;
- Technical barriers: including technologies for waste heat collection at each source, integration and distribution, and transmission of heat, as well as the operation control on industrial waste heat systems for close cooperation between industrial enterprises and distract heating system operators
- Market price crash of industrial products and industrial overcapacity - uncertainty of some industries' prospects and hence waste heat resources

Case study: Qianxi County in Hebei using low-grade industrial waste heat for district heating

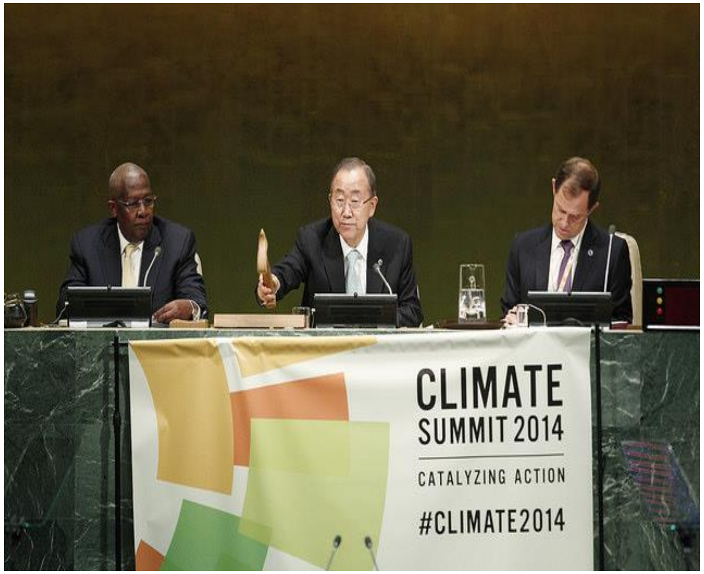
- Three heat sources in Qianxi were all small coal-fired boilers, which were of low energy efficiency, high pollution emissions, and high operating costs. 河
- Around 10 km from the city, there are two big iron and steel plants, Jinxi and Wantong, which produce large amount of waste heat from their processes;
- Enough waste heat to meet the current and future residential space heating needs in Qianxi
- In 2014, Qianxi implemented a urban district heating project based on low-grade industrial waste heat. The project total investment was 560 m RMB and includes three phases. Phase I space heating capacity 150 MW, for 3.6 m m2 of floor area; Phase II total heat supply capacity 361 MW, for 6.84 m m2 of floor area; and Phase III 561 MW, for 10.84 m m2 of floor area.

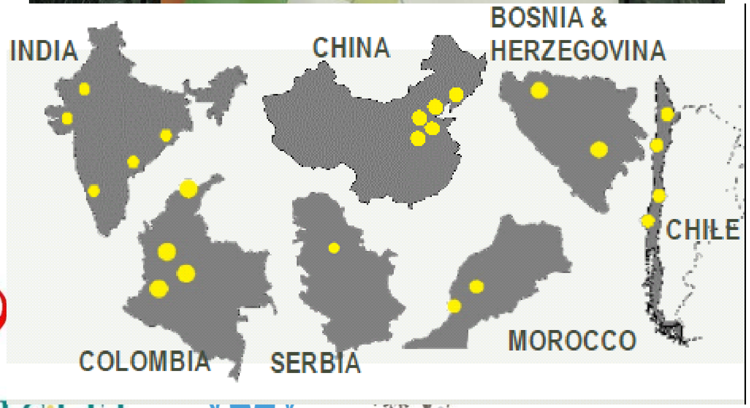
Qianxi's experience

- Phase I of the project has been in operation for over one year, it can provide space heating for all the 3.6 million m2 of floor area in the Qianxi county seat, and replaced seven 40-t coal-fired boilers; industrial waste heat use is about 63512 tCe/year, GHG emission reduction 167,580 tonnes/year, and avoided SO2 emissions 543 tons/year; NOx emission reduction 473 tonnes/year, and water saving 560000 tonnes/year, total energy efficiency improvement over 85%, and this can significantly reduce the city's PM2.5 level in winter.
- Qianxi plans to use the waste heat from the two iron and steel plants to meet its continually growing demand for space heating;
- Qianxi is the first pilot city in Hebei, or even China, that has completely switched to industrial waste heat-based district heating for urban residential space heating.
- Qianxi's experience indicates innovative the technical and economic feasibility of long-distance transmission of industrial waste heat for district heating in urban areas.

The District Energy in Cities Initiative

- Launched at Climate Summit
- Assist in **modernisation** process.
- **Share** experiences between cities and partners.
- Build local **capacity** for delivering modernisation.
- Improve local and national **enabling frameworks**.
- Leveraging partnership and pool of expertise to provide successful market transformation





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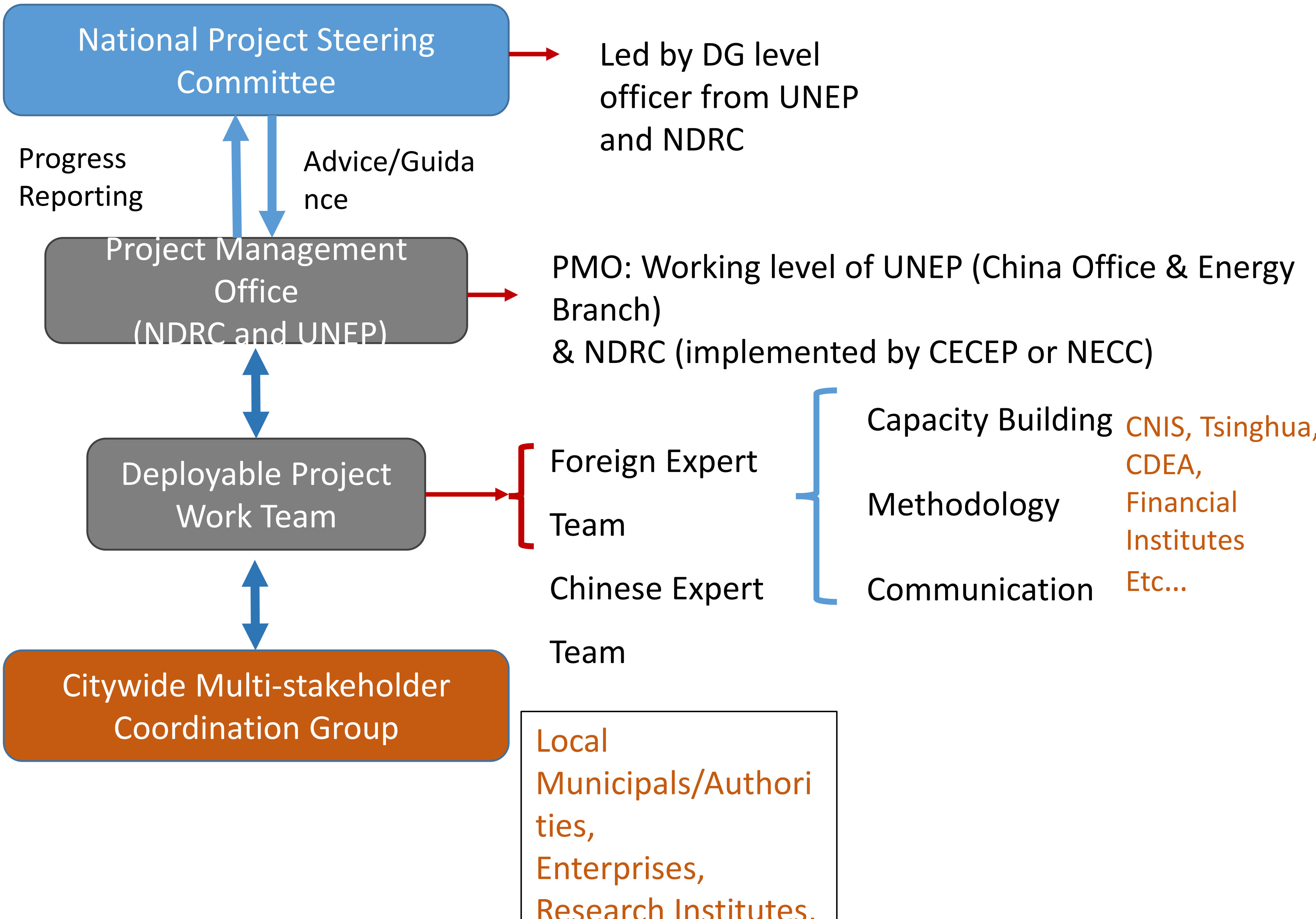
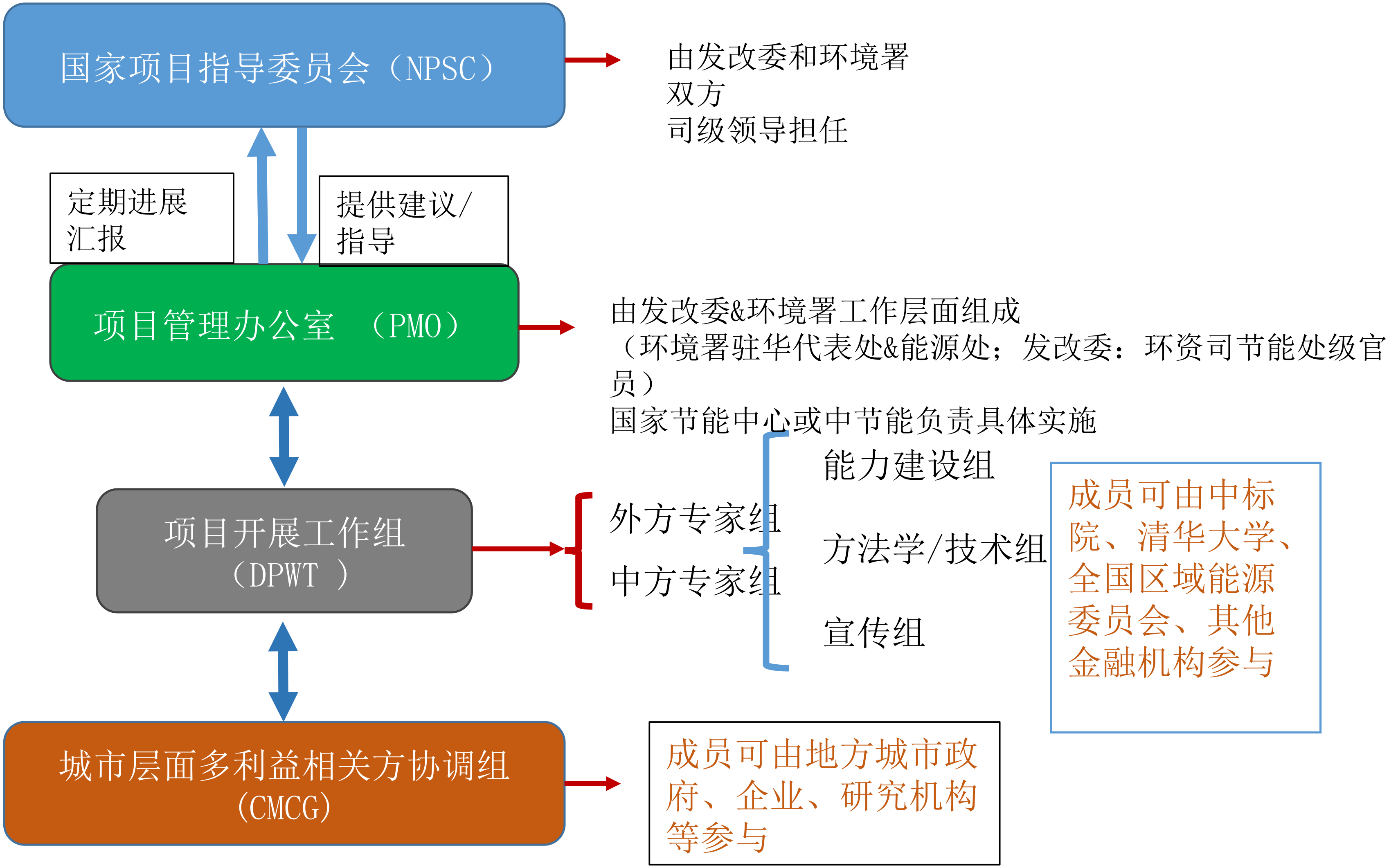
Scope of activities in China

Light Touch: eight cities should receive rapid assessments, and these cities should be selected through an online application process.
Deep Dive: four demonstration cities, rather than one, should receive support on energy mapping and planning, policy development, and the implementation of district energy.
City Typology: diverse city types should be selected, including at least one city from Northern China for district heating, one from Southern China for cooling, one from Central China (along the Yangtze River) for a heating/cooling hybrid model

National Project Structure of GEF DES in China



区域能源全球环境基金中国示范项目结构



DISTRICT ENERGY IN CITIES INITIATIVE

CHINA

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Overview of the latest activities	Actions of the month	Next steps
• **'City Call for Application'** to the DES Initiative and weighting criteria prepared for review by the NDRC • Partnership between UNEP DES Initiative, IEA and Tsinghua University to develop a **China District Energy Scorecard**. • Country scorecards typically provide market analyses, policy recommendations, & country rating based on 3 criteria: effectiveness of past policies; existence of policy incentives; and commitments of intent on policy and targets. This will have to be negotiated with the NDRC.	• Sept 22 Beijing: UNEP meeting with the NDRC on project progress and China District Energy Scorecard. • **Sept 22 Beijing: IEA, Tsinghua University, UNEP Workshop on the use of industrial waste heat** • Sept. 23 Beijing: **First country taskforce meeting for China.**	• November/December: NDRC will issue a call for cities to apply to participate in the programme's light touch phase (rapid assessments).

Key steps in developing a district energy system

- Ten key steps that cities can take to support the development of DES
- These steps can be taken individually or packaged to meet specific city conditions and needs.
- Depending on city type some steps may have already been completed

1.	**ASSESS** existing energy and climate policy objectives, strategies and targets, and identify catalysts
2.	**STRENGTHEN** or develop the institutional multi-stakeholder coordination framework
3.	**INTEGRATE** district energy into national and/or local energy strategy and planning
4.	**MAP** local energy demand and evaluate local energy resources
5.	**DETERMINE** relevant policy design considerations
6.	**CARRY OUT** project pre-feasibility and viability
7.	**DEVELOP** business plan
8.	**ANALYSE** procurement options
9.	**FACILITATE** finance
10.	**SET** measurable, reportable and verifiable project indicators

Responsibilities of the C2E2 City Team

- A major role of C2E2 in the DES project is provided through the City Team, consisting of 3 district energy experts working full-time over the next three years on the DES project.
- The Technical Support Team shall focus on the following deliverables over the course of the three year project period:
  - ✓ Assess the potential of DES in selected cities;
  - ✓ Assess the short and long-term technical and economic potential of district energy, analyze barriers to project development, and identify potential policy options
  - ✓ Conduct project pre-feasibility studies, including financial estimates
  - ✓ Conduct pre-assessments of city potential and opportunities in focus regions
  - ✓ Provide expert technical assistance, advice on heat or cool planning, training and other direct support to city authorities

Other roles of C2E2 in the DES project

- Developing methodology and guide for the Monitoring and Evaluation (M&E) work of DES project
- Training activities
- Analytical support
- Co-chair with ICLEI the Capacity Building Task Force

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Thank You

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