World Resources Institute (WRI) Building Efficiency Accelerator (BEA) Targets Playbook

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CONTEXT

Backgroun

- The 2015 Paris Agreement aims to keep global surface temperature rise well below 2°Celsius (C) above pre-industrial levels by the end of the 21st Century (UNFCCC 2017).

- A critical component of achieving mitigation goals is to reduce energy usage in buildings, which account for over one-third of final global energy consumption (IEA 2013).

- WRI's Building Efficiency Accelerator Programme – the goal is to double the rate of energy efficiency improvements in the building sector by 2030

Methodolo

- Literature review & desk research
- Field research & expert interview

Changning District, Shanghai, China —— Case Study

Changning Hongqiao Region

(*Source*: World Bank 2013, pp.25; Wikipedia 2019. Changning District Basic Facts; Sherlock et al. 2018)

- Centrally located in Changning District, Shanghai
- One of the fully developed area in downtown Shanghai, which focuses on service industries (i.e. trading, exhibition, HQ, etc.), contributing 93% of its GDP
- Area: 3.15 km² (8.47% of Changning)
- Population: 80k (2010)
- GDP: 9.1 Bn RMB, 2010 (28.46% of Changning)
- Power Demand: 201 kton standard coal (2010)
- GHG emission: 435 kton CO_2

- ☐ **Shanghai** is China's largest economic center, and in 2017 had an estimated per capita gross domestic product (GDP) of US$18,450, equivalent to that of a medium developed country

- ☐ Shanghai is also one of the four municipalities in China that has a status equivalent to a province and reports directly to the central government

- ☐ The city is striving to become a global center for finance, trade, and technology innovation **by 2035,** while at the same time transitioning to a **"low-carbon city"**

- ☐ **Changning District** is one of 16 districts in Shanghai and located in the West Downtown area. It covers an area of 38.30 km2 and has a resident population of 693,700

- ☐ An established district with **mostly commercial buildings** and few industrial activities

- ☐ At **the forefront of Shanghai's effort to transition to a "low-carbon city." Vision to** "transform Changning into a leading low-carbon district…anchoring to green growth as the engine for the competitiveness of the district"

- ☐ Sought to **achieve this vision by leveraging international expertise and piloting innovative policies and programs**, yet to be implemented anywhere in the country

- ☐ In 2011, **Hongqiao Business District**, belonging to Changning, was selected as one of the eight low-carbon demonstration areas in Shanghai

- ☐ The World Bank and an international consulting firm were invited to partner with the Shanghai Energy Conservation Supervision Center (SECSC) to **develop a carbon dioxide (CO2) abatement cost curve** -- identified the abatement potential, cost, and ease of implementation of various CO2 mitigation options and helped to **inform** Changning District's CO2 abatement **targets and identify priority actions and investments**

- ☐ Changning District government, in collaboration with Chinese and international partner institutions, conducted a series of upstream analytical studies to identify and assess technical, economic, and financial feasibility; implementation barriers; and recommend policy changes

- ☐ Those upstream analytical and project preparation studies led to **the International Bank for Reconstruction and Development/Global Environment Facility (IBRD/GEF) Green Energy for Low Carbon City project.** The project provided loans of US$100 million, combined with an additional US$146 million from institutional investors, to facilitate EBEE improvement, near-zero-emission buildings, distributed generation, and green mobility.

Framework of city-level EBEE targets & improvement program

Generally, establishing a city-level voluntary EBEE targets and improvement program includes four phases: **(I) Assess, (II) Develop, (III) Implement, and (IV) Improve.** Each phase contains several steps. These phases and steps constitute a basic uniform framework.

ASSESS   I

DEVELOP   II

IMPLEMENT III

IMPROVE   IV

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ASSESS-A: Collect Existing Resources and Information

First stage for establishing a voluntary EBEE-TIP in a city is to assess the current situation as pertains to targets, policies and programs, and data to understand possibilities and potential barriers

Targets
- Are there any national, provincial, or local city-level energy or greenhouse gas (GHG) emissions reductions targets for the building sector?
- If so, what are the targets, and how is progress towards the targets measured?

Policies & Programs
- What mandatory and voluntary EBEE policies and programs are in place, or planned, at a national, provincial, or city-level? For instance, what codes, standards, regulations, incentives, training, information programs, etc. exist or are planned?
- What achievements in building energy conservation have been reached as a result of these policies and programs?
- How would a voluntary EBEE targets and improvement program fit into the existing framework of policies and programs? For instance, could national financial incentives or subsidies be leveraged?

Data
- Is there an inventory of the existing building stock of the city?
- Are data on the characteristics (e.g., size, location, type, construction year) and energy usage of existing buildings (e.g., monthly or annual energy consumption by fuel type) collected, cleansed, organized, stored, and analyzed in the city?
- If so, what data are collected, by whom, how often, in what format, and for how many buildings of which types?
- Where is the data stored, and what analyses are conducted on the data?
- If not, where and how could one obtain the necessary data and information above?

ASSESS-A: Collect Existing Resources and Information

**Changning District Case Study**

Targets
- Are there a national or local energy or GHG emissions reductions targets for the building sector to help establish a voluntary EBEE targets and improvement program: *Chinese national energy and GHG emission reduction targets → Shanghai's low-carbon target → Changning District's low-carbon target.*

Policies & Programs
- Undertook a comprehensive review of national, provincial, and municipal building EE programs and policies. Include:
  - National building EE codes and retrofit policies, and financial incentives.
  - Shanghai building EE codes, retrofit policies, and financial incentives.
  - Building EE codes, retrofit policies, and financial incentives from other Chinese cities and foreign countries, provinces, and cities.
  - Achievements from various building EE policies and programs.
  - Current municipal building EE retrofit business models (SECSC et al 2013).
- Changning had made steady progress in: ①*Enforcement of mandatory EE codes;* ②*Exploration of opportunities for existing building retrofits;* ③*Promotion of integrated RE application;* ④*Supervision on building EE;* ⑤*Training on building EE*

Data
- Data are at the core of EBEE target setting and improvement.
- One of the preconditions for Changning District's EBEE targets and improvement program was the Commercial Building Energy Consumption Monitoring Platform (ECMP)
- The platform was officially put into operation in July 2011
- ECMP covered 100 commercial buildings:
  - Building Characteristics: location; type and function; building size; construction year; occupancy
  - Building Energy Data: total energy consumption; energy consumption by end-uses/system & by fuel type
  - Other: water consumption; retrofit information, etc.
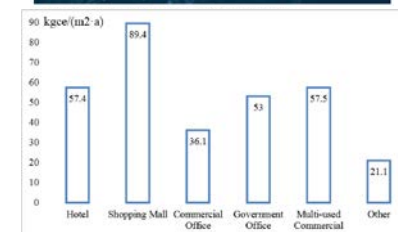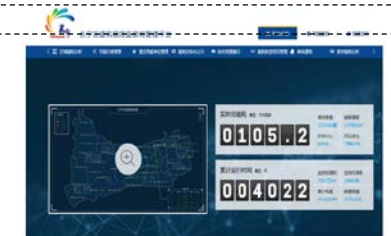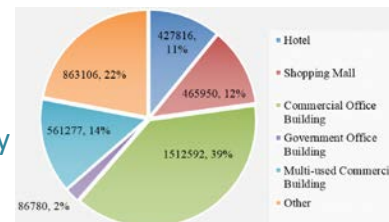
Assess B: Understand Benefits and Potential Barriers

EEBE-TIP have reduced building gross energy usage, GHG emissions, and energy costs, while also creating new jobs and increased business for energy service companies (ESCO).

Despite the benefits, a number of barriers typically must be addressed.

Typical barriers include: (1) lack of access to building energy data to develop targets; (2) lack of motivation by building owners and managers to adopt voluntary EBEE targets, once established;

or (3) lack of technical capacity among building owners/operators to implement voluntary EBEE improvements, once targets are established.

Questions municipalities will need to answer at this stage include the following:

QUESTION LIST

- What information exists on the benefits of city-level voluntary EBEE targets and improvement programs (e.g., case studies, reports, analyses)?
- What additional information is needed to assess the benefits, and how could this be obtained?
- What barriers may be faced in development and implementation of voluntary EBEE targets and improvement program?
- How can these barriers be overcome?
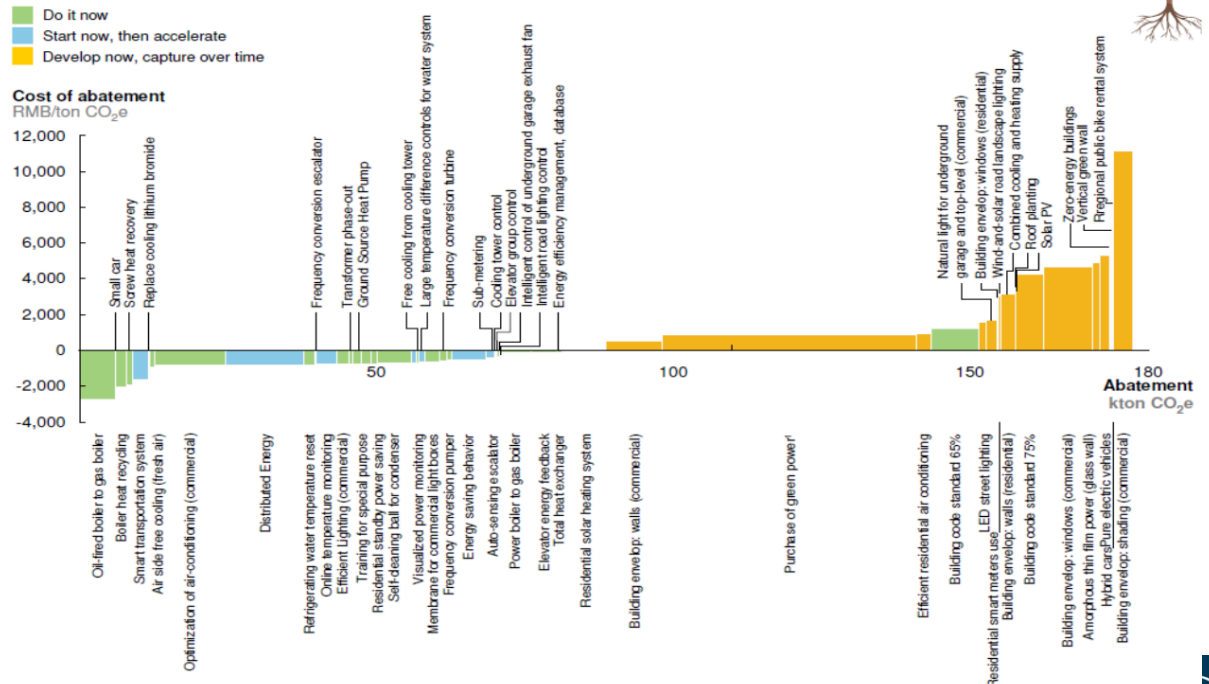
Assess B: Understand Benefits and Potential Barriers

Changning District Case Study

Activity 1: Assess Benefits

– Changning invited WB and an international consulting firm to partner with the SECSC to develop a CO_2 abatement cost curve for the District. Hongqiao Economic and Technology Demonstration Zone (ETDZ) was selected for the abatement curve study
– Cost curve was used to set a low-carbon target and identify priority mitigation options:
  o 100 buildings (6 offices, 13 hotels, 7 shopping centers, 46 commercial buildings, 9 mix-use buildings, and 19 others)
  o three alternative abatement scenarios (Frozen Technology Scenario; Baseline Scenario to Meet the National Government's Target; and Stretch Scenario beyond National Government's Target) were developed
  o a CO_2 abatement cost curve showing abatement potentials, costs, and ease of implementation for various mitigation options was developed
– Target to achieve Stretch Scenario and to reduce current energy consumption in 100 existing building in the Hongqiao ETDZ by 18%, equivalent to 33,000 TCE

Activity 2: Assess Barriers

– Identified barriers to establishing a voluntary EBEE targets and improvement program:
  o Lack of Mandatory Retrofit Policy
  o Split Incentives
  o Lack of Financial Incentive Mechanisms and Business Models

For Changning's details about using "CO2 Abatement Cost Curve Tool", please see in link:
https://openknowledge.worldbank.org/handle/10986/16710

(Details in Target Playbook, pp.11-13)

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Assess C: Identify Stakeholders, Tools and Resources Needed

The third stage in establishing a voluntary EBEE-TIP in a city is to determine:

(1) what specific institutions and individuals need to be involved in the design implementation of the program

(2) what roles should these institutions and individuals take (e.g., leadership in design of targets, technical and strategic advisory for program implementation);

(3) what resources/tools these institutions and individuals need to fulfill their roles

(4) how to ensure these institutions and individuals have access to these tools/resources

Questions municipalities will need to answer at this stage include the following:

QUESTION LIST

– What institutions in the city have responsibilities and/or expertise in EBEE (e.g., government, academic, research, private sector, non-profit, consultants)?

– Which institution(s) should be assigned leadership and/or support roles in establishing the EBEE targets, designing the improvement program, implementing the improvement program, and/or advising technically and/or strategically?

– Do these institutions have all of the tools and resources required (e.g., financial, equipment, skills) to fulfill their roles? If not, where and how could the necessary resources be procured?

(Details in Target Playbook, pp.13-14)

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Assess C: Identify Stakeholders, Tools and Resources Needed

Changning District Case Study

Activity 1: Identify Stakeholders and Assign Roles

– Changning's first step was to identify all stakeholders relevant for designing and implementing a voluntary EBEE targets and improvement program. For commercial buildings:
  o Municipal Government and sector government (e.g. in charge of schools and hospitals)
  o Owners
  o Operation management team/Property management companies
  o Developers/ESCOs
  o Financial institutions (e.g. banks)
  o Renters/Government service occupants

– Changning's second step was to set up a new institution - the Shanghai Changning District Urban Renewal and Low Carbon Project Management Center (URLCPMC) -to coordinate and integrate the strengths of different stakeholders take charge of the low-carbon transition of the district
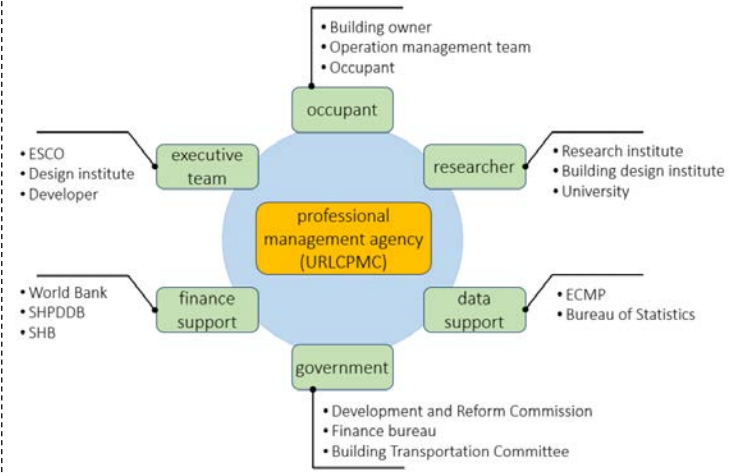
Activity 2: Identify Tools and Resources

– **Tools**
  o Online Real-time Commercial Building ECMP
  o World Bank's Abatement Cost Curve Tool
  o Benchmarking Tool
  o Building Simulation Tools
  o Project Implementation Plan –Computer Aided Tool
– **Resources**
  o International case studies
  o Government financial support
  o External expert guidance from Word Bank, GEF, ICF, EFC
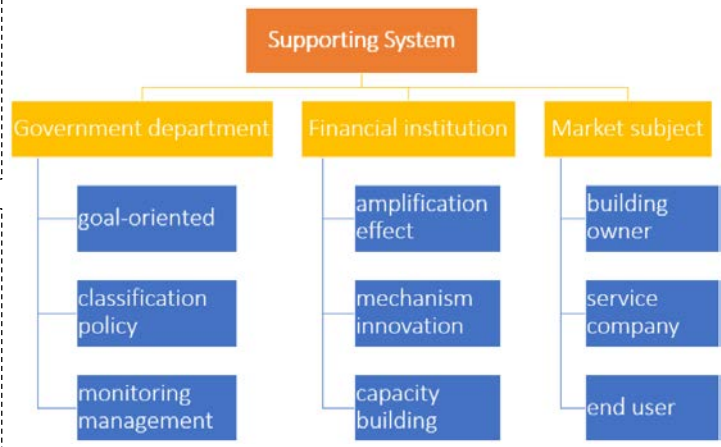
Framework of city-level EBEE targets & improvement program

ASSESS I

DEVELOP II

IMPLEMENT III

IMPROVE IV

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Develop A: Define Scope of the Policy or Measure

**Questions municipalities will need to answer at this stage include the following:**

- What type of EBEE targets and improvement program will be established? (e.g., EUI-based target, percentage better than baseline target, better than code target, energy consumption quota, cap and trade system, information program)?

- How will the EBEE target(s) be established (i.e., what science-based method(s) will be utilized to set the target(s))?

- What are the advantages and disadvantages of various approaches to establishing EBEE target(s)?

- What are the estimated costs and impacts of the EBEE targets and improvement program?

- On which buildings (i.e., space type, size, location) will the EBEE targets and improvement program be implemented?

- What will be the scope of the EBEE targets and improvements program (i.e., will the program include any training, use of benchmarking tools, financing, ESCOs)?

Develop A: Define Scope of the Policy or Measure

Changning District Case Study

Activity 1: Select the Type of EBEE-TIP

– Considered two distinct methods for target-setting at the individual building-level
- National Building Codes as the Targets
- Performance-based targets in Kilowatt-hours Per Square Meter (kWh/m2)
  - Ranking kWh/m^2 for all Buildings (Overall Ranking)
  - Ranking kWh/m^2 for Buildings by Categories (Categorized Ranking)
  - Ranking kWh/m^2 for Buildings in Each Category and Using Top Runner Buildings as the Benchmark for that Building Category (Top Runner Ranking)
  - Ranking KgCE/m^2 for Buildings in Each Category and Setting the Adjusted EUI as the Target for that Building Category (Normalized Target-Setting)
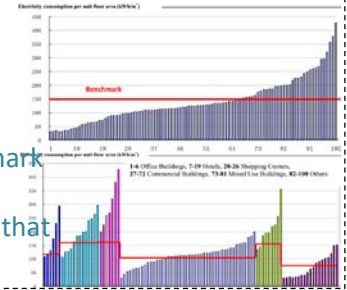
Activity 2: Evaluate Various Approaches

– Each target-setting methodology has its pros and cons
- Performance-based targets:
  - Links directly to energy savings target.
  - M&V is based on total energy consumption and floor area, and is straightforward to implement
  - need to factor out (or normalize) all the variables that influence building energy consumption but are outside the owner/manager's control
  - May require additional data collection and skills in regression analysis.
- Targets based on current building codes:
  - It is more legitimate to enforce
  - No direct link to the energy saving and emission reduction target
  - Input-based and technology-focused approach.
  - Less flexibility to select the most effective EE measures that link to the actual performance

Activity 3: Estimate Costs and Impacts

– Estimate the costs and impacts of each target-setting approach

Approaches		# of buildings	Total floor space (10^{4}m^2)	Total energy consumption(10^{4}TCE)	Potential for Retrofit				
					Investment (10^6 US$)	Savings (10^{4}TCE)	Investment per TCE saved (10^{4}US$)	Investment per m^2(US$)	% of savings
Energy Consumption per m^2	Overall Ranking	28	1.24	98.0	82.04	35.3	2.32	66.09	36.0
	Categorized Ranking	56	2.45	134.5	86.67	36.2	2.39	35.36	26.9
	Advanced Benchmarking	64	2.81	154.5	117.12	48.0	2.43	41.74	31.1
	Normalized Benchmarking	43	1.64	100.5	37.71	17.2	2.22	23.33	17.1
Approach Based on National Building Codes		90	3.57	172.45	62.29	33.4	1.80	17.39	20.3

Activity 4: Determine Buildings

– Determined utilize **Normalized Target-Setting method** to both select buildings and establish energy savings targets

Existing Building Type		Amount	Total Energy Savings (TCE)		Percentage of Energy Savings
Hotel	Five-star	13	1577.9	2876.5	9%
	Four-star		956.0		
	Three-star and below		342.6		
Shopping Mall		7	8410.6		25%
Commercial Office Building		48	10572.2		32%
Government Office Building		6	982.5		3%
Multi-used Commercial Building		7	7284.7		22%
Other		19	2873.4		9%
Total		100	33000		/

Develop B: Develop Locally-appropriate Policy, Building on National, Regional, or Global Models

Questions municipalities will need to answer at this stage include the following:

QUESTION LIST

- Will there be any incentives and/or disincentives to motivate buildings to achieve their EBEE targets?

- If so, what types of incentive(s) (e.g., certification, award, subsidies) or disincentives (e.g., higher utility rates, name and shame list)?

- Will there be technical assistance for buildings to achieve their EBEE targets?

- If so, what type(s) of technical assistance (e.g., training, tools, experts)?

Develop B: Develop Locally-appropriate Policy, Building on National, Regional, or Global Models

Changning District Case Study

Activity 1: Develop Policy Options

– Changning evaluated a range of practical and implementable incentives and disincentives to As a result, promote stakeholder buy-in of its overall EBEE targets and improvement program
  o Table - Possible Incentives and Disincentives by Stakeholders
– in January 2013, Changning developed a new policy, the Management Method of the Special Funds for Low-Carbon Development in Shanghai Changning District – which could be valid for five years

	Generic Incentives/Disincentives	Owners	Retrofit Developers/ESCOs	Financial Institutions	Renters	Government Agencies in Charge of Retrofit Permits	Municipal Government	Government Service Occupants
						Stakeholders		
Incentives	Grant	X					X	
	Technical Assistance and Education	X	X	X	X	X	X	X
	Green Performance Award	X			X		X	X
	Low Interest Loan/Line of Credit		X	X			X	
	Rebate	X			X		X	X
	Tax Incentive	X	X					
	Permit Process Incentive	X	X			X		
Disincentives	Administrative and Failure to Perform Fines	X					X	
	Higher Utility Rate/Surcharge	X			X			
	Name and Shame List	X					X	

Policies

o **Existing Building EE Retrofit Projects**
o Subsidy for Demonstration Projects
o **Subsidy for Interrupted Operation from a Retrofit**
o Subsidy to Develop Retrofit Project Plans
o **Subsidies for Fundamental Work to Build the Low-Carbon Demonstration Area**
o Subsidies for Envelop Retrofit Projects and Green Outdoor Lighting Retrofits
o Co-funding for Projects which Receive National or Municipal Funding Support

(Details in Target Playbook, pp.26-28)

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Develop C: Adopt Policy

Questions municipalities will need to answer at this stage include the following:

QUESTION LIST

- What will be the specific EBEE targets by building type?

- What specific policy measures to facilitate the EBEE targets and improvement program will be adopted?

Develop C: Adopt Policy

Changning District Case Study

Activity 1: Set EBEE Targets by Building Type

– Changning decomposed the total energy saving target (the 33,000 TCE) to different EB types for retrofit in Table 10
– The breakdown was based on the identification of each EB type's retrofit baseline
– Figure 9 is the process for Changning to perform this work

Table 10. 33,000 TCE Energy Saving Breakdown Table

ECB type		Amount	Total energy savings (TCE)		Percentage of energy savings
Hotel	Five-star	13	1577.9	2876.5	9%
	Four-star		956.0		
	Three-star and below		342.6		
Shopping Mall		7	8410.6		25%
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Government Office Building		6	982.5		3%
Multi-used Commercial Building		7	7284.7		22%
Other		19	2873.4		9%
Total		100	33000		/

Source: SABR 2019, 6-7.

Activity 2: Select Policies to Facilitate

– Changning also considered and adopted some of the following energy conservation and emissions reductions requirements; management measures; financial incentives; and reward measures:
  o A. Energy Conservation and Emission Reduction Requirements
  o B. Management Measures
  o C. Incentive Policies for Building Retrofit
  o D. Financial Support
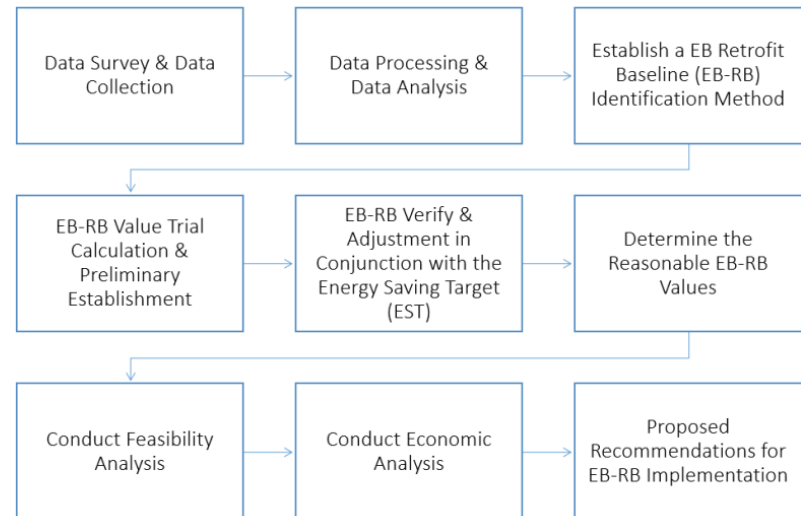 o E. Reward Measures
  o F. Financing Support

Figure 9. Process to identify the retrofit baseline for different EB types for breakdown the energy saving target (*Source:* EFC(a) 2012, 15)

(Details in Target Playbook, pp.28-35)

Develop D: Develop Implementation Plan

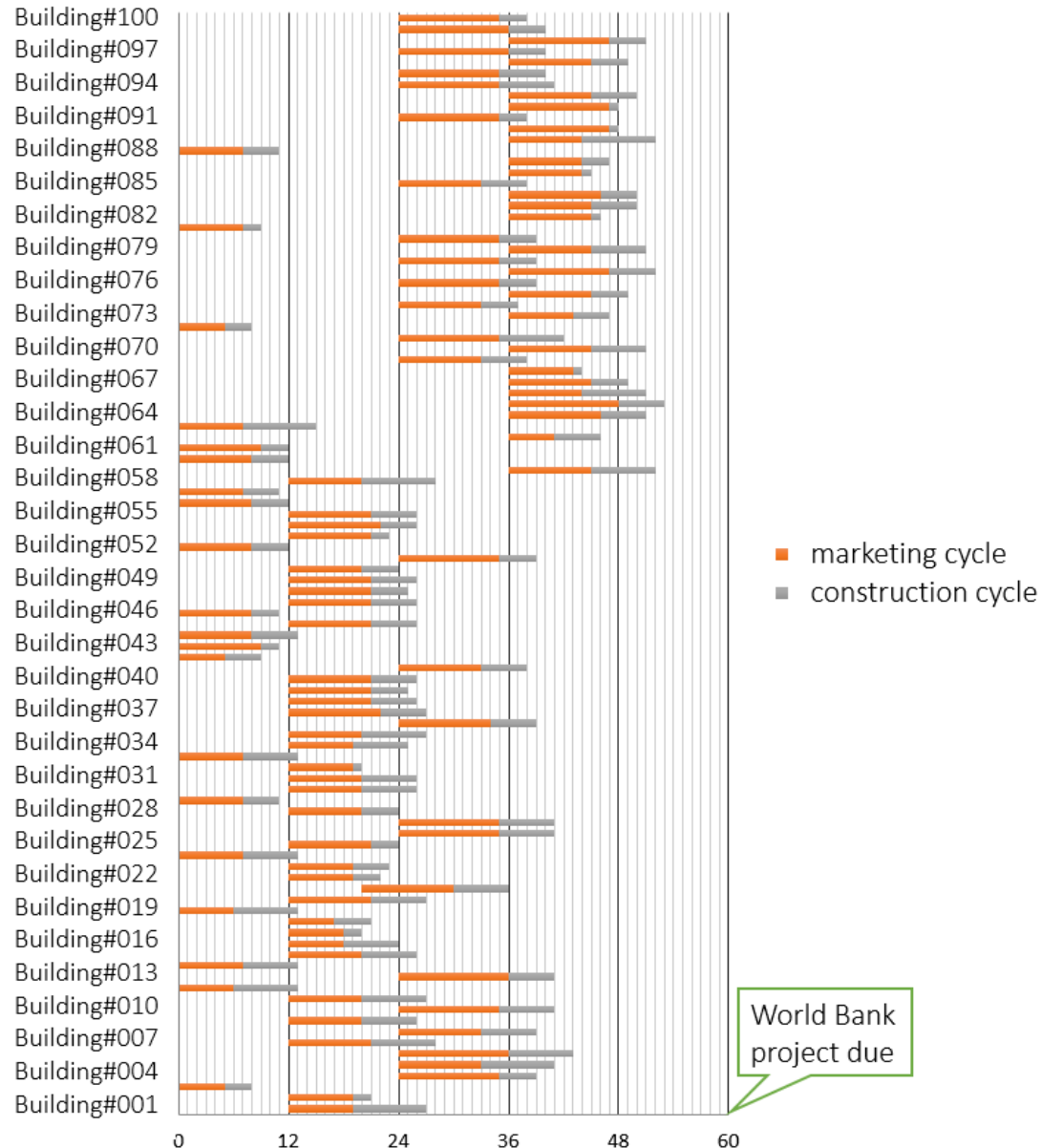**Questions municipalities will need to answer at this stage include the following:**

- What will the implementation plan for the EBEE targets and improvement program contain?

- Will there be a timeframe for buildings to achieve the EBEE targets?

- What tools and resources will be needed?

(Details in Target Playbook, pp.35)

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Develop D: Develop Implementation Plan

Changning District Case Study

Activity 1: Develop an Implementation Plan and Timeframe

– Phase I – focuses on improving EE in the buildings where actual EUI is higher than the target value. They represent large energy saving potential that can be achieved at lower cost (e.g., operational improvements, lighting retrofits).

– Phase II – focuses on improving EE in buildings where actual EUI is higher than the target value. They represent large energy saving potential that can be achieved at higher cost (e.g., envelop retrofit)

– Phase III – focuses on buildings where actual EUI is higher than the target value, but the actual energy saving potential is small

– Changning also constructed a time series plan for the program based on the WB project duration (5 years) and marketing cycle theory with PIP-CAT

Legend: marketing cycle (orange), construction cycle (gray)

World Bank project due

(Details in Target Playbook, pp.36-37)

Framework of city-level EBEE targets & improvement program

ASSESS I

DEVELOP II

IMPLEMENT III

IMPROVE IV

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Implement A: Implement Energy Saving Actions

Questions municipalities will need to answer at this stage include the following:

QUESTION LIST

- What procedures in a plan are needed to implement the voluntary EBEE target program?

- How will the stakeholders participate in and interact with each other in the implementation process?

Changning District Case Study

Activity 1: Analysis Possible Problems

Table 10. Comparison of Specialized Management Institutions and Traditional Models

Possible problems	Specialized management institutions model	Traditional models
Problem 1- Uncertainty of the owner's return on investment	▪Method- Policy and financial explanations ▪Effect- Help owners understanding the return on investment of the project and make quick judgments ▪Process- Organizing experts to perform evaluation during energy diagnosis process	▪Method- Measured by the owners or third parties ▪Effect- The calculation results are not comprehensive enough for specialized management organizations
Problem 2- Both parties of retrofit does not trust project cost, technology, and effectiveness	▪Method- Expert review system ▪Effect- In the perspective of fair and authoritative third parties, the retrofit plan and results will be evaluated to eliminate the mistrust of the owners and service companies ▪Process- Organizing experts to perform evaluation during remodeling process	▪Method- The third-party service company communicates with the owner individually ▪Effect- There is still a problem of mistrust between the owner and the service company
Problem 3- Is it possible to get financial subsidies?	▪Method- Pre-trial filing system ▪Effect- At the beginning of the retrofit project, the two parties carried out the identification of the retrofit project content, technology, energy saving rate and management requirements, and ensured that the subsidy was successfully obtained in the later stage of the project ▪Process- Filing acceptance	▪Method- Apply for subsidies after the project is completed ▪Effect- Many projects did not meet the subsidy requirements and lost the subsidy

Activity 2: Develop Project Management Processes
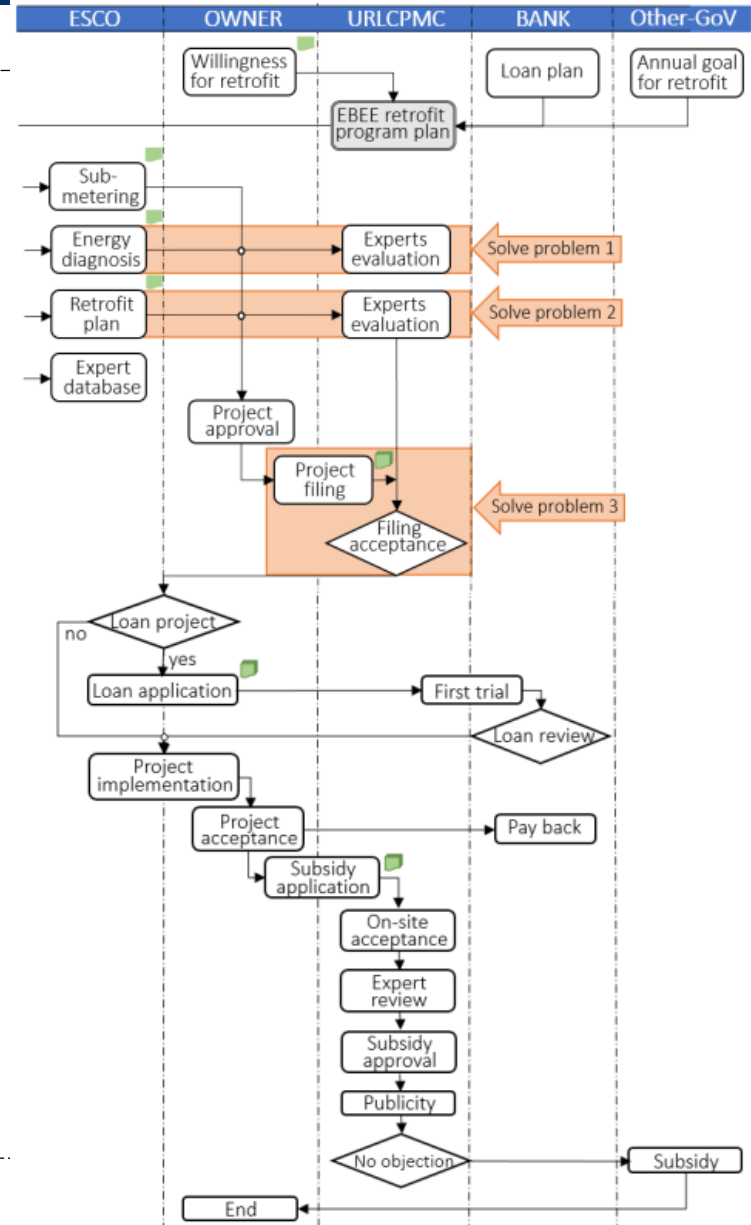
(Details in Target Playbook, pp.38-40)

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Implement B: Monitor Progress and Make Adjustments, Taking Immediate Action to Resolve Problems that Arise

Questions municipalities will need to answer at this stage include the following:

QUESTION LIST

- How will the impact of the EBEE targets and improvement program be measured and evaluated (e.g., what key performance indicators (KPI) will be measured and evaluated, how so, how often)?

- What outcome indicators will be used to evaluate the EBEE targets and improvement program?

- How will progress towards EBEE targets be measured and verified?

- Who will participate in measurement and verification (M&V)?

- What is the level of participation in the voluntary EBEE targets and improvement program?

- Identify problem areas and take corrective actions.

Implement B: Monitor Progress and Make Adjustments, Taking Immediate Action to Resolve Problems that Arise

Activity 1: Monitor Progress

- Changning continued to measure and evaluate the EBEE targets and improvement program's progress by using a few key performance indicators (KPI) include:
  - Number of buildings implementing EE measures
  - Total floor area implementing EE measures
  - Energy savings realized through EE measures
  - Energy savings rate realized through EE measures
  - Total CO_2 emission reduction through EE measures
  - Total subsidies approved to the EE measures
  - Percentage of the target achieved
- Monitor the progress is helpful for the government to take corresponding control or manage measures when necessary and facilitate a success of the program

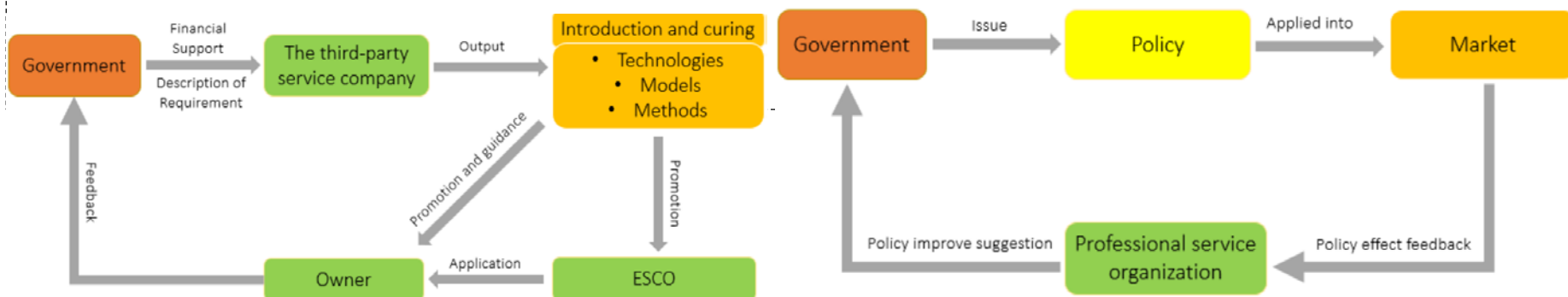**Activity 2: Build Feedback Mechanisms**

Figure 11. Technical effect feedback mechanism in Changning District (*Source*: SABR 2019, 20)

Figure 12. Policy effect feedback mechanism in Changning District (*Source*: SABR 2019, 20)

(Details in Target Playbook, pp.41-42)

Implement C: Showcase to Stakeholders and the Public What Results have been Achieved

Questions municipalities will need to answer at this stage include the following:

QUESTION LIST

- What level of energy and/or GHG emissions reductions have been achieved?

- What other benefits from the voluntary energy efficiency targets have been realized (e.g., increased market for energy efficiency services, increased building comfort)?

- To what extent have the targets helped to support energy and GHG emissions reductions in buildings?

- How can participants and outstanding performers be recognized (e.g., annual awards, certification, website)?

(Details in Target Playbook, pp.42-43)

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Implement C: Showcase to Stakeholders and the Public What Results have been Achieved

Changning District Case Study

Activity 1: Showcase to Stakeholders

– During the 60-month period of the WB project, the MOHURD Policy 2014-2016, the first completed project with good retrofit results had been summarized and presented to higher-level government departments, other ECB owners, WB&EFC and other relevant institutions. In the end, significant achievements have been made:

- – 45 ECBs have improved EE performance
- – with a total floor area of 2.87 million m2
- – the total energy saving is 31,233 TSC
- – the total emission reduction is 63,285 tons of CO_2
- – a total number of 18 buildings were subsidized by the Changning Government
- – with a total subsidy of 27.095 million RMB (US$3.93 million)

Activity 2: Public What Results have been Achieved

– URLCPMC of Changning participated in a lot Summit, Forum, Technical Seminar, etc., and established contacts with Asian banks, C40 and other international organizations to share experience. In China, professional forums, demonstration project brochures, promotion videos and training were held to introduce the cases, share the experiences and create impacts.

Framework of city-level EBEE targets & improvement program

ASSESS I

DEVELOP II

IMPLEMENT III

IMPROVE IV

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Improve A: Review and Evaluate Implementation, Impacts and Potential

Questions municipalities will need to answer at this stage include the following:

QUESTION LIST

- What is the level of participation in the targets program?

- What is the energy/GHG impact from the targets?

- How effective have the supporting tools/resources been?

- How effective have the incentives been?

- Has the institutional set-up been effective?

- What other benefits from the voluntary energy efficiency targets have been realized?

- What is the scale-up potential for the targets program (i.e., how can more buildings or savings be achieved)?

- How can these benefits be scaled?

Improve A: Review and Evaluate Implementation, Impacts and Potential

Changning District Case Study

Activity 1: Continually Extend and Improve the ECMP

– **187 commercial buildings online** the ECMP has been completed, effectively covering more than 95% of the large commercial buildings and state office buildings in the region.

– Changning also extended and upgraded ECMP's multiple functions and made the ECMP support governments and other relevant stakeholders
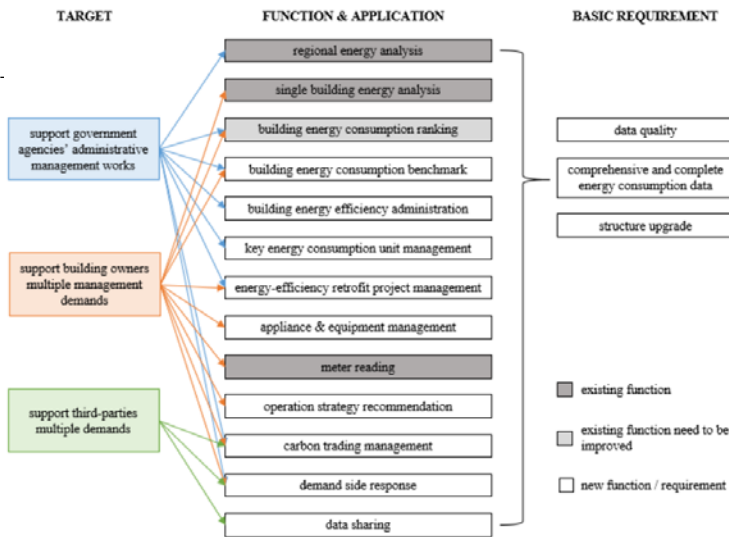

Figure 14. Top-level design structure diagram of ECMP in Changning in 2016
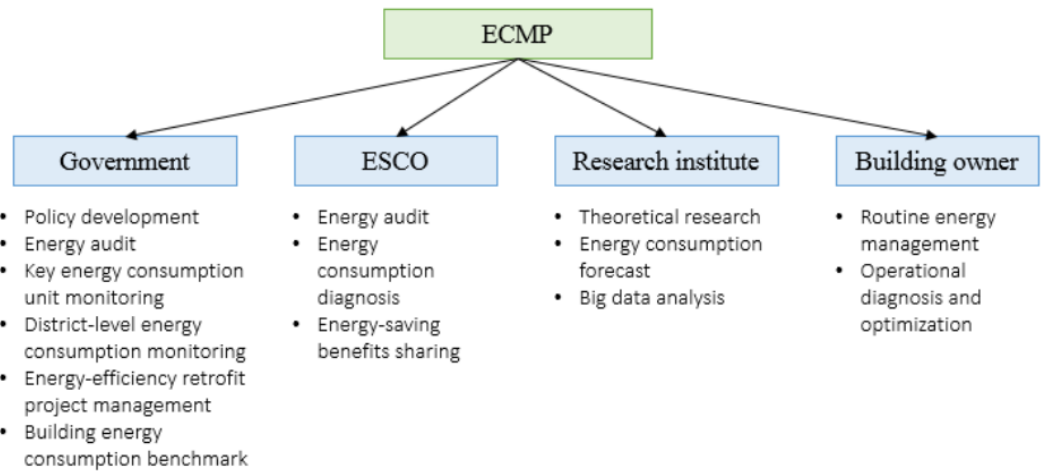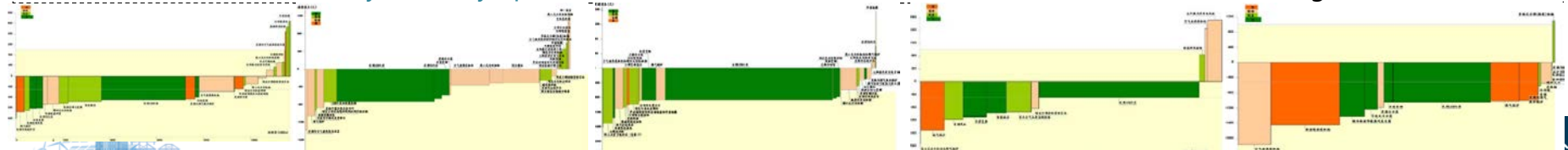(Source: SABR 2019, 48)

Figure 15. Top-level design structure diagram of ECMP in Changning in 2016

Activity 2: Update the Cost Curve

– Based on real data from 100 existing commercial buildings which had finished EE improvement, Shanghai and Changning continually improved the data accuracy for developing a set of updated cost curves include different ECB types to provide better guidance to EBEE projects in the area.

– These cost curves will be dynamically updated with more and more retrofitted ECBs data and information get involved in.

(Details in Target Playbook, pp.45-48)

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Changning District Case Study

Activity 3: Develop Useful Tools

– Based on the accumulated experiences and date, Changning's partner- the East China Architectural Design Institute (ECADI) developed an EBEE retrofit optimization tool:
  - Energy consumption status assessment & diagnose
  - Energy-efficiency technology introduction & display
  - Energy-efficiency retrofit plan & optimization
  - CO2 abatement cost curve
  - Case database

Activity 4: Review and Evaluate Impacts

– Changning plays a demonstrating role for low carbon city development
– Changning's exploration on EBEE provided practices on techniques, policies and mechanism
– Not only bring significant energy-saving and emission-reducing benefits and social benefits
– Introduced a set of internationally advanced project management methods and mechanisms
– Success in this pilot would be replicable

EBEE retrofit optimization tool developed in Changning by ECADI
(*Source:* http://2a20h48668.imwork.net)

(Details in Target Playbook, pp.48-50)

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Improve B: Analyze Evaluation Results to Assess Next Steps

Questions municipalities will need to answer at this stage include the following:

QUESTION LIST

- What has and hasn't worked well in the voluntary energy efficiency targets program?
- What is necessary to improve the targets program?
- Is it feasible to increase targets and/or apply them to more buildings?
- How can this be achieved, and in what timeframe?

Improve B: Analyze Evaluation Results to Assess Next Steps

Changning District Case Study

Activity 1: Plan for Next Steps	– For next steps, through the use of various energy-saving and low-carbon technologies in the Changning District, which has been comprehensively developed and well accumulated, a number of ECBs in this district and Shanghai municipal city will be further implemented, and the transformation modes and mechanisms will also be further explored.
	– In terms of technology, policies, and institutional mechanisms, Shanghai and China provides experience in building energy-saving renovation of existing buildings to promote the construction of low-carbon cities.

TIPS

- **Potential drivers for EBEE Program**
  - Internal: improve building service/comfort level; transfer energy saving potential to cost savings; optimize building function through renovation, etc.
  - External: requirement from authority; subsidy/incentive policies from government (central and/or local); persuaded by ESCOs or other stakeholders, etc.

- **About data**
  - Data are at the core of EBEE target setting and improvement.
  - Data basis is critical important for Building Energy Efficiency Improvement (BEEI). It affect/influence the feasibility and effect of BEEI program.
  - Regardless if one is determining a building energy savings potential, profiling abatement cost curves, or designating a baseline, massive building energy use data are necessary.
  - Continue to strengthen BE's data base is a long-term strategy.

- **About training**
  - There are often gaps among design phase, construction/implement phase and operation phase. Training to retrofit workers, building energy manager, and occupancies can reduce the gaps.

- **About information**
  - Information disclosure, publicity and sharing can reduce information asymmetry and promote EBEE Program.

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THANK YOU! QUESTIONS?

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