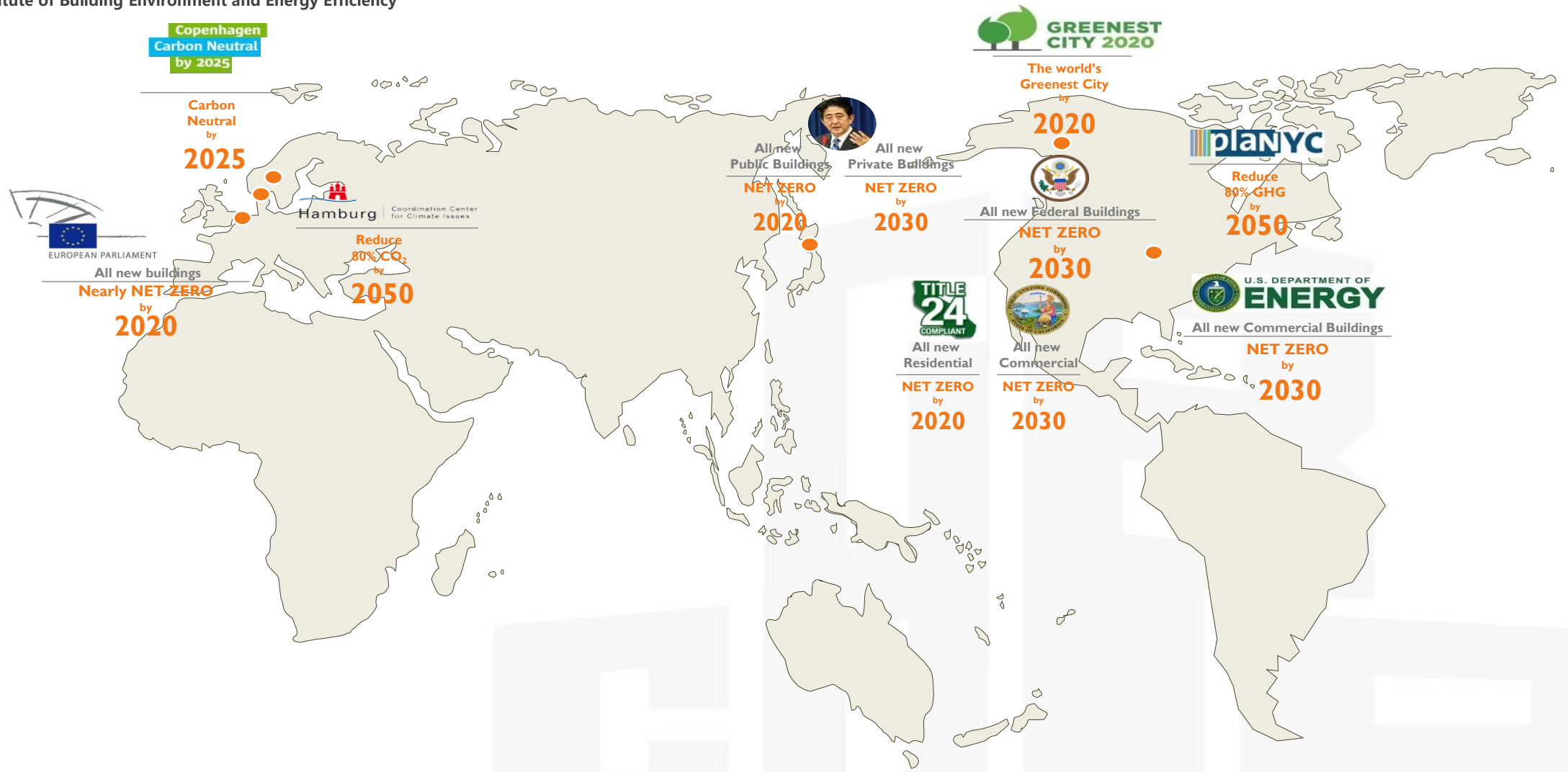
中國建築科學研究院
China Academy of Building Research
建筑环境与节能研究院
Institute of Building Environment and Energy Efficiency

Update on Nearly Zero Energy Building (NZEB) Development in China
– Standard, Policy and Case Studies

Xi Chen, Jianlin Wu
Institute of Building Environment and Energy, CABR
Sep. 21, 2018

NAPHC2018， Boston

NZEB worldwide



Source: Yaki Wo， Architecture 2030，ywo@architecture2030.org

In China

Hamburg city exhibition building at

Shanghai Expo 2010

Riverside Apartment in

Qinhuangdao, Hebei Province

CABR Nearly Zero Energy

Building, Beijing

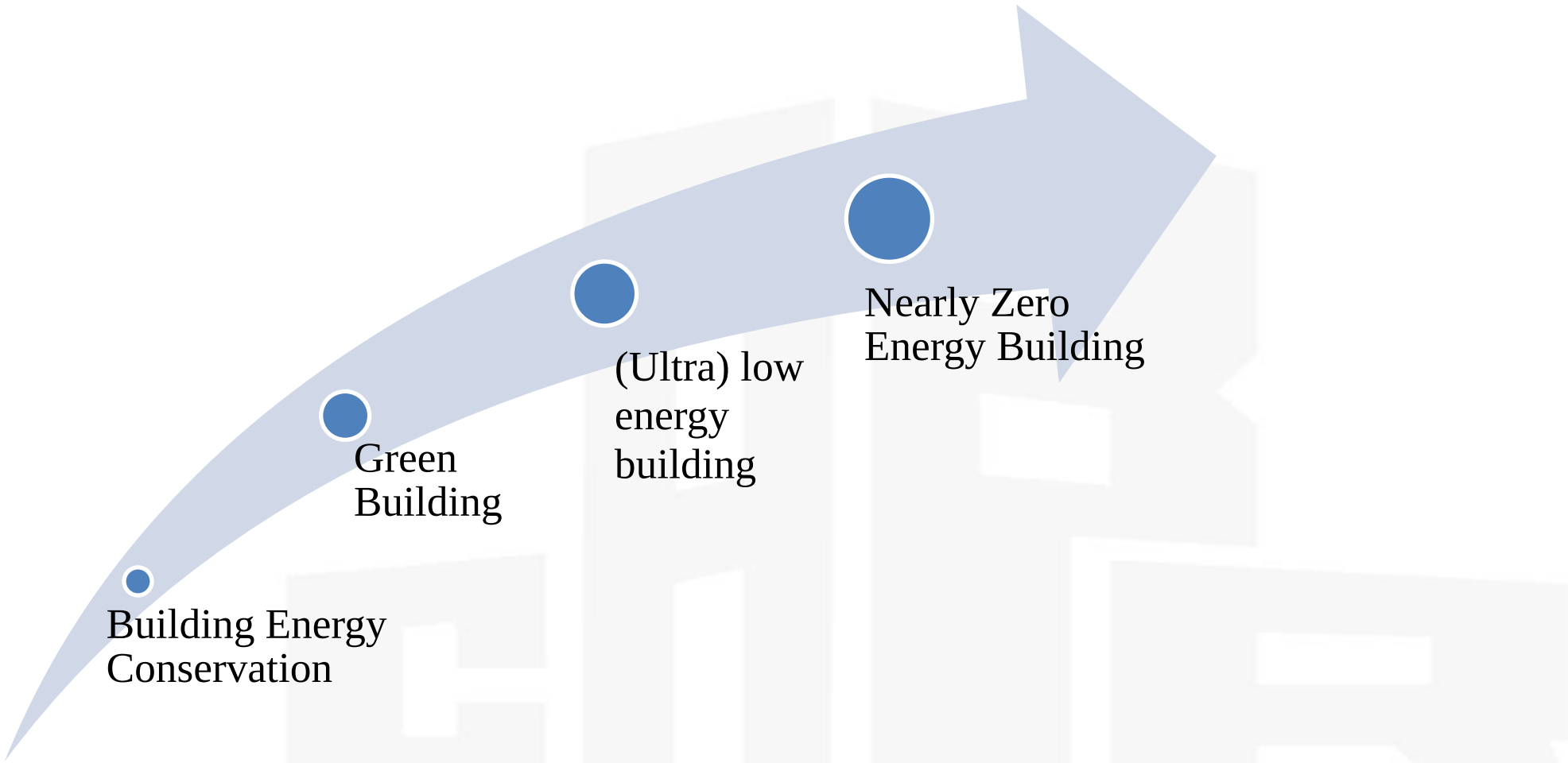
Outline

1. Standards and code
2. Policy and incentive
3. Study on NZEB best practice
4. Other related work

Outline

1. **Standards and code**
2. Policy and incentive
3. Study on NZEB best practice
4. Other related work

Standards and code



Development of ULEB and NZEB standards and code in China

（1）Learn from development paths and experience from US and European countries. Adapted to China's BEE status, climate zone, building type, occupants behavior etc. Develop standard and code for ultra-low-energy and nearly zero-energy building with Chinese characteristics.

（2）Progressive promotion of nearly zero-energy buildings from 2015.
Definition: low-energy building, ultra-low-energy building, nearly-zero-energy building, net-zero-energy building.

（3）Different indicator system for public and residential buildings.

MOHURD issued Technical Guideline for Passive Ultra-Low-Energy Green Buildings

住房城乡建设部文件

建科〔2015〕179号

住房城乡建设部关于印发被动式超低能耗绿色建筑技术导则（试行）（居住建筑）的通知

各省、自治区住房城乡建设厅，直辖市建委，新疆生产建设兵团建设局：

为贯彻落实党中央、国务院推进生态文明和新型城镇化建设的战略部署，进一步提高建筑节能与绿色建筑发展水平，在充分借鉴国外被动式超低能耗建筑建设经验并结合我国工程实践的基础上，我部制定了《被动式超低能耗绿色建筑技术导则（试行）

— 1 —

目录

First technical guideline for ULEB in China, Issued on Nov. 2015

National standard “Technical Standards for Nearly Zero-Energy Buildings”

- Compiled by 50 agencies.
- Public buildings+Residential builidngs
- Covering design, construction, operation and evaluation.
- Launched in Jul 2017
- Currently open for comments
- To be published in Dec 2018.

First national standard for NZEB in China, To be released on Dec. 2015

Provincial and city-level ULEB code

- Hebei: Passive Low Energy Residential Building Energy Efficiency Design Code-2015
- Shandong: Passive Low Energy Residential Building Energy Efficiency Design Code-2016
- Qingdao: Passive Low Energy Building Energy Efficiency Technical Guileline-2015
- Hebei: Specification for Construction and Acceptance of Passive Low Energy Buildings-2017
- Hebei Passive Low Energy Public Building Energy Efficiency Design Code-2018
- Beijing Ultra Low Energy Building Energy Efficiency Design Code-2018
- Topics: fundamentals, index, design, construction, O&M, evaluation, pilots
- Research period: 2017-2010
- National Science and Technology Demonstration Project

Technical requirement for ULEBs in China

I Residential building

Climate zone		Severe Cold	Cold	Hot summer and cold winter	How summer and warm winter	Mild
Energy	Annual heating load (kWh/m^2a)	≤18	≤15	≤5		
	Annual heating load (kWh/m^2a)	$\leq 3.5+2.0*WDH_{20}+2.2*DDH_{28}$				
	Primary energy consumption (for heating, cooling and lighting)	≤60kWh/m^2a (or 7.4kgce/m^2a)				
Air tightness	N_{50} (Air exchange rate under 50Pa)	≤0.6				

WDH20 (Wet-bulb Degree Hour 20): accumulation of the difference between the wet-bulb temperature and 20oC when the wet-bulb temperature is above 20oC in a year.
DDH28 (Dry-bulb Degree Hour 28): accumulation of the difference between the dry-bulb temperature and 28oC when the dry-bulb temperature is above 28oC in a year.

II Public building

Energy: additional saving of 60% vs. reference building conforming to national BEE standard
Airtightness: N50 <1.0

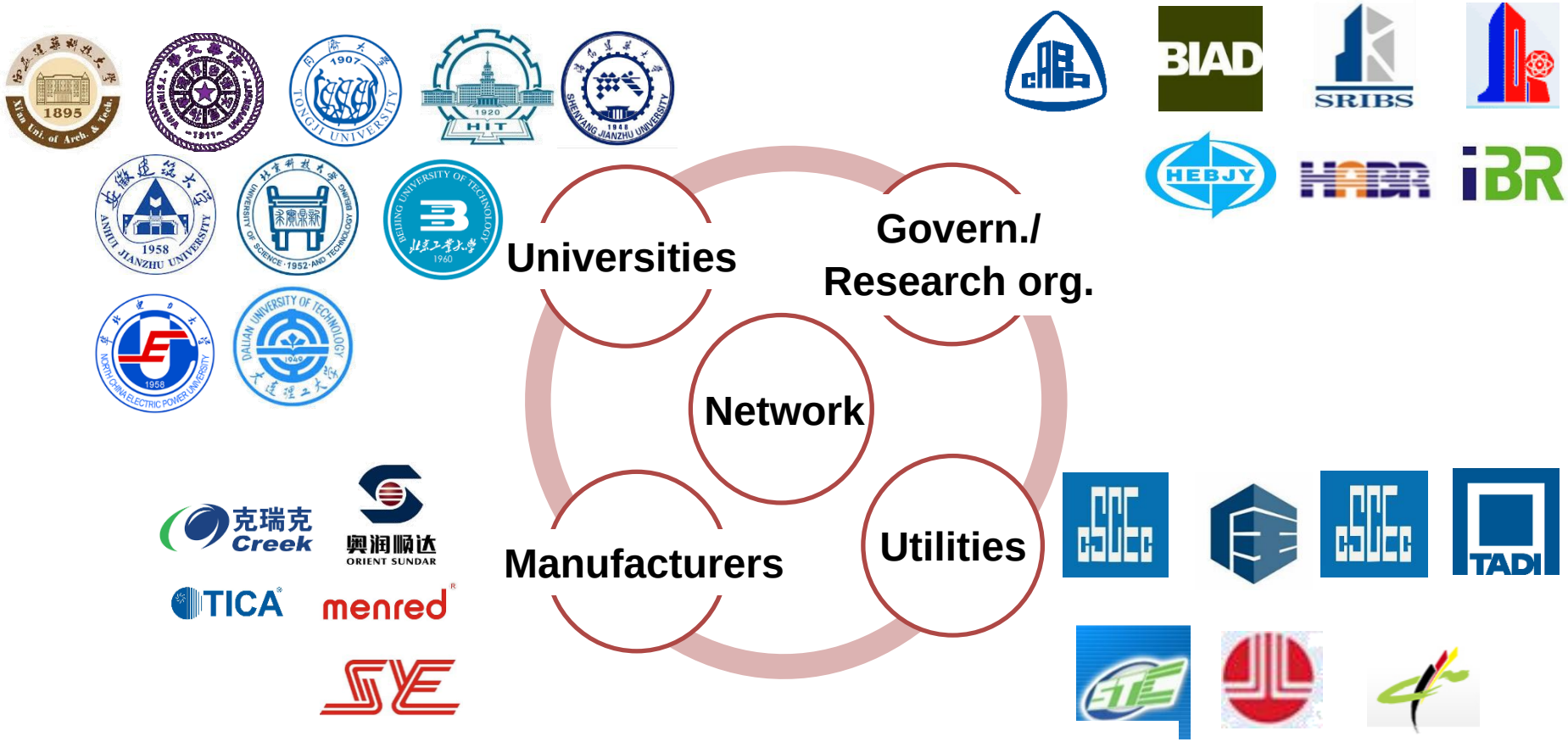
Key R&D Plan of “13th FYP”

“Technological System and Key Technologies for Nearly Zero-Energy Buildings”

- 120 Million RMB Research Fund
- Led by CABR, Participated by 29 agencies
- Topics: fundamentals, index, design, construction, O&M, evaluation, pilots
- Research period: 2017-2010
- National Science and Technology Demonstration Project

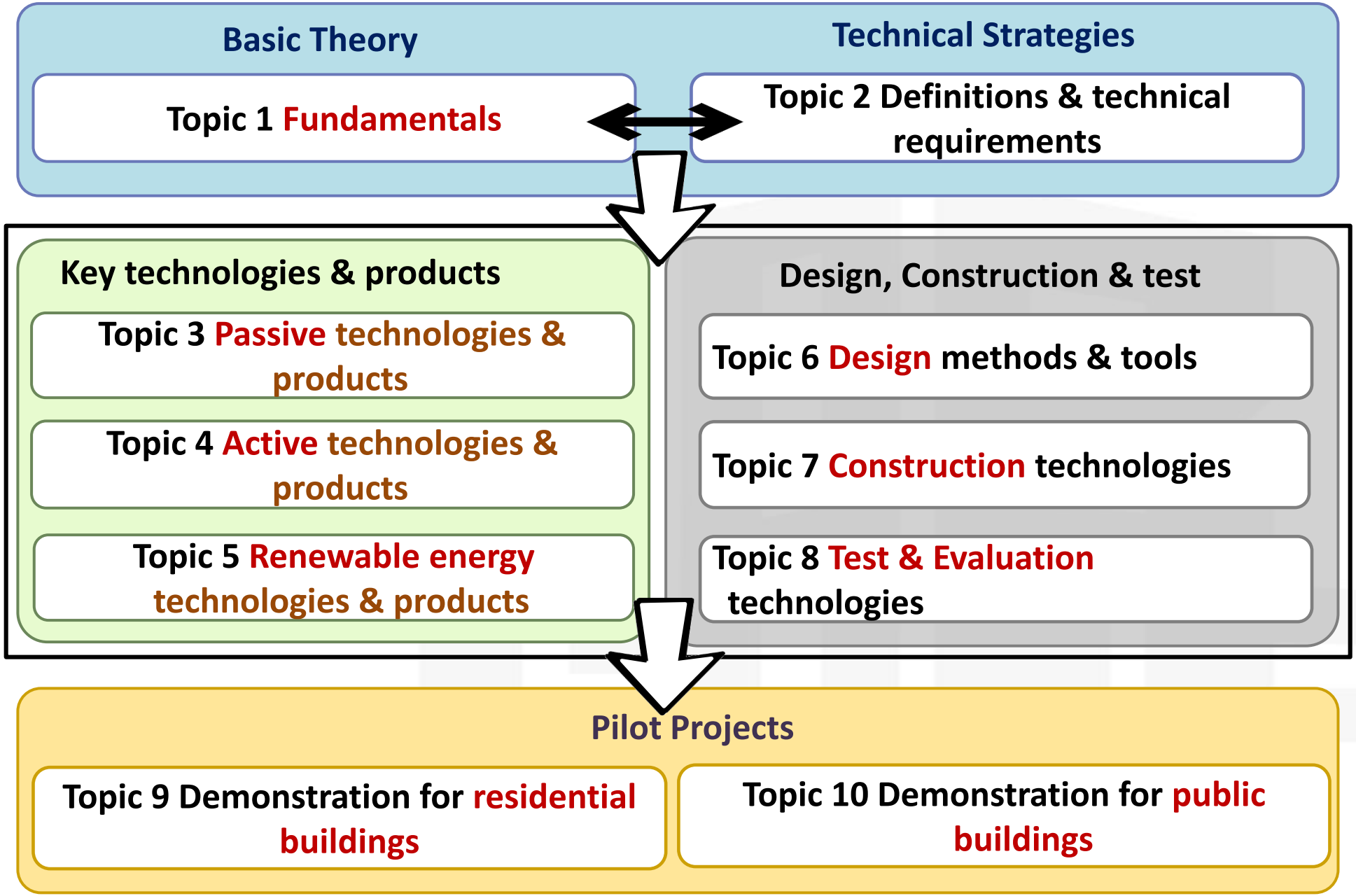
Key R&D Plan of “13th FYP”

“Technological System and Key Technologies for Nearly Zero-Energy Buildings”



Funding Amount: USD 19.5 million

Standards and code



Outline

1. Standards and code
2. **Policy and incentive**
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Policy and incentive

1 13th Five-Year-Plan for Development of Energy Efficient Building and Green Buildings

"Carry out ultra-low-energy building and nearly zero-energy building construction pilot projects. By 2020, over 10 million ㎡ of ultra-low-energy buildings and nearly zero-energy buildings shall be constructed. Encourage zero-energy building and positive energy building pilot projects."

2 13th FYP for Housing and Urban-Rural Construction

"Construct ultra-low-energy or nearly zero-energy demonstration buildings in areas with different weather conditions as soon as possible to let building energy efficiency become models and play the leading role."

"Launch ultra-low-energy community pilot project."

3 Hebei：Provincial and Municipal Policies

Provincial:

1,000,000 m^2 of ultra-low-energy building constructed by 2020
Subsidy of RMB 3,000,000 for ultra-low-energy pilot projects.
Subsidy of RMB 600/m^2 for pilot building renovated according to ultra-low-energy standard.

City of Shijiazhuang & Baoding:

200,000/Mu discount of land acquisition cost for ultra-low-energy buildings in down-town area.
Extra 9% of above-ground buildable floor area.
Sale price cap raised by 30%.
Subsidy of RMB 300/m^2 for ultra-low-energy pilot projects.

Policy and incentive

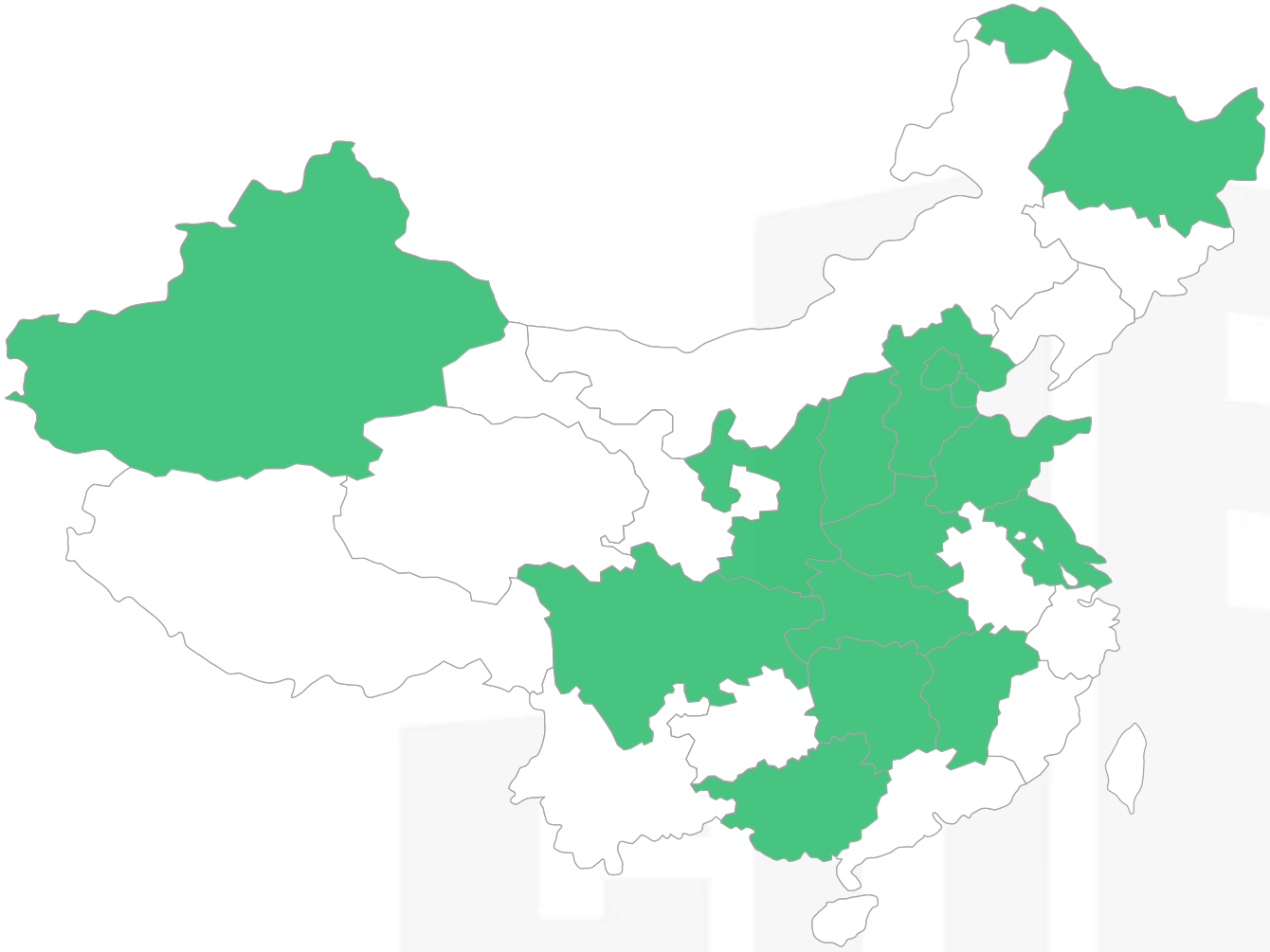
4 Beijing: Action plan for the development of ultra low energy building (2016-2018)

No less than 300,000 m^2 of ultra-low-energy demonstration buildings shall be constructed from 2016-2020, among which, at least 200,000 m^2 will be supported by government fund.
Subsidy level: 2016-1000 RMB/m^2, 2017-800 RMB/m^2, 2018-600 RMB/m^2
Promote large-scale development of ultra-low-energy buildings in ecological demonstration zones like city center.

5 Shandong: Fund for building energy efficient and green buildings

Provide financial incentives for passive ultra-low-energy buildings based on incremental costs. The thresholds for residential and public buildings are 5000㎡ and 3000㎡ respectively.

Policy and incentive



Provinces with supporting policy for ultra low energy building

Outline

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Early results of national pilot projects

Name	Location	Typy	Climate	Floor Area (m^2)	Occupancy	Target	Real Energy Consumption or Calculated Energy Consumption
VELUX Office Building	Langfang	Public	Cold	2014	Full	Active House	Energy Efficiency 75%
Happy Castle Commercial Building	Urumchi	Public	Severely Cold	4520	Partial	Passive House	Cumulative Heating Load: 19kwh/m^2·a
CABR Demonstration Building	Beijing	Cold	Cold	4025	Full	NZEB	Disclosed Energy Consumption 23kwh/m^2·a* (real-time)
Landsea Brooker Hotel	Huzhou	Public	Severely Cold	2445	Intermittent Use	Passive House	Cumulative Heating Load 15kwh/m^2·a Cumulative Cooling Load 31kwh/m^2·a
Riverside	Qinhuangdao	Residential	Cold	28050	Small Part	Sino-Germany Cooperation Low-Energy	Cumulative Heating Load≤15kwh/m^2·a
Xishutingyuan B4	Harbin	Residential	Severely Cold	7800	Small Part	Sino-Germany Cooperation Low-Energy	Cumulative Heating Load≤15kwh/m^2·a

***Energy consumption of heating, air-conditioning and lighting**

Study on NZEB best practice

Sichuan Office Building
China New Building Huagou Nearly Zero-Energy Demonstration Building
13,078 ㎡

Hebei Residential Building
Train City
340,000 ㎡

Tianjin Residential Building
Ecological City Passive Houses
14,000 ㎡

Beijing Office Building
CABR Nearly Zero-Energy Demonstration Building
4,200 ㎡

Henan School
Menred Nearly Zero-Energy Experience Center

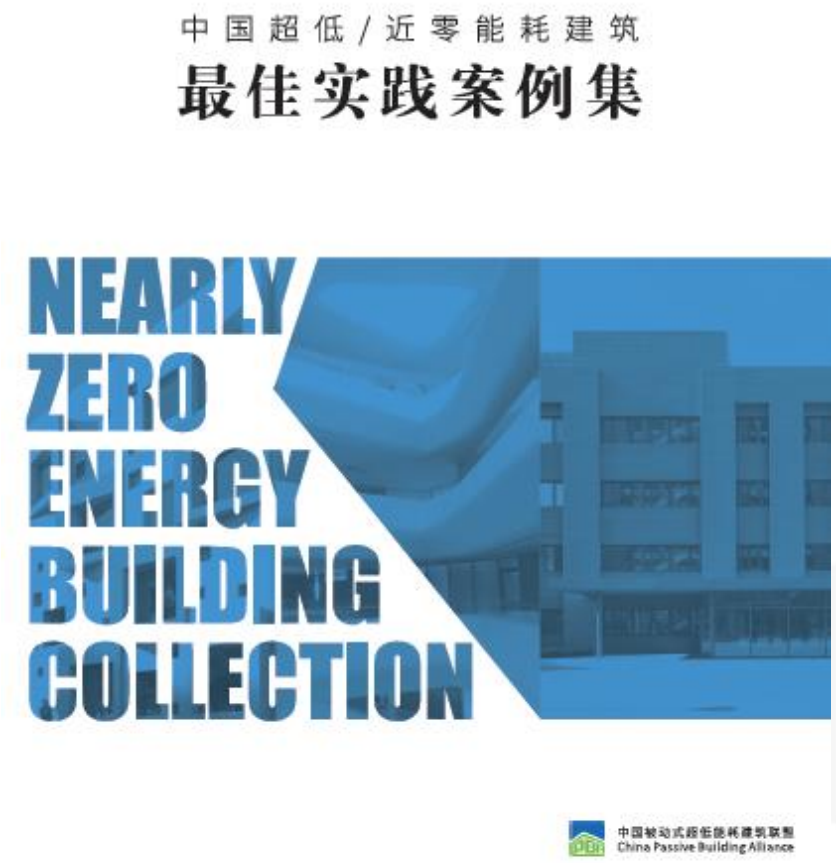
Shandong School
Shandong Urban Construction Vocational College Experiment and Training Center
20,383 ㎡

Wenzhou, Zhejiang Office Building
Menred Nearly Zero-Energy Experience Center

Zhuhai Exhibition Center Gree
Nearly Zero-Energy Experience Center

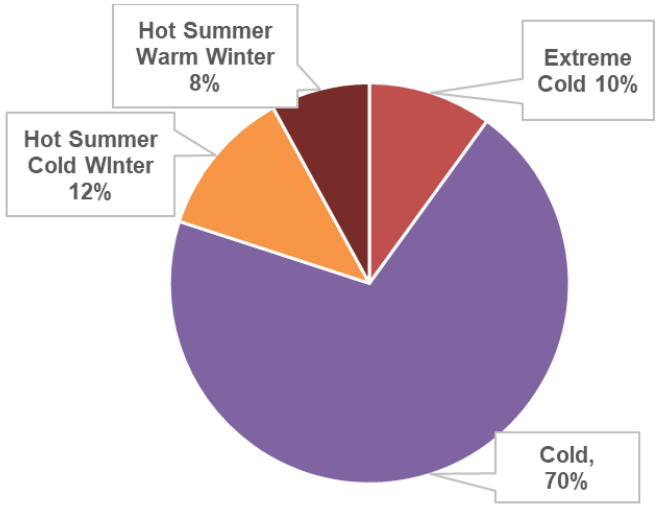
Shandong Excibition Building
Qingdao Ecological Park Passive House Experience Center 10,000 ㎡

Collection of Best Practice of ULEB/NZEB in China

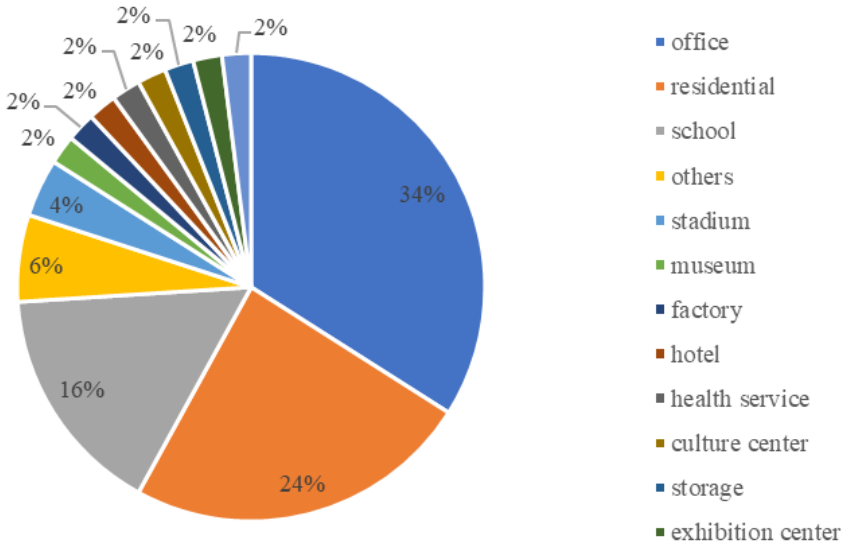


- **Compiled by 33 Institution, developer and agencies.**
- **Information of 50 NZEB pilot projects.**
- **Published in late July, 2017.**
- **First Chinese ULEB Open House in Sep. 2017.**

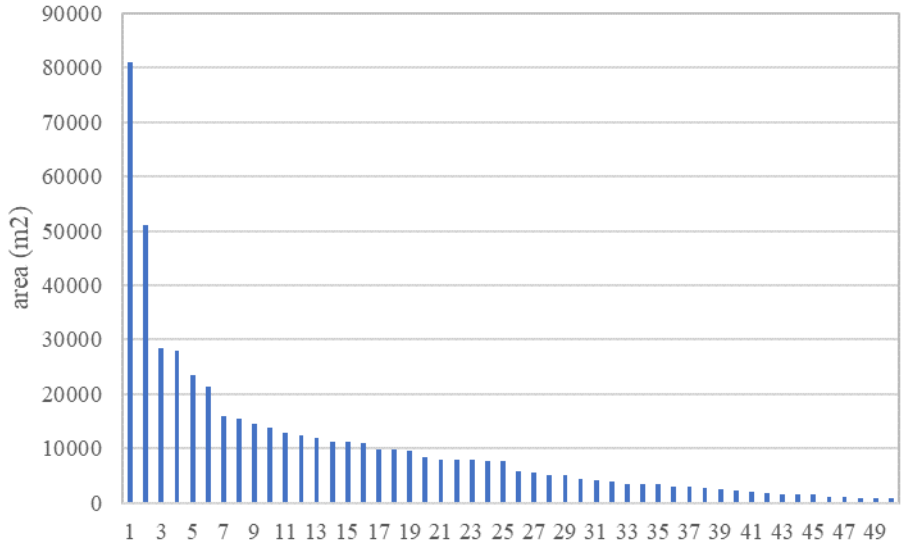
Study on NZEB best practice



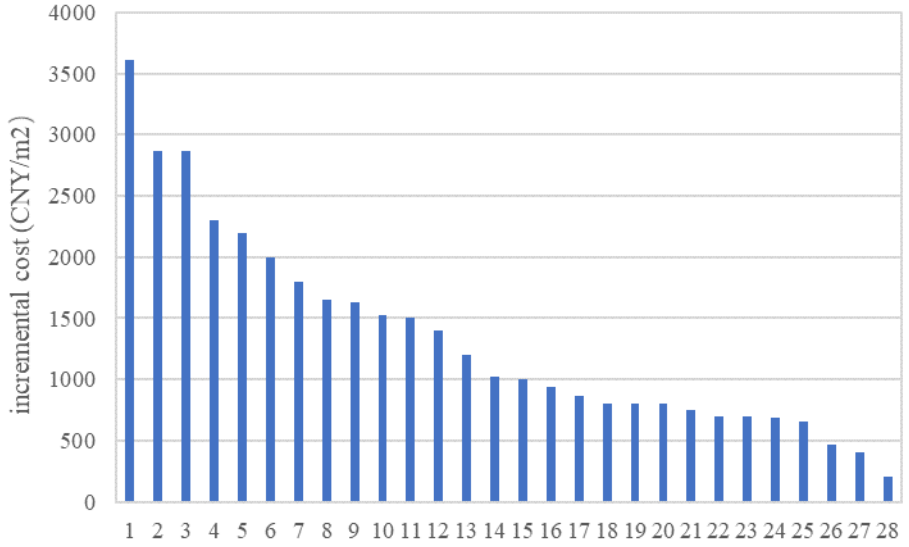
Percentage of ULEB demonstration buildings by climate zone



Percentage of ULEB demonstration buildings by building type

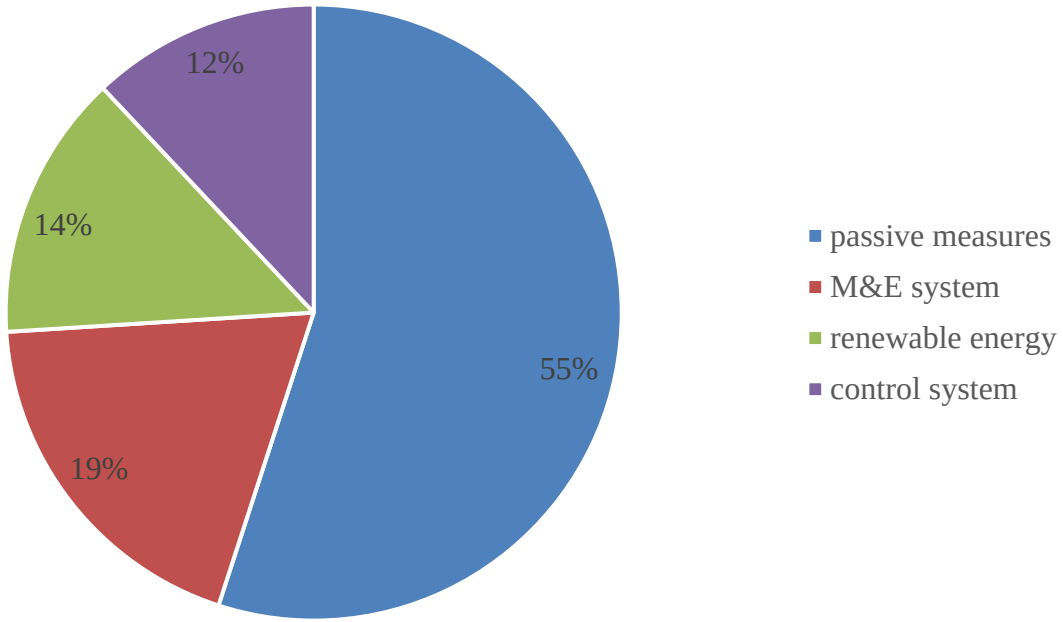


Ultra low energy demonstration buildings by area

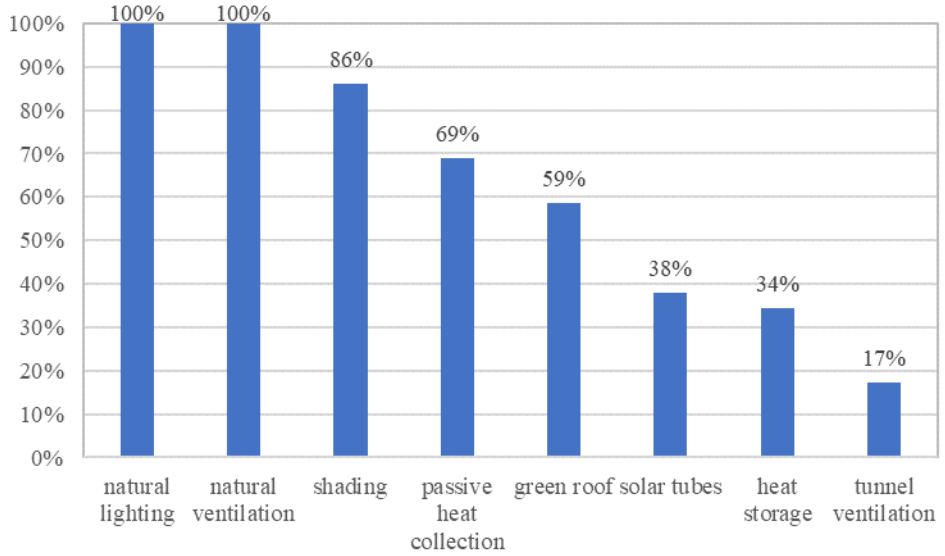


Ultra low energy demonstration buildings by incremental cost

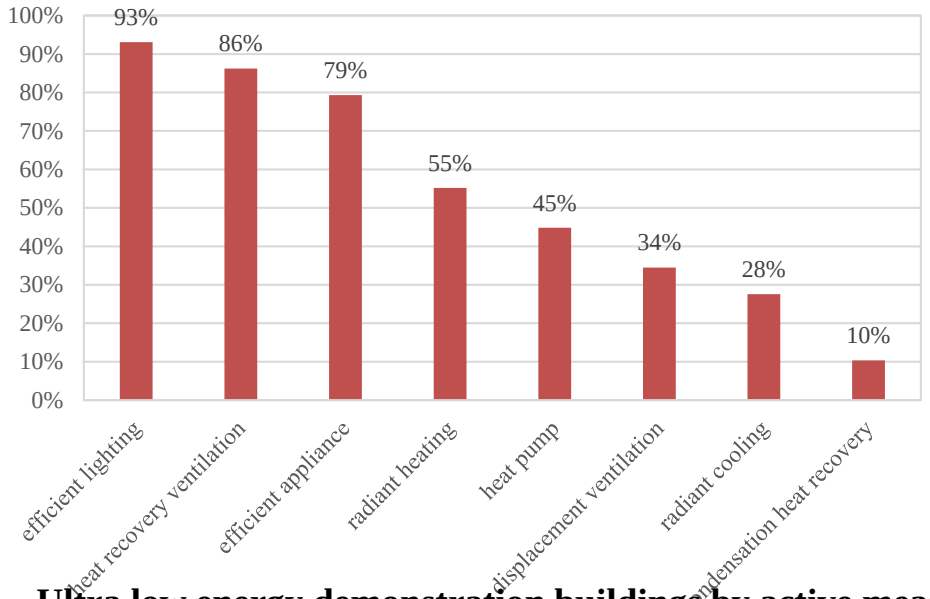
Study on NZEB best practice



Average incremental costs by system of technical measures for ULEB demonstration buildings



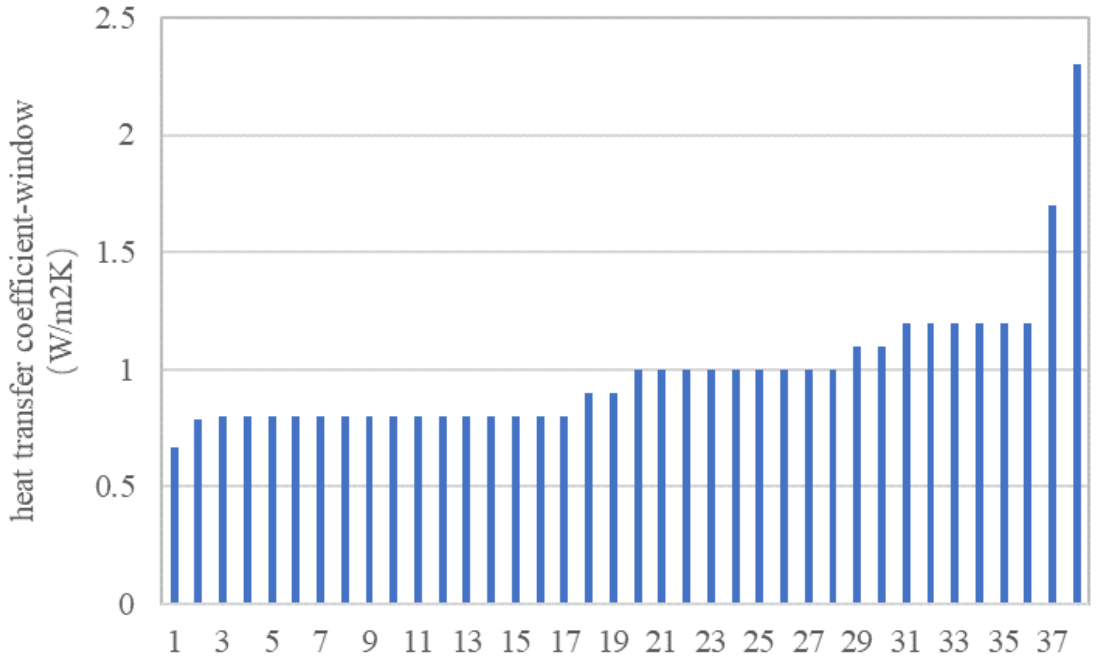
Ultra low energy demonstration buildings by passive measures



Ultra low energy demonstration buildings by active measures

Study on NZEB best practice

Heat transfer coefficients roof and wall for ULEB demonstration buildings



Heat transfer coefficients of windows for ULEB demonstration buildings

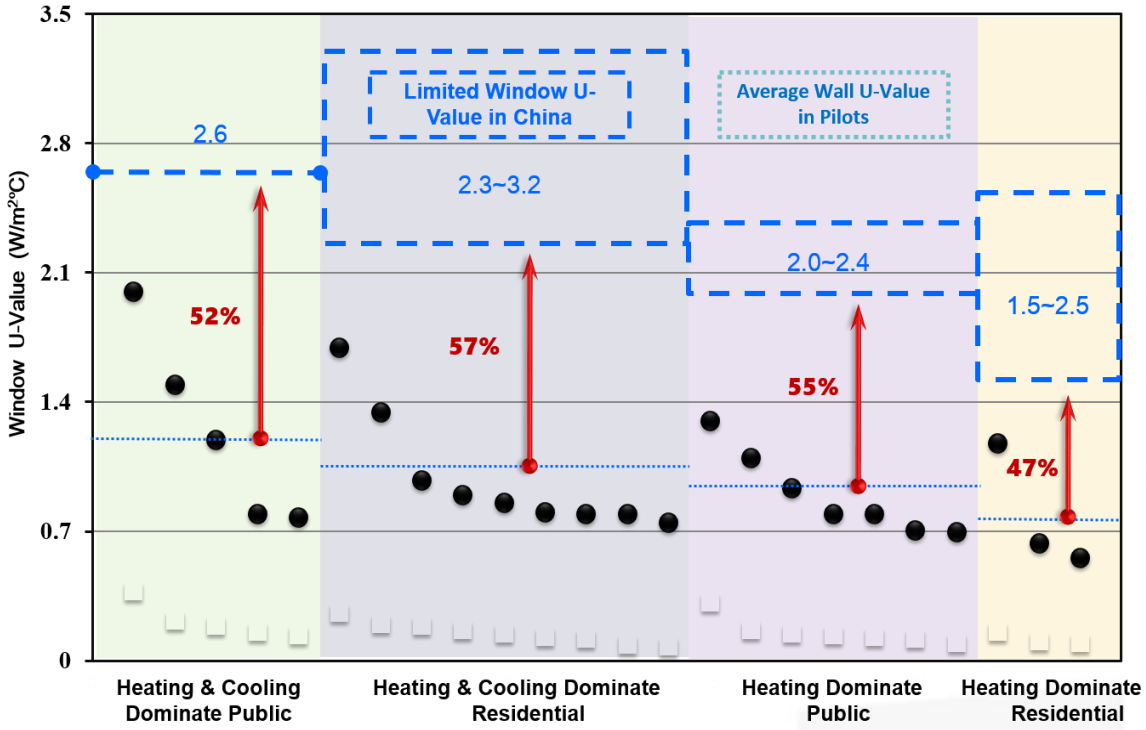
Roof & Wall:

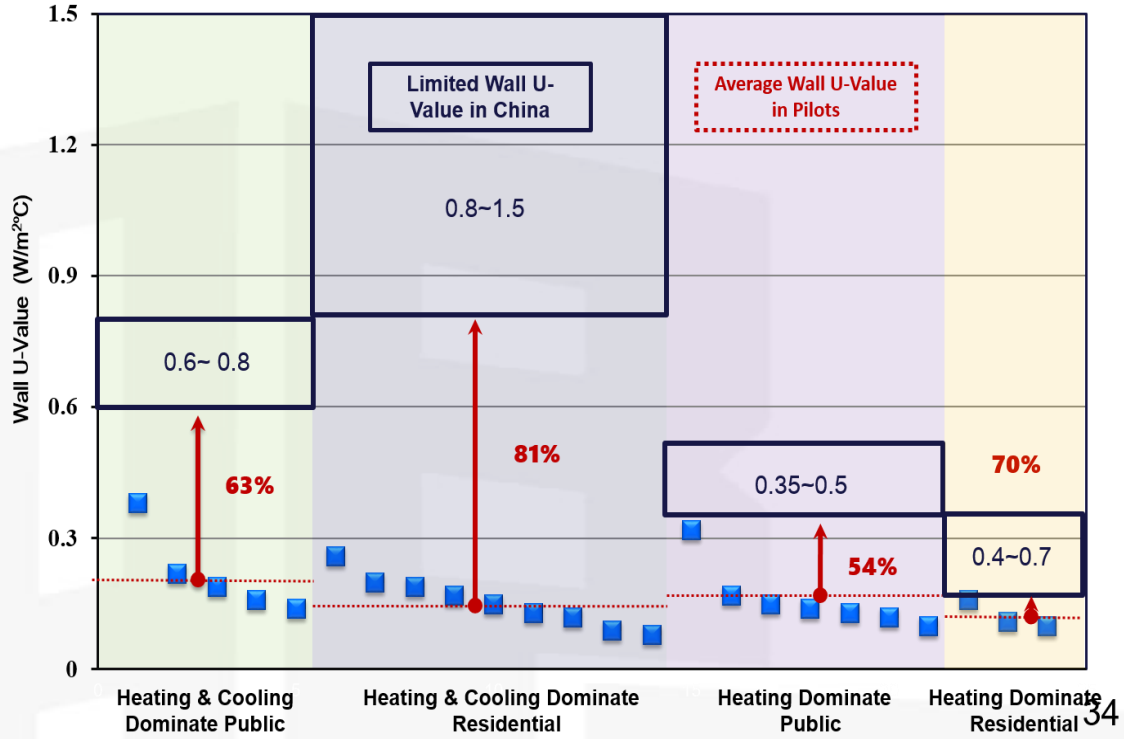
- Heat transfer coefficient adopted smaller heat transfer coefficient than the code limit.
- Most roof/wall below 0.15W/m^{2}K, only about 35% of the code limit.

Windows:

- Lower transfer coefficient and higher SHGC than the code limit.
- Triple-pane windows, K value below 1.2W/m^{2}K, code limit: 2.0~2.5/m^{2}K

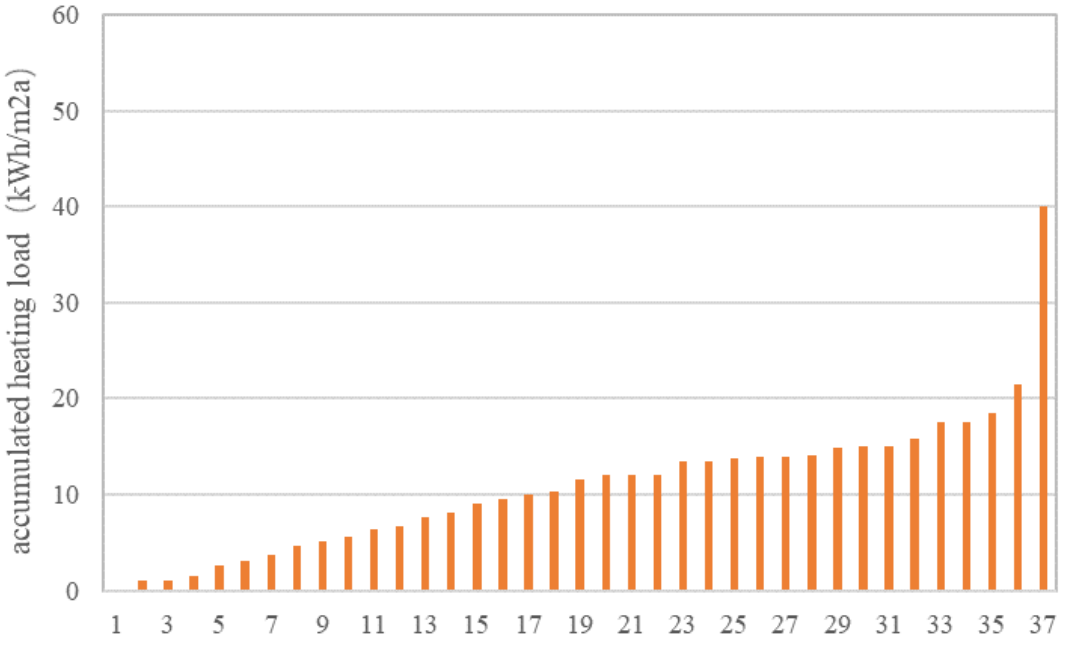
Study on NZEB best practice



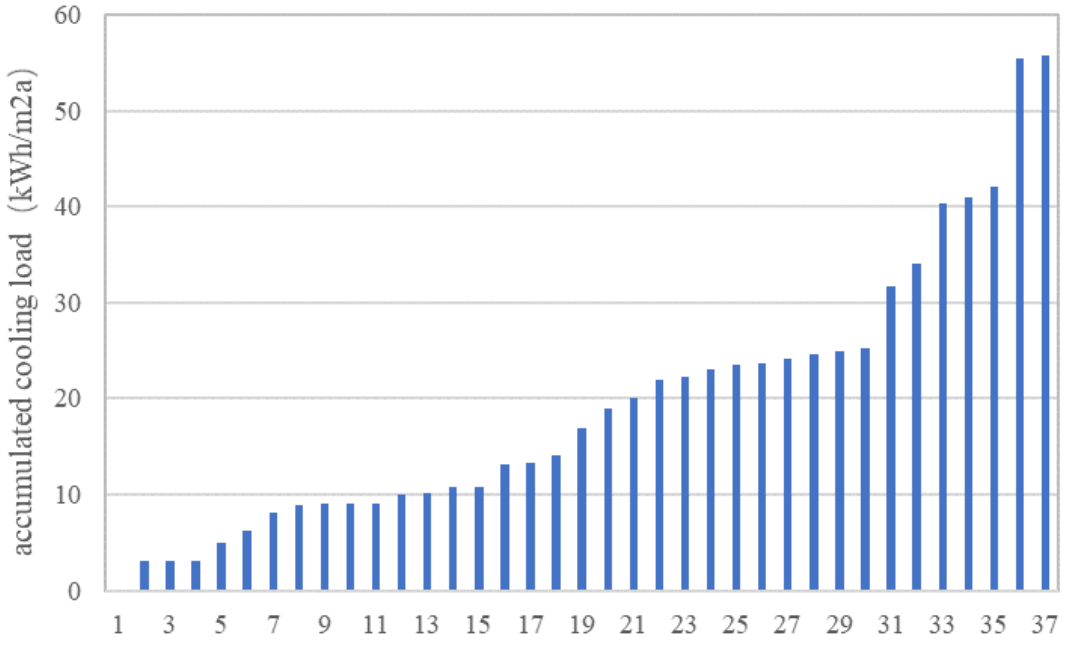


The gap between the best practices and the building codes now is the future trend of China building codes revision.

Study on NZEB best practice



Accumulated heating load for ULEB demonstration buildings



Accumulated cooling load for ULEB demonstration buildings

- **Accumulated heating load of most ULEB demonstration projects are below 15kWh/m2.a, in line with passive house criteria.**
- **Accumulated cooling load given in the figure 16 range from 3 to over 50 kWh/m2a, varying with climate zones with different cooling and dehumidification demand.**

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1. Standards and code
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4. **Other related work**

MOHURD Testing on Ultra-Low-Energy Buildings

Nearly Zero Energy Building Label

Nov. 2016：
17 projects

Nov. 2017：
14 projects

Dec. 2018： 30+ projects upcoming

China-US Clean Energy Research Center Program Phase 1.0-2.0 （2012-2020）

Partners

China	Overseas

Energy Consumption

Target: 25 kWh/(m^2.a)

Winter: zero use of fossil fuel for heating

Summer: cooling energy consumption reduced by 50%

CERC demonstration project: China Academy of Building Research – Nearly Zero Energy Building

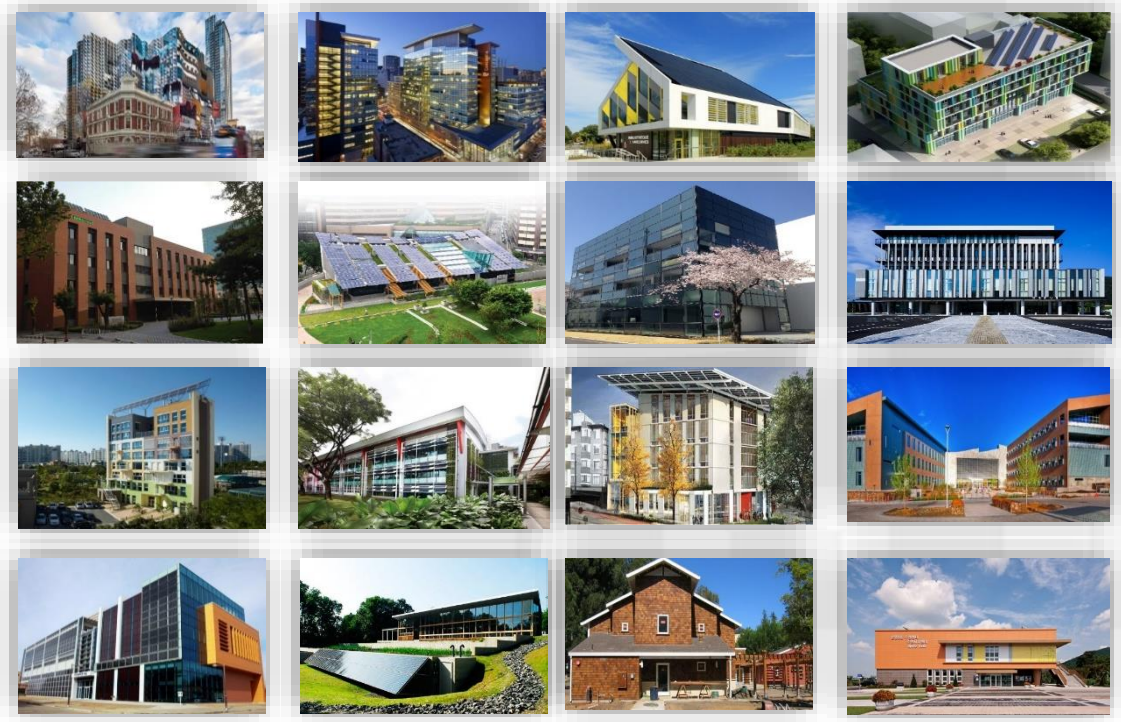
China-Germany Passive Building Technology Cooperation

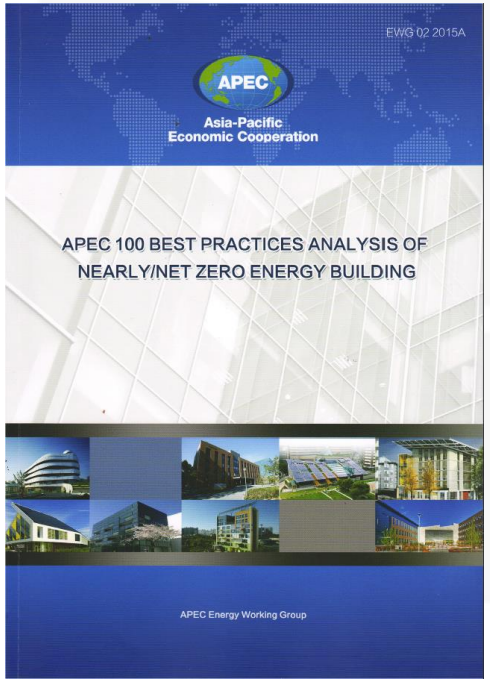
◆China-Germany Ecological Park
◆MOHURD International Science & Technology Cooperation——Passive Buildings
◆China-EU Nearly Zero-Energy Building Seminar

APEC Nearly/Net Zero Energy Building Program (2012-2020)

Program under APEC energy working group, 52 experts from 43 research institutes in 21 economies of APEC

- **Phase I （2013-2014）Research on policies and standards for APEC nearly zero-energy buildings**
- **Phase II （2016-2016）Research on typical projects and best cases of APEC nearly zero-energy buildings**
- **Phase III（2017-2018） Research on the roadmap of APEC nearly zero-energy buildings**





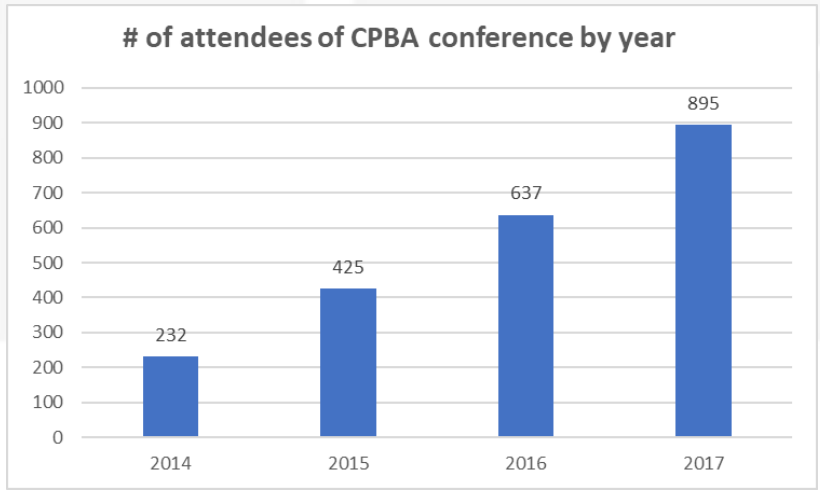
China National NZEB Conference (CPBA)

1st national NZEB conference, Gaobeidian, Shandong Province

2nd national NZEB conference, Qingdao, Shandong Province

3rd national NZEB conference, Jinan, Shandong Province

4th national NZEB conference, Gaobeidian, Hebei Province



Other related work

Training of Technical Guideline for Passive Ultra-Low-Energy Green Buildings by MOHURD, Gaobeidian, Qingtao: 1000 Trainees

Other related work

Industry Alliance

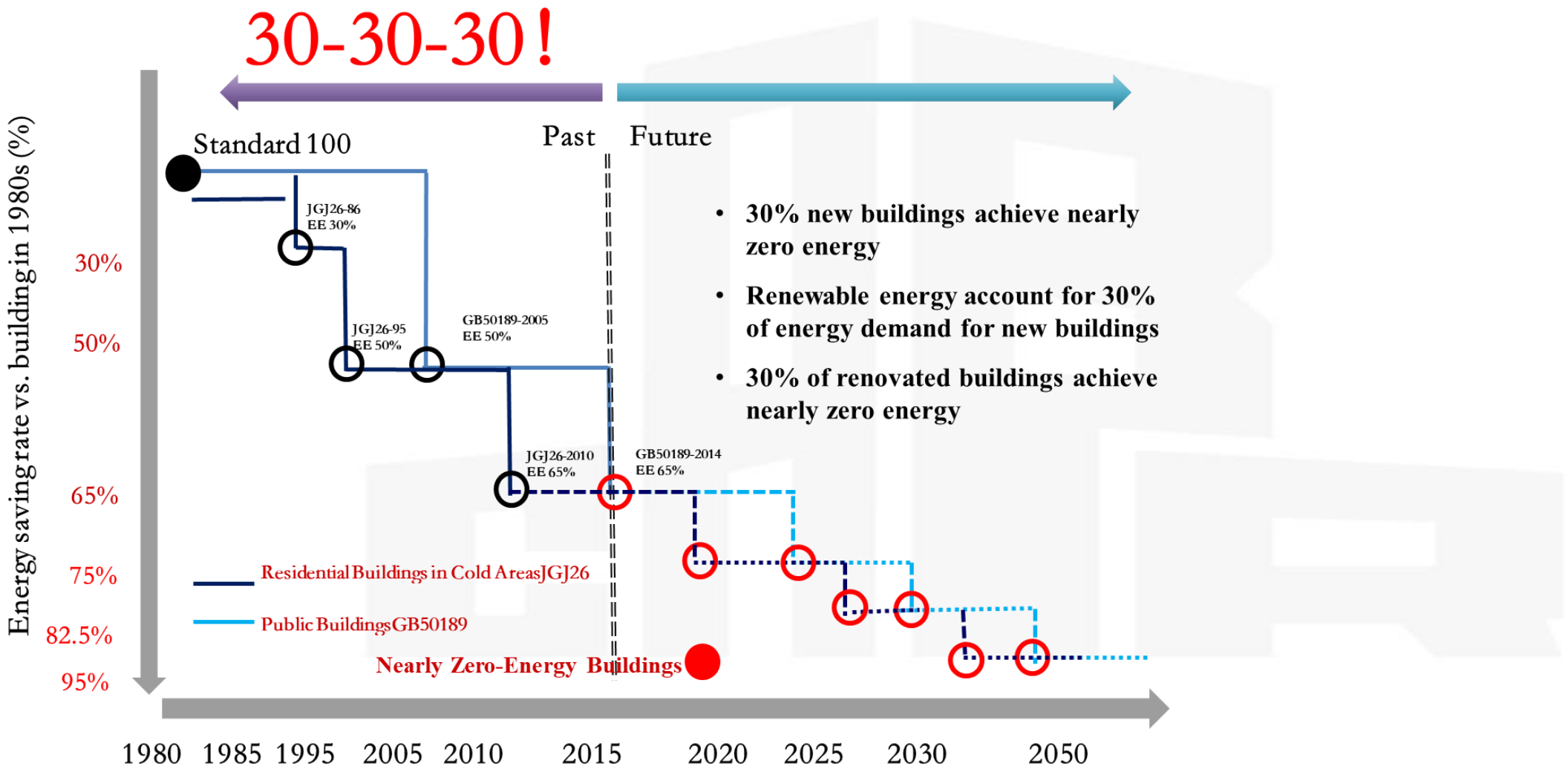
CHINA PASSIVE BUILDING ALLIANCE, or CPBA, under China Association of Building Energy Efficiency

中国被动式超低能耗建筑联盟
CHINA PASSIVE BUILDING ALLIANCE

CABR in charge of primary work

Concluding remarks

China Building Energy Efficiency Standard Roadmap



China Building Energy Efficiency Near-long Term Target

1. Plus energy building
2. Net zero energy building
3. Nearly zero energy building
4. Ultra low energy building
5. Low energy building
6. Code compliant building

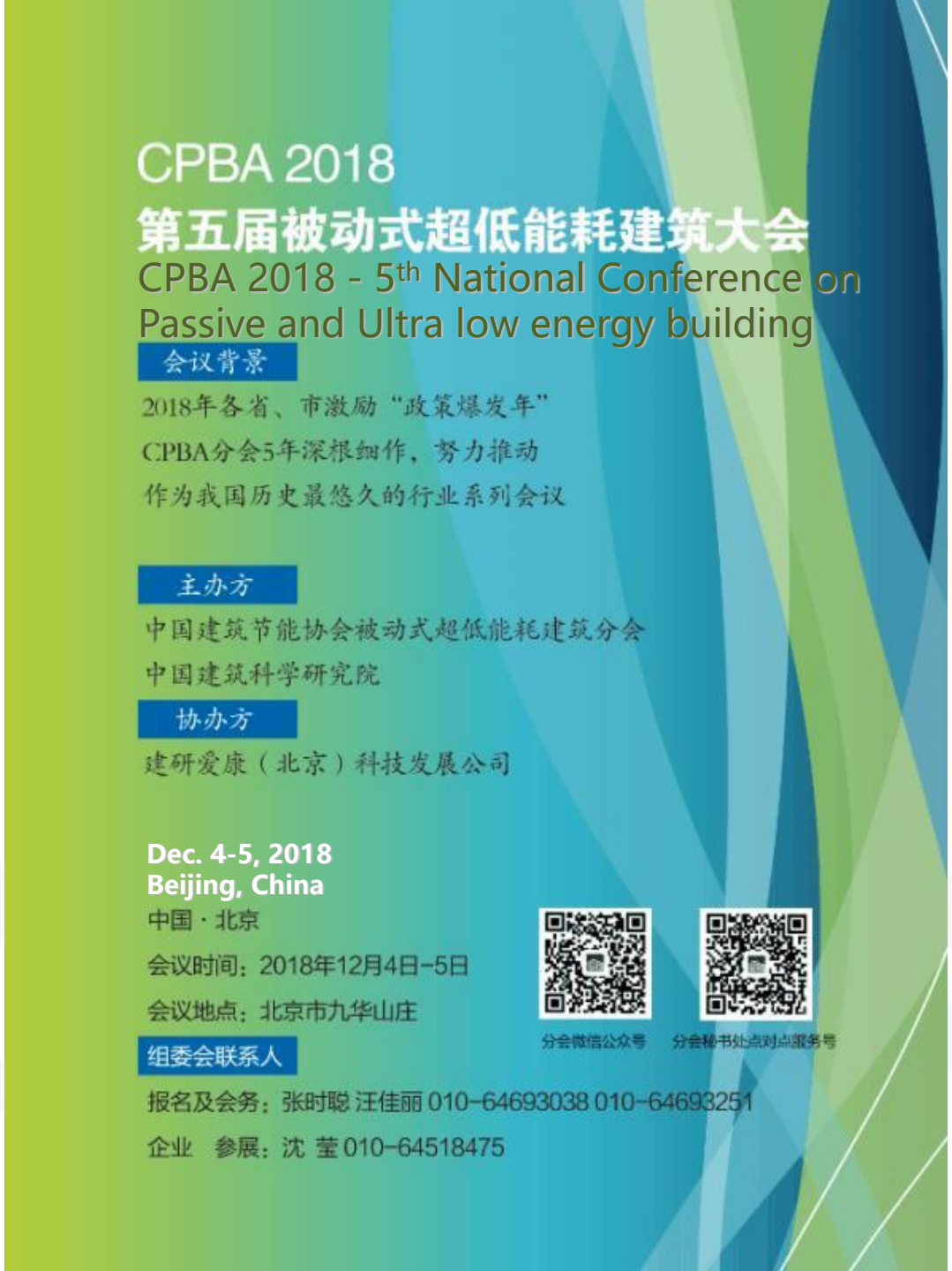
Mid-long term target

New building

Starting from 2015, progressive realization of low energy building, ultra low energy building and nearly zero energy building

Residential→Public　　North→South　　Pilot→Scaleup

Thank you!


CPBA 2018
第五届被动式超低能耗建筑大会
CPBA 2018 - 5th National Conference on
Passive and Ultra low energy building
会议背景
2018年各省、市激励“政策爆发年”
CPBA分会5年深根细作，努力推动
作为我国历史最悠久的行业系列会议
主办方
中国建筑节能协会被动式超低能耗建筑分会
中国建筑科学研究院
协办方
建研爱康（北京）科技发展公司
Dec. 4-5, 2018
Beijing, China
中国 · 北京
会议时间：2018年12月4日-5日
会议地点：北京市九华山庄
分会微信公众号
分会秘书处点对点服务号
组委会联系人
报名及会务：张时聪 汪佳丽 010-64693038 010-64693251
企业 参展：沈 莹 010-64518475