

An aerial night photograph of a city, likely Paris, showing a large stadium with a glowing roof in the foreground. The city lights are visible in the background under a dark sky.

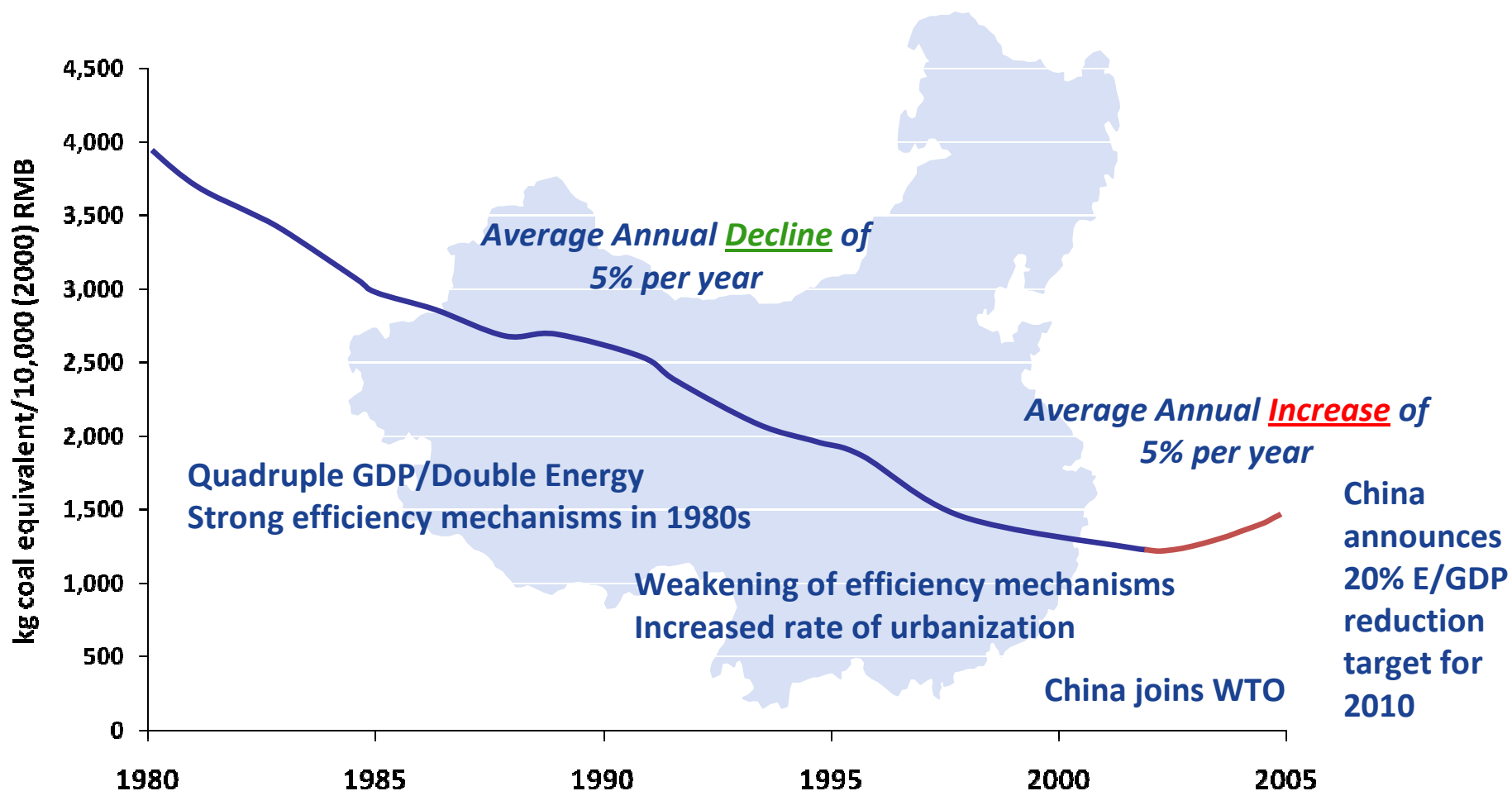
Assessment of Building Energy-Saving Policies and Programs in China During the 11th Five Year Plan

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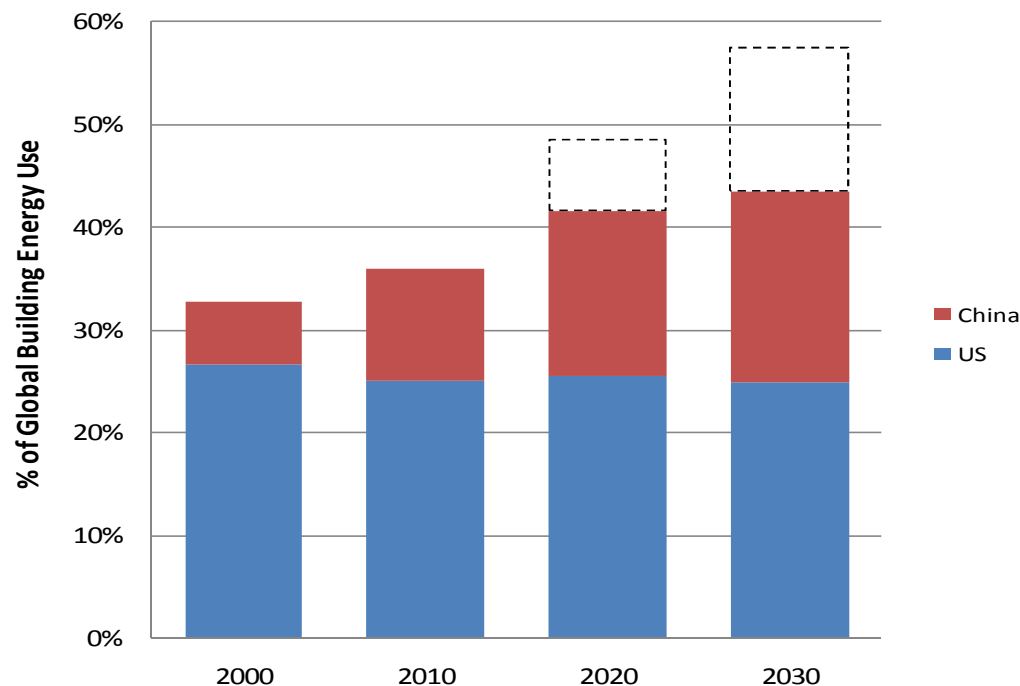
Overview: Energy Intensity Trends and Policy Background



Source: National Bureau of Statistics, *China Statistical Abstract*, various years.

Zhou, N., Levine, M.D., and Price, L., in press. "Overview of Current Energy-Efficiency Policies in China." Invited for a Special Issue of *Energy Policy*.

- Total floor area was approximately 58 billion m² in 2007.
- Two billion m² of building space have been added each year during the past several years, accounting for half of the construction in the entire world.
- U.S. and China presently account for 33% of the world's building energy use.
- The comfort conditions in China's buildings are very low by western standards. China's energy use in buildings would be much higher if western comfort conditions were met.

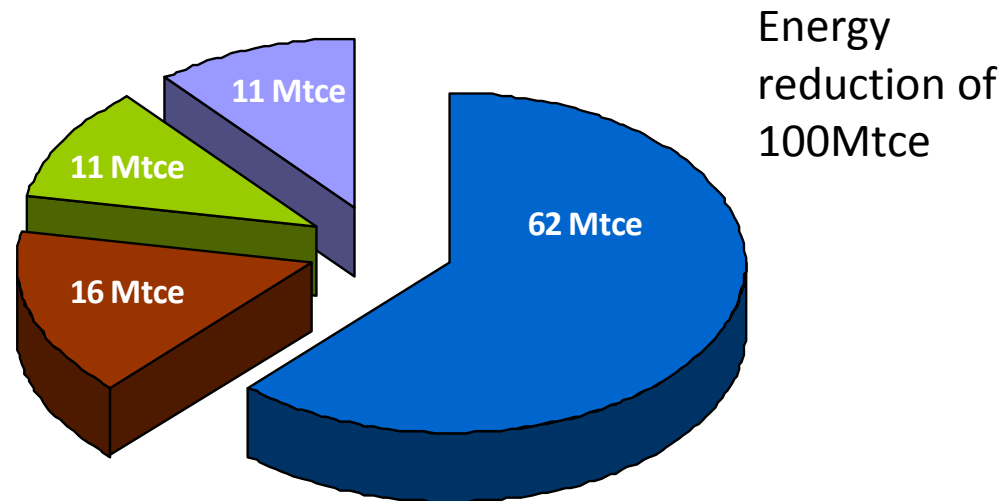


China Adopted an Energy Intensity Reduction Target During the 11th Five-Year Plan

- China's 11th Five Year Plan (2006-2010): outlined goal of reducing energy consumption per unit of GDP by 20% between 2006 and 2010
- Few people believed such a reversal was possible.
- Similar targets allocated to each Province
- Binding target; promotions attached to achievement
- Many policies and programs established in support of target
- LBNL's China Energy Group reviewed current progress to-date of energy efficiency policies and programs undertaken during the current Five Year Plan period (2006-2010). Programs reviewed includes:
 - Ten Key Projects
 - **Buildings Energy Efficiency**
 - Top-1000 Energy-Consuming Enterprises
 - Structural Adjustment/Small Plant Closures
 - Appliance Standards

- 4 • Research conducted through document reviews, web searches, and interviews

Breakdown of Building Sector Primary Energy-Saving Target in the 11th FYP (Mtce)



- Enforcing building codes in new buildings
- Building retrofits and heating supply system reform
- Energy management in government and large public buildings
- Renewable energy in buildings

Evaluation was conducted for these programs

Mtce stands for Million ton of coal equivalent . Note: Mtce>> EJ = 0.0293; EJ >> Quads = 0.9478

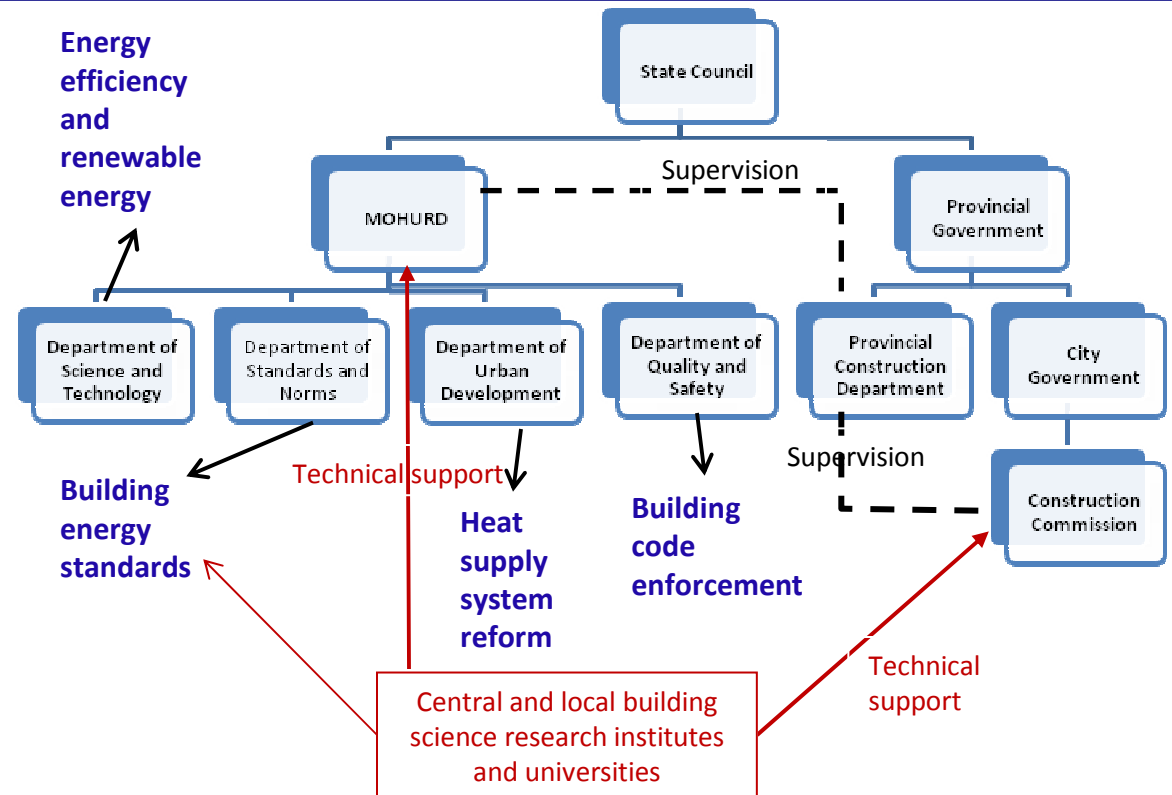
Caveats and Difficulties

- Analysis constrained by:
 - **Lack of basic and transparent data**
 - **Lack of publicly-available systematic reporting and monitoring of these programs**
 - Information often reported in units that are not clearly defined (e.g. whether electricity is accounted for at the site, 0.1229 kgce/kWh, or source, 0.404 kgce/kWh, value)
 - Programmatic targets are not clearly delineated as to whether they represent annual or cumulative savings goals through 2010
 - **Conflicting and difficult to interpret information is provided through interviews, reports, and websites**
 - **little clarity on how the baseline was determined, how the target was set, and the methodology for disaggregating the target**

Government Organization in Building Energy Efficiency

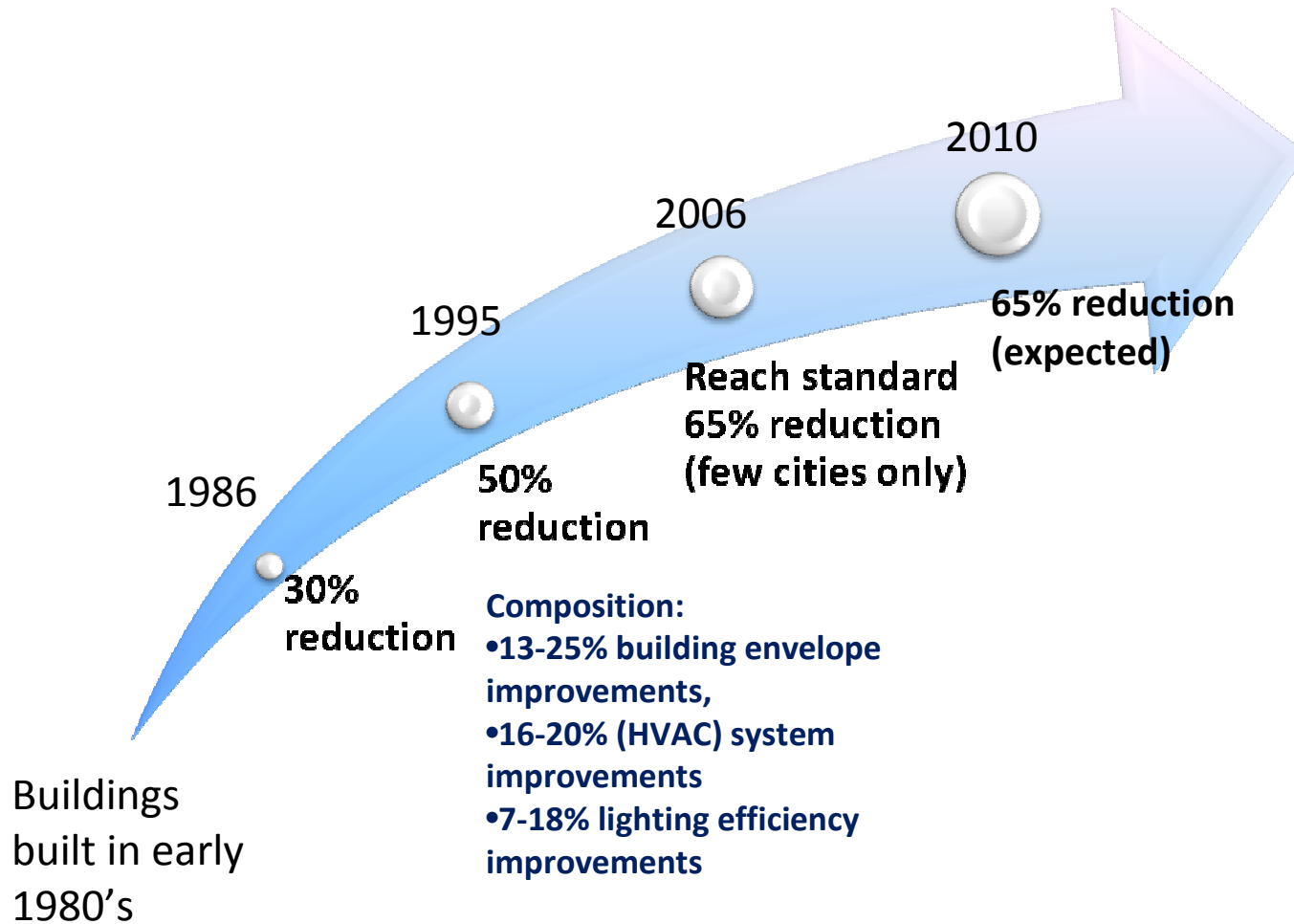
Newly established organizations for the 11th Five year Plan:

- a **Leading Group Of Building Energy Conservation** led by the key officials at the responsible government agencies nation wide.
- In 12 provinces (city, district), an **Energy Saving Work Coordination Leading Group** that involves the departments of finance, construction, and DRCs.
- **Corresponding agencies** at each city.
 - Shanxi province: **energy conservation supervision agencies** at the both provincial and city level, with a total of 111 staff
 - Shanghai: **energy conservation management offices in** 19 districts, and a total of 101 staff.

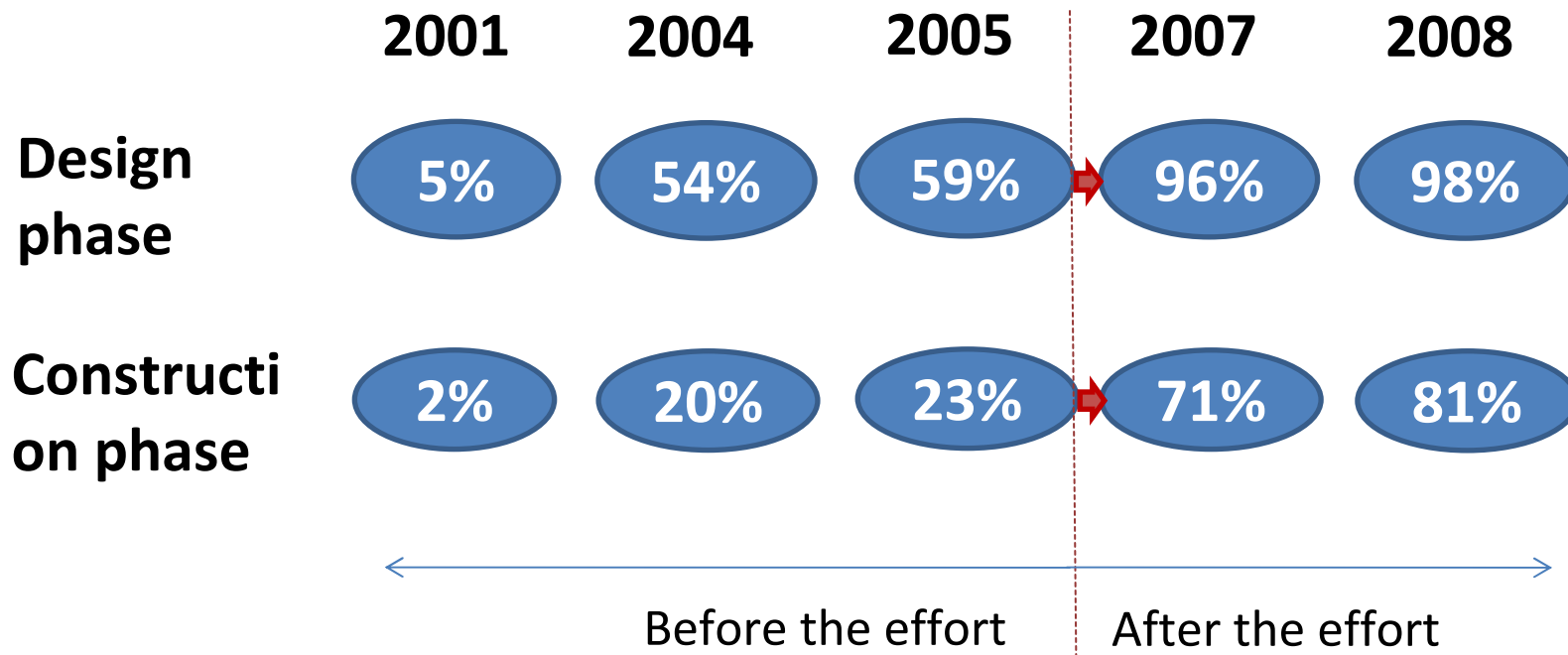


Government Organizations in Building Energy Efficiency

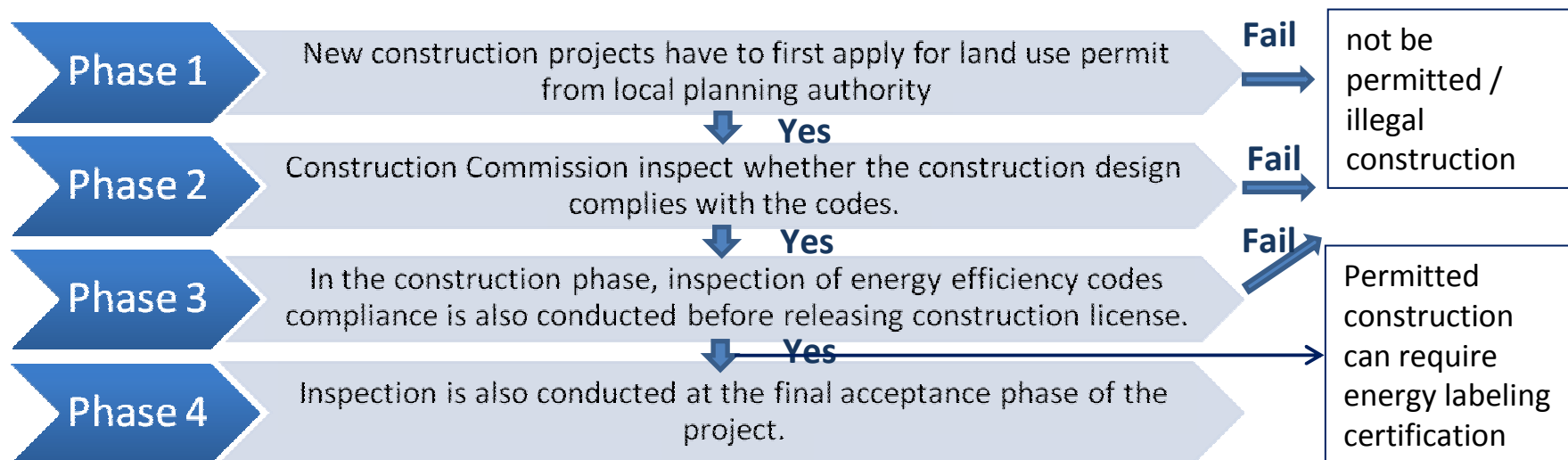
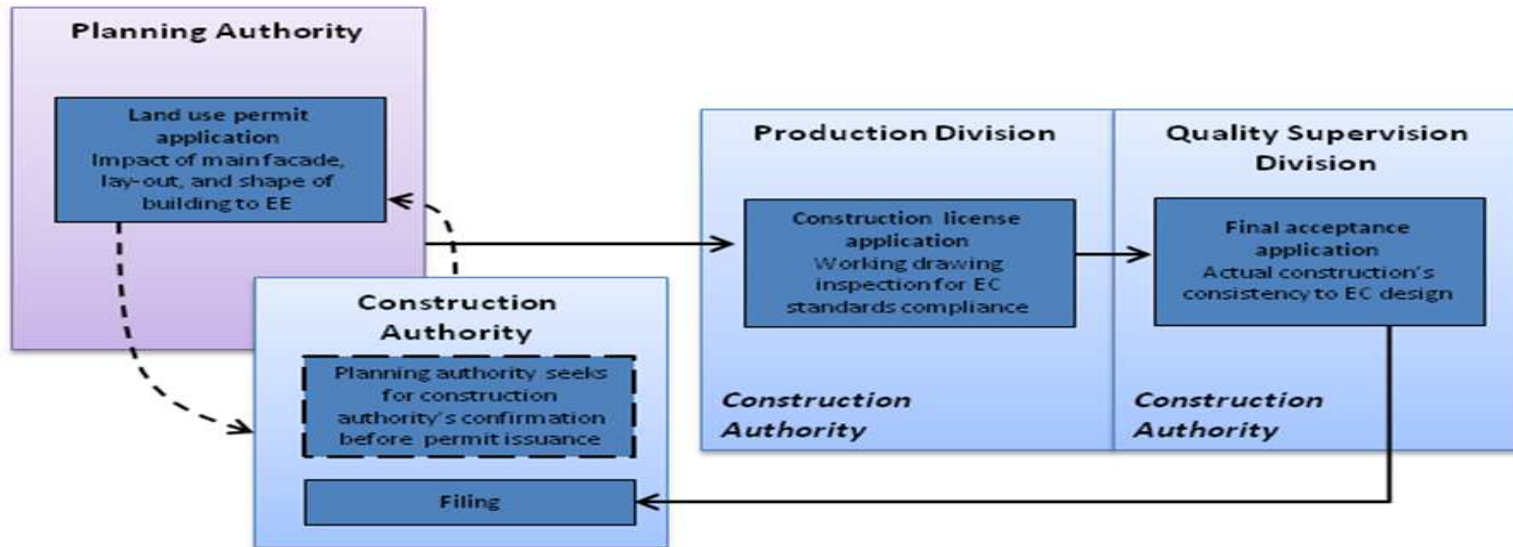
Policy for New Building Energy Efficiency Code



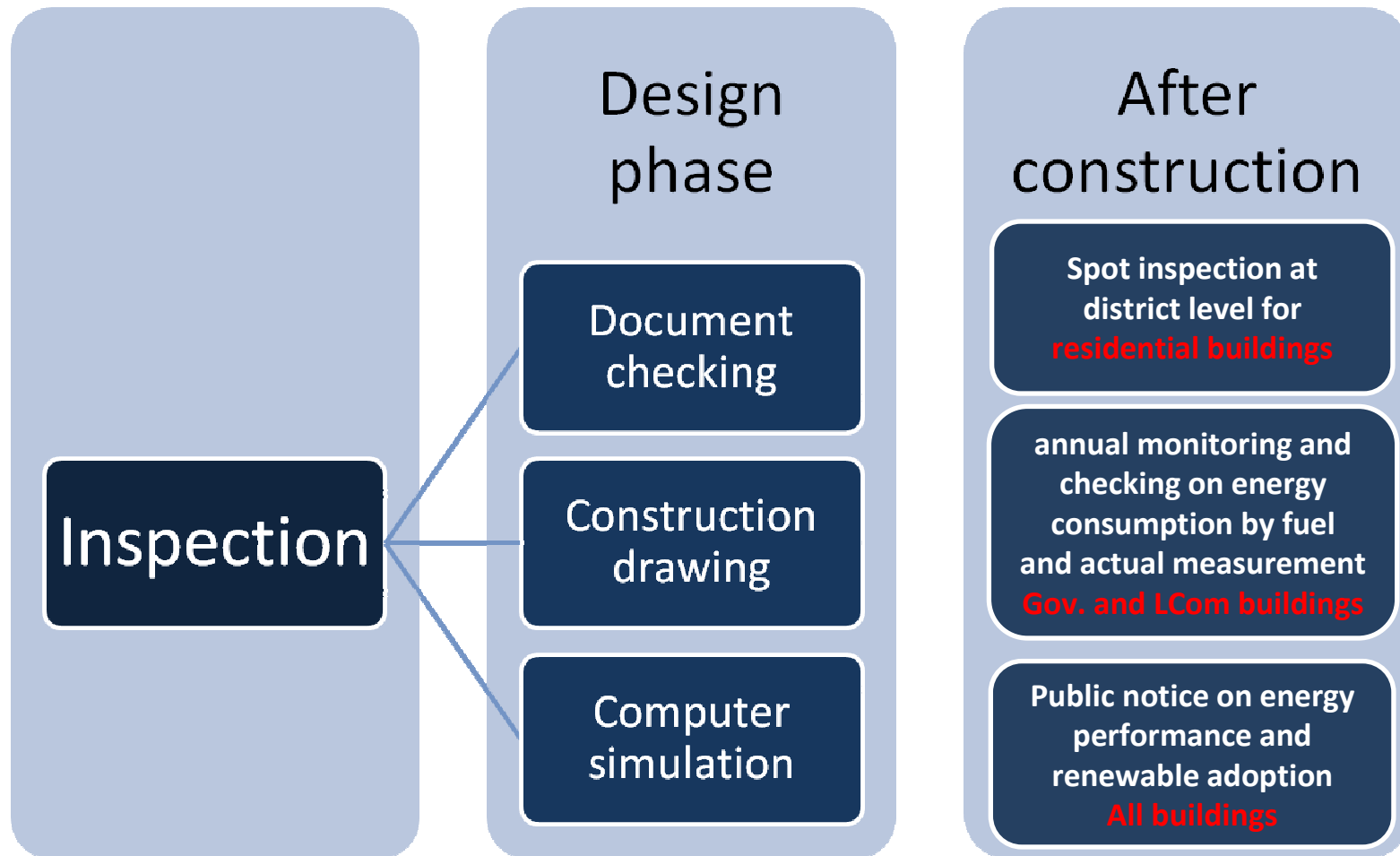
Effort in Enforcement and Compliance of Building Codes



Effort in Enforcement and Compliance of Building Codes

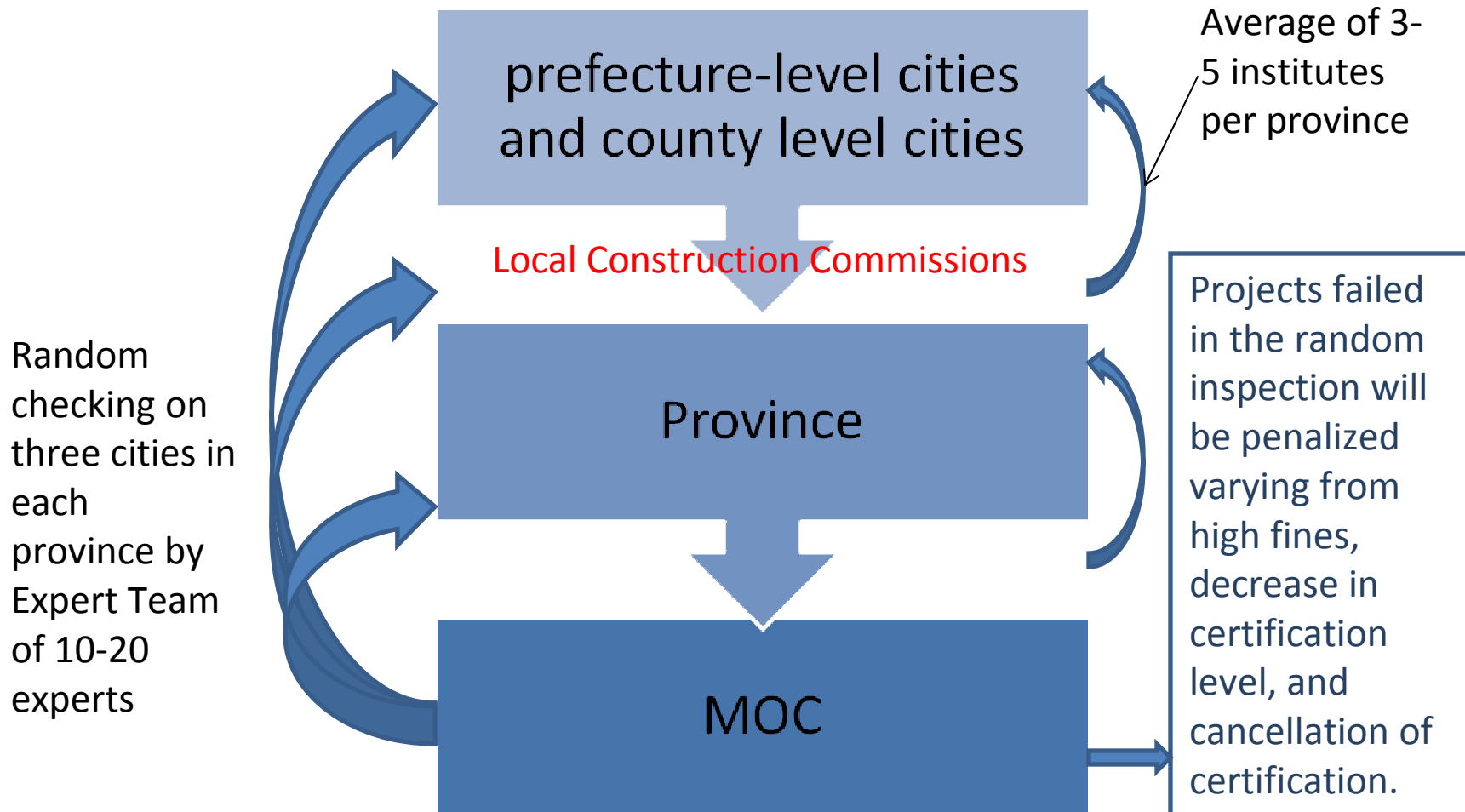


What is being checked

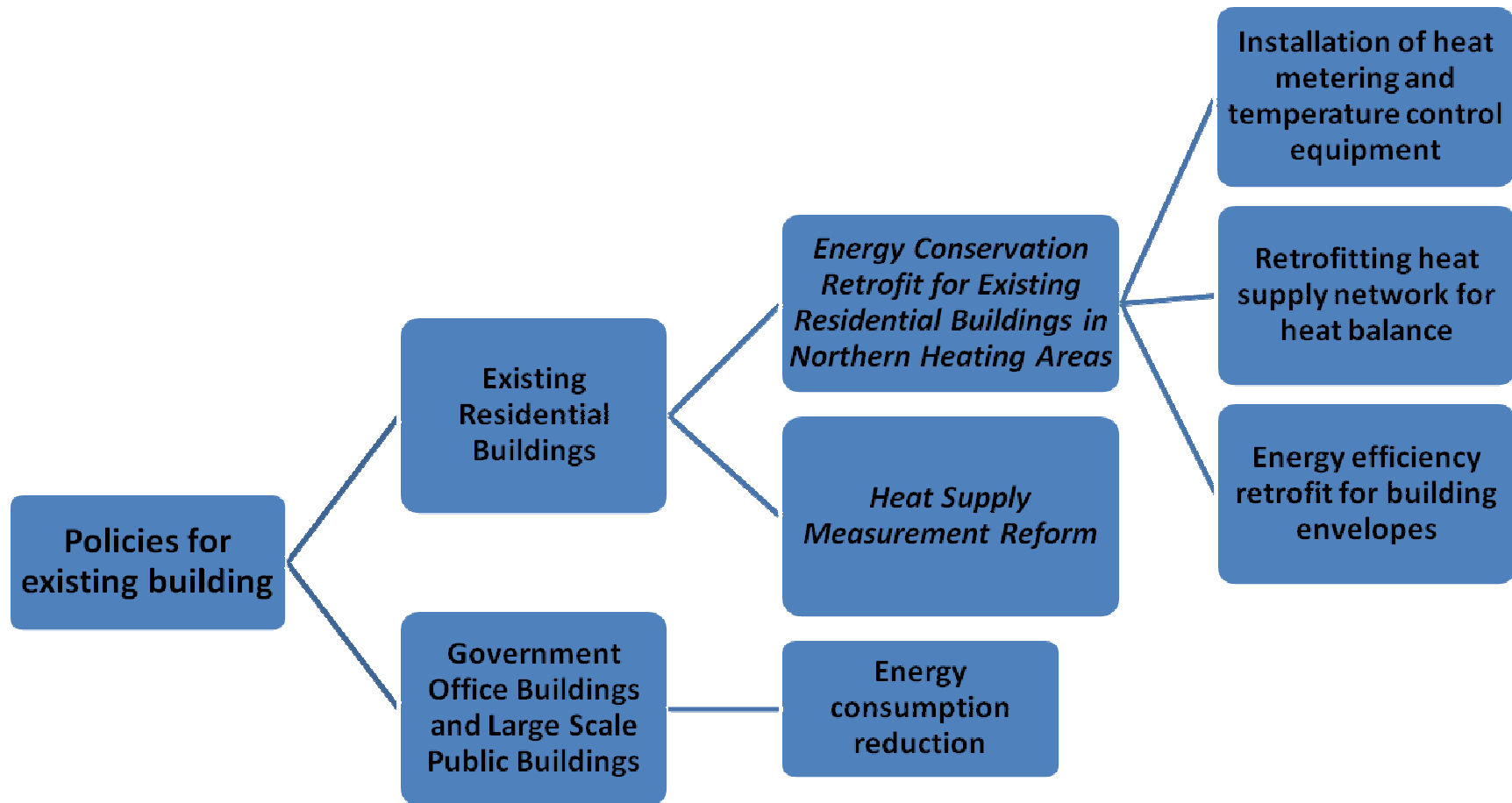


Note: LCom =Large Commercial Buildings

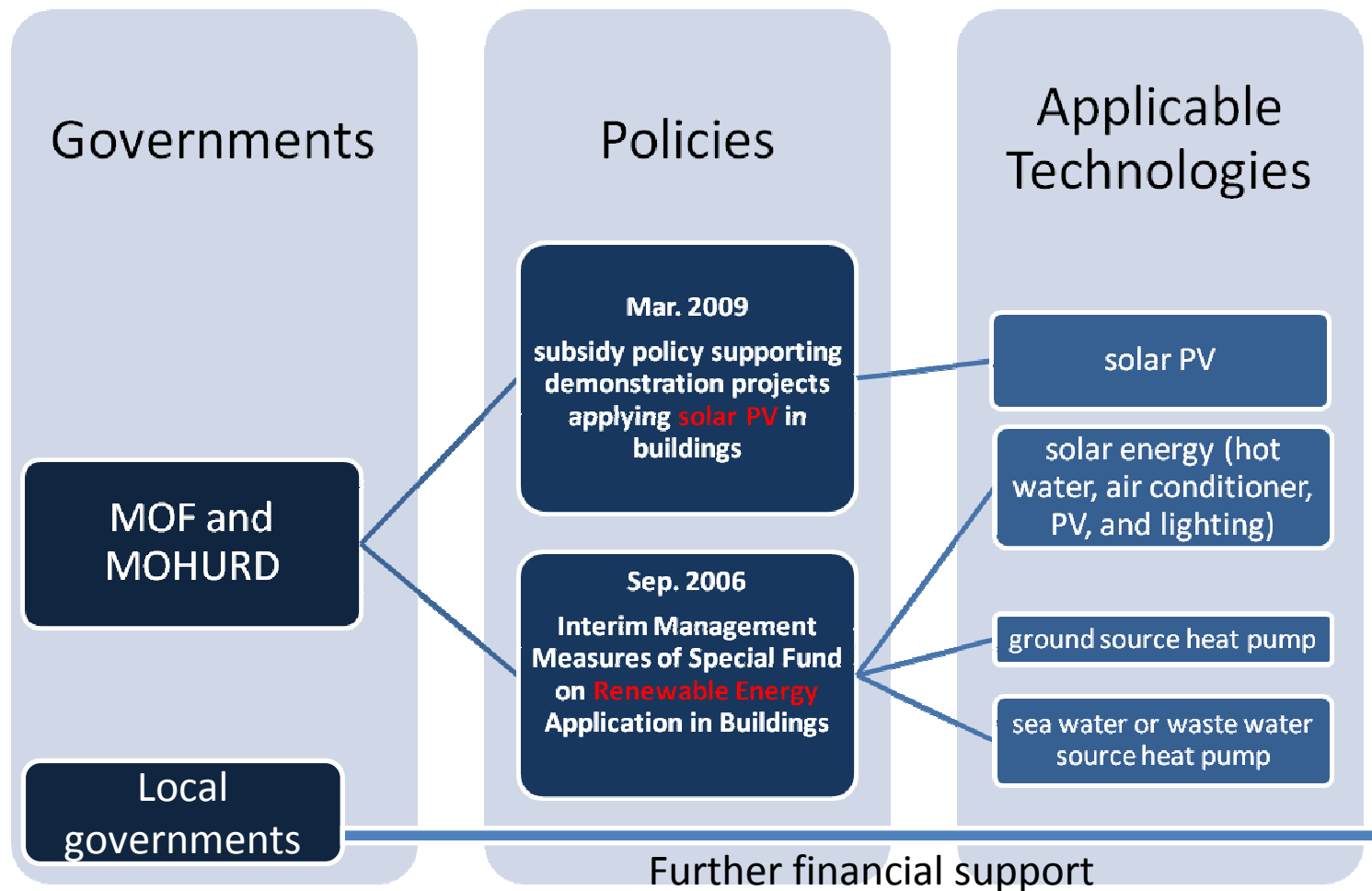
How is the Inspection and Reporting Done?



Policy for Energy Efficiency Retrofit in Existing Buildings



Renewable Energy Application in Buildings



Building Energy Efficiency Certification/Label

Basic Assessment Item	Compulsory Assessment Item	Optional Item	Levels
Energy saving level	Meet all mandatory standards	Additional points based on application of renewable energy, natural lighting and ventilation, advanced new EE technologies and products, and energy management.	★
50%-65%			★★
65%-75%			★★★
75%-85%			★★★★
>85%			★★★★★
>85% (Label will be upgraded if the score in this item reaches 65 (out of 100))			★★★★★

- building energy efficiency label has 5 levels of efficiency based on basic assessment, code compliance, and optional assessment items.

Certification of Building Energy Efficiency
Jian zhu neng xiao ce ping deng ji zheng shu

Project Title: _____
Assessment Origination: _____
Rating: ★★★★★
Date: YYYY MM

Ministry of Housing and Urban-Rural Development, PRC
Date: YYYY MM

Assessment Items

Building Code
L - calculated value
S - Real Value
Regional Code

Project Identification

Project Title:	Public	
Property:	Cold	
Climate Region:	YYMM	
Complete Date:	***	
Location:	***	
Site Area:	***	
Floors:	20	

Calculate Value of BEQ

Basic items	Required items	Optional items
Energy Consumption of AC: KWh/(m ² .a)	Enclosure Structure	Renewable Energy
Saving	A.C.	Natural Light
		Wind
		Advanced technique
		New Products
		Consumption Mgmt

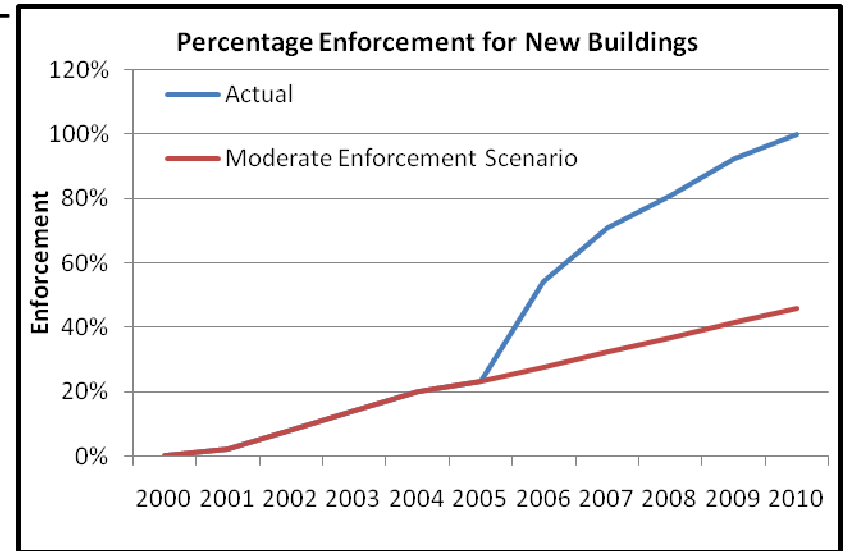
Real Value of BEQ

Basic items	Required items	Optional items
Energy Consumption of AC: KWh/(m ² .a)	Enclosure Structure	Renewable Energy
Saving	A.C.	Natural Light
		Wind
		Advanced technique
		New Products
		Consumption Mgmt

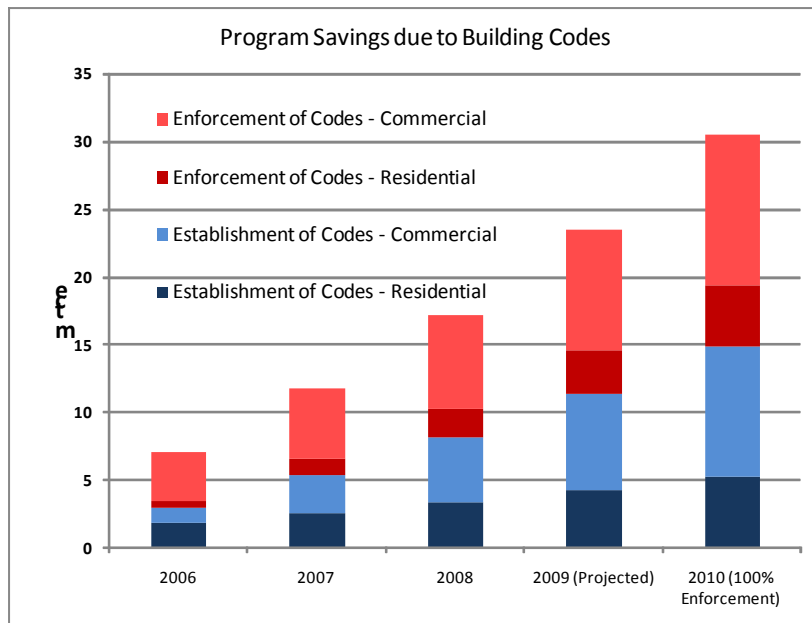
Region

Estimated Savings from Enforcement of New Construction Codes

- Enforcement jumped dramatically after 2005 – approaching total compliance by 2008.
- Assume same compliance rate for R+C
- Urban residential only
- BAU linear trend (2000-2005 rate)
- Heating improvement 50%
- No savings for district heat
- Cooling improvement 25%



Source: 2001-2008 Qiu B.X., 2009, Wu Y., 2009. 2009-2010 projections and Moderate Enforcement Scenario - LBNL Assumption



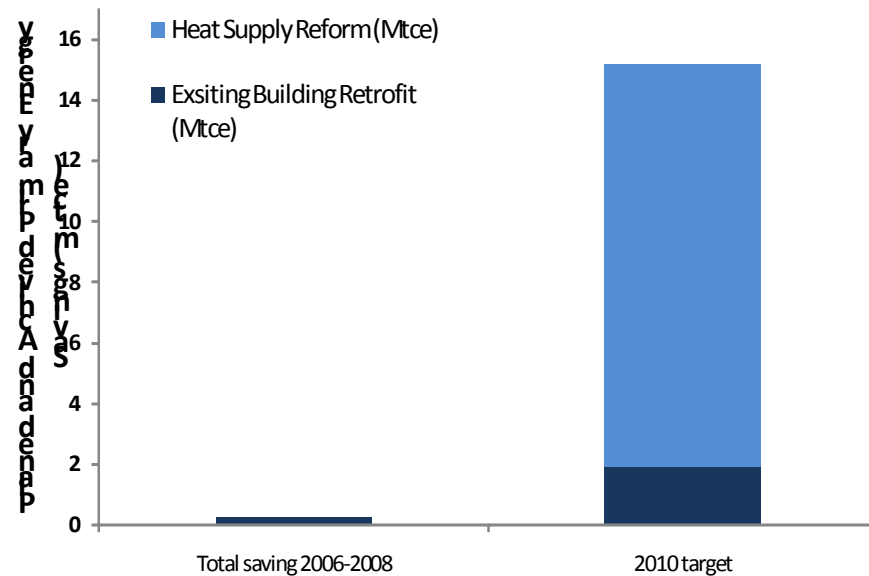
		2006	2007	2008	2009 (Projected)	2010 (100% Enforcement)
Annual	Establishment	3.0	5.4	8.2	11.4	14.9
	Enforcement	4.2	6.4	9.1	12.1	15.6
	Total	7.1	11.8	17.2	23.5	30.5
Cumulative	Establishment	3.0	8.3	16.5	27.9	42.8
	Enforcement	4.2	10.6	19.7	31.8	47.3
	Total	7.1	18.9	36.2	59.6	90.1

Enforcement doubles savings of establishment only (relative to 'frozen' case)

Targeted and Estimated Saving of the Existing Building Retrofit and Heat Metering Reform

Estimating the savings

			2008*	Target 2010
Existing Building Retrofit	Retrofit floor area (million m ²)		39.5	150
	Estimated Savings in kgce per m ²		6.75	12.5
Heat System Reform	Heat supply reform floor area (million m ²)		21	2660**
	Estimated Savings in kgce per m ²		N.A.	5
Primary Energy Savings (Mtce)				
Existing Building Retrofit	Energy Saving (Mtce)		0.27	1.9
Heat System Reform	Energy Saving (Mtce)		<0.1	13.3
	Total Primary Energy Savings (Mtce)		<0.4	15.2 ¹



- Total retrofitted area was expected to be 62% of the total target of 150 million m² by 2009, leaving another 60 million m² to be completed in the remaining year.
- The total estimated primary energy saving in 2008 is only 0.27 Mtce, accounting for merely 14% of the overall target.
- Less than 1% of the targeted floor area has completed the heat metering reform
- Heating supply companies and energy retrofits are under different government jurisdiction, and the incentive thus far provided applies only to the building retrofit

Estimate Savings from Energy Management of Government Office Buildings and Large-Scale Public Buildings

	Floor Area	Public Buildings	Government Buildings	Large-Scale Public Buildings
Total Floor area (billion m ²)				
2005	42	4.5	0.46	0.33
2008			0.50	0.36
2010		5.1	0.52	0.37
Energy Intensity (kWh/m ² -year)				
2005		30-60	81	142.4
2008			70	
2010			64.8	114
Total Estimated Energy Consumption (TWh)				
2005			37.26	46.99
2010			33.696	42.18
Total Estimated Accumulative Savings 05-08 (Mtce)			4.56	11.23
Total Savings Target 05-10 (Mtce)				

- no official data or publications that report the savings to date.
- little information has been made public either on the calculation methodology or on the definition of the baseline.
- we assembled information to provide a plausible estimate of energy savings, based on estimates of floor area and average energy intensities of the Gov. and LCom buildings.
- They are on track to meet the target, the savings is estimated to be 4.56 Mtce.

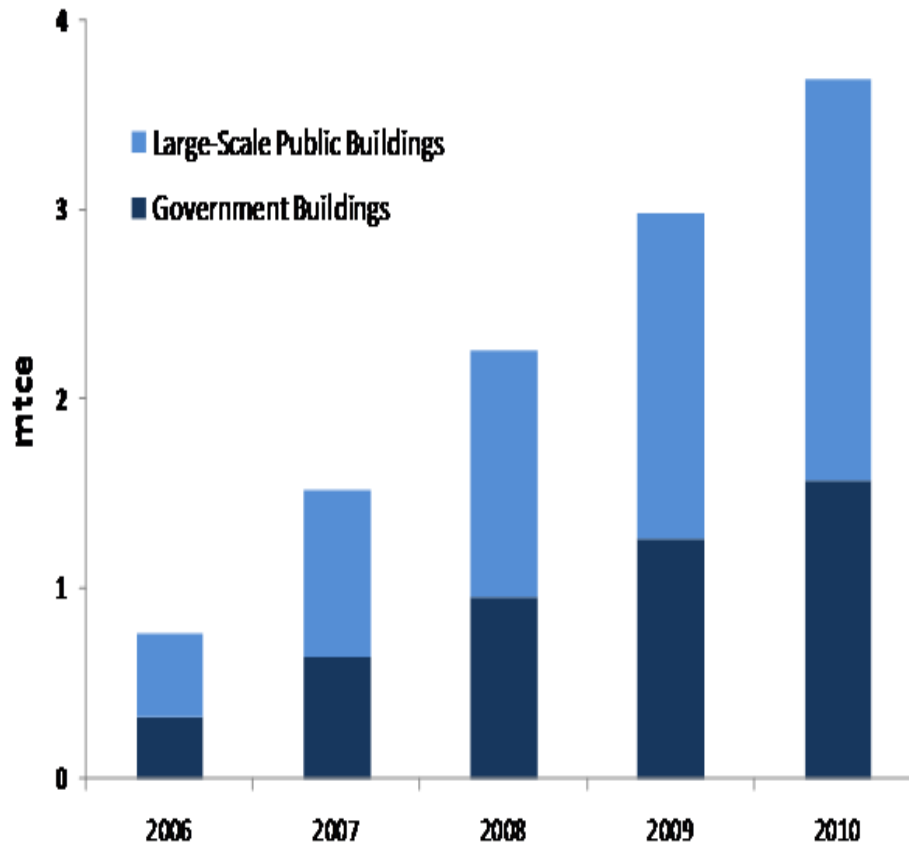
[1] Applying the growth rate of the public building floor area estimated in Zhou(2007)

[2] Based on LBNL's estimate (Zhou, 2007 LDRD report)

[3] Based on personal communication with

[4] The target is to reduce the energy intensity by 20% by 2010, equivalent to 11-15 Mtce (<http://www2.tyqgzx.gov.cn:8888/qgbwww/zcfg/gjxzcfg/2009-06-24/143.html>). Mohurd has estimated savings based on experience that approximately 10-15% of the savings could be achieved through the energy management.

Program Savings Due to Energy Management in Government Buildings and Large-Scale Public Buildings



Other measures:

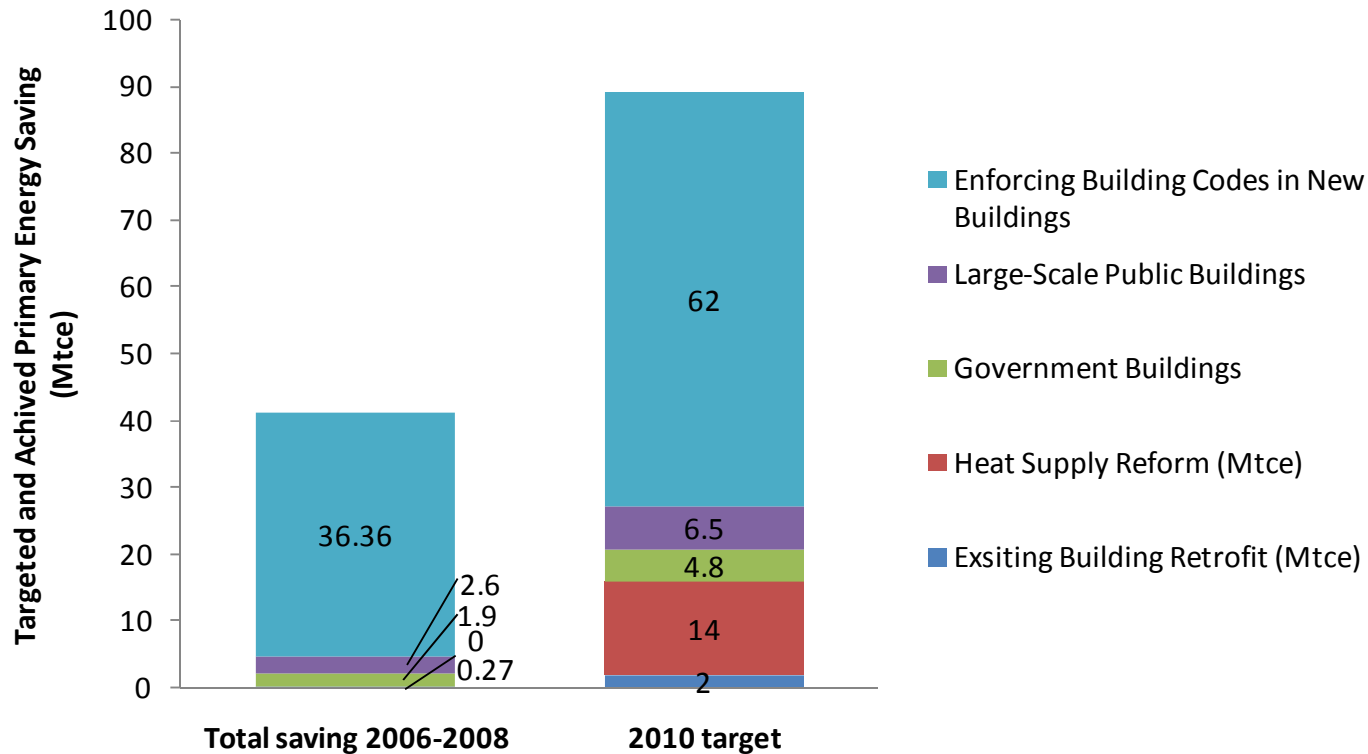
- energy consumption survey -- 11,607 Gov. and LCom buildings.
- energy audit --768 buildings and 59 universities,
- publicizing energy consumption data --827 buildings.
- metering devices and real time monitoring installed --324 pilot buildings.

Planned measures in the near term:

- consumption quota system
- subsidies for ee retrofit under ESCO framework.

Findings: Energy-Saving Programs - Buildings

LBNL Estimated 05-08 Building Sector Primary Energy-Saving from the Programs and Policies implemented in 11 FYP(Mtce)



Findings:

Energy-Saving Programs - Buildings

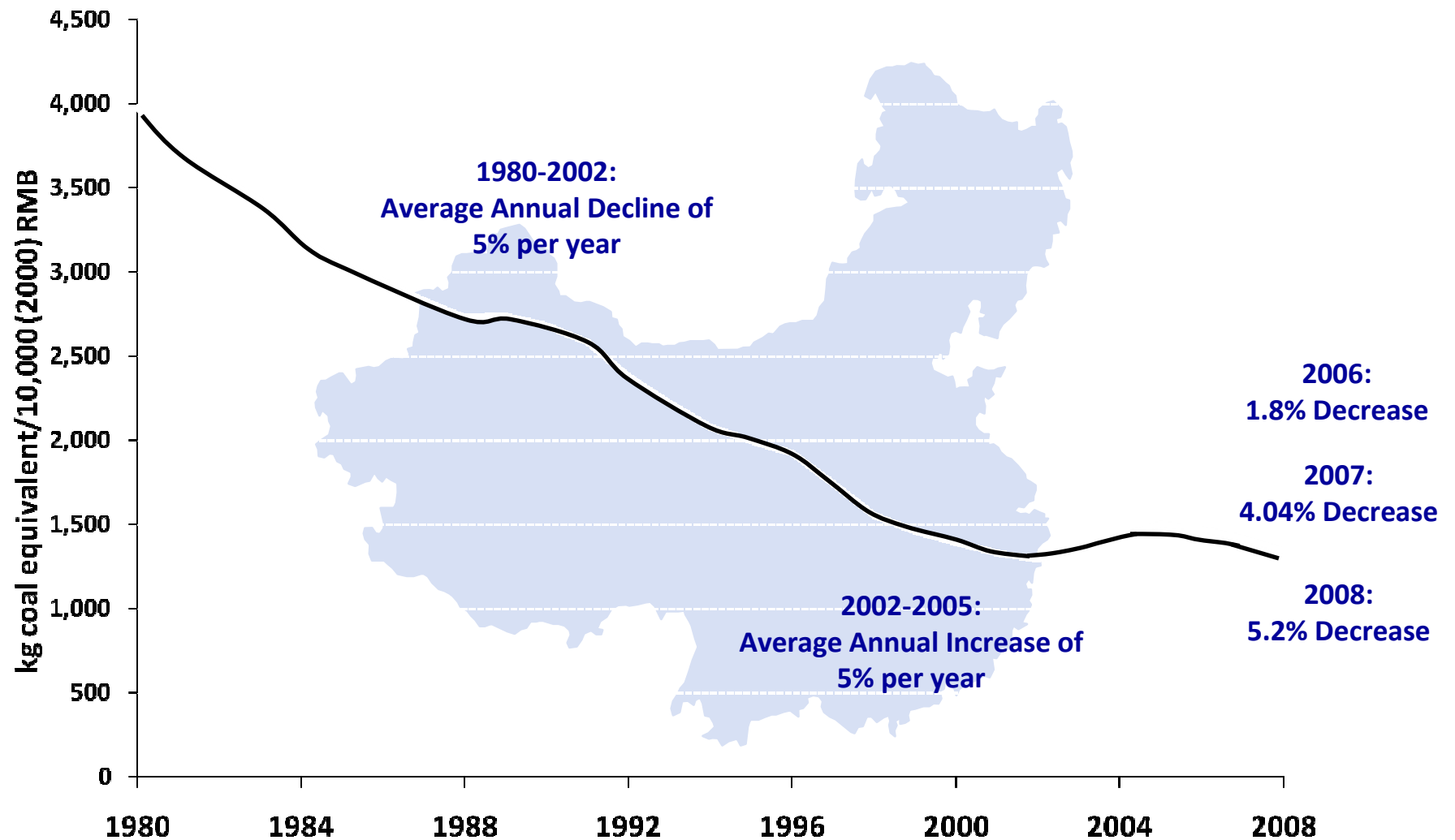
- A comprehensive enforcement scheme for new buildings has been established and strictly followed in the large cities. New construction - rate of **compliance** with new building standards improved
 - **Design phase - reported to be up to 98% by 2008 from 5% in 2001**
 - **During enforcement - estimated at 81% in 2008 from 2% in 2001**
- China has put into place a system that gives the proper incentives to the design institutes and builders which appears to be quite effective
- **Retrofits are estimated to meet target for total retrofitted area, but the energy savings target will be missed by a considerable margin.**
- For **government office buildings and large-scale public buildings, energy management improvements are estimated to have saved 4.6 Mtce between 2005 and 2008**
- MOHURD has worked with the Ministry of Finance to **offer incentive mechanisms for building shell measures and heat metering**
- MOHURD **has not adequately addressed major barriers such as changes in urban heating prices and subsidies for urban heating retrofits**, to promote implementation of building energy-efficiency programs

Findings:

Energy-Saving Programs - Buildings

- **Major barriers such as subsidized heating and heating prices based on square meters of space rather than usage have not been adequately addressed**
- There is widespread use of highly energy-intensive building materials, and little consideration for life-cycle energy use
- Developers lack incentives to include energy-efficient design and materials, and **city heating supply companies lack incentives to improve the efficiency or install controls on their systems**
- **There is a lack of official reports and absence of standardized data-gathering methodologies make it difficult to determine building energy use and savings**
- Infrequent surveys on building characteristics and energy consumption patterns, as well as a lack of publicly available data, further hamper efforts to monitor progress toward 11th FYP goals
- **For residential building in the north, occupants may take the benefits of more efficient buildings as improvement in comfort rather than in reduced heat, thus lead to no significant reduction in energy use..**

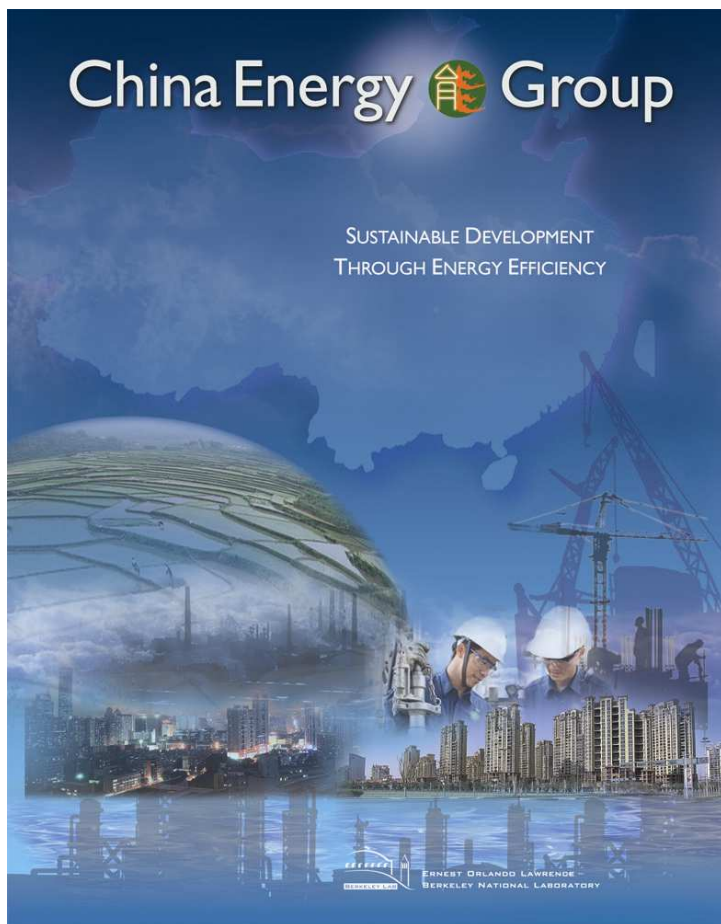
Current Situation



Recommendations:

- Revise the approach to existing building energy retrofits in cold climates, treating building envelope, control systems, and heat supply together
- Expand the enforcement of building energy standards that have been effective in large urban areas to the rest of the nation improve building energy labels and provide incentives for “green building”
- Continue to place large emphasis on energy management of large-scale public and governmental buildings
- Enhance policy design and effectiveness through expanded surveys, monitoring and establishing meaningful baselines of building energy consumption/efficiency

Thank you!



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Policies and Regulation Measures in China

Building Sector

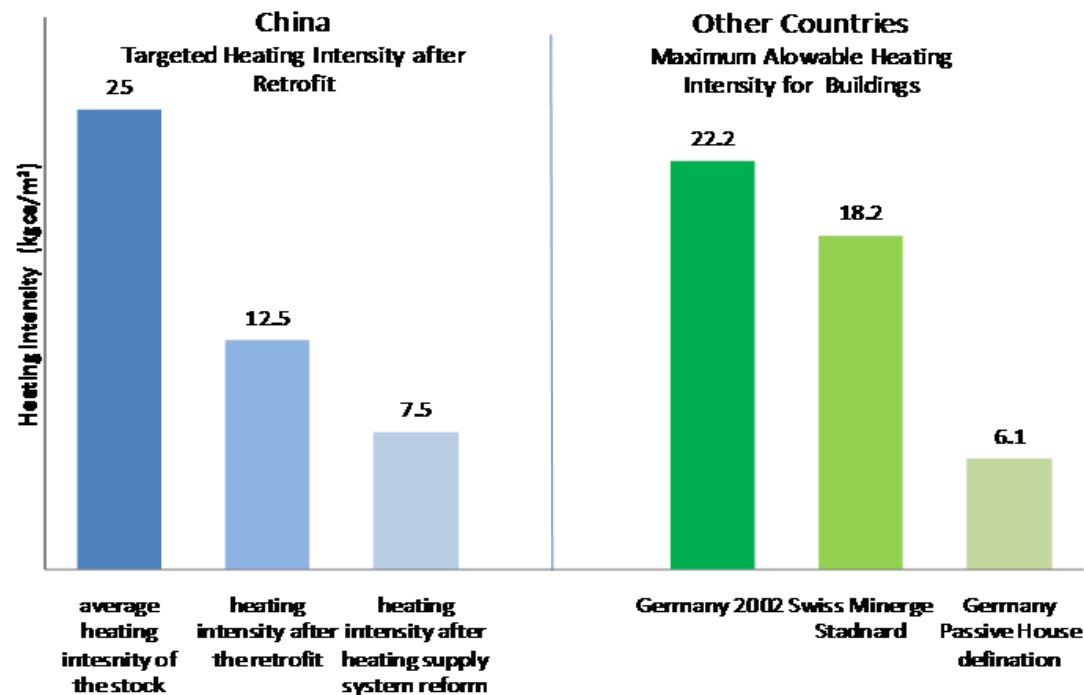
Category	Measures	Year of Release	Who is responsible	Sectors covered	Geographical coverage	Target	Relevant information
Regulations	Regulations on Energy Efficiency in Civil Building	2008	MOHURD (MOC)	Residential, government office and commercial building, public buildings	National	N . A .	14 provinces (city, district) have issued energy conservation regulations or relevant legislation on resource conservation and wall material renovation (Qiu, 2009)
Standards	Various energy conservation design standards	1987-2004	MOHURD (MOC)	Residential, government office and commercial building, public buildings	National	Among which, energy conservation design standard for public building has a 50% energy saving target compared to early 1980's level	Cities with economic affordability can go further with 65% energy saving target. and have already started to implement this target
Policy	Urban heating system reform	2003	MOHURD (MOC)	Residential	Northern area	Realize market base heating system and heat measurement base payment	N . A .
Policy	Energy efficiency retrofit in northern area district heating	2008	MOHURD (MOC)	Residential	Northern area	Retrofitted area to achieve 150 million m ²	A fiscal subsidy was also released to support this work.
Fiscal Policy	Special fund for demonstration projects of RE application in buildings	2003	MOF & MOHURD (MOC)	Residential, commercial & public buildings	National	Realize 200 demonstration projects during 11 th FYP period	Until late 2008, a total of 359 demonstration projects were supported
Fiscal Policy	Subsidy for demonstration projects of solar PV application in buildings	2009	MOF & MOHURD (MOC)	Residential, commercial & public buildings	National	N . A .	N . A .
Policy	Government office buildings and large-scale public buildings energy conservation management	2007	MOHURD (MOC)	Government office buildings and commercial & public buildings larger than 20,000 m ²	National	Total energy consumption to decrease by 20%, realize 11-15 million tce energy saving	A fiscal subsidy was also released to support this work.
Policy	Promotion of energy efficient lighting products	2007	NDRC	Lighting	National	Promote 50 million and 100 million lamps in 2008 & 2009, respectively	In 2008, approximately 62 million lamps were promoted, realizing 3.2 billion kWh energy saving
Policy	Supervision and inspection work of energy conservation and emission reduction work in the building sector	2007 & 2008	MOHURD (MOC)	General	National	N . A .	N . A .

Comparison to International “Best Practice”-- Data collection

- Measures such as the building codes enforcement have showed significant improvement.
- However, not enough official data released on respective savings to date of each program, nor evaluation and actual measurement has been followed up to verify the savings, except for a few demonstrative projects in residential building retrofit and the government and large scale buildings.
- Solid data collection framework provides a foundation for defining baseline, evaluating policy and market analysis, which in turn better informs the policy decision process.
- In the U.S., The Commercial Buildings Energy Consumption Survey (CBECS) and Residential Energy Consumption Survey (RECS) are national sample surveys that collects information on the stock of U.S. commercial buildings, their energy-related building characteristics, and their energy consumption.

Comparison to International “Best Practice”-- baseline and target setting

- ❑ Baseline definition, target setting and methodology in disaggregating the target are not clearly reported.
- ❑ The target for building sector might have been too ambitious:
 - The heating intensity target set for existing buildings is close to the international best practice.
 - The energy intensity target set for new buildings did not take account more delivered service and higher comfort level

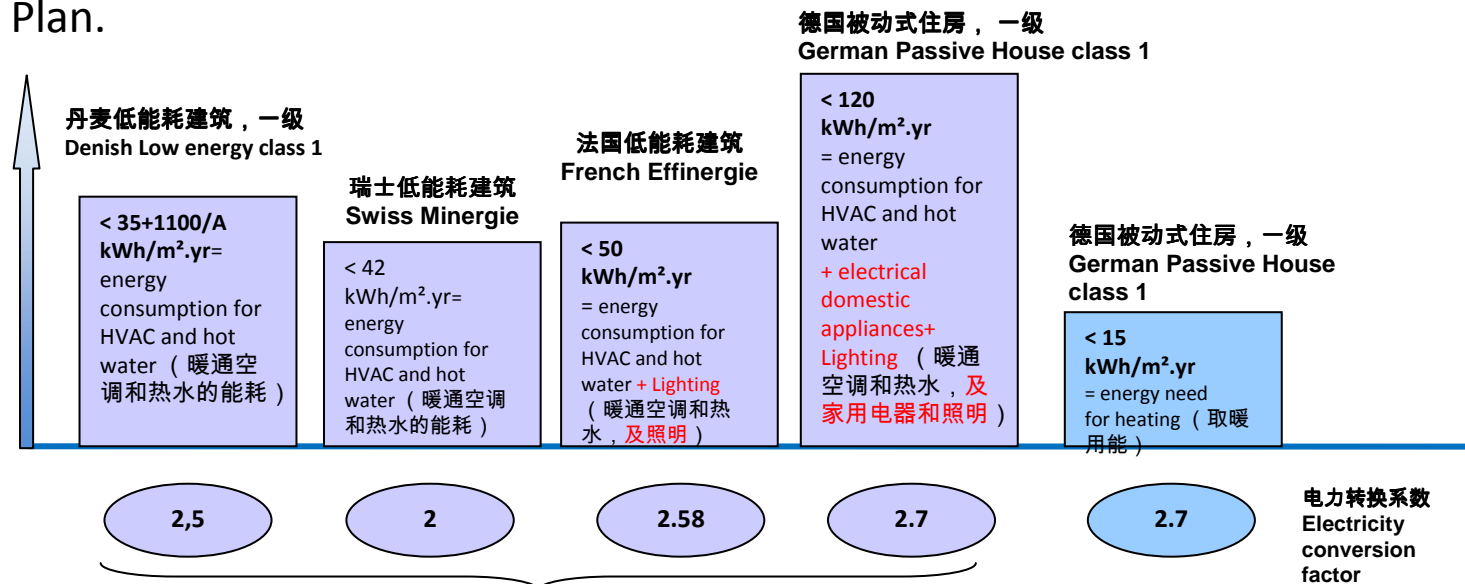


A comparison of base line and targeted heating intensity for building retrofit and international standards

注：除发电燃料组合效果以外，均使用中国终端电量转化系数（1kWh=0.404 kgce）。
Note: Chinese electricity conversion factor (1kWh=0.404 kgce) was applied to all intensity numbers, to exclude the power generation fuel mix effect.

Comparison to International “Best Practice”-- Benchmarking

- ❑ Benchmarking is a common way to evaluate a building’s energy performance.
- ❑ Benchmarking of energy use provides means to compare a building to other buildings or national average or best practice, helps the policy maker or owner of the building to understand the current situation, determine the baseline and set the target.
- ❑ However, this approach has not been fully undertaken during the 11th Five Year Plan.



不同建筑标准的比较

Comparison of different performance standards

Comparison to International “Best Practice”-- Building Codes

- ❑ Currently, heat loss through exterior walls is about 3–5 times as high in Chinese buildings as in similar buildings in Canada or Japan. Loss through windows is over twice as high.
- ❑ A comparison between the Chinese building energy efficiency codes and the U.S. ASHRAE standard shows that the Chinese standards are less comprehensive and stringent (Hong, 2008). (commercial paper, Zhou, 2008).

Comparison of the Building Standards in Heat Transfer Coefficiency in Selected Countries

<i>Country</i>	<i>External wall</i>	<i>External window</i>	<i>Roof</i>
Beijing, (China)	1.16-0.82	3.5	0.80-0.60
Russia	0.77-0.44	2.75	0.57-0.33
Berlin, (Germany)	0.5	1.5	0.22
Hokkaido, (Japan)	0.42	2.33	0.23
Canada	0.36	2.86	0.23_0.4
USA	0.32–0.45	2.04	0.19
Sweden	0.17	2.5	0.12

Source: Jing Zhao, 2009