Sustainable Energy Future in China's Building Sector

Jun LI

École des Mines de Paris/ IDDRI

2007 International Conference for Enhanced Building Operations

San Francisco, November 1-2, 2007

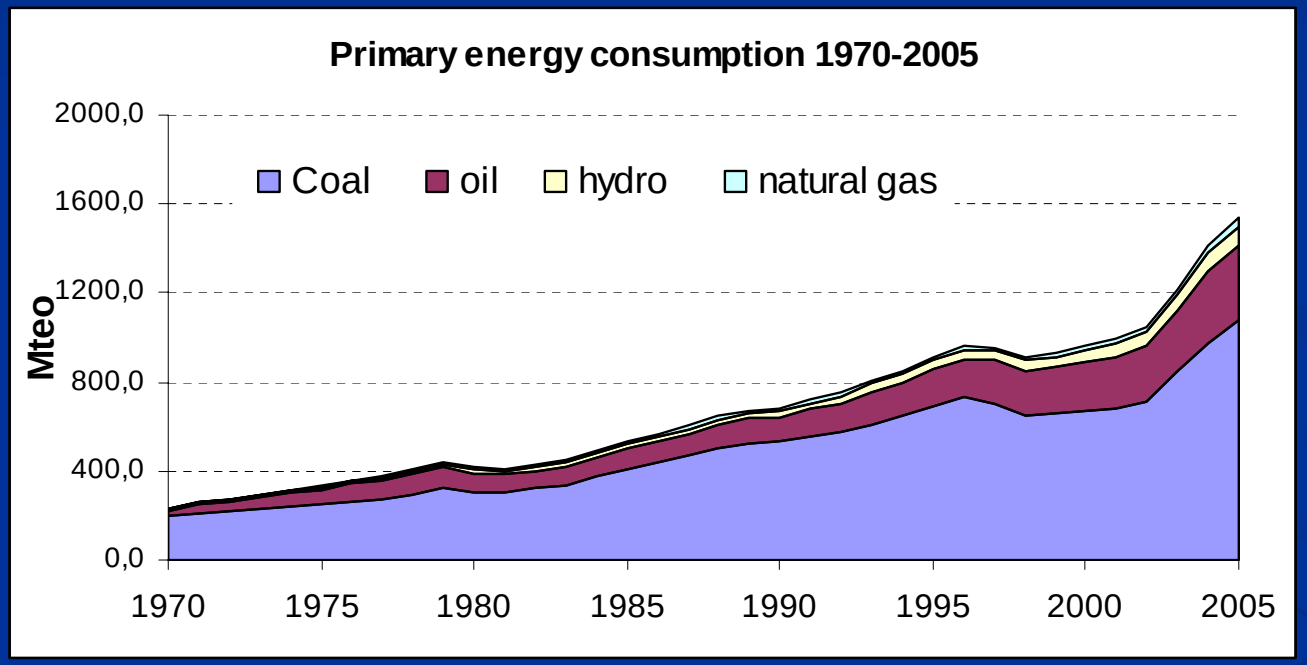
Overview

- Aim of the paper: exploring the energy demand and CO2 emission saving potentials in different scenarios
- The essential part of increase of energy demand and GHG emissions would come from the developing countries in the next decades (IEA WEO, 2006).
- Globally, total emissions from buildings are estimated to account for almost one-third of total GHG emissions (IPCC 2007), in China this figure is about 18-20% and would be 25-27% if embodied energy is taken into account
- IPCC 2007: 29% cost effective CO2 savings from energy use in buildings can be achieved by 2020
- From a life-cycle perspective, Chinese existing building codes allow to reduce energy intensity by 45%, more than 60% if current building standards in Sweden (embodies energies have been accounted) is implemented.

- China is the one of fastest-growing economies in the world, the GDP has been increasing at 9.7% per annum over the past 20 years.
- China aims to build All-round well-off society in 2020.
  - Quadruple the GDP of the year 2000 by 2020
  - Per-capita GDP:3000 US$
  - Urbanization rate will be increased to 57%~ 60% by 2020
- Ambitious goal of 20% reduction of GDP's energy intensity by 2010 was set in the "11th 5-year plan".

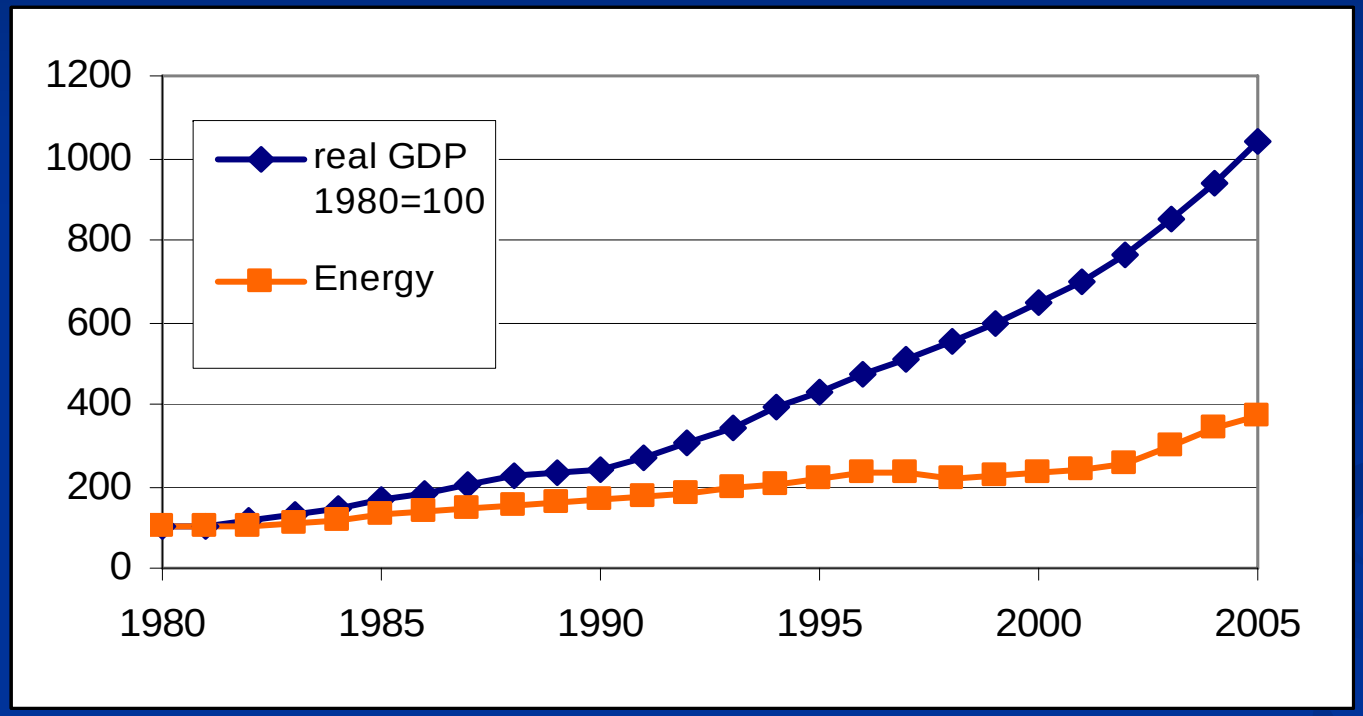
General situation of energy demand in China

China is the second biggest energy consumer in the world, primary energy consumption in 2005 was 1550 mtoe, which represents 14.7% of global energy consumption. Coal predominates domestic energy supply in China



Source: IEA 2006

Over the period 1980-2005; a four-fold energy growth has fuelled a 10–fold GDP. However, energy consumption increased sharply over the period 2002-2005 and dominated GDP's growth, annual energy demand growth rate was 15.9% in 2004! building construction boom has been a major driving force!



Source: China Statistical Yearbook 2006

Comparaison of energy demand and CO2 emission scenarios

- Studies : IEA(2006) , EIA(2006), Jiang and Hu(2006), ERI(2003), NDRC(2004), Kang and Wei(2005)
- Models: Top-down, bottom-up, general equilibrium model, technology selection model, econometric model (LEAP, IPAC IEA etc.)
- Modelling time horizons : 2010, 2020, 2030

Primary energy demand scenarios

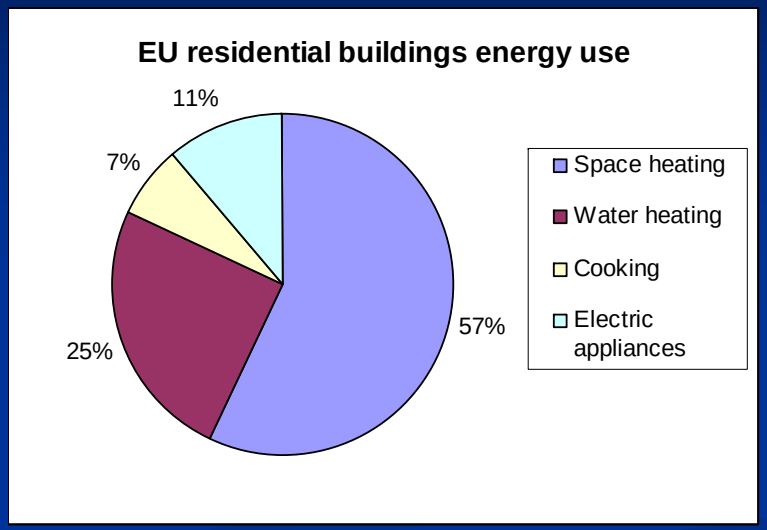
	2005 million toe	2010 million toe	2015 million toe	2020 million toe	2030 million toe
ERI (2003)					
ordinary effort				2149	
promoting sustainability				1910	
Green growth				1600	
NDRC(2004)					
A		1158		1774	
B		1129		1609	
C		1017		1361	
EIA (2006)					
Reference		1940	2313	2686	3505
High economic growth		2013	2495	3018	4278
Low economic growth		1869	2147	2391	2890
Jiang&Hu(2006)					
baseline				2100	2700
high demand				2300	2900
policy				1855	2420
IEA(2004)					
reference		1662		2072	2539
alternative Policy		N/A		1877	2205
IEA(2006)					
reference			2509		3395
alternative Policy			2385		3006

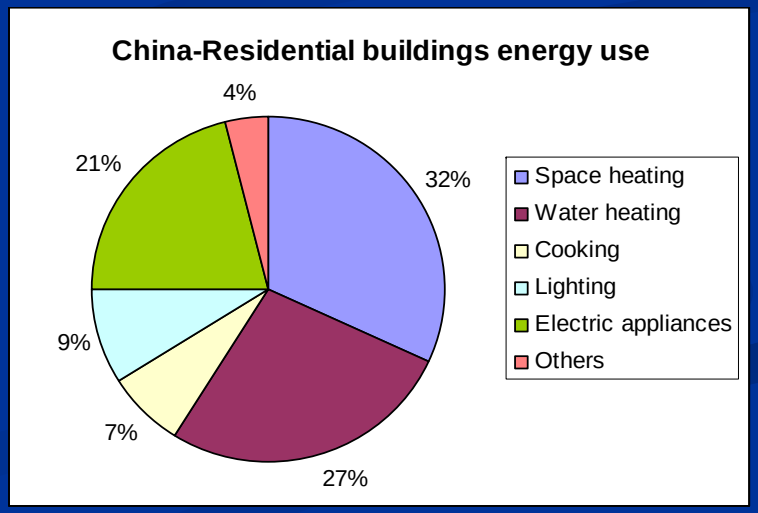
CO2 emission scenarios (Mt)

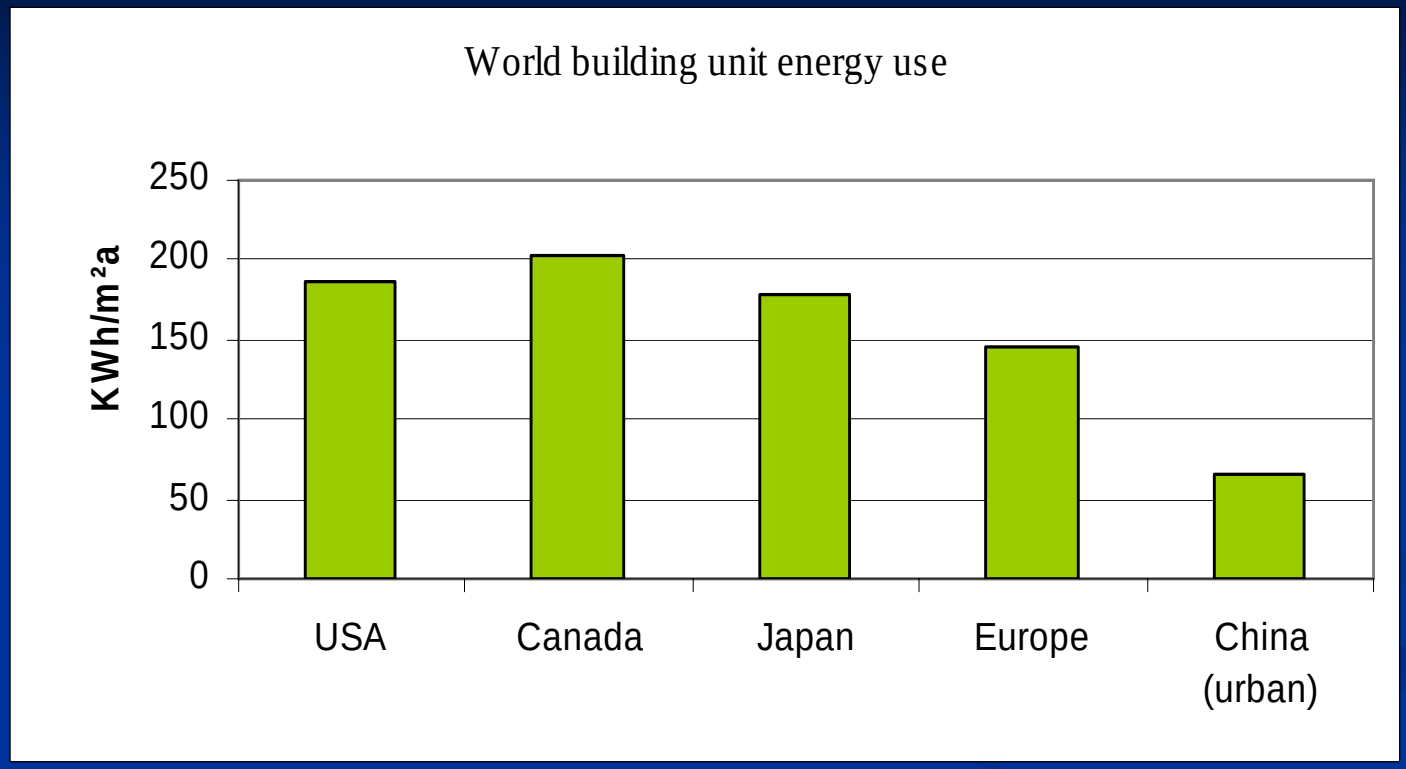
	2010	2015	2020	2030
ERI (2003)				
ordinary effort	4891	5837	6967	
promoting sustainability	4561	5287	6233	
Green growth	3916	4260	4766	
NDRC(2004)				
A	4246		6504	
B	4140		5900	
C	3729		4990	
EIA (2006)				
Reference	5857	7000	8159	10716
High economic growth	6110	7608	9287	13312
Low economic growth	5614	6442	7164	8652
Jiang&Hu(2006)				
baseline	5500		6600	8060
high demand			7180	8800
policy scenario			6100	7700
IEA(2004)				
reference	4386		5708	7144
alternative Policy			5053	5856
IEA(2006)				
reference		7744		10425
alternative Policy		7298		8801

Buildings Play Important Role

- Account for: 20% of final energy consumption in China
- 2020, new build in China total 20 billion m squared = total EU 15 current building stock
- China housing program uses 20% of steel and 17.6% cement output
- A building can last 60-80 years : carbon lock-in risk



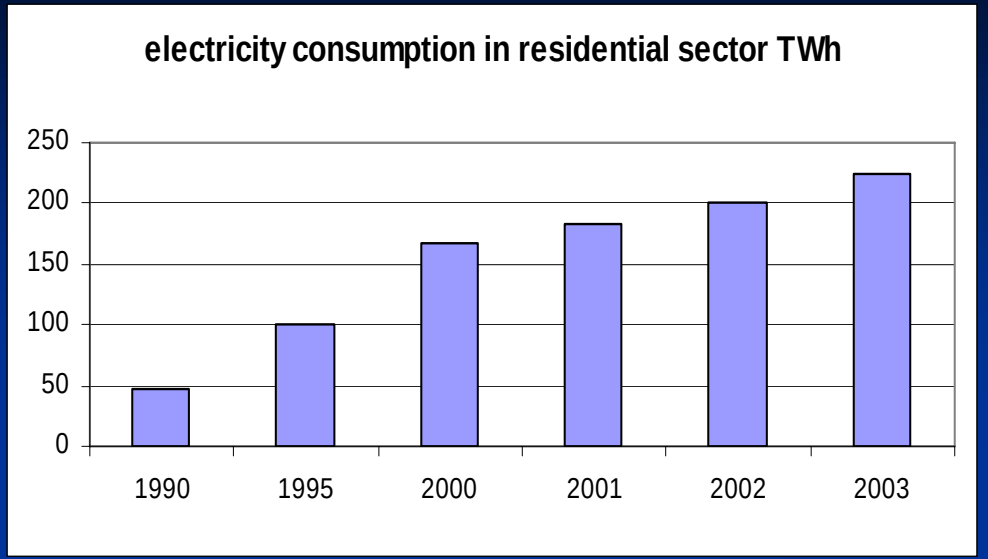


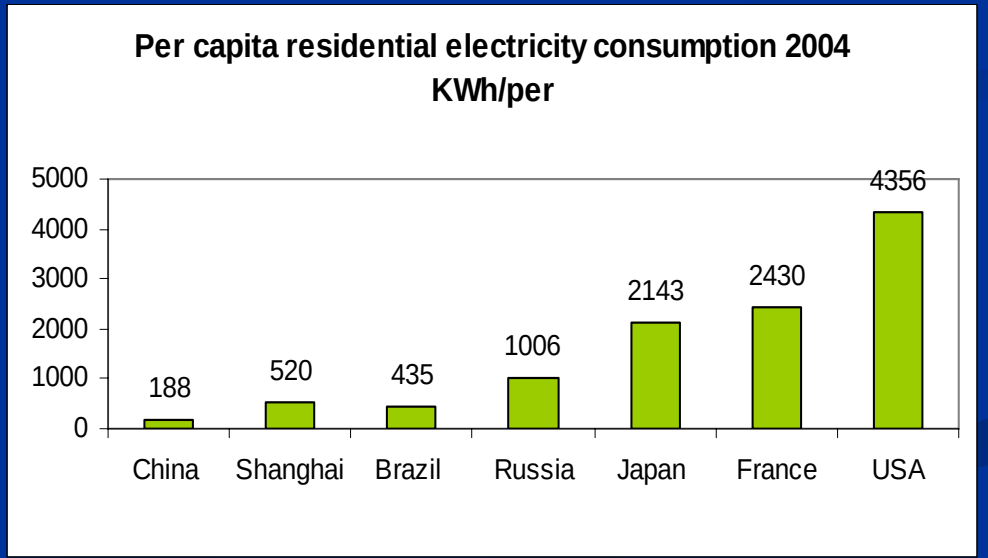


Source: International Energy Outlook2006, EIA

China's unitary energy use in building is still much lower than in the developed worlds, mainly due to household income constraints and the comfort level is relatively low

- Fast developments of electricity consumption in residential sector, about 80% of electricity are being generated from coal-fired power plants!
- However, per capita electricity consumption in residential sector is still very low compared to developed countries (income constraints, relatively low household appliance ownership…) , this implies a huge potential of increase in the coming years





Source: IEA; UNFPA; China energy statistical yearbook

Driving force of energy use increase in buildings

- Population and urbanization growth
  - 57-60 % of Chinese people will live in urban area in 2020
  - increase of per capita living area (35 m² in 2020).
  - More than 20 billion m² would be constructed in the urban area by 2020

- Economic development and standard of living improvement: per capita GDP in 2020 and 3000 US$ (10000 US$ in PPP term)

Energy and environmental concerns

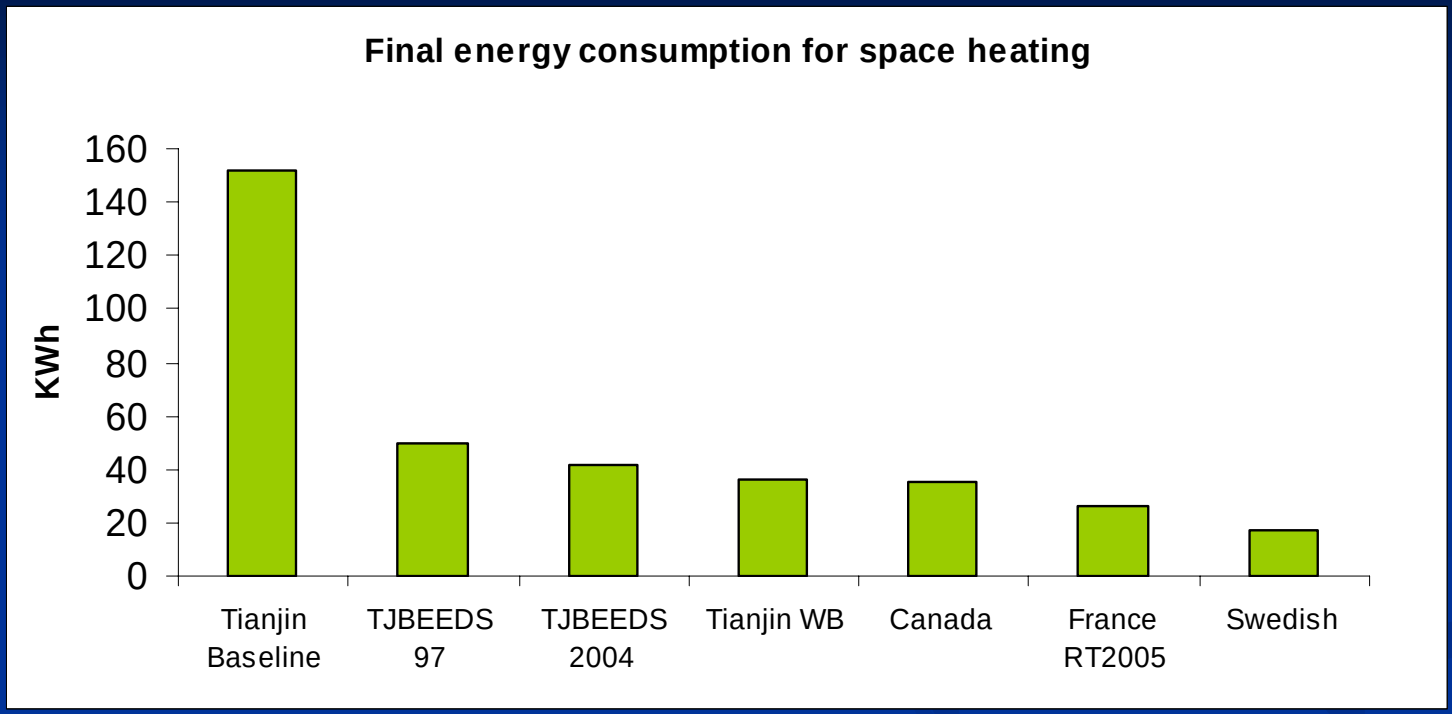
Close relationship between economic growth and demand increase in energy services; in particular electricity consumption in residential and service sector

Supply vs demand side action

- Deployment of large-scale High-end supply technologies (CCS, PV) could not be commercially available in the short run , development of low carbon technologies alone will not be a sufficient solution if the infrastructure is not built in efficient way
- « fuel switch coal to oil and gas » policy in energy supply aiming to reduce GEG emission intensity is very costly and confronts resources availability uncertainty (Per capita oil and gas reserve in China is only 11% and 4% of world's average.) and security of supply (50% of oil consumption in China is exported in 2006)
- Building energy efficiency is the cheapest (even with negative cost) and fastest way to save energy and cut CO2 emission

Heating and cooling in buildings

- Spacing heating represents approximately 54% of energy consumption in buildings in China, 180 Mt of coal in the urban sector in the heating zone alone each year
- efficient house (comply with 1995 National Building efficiency code) in China (20W/m² on average) is still almost twice higher than the most efficient houses in Sweden, Denmark, The Netherlands and Finland (11W/m²).
- Space cooling in buildings represents more than 40% of peak load in summer time in the south of China which poses a huge challenge to the power grid security



For a house complying with the Chinese building code, heating consumption can be reduced further with the regulatory requirements practiced in the Northern Europe.

Technique improvement needs

- Energy loss due to hydraulic unbalance is quite common and inside temperature is difficult to be maintained homogeneous in the absence of state-of-the-art regulation.
- End-users are often not allowed to adjust the inside temperature (no thermostatic device) according to the real requirement resulting in extra energy loss in heating
- Overestimate of heating capacity is still common due to designer's conservatism → Compromising system efficiency and return of capital investment

Institutional barriers

- Lack of economic incentive scheme for developers to build more efficient house since no explicite economic incentives exist
- High-performing energy system confronts many institutional barriers : e.g. access to grid of distributed energy of CHP or CCHP
- Lack of interagency collaboration between the different public institutions (e.g.Ministry of Construction, Ministry of Fiance)

Regulatory framework and policy instruments

- Incentives/ Schemes
- Utilities compulsory obligations, e.g. emission abatement energy intensive manufacturing: steel, cement, glass and other major building materials manufactering
- Tax cut or subsidy to energy performing products
- Certificate, labelling system
- Carbon allowance trading(EU's system)
- Integrate Kyoto financing tool: ***CDM*** in buildings

Policy recommendations for low-carbon future

- Tightening energy efficiency requirements for both new and existing buildings in line with the best practised technologies.
- Reinforce the implementation of building codes
- Standardization of appliances and building materials quality
- Promoting high-performing appliances and renewable energy R&D through specific scheme, minimising district heating distribution energy loss in the northern cities
- Development of high efficient energy supply technologies (CHP, CCHP, geothermal etc.)
- Inclusion of energy planning scheme into the long term urban development strategies.
- Diversify supply resources in efficient buildings: supportive policies for RES and solid wastes incineration power in new urban redevelopment scheme .
- Demonstration and scaling-up of low-carbon buildings zone
- Institutional reforms: heating reform; pricing design

Conclusion

- Energy demand in buildings could be reduced by 100-300 mtoe in 2030 in policy scenarios compared with BAU scenarios according to the different models.
- Accordingly, nearly 600-700 Mt CO2 emission can be saved in 2020 by implementing appropriate policies
- low-carbon scenario of buildings in China requires a fundamental change in consumption pattern and improvement of energy performance of buildings from NOW.
- Both regulatory instruments and economic incentives should be formulated as soon as possible under a coherent institutional framework

Thank you!

junli@iddri.org