

Energy Use in Commercial Building in China: Current Situation and Future Scenarios

ECEEE

2007 8th ECEEE Summer Study
4-9 June 2007

Nan Zhou

Environmental Energy Technologies Division
Lawrence Berkeley National Laboratory

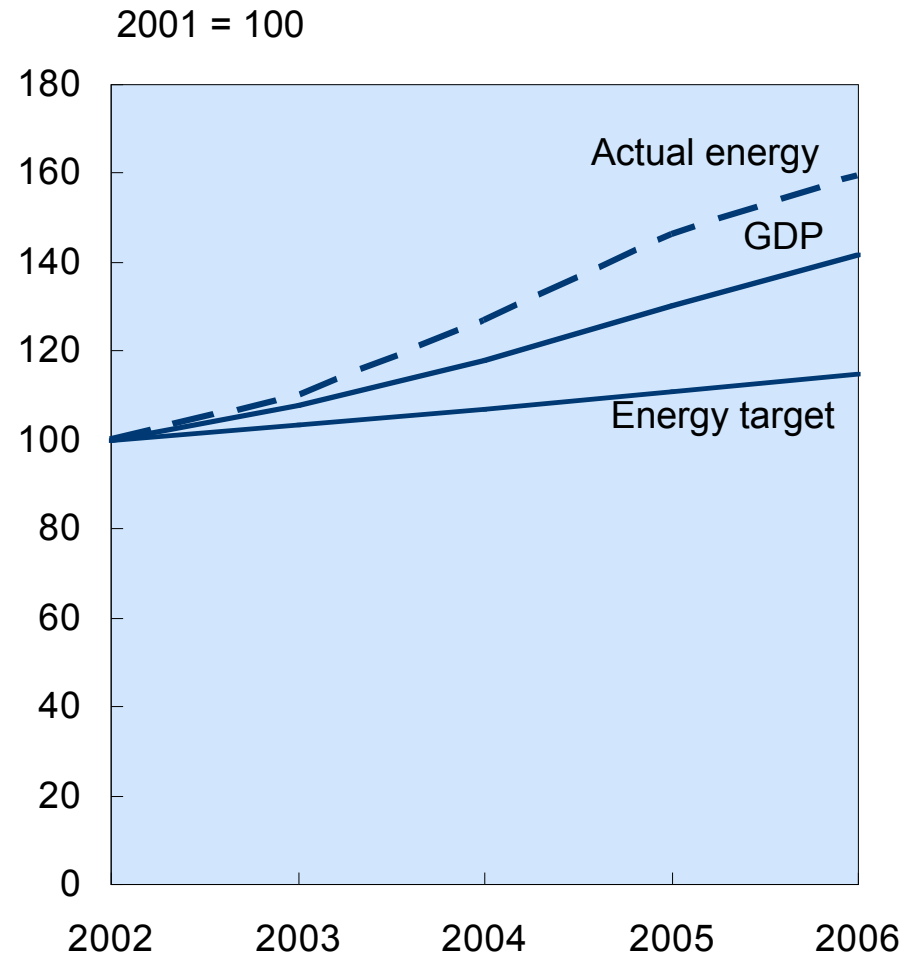
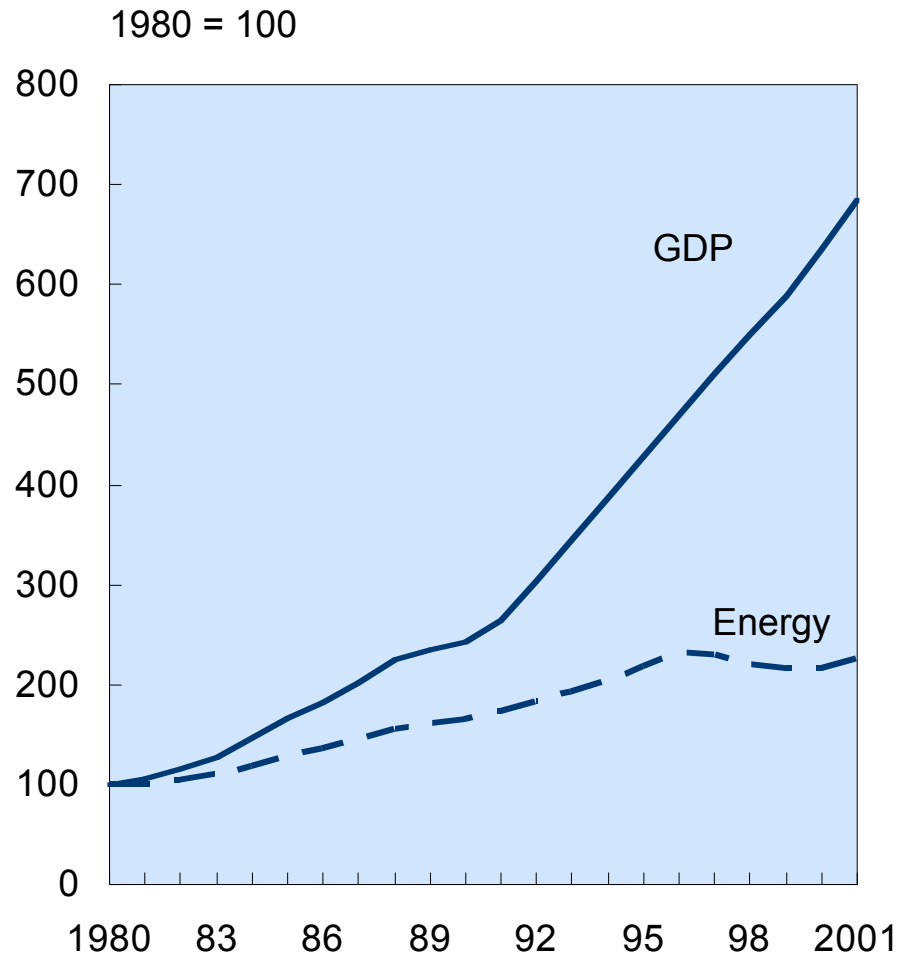
OUTLINE

- Background
- Commercial Building Energy Consumption in China
 - Current
 - Base case projection
- Drivers of demand
- Alternative Scenarios

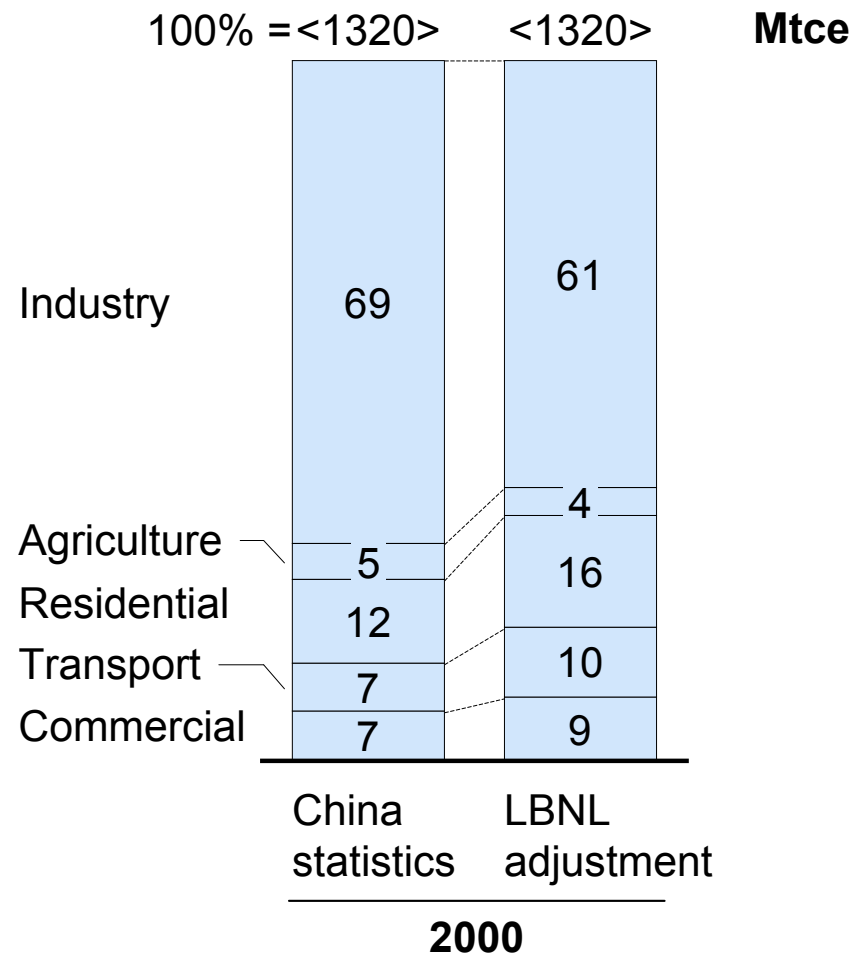


FOR TWO DECADES, ENERGY AND GDP GROWTH WERE DECOUPLED, BUT NO LONGER

Evolution of real GDP and total energy demand



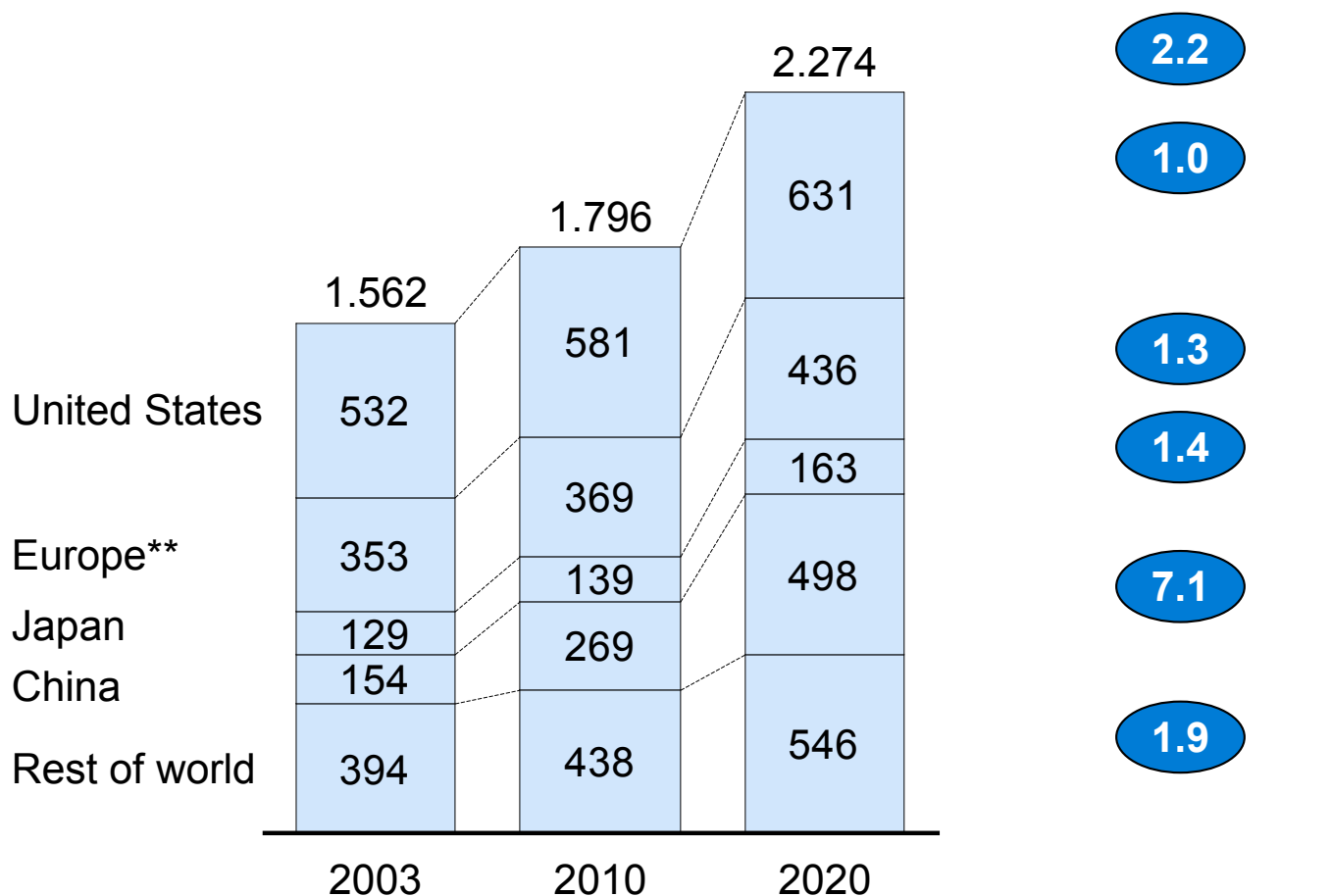
COMMERCIAL PRIMARY ENERGY CONSUMPTION BY SECTOR



CHINA'S COMMERCIAL SECTOR WILL SEE THE FASTEST GROWTH AT OVER 7 PERCENT A YEAR TO 2020

End-use energy demand*
Million tons of coal equivalent

CAGR 2003-20
Percent

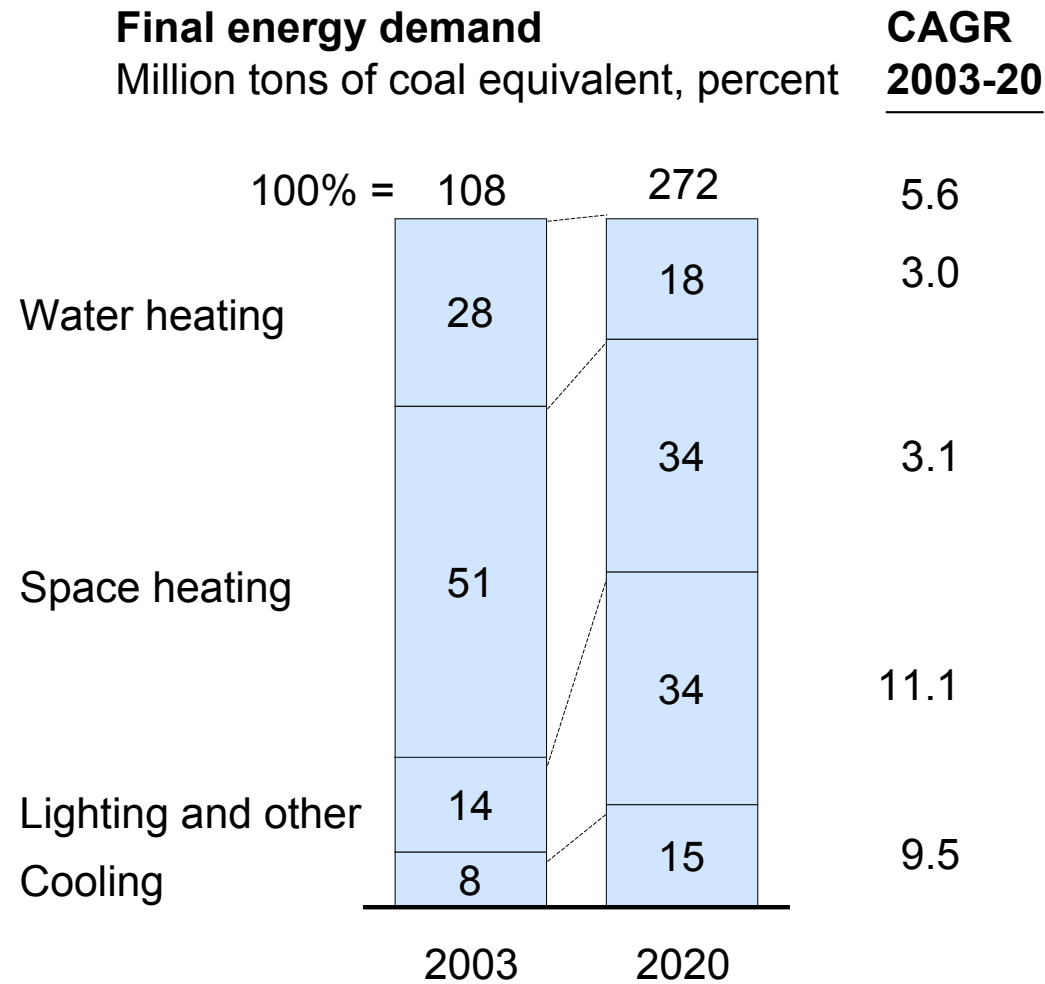


* Transformation losses (power generation and refining) allocated to end-use segments.

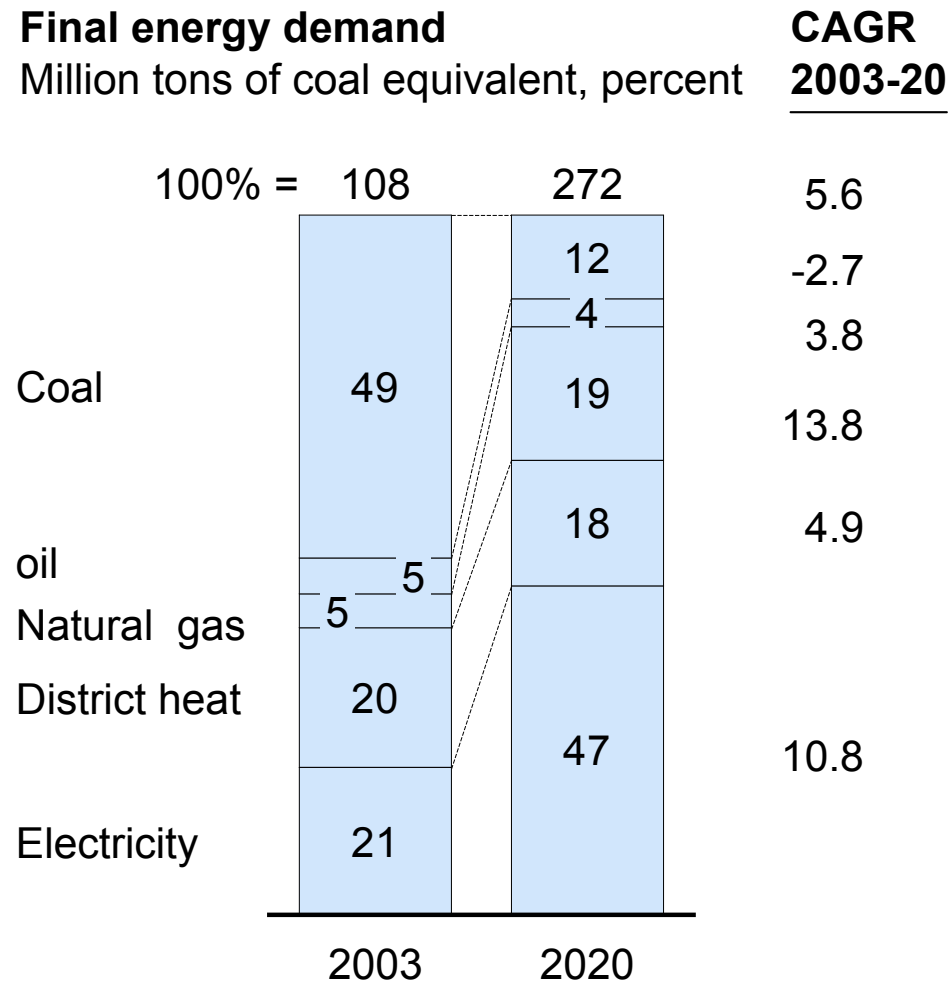
** Including Northwest Europe, Mediterranean and North Africa, and Baltic/Eastern Europe.

Source: IEA; McKinsey Global Institute Global Energy Demand Model

THE MIX OF END-USES WILL SHIFT STRONGLY TO 2020...

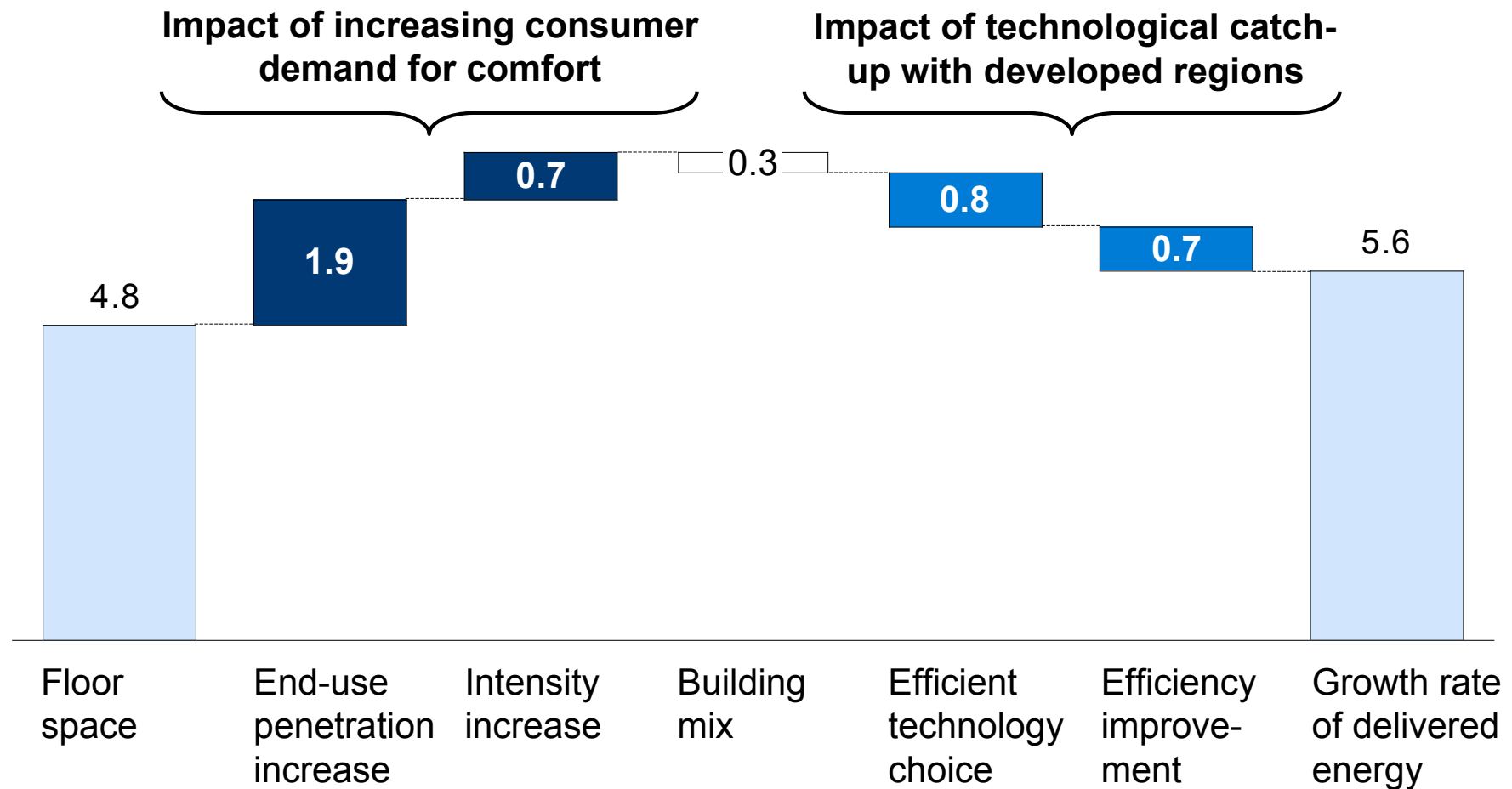


... AS WILL THE FUEL MIX

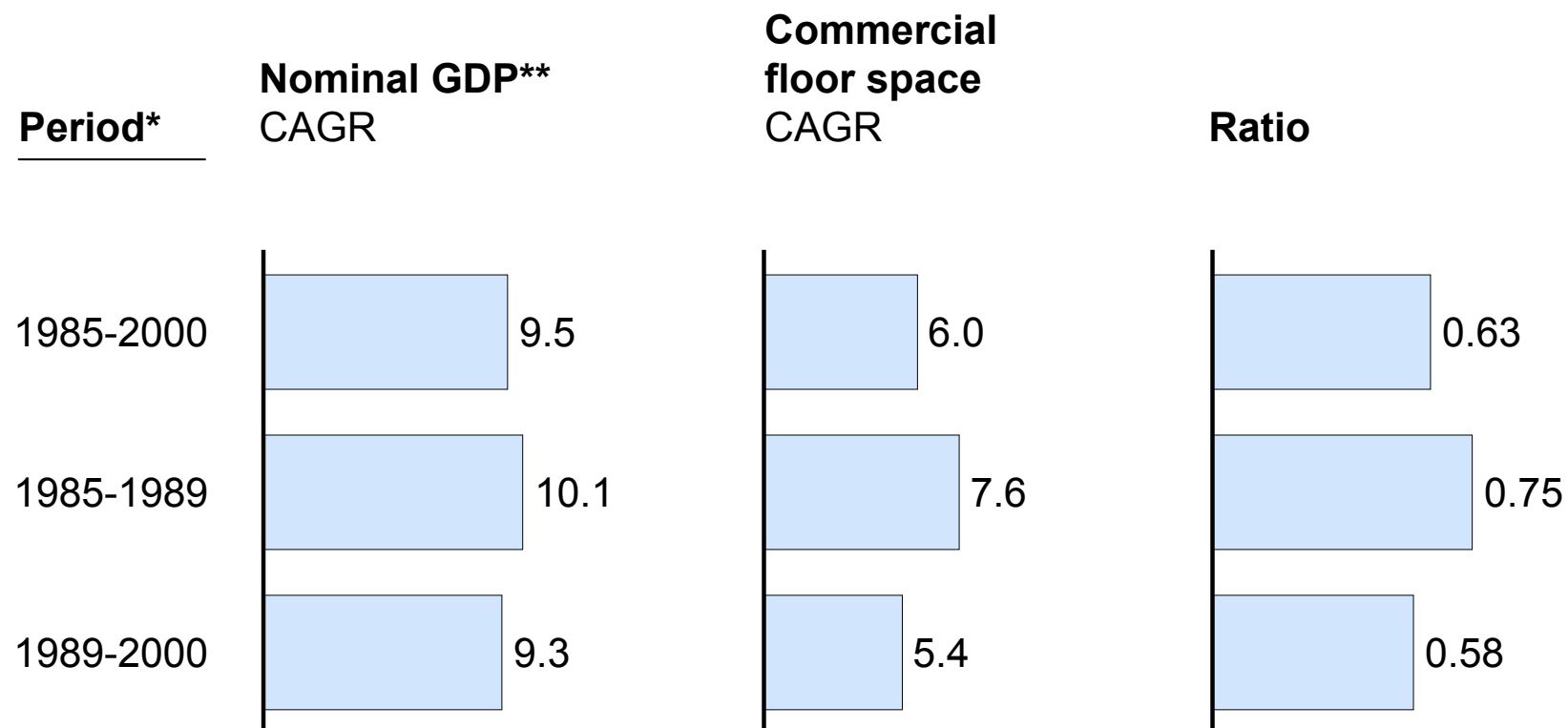


INCREASED PENETRATION AND INTENSITY WILL MORE THAN OFFSET PROJECTED ENERGY-EFFICIENCY IMPROVEMENTS

Key drivers of China commercial sector energy demand growth, 2003–2020
Percent



IN CHINA, THE ELASTICITY OF FLOOR-SPACE GROWTH TO GDP GROWTH HAS DECLINED OVER TIME



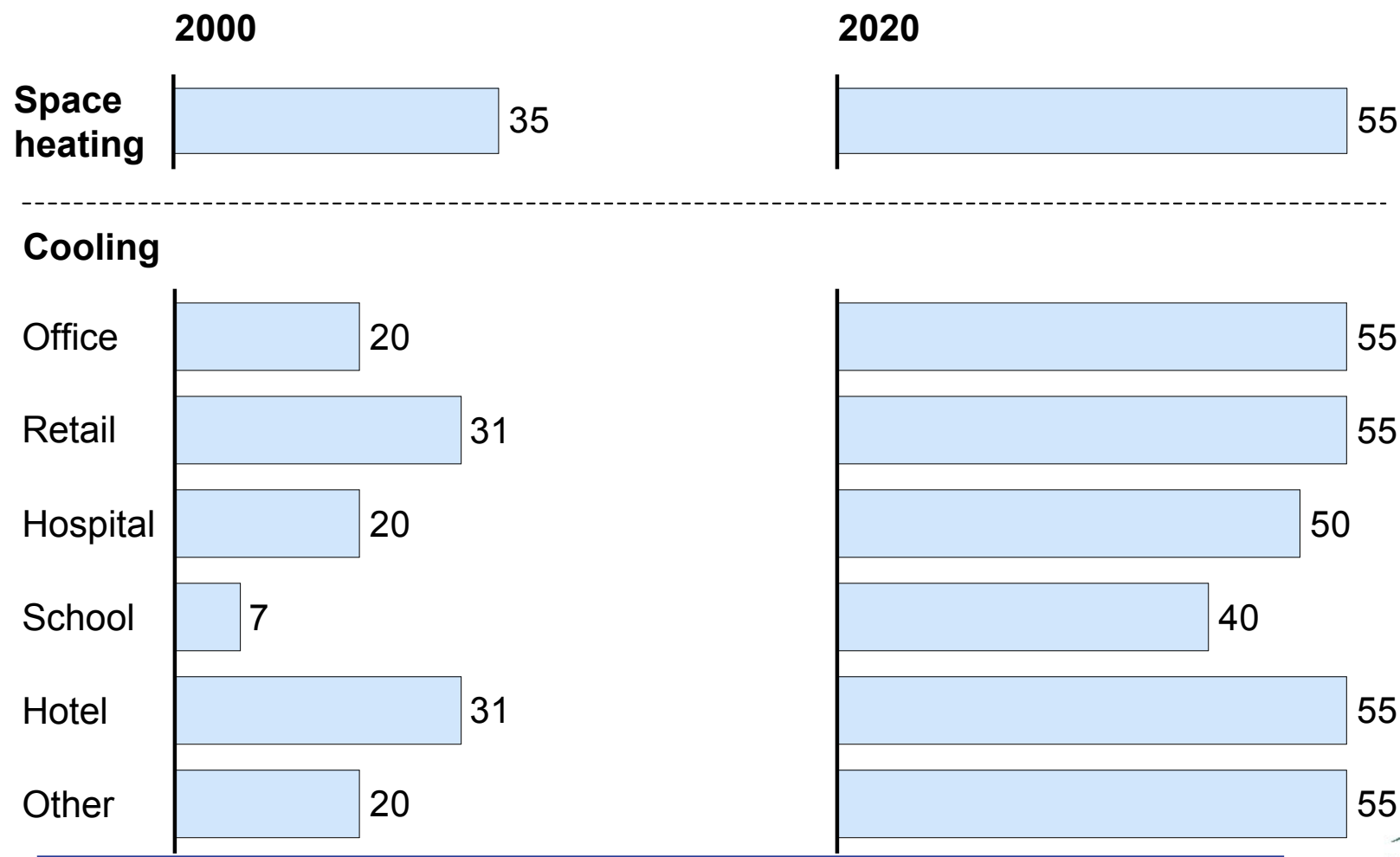
* Total commercial floor area could be derived only for 1998 and 2000 from existing research. The rest of the years were estimated based on China's statistical yearbook. **) Due to data limitations, nominal GDP was used as a proxy for services GDP in this analysis.

Source: LBNL; Global Insight; MGI analysis

IN CHINA, PENETRATION OF MAIN-BUILDING ENERGY END USES IS PROJECTED TO INCREASE SIGNIFICANTLY ACROSS ALL SECTORS...

End-use penetration in China commercial sector, 2000–2020

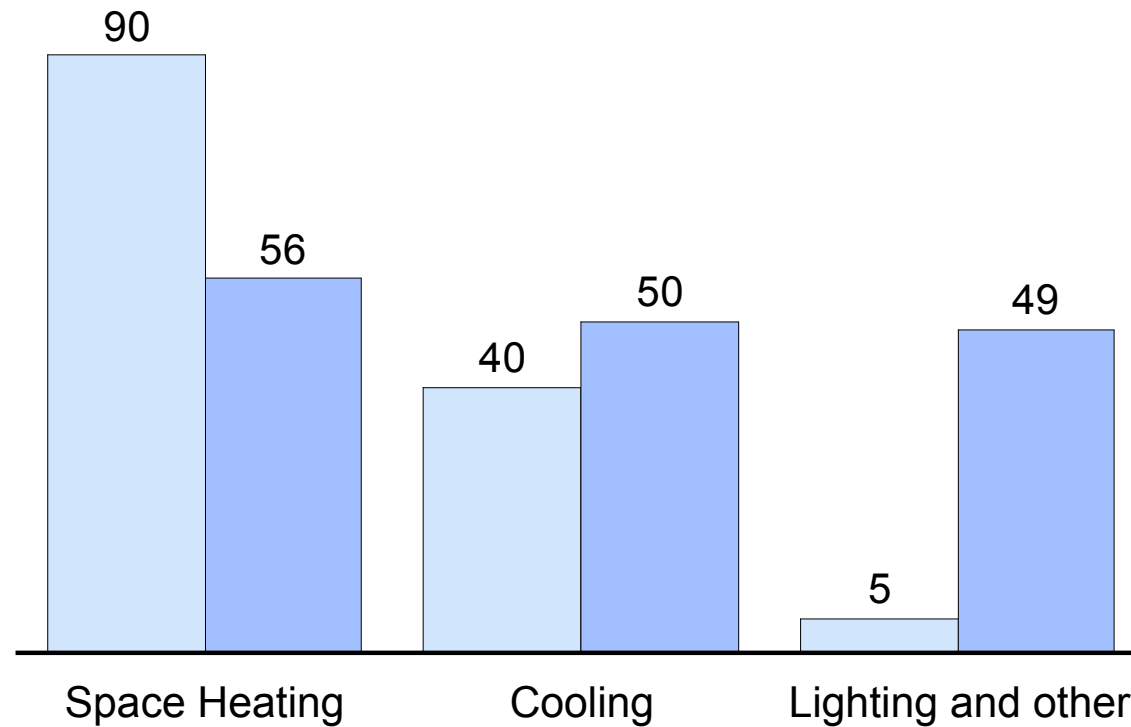
Percent



ENERGY INTENSITY OF A BUILDING WILL INCREASE TO MAINTAIN A SUITABLE WORKING AND LIVING ENVIRONMENT, EXCEPT FOR SPACE HEATING

Energy intensity

Kilowatt-Hour per Square Meter



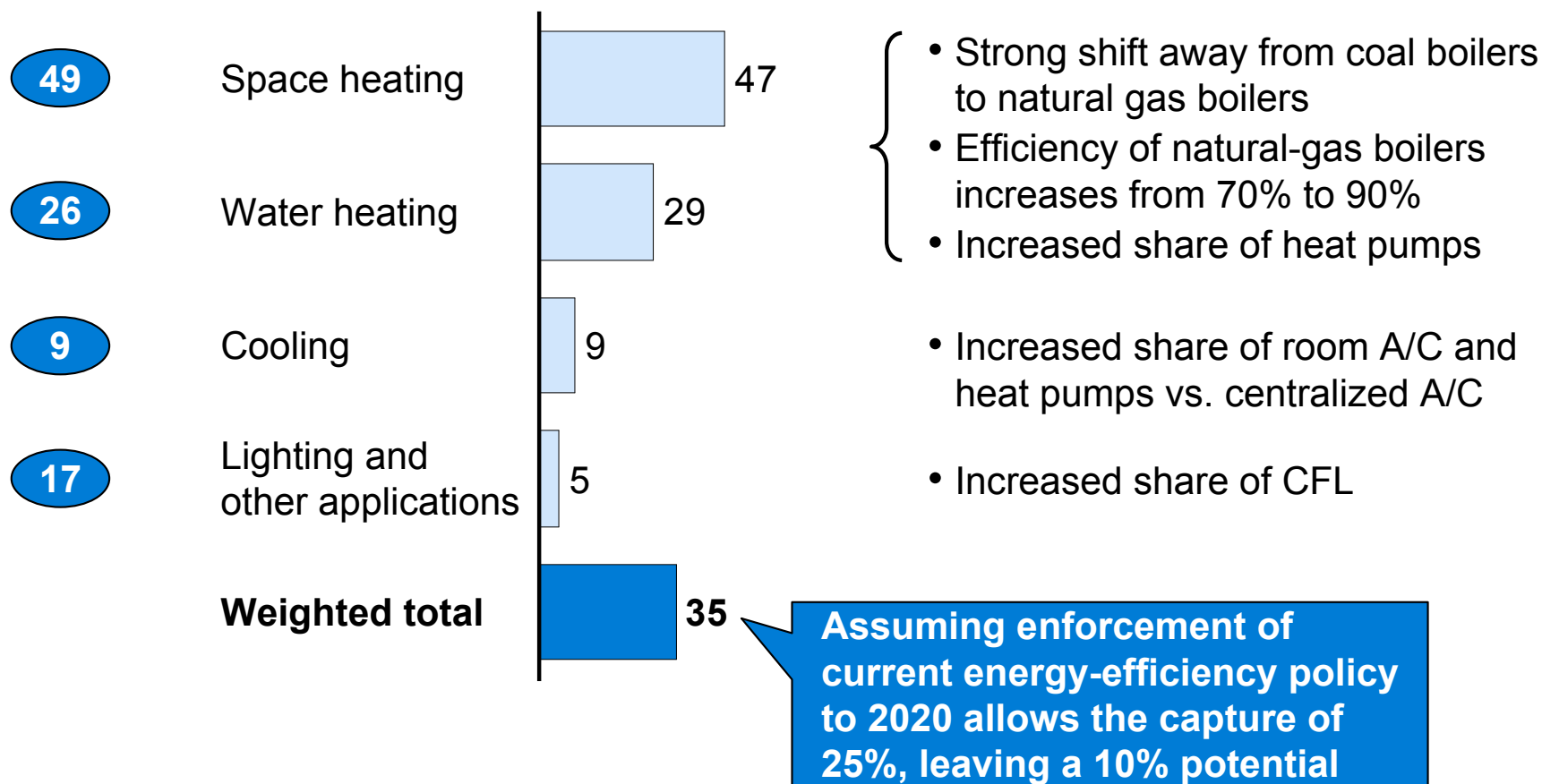
CHINA'S ENERGY EFFICIENCY POTENTIAL REACHES 35 PERCENT

Percent

Share of demand, 2005

Energy demand abatement potential*

Examples of efficiency improvements



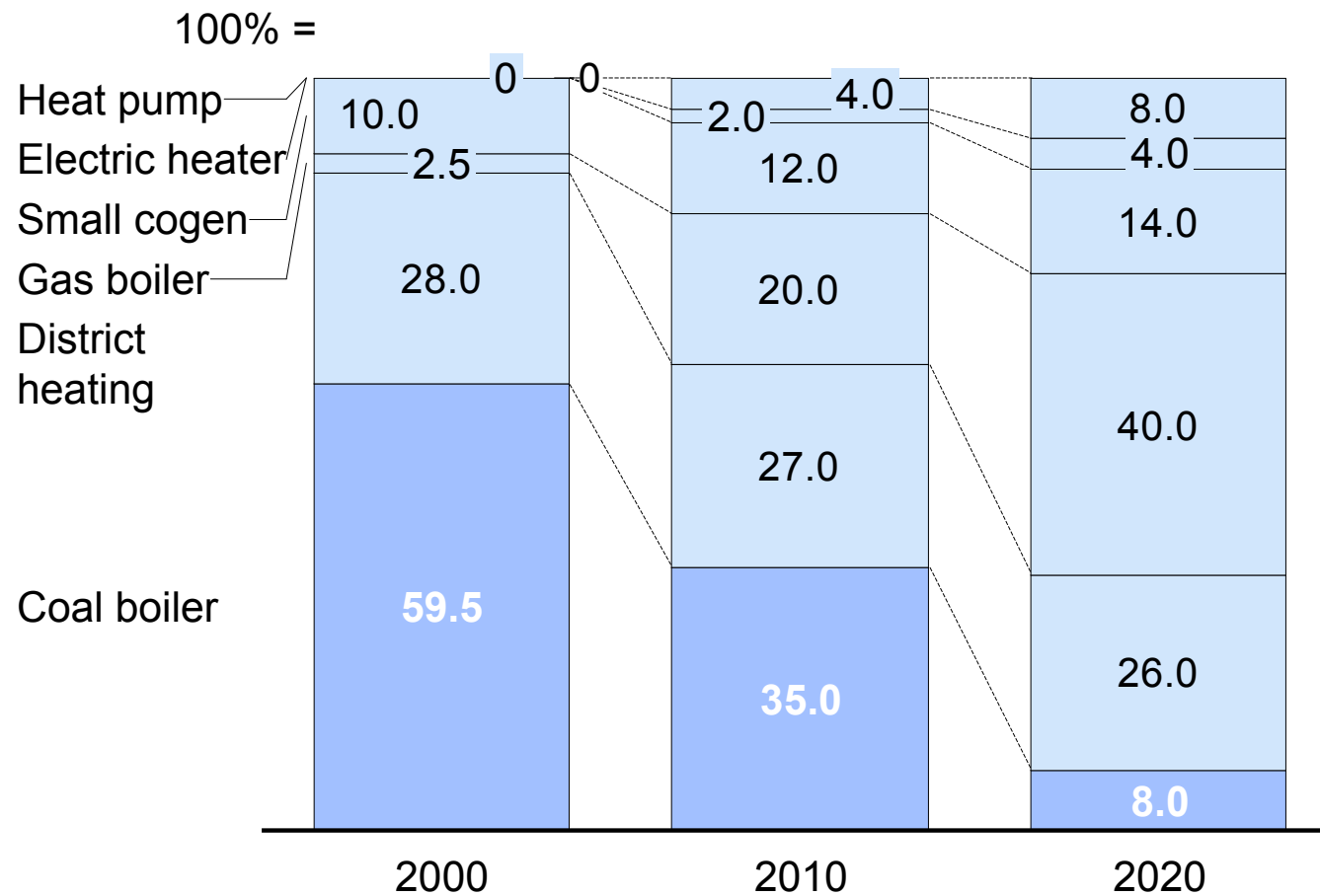
* As an example, doubling energy efficiency for a given end use leads to a demand reduction of 50%.

Source: LBNL, China Energy Group; MGI analysis

A RADICAL SHIFT IN CHINA'S SPACE-HEATING TECHNOLOGY CHOICES WILL LEAD TO A DRAMATIC CHANGE IN FUEL MIX ...

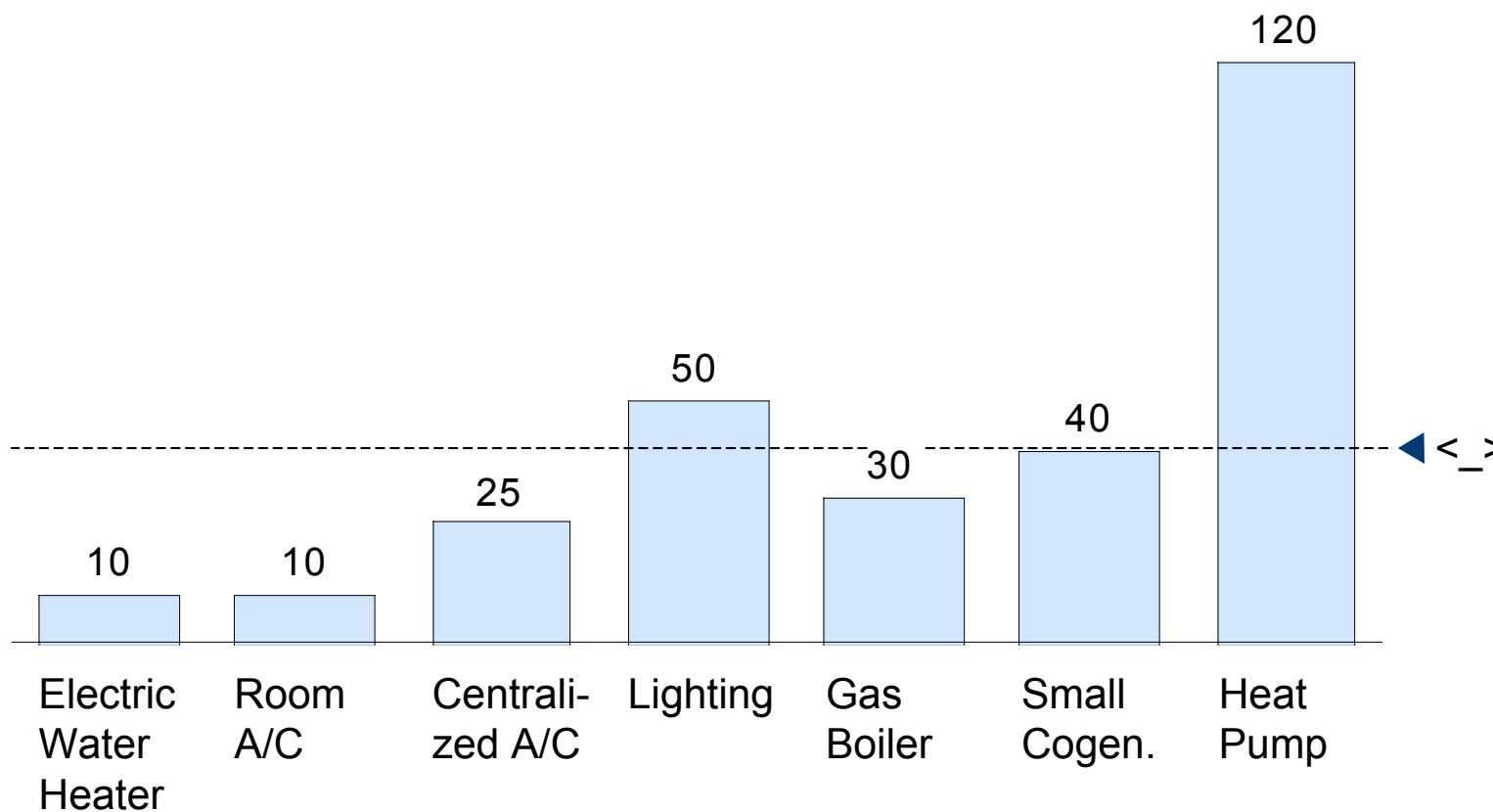
Share of space-heating technologies in Chinese office buildings

%

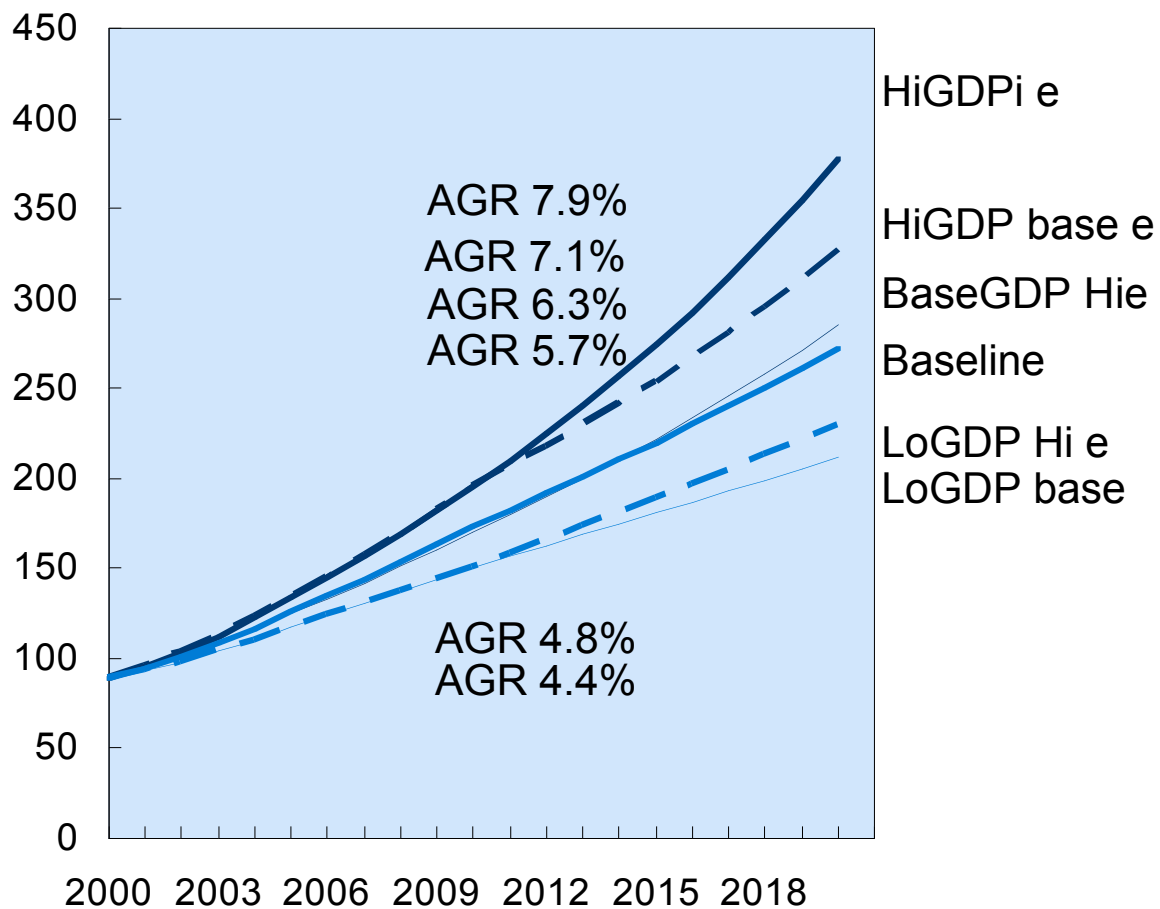


EFFICIENCY IMPROVEMENTS BY TYPE OF EQUIPMENT

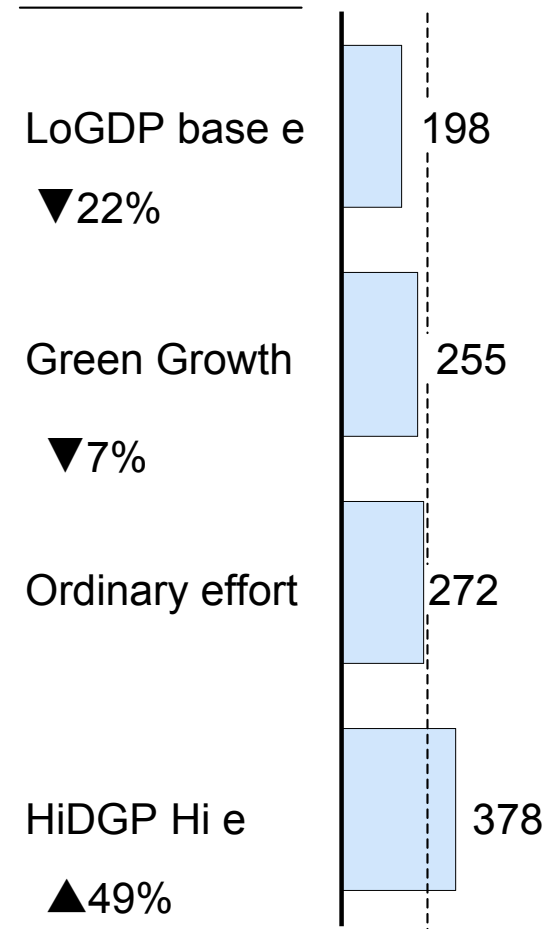
Technical efficiency improvement, 2003-2020
Percent



OTHER SCENARIOS



Mtce



DIFFERENT TYPES OF POLICY INSTRUMENTS

Examples

Building codes

- New building codes, with increasing industry involvement
- 35% to 50% target energy savings at less than 10% extra cost
- Implementation implies upgrading envelope insulation and installing advanced window, HVAC and lighting technologies
- Currently low compliance rate in new constructions (~5 percent)

Efficiency standards and Labeling

- China already has minimum standards for HVAC equipment...
- ... as well as labeling program for air conditioners and office equipment
- Standards remain lower than in several developed countries

Reform of heat system

- Heat metering
- Heating technology improvements
- Combined heat and power

Government procurement

- Government buildings account for an estimated 5% of China's energy consumption. Energy-saving retrofits in these building could reduce energy intensity and set an example for other buildings

Thank you!

For more information, please contact:

Nan Zhou

Environmental Energy Technologies Division

Lawrence Berkeley National Laboratory

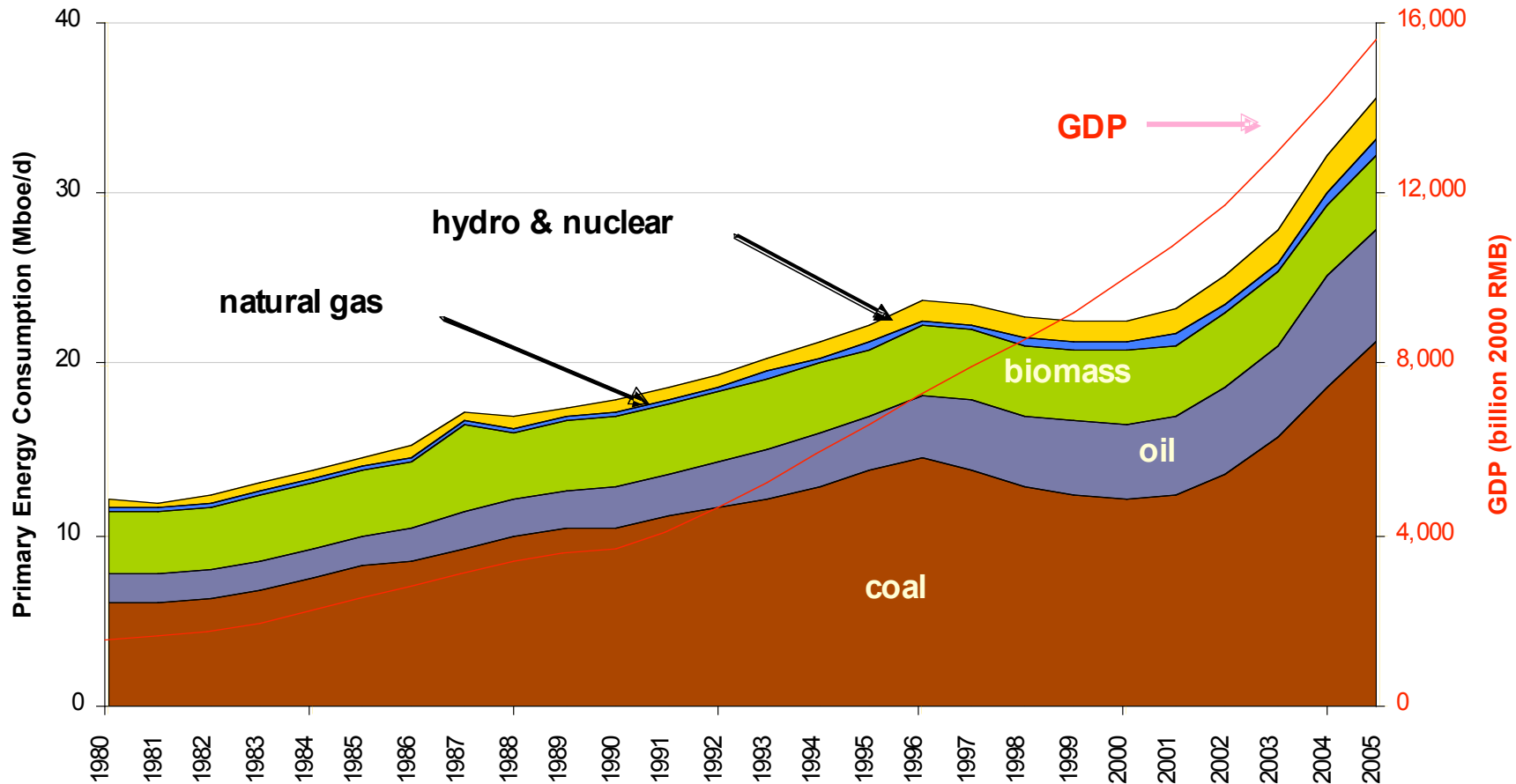
1 Cyclotron Road, 90R4000

Berkeley, CA 94720

NZhou@lbl.gov

BACKUP

China's current energy picture looks in many ways like its past, but larger



Methodology

- LEAP model
- Drivers

$$E_{RB} = \sum_k^{OPTION} \sum_n^{OPTION} \sum_q^{OPTION} \left[A_{CB,n} \times P_{q,n} \times \left(\sum_k Intensity_{q,n} \times Share_{k,q} / Efficiency_{k,q} \right) \right]$$

k = energy type (technology type)

q = type of end-use,

n = building type

ACB,n = total commercial floor area in commercial building type n in m²

$P_{q,n}$ = penetration rate of end-use q in building type n

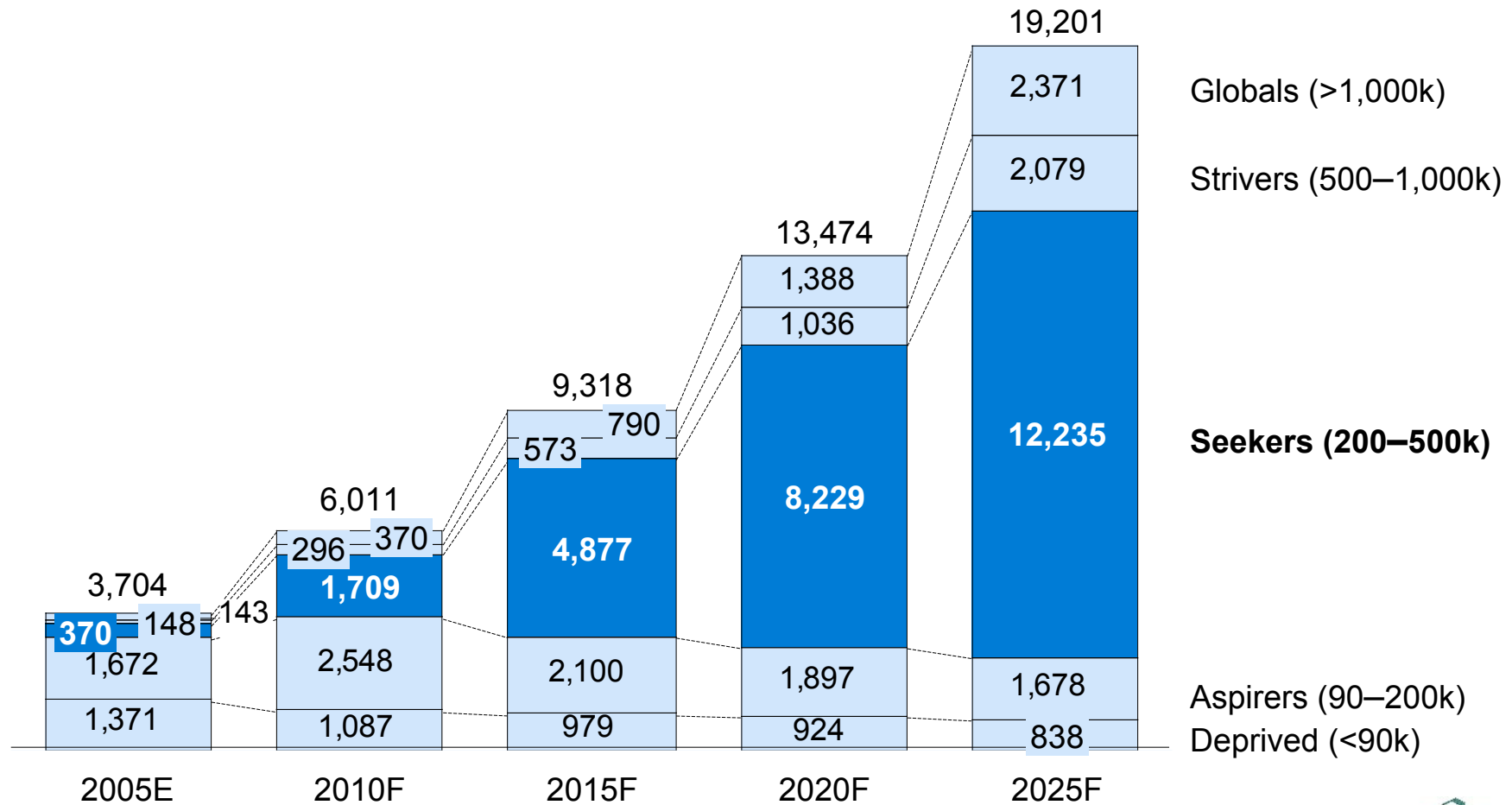
$Intensity_{q,n}$ = intensity of end-use q in building type n

$Share_{k,q}$ = type of technology k for end-use type q , and

$Efficiency_{k,q}$ = efficiency of technology k for end-use type q

THE RISE OF CHINA'S URBAN MIDDLE CLASS WILL DRIVE STRONG GROWTH IN PRIVATE CONSUMPTION...

Urban consumption expenditure by income class
Billion, renminbi, 2000



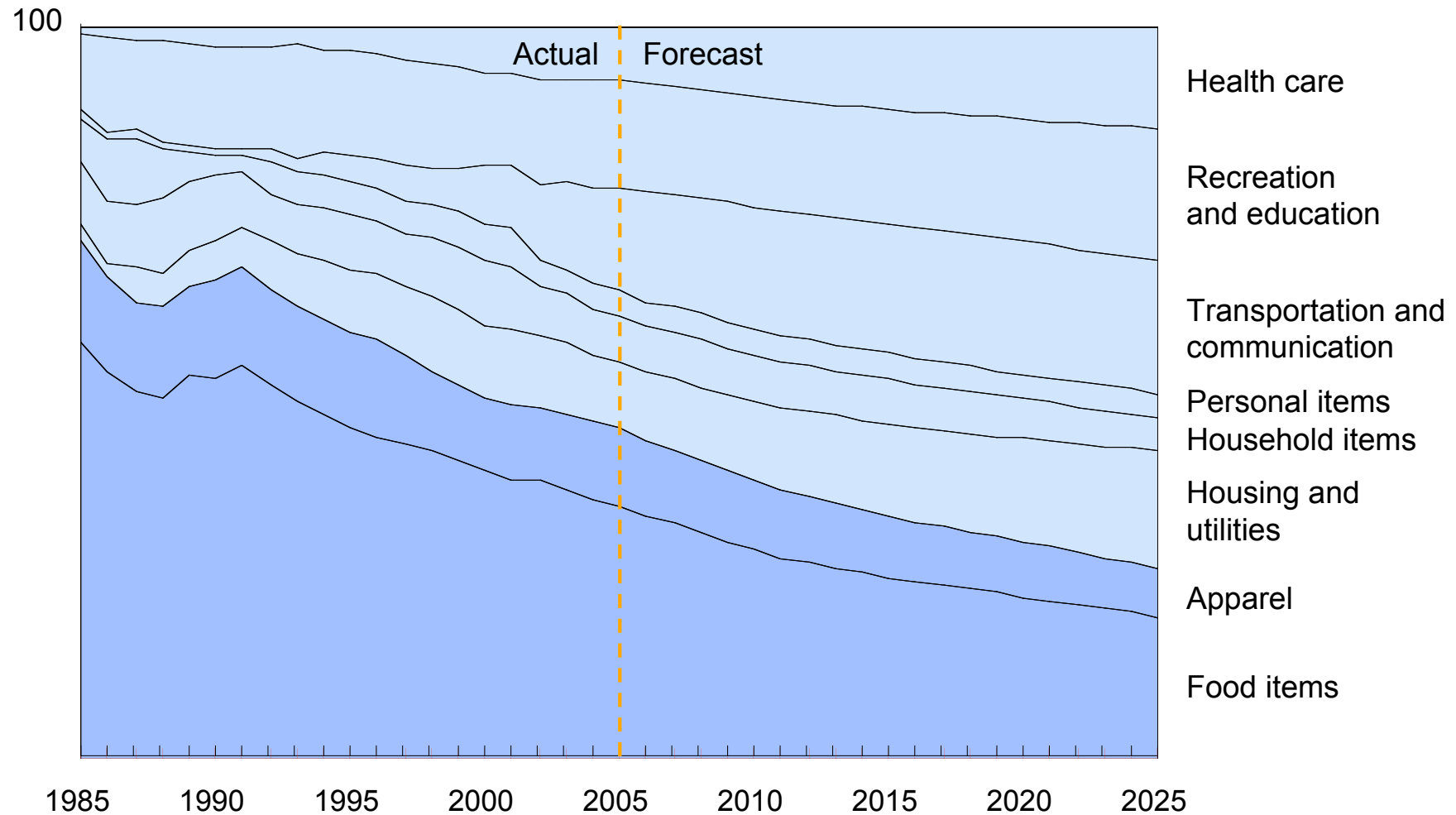
Source: MGI China Consumer Demand Model



... WITH A RAPID SHIFT OF SPENDING TOWARD DISCRETIONARY CATEGORIES, INCLUDING SERVICES

Discretionary
Basic needs*

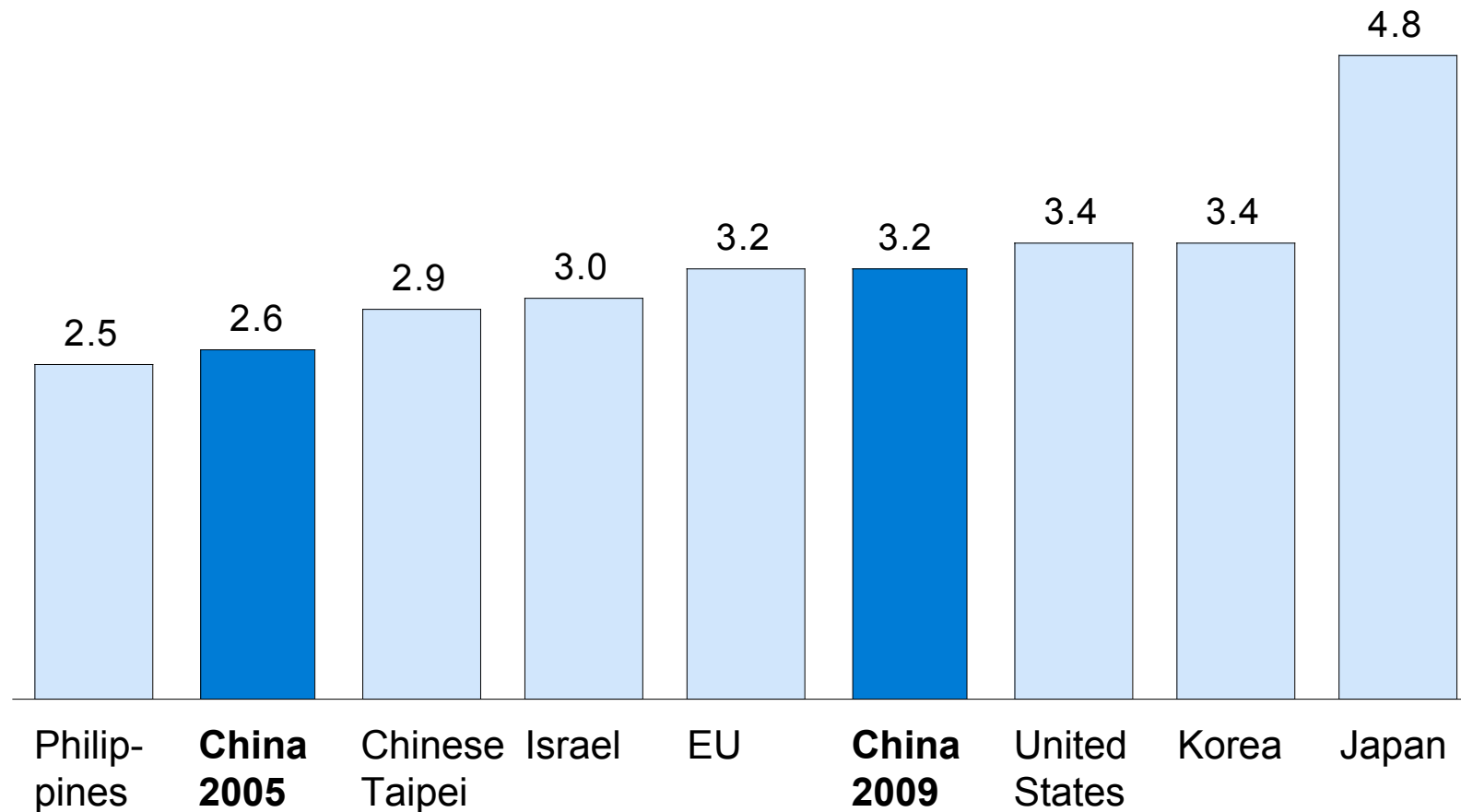
Relative share of consumption categories, 1985–2025
%



CHINESE AIR-CONDITIONING EFFICIENCY STANDARDS WILL GRADUALLY RISE BUT STAY BELOW US AND JAPANESE STANDARDS

Compared air-conditioning efficiency standard

Energy Efficiency Ratio*



* The higher the EER rating, the more energy efficient is the air conditioner.

Source: LBNL, China Energy Group