Methodology for Creating Heat Road Map China

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Outline

1. Overview of China's district heating development
2. Methodology
3. Modelling the Reference scenario
4. Designing the Heat Roadmap China scenario
5. Results and Discussion

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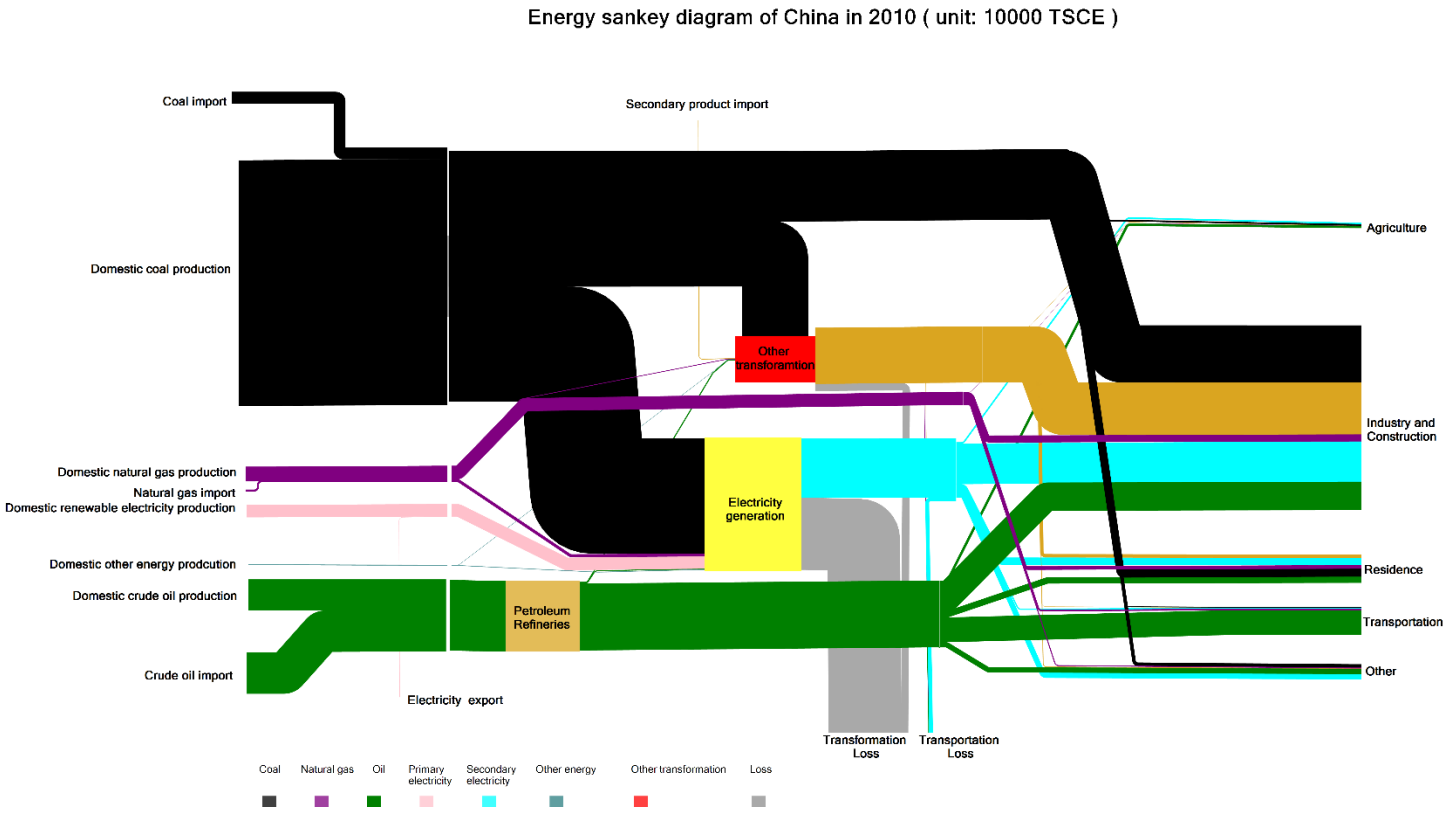
Overview of DH in China

- Coal-dominated supply and industry dominated energy consumption in China

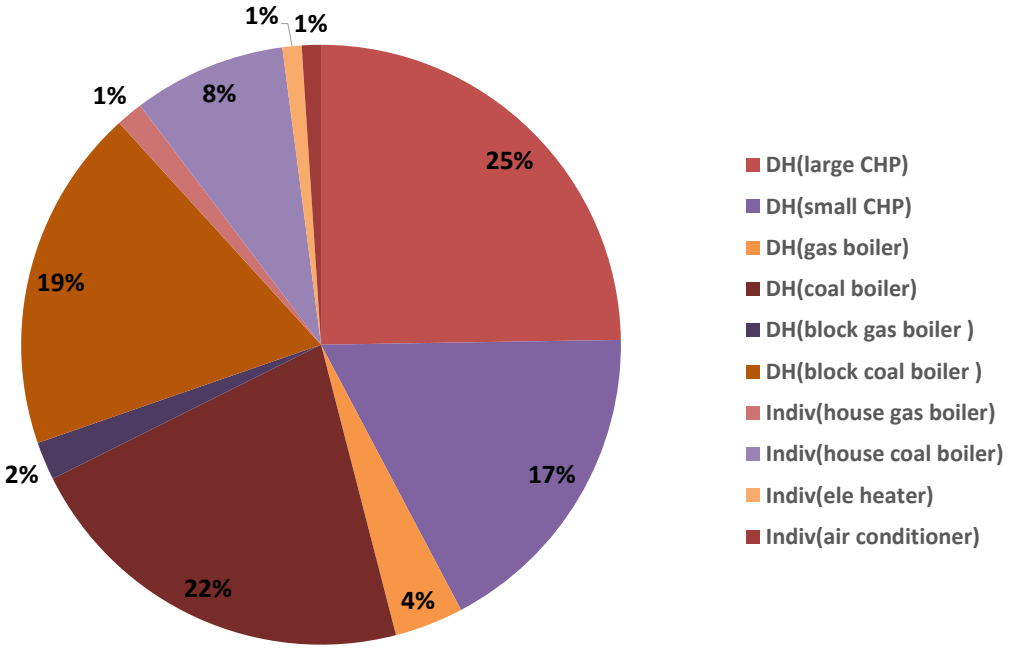


Data Source: NBS 2011., MOC 2010.

Please do not cite or quote

Overview of DH in China

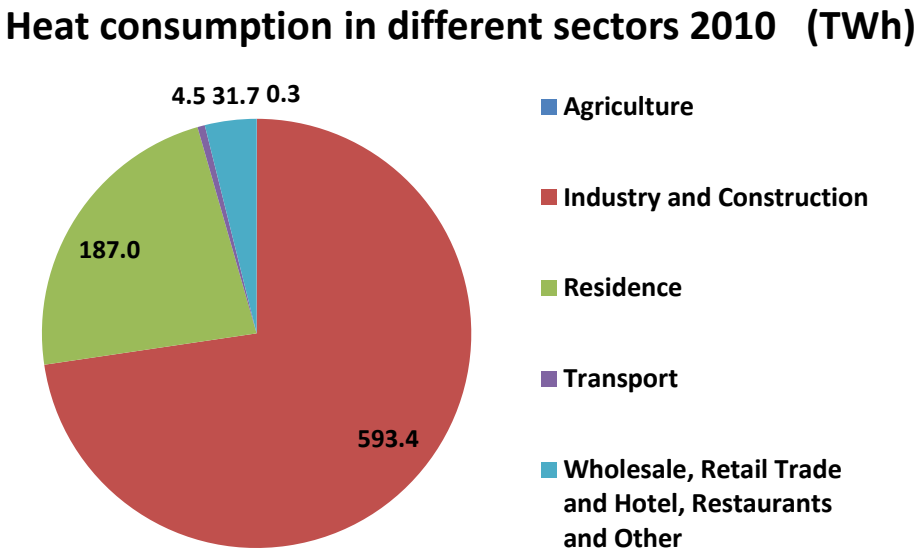
- District heating in China is dominated by coal boiler and coal CHP plants

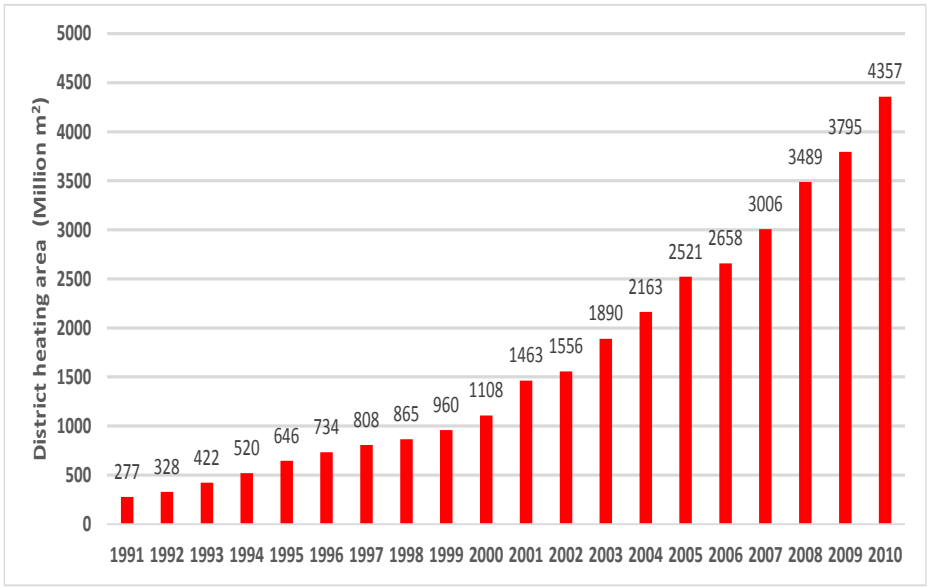


Data Source: NBS 2011., MOC 2010.

Overview of DH in China

- Heat sector in China (hot water in house hold excluded)
  - High energy consumption density(160kWh/m^2) vs 80kWh/m^2 Euro





- Current Tendency: Double energy demand in 2030 ?

Data Source: NBS 2010. MOC 2002-2010

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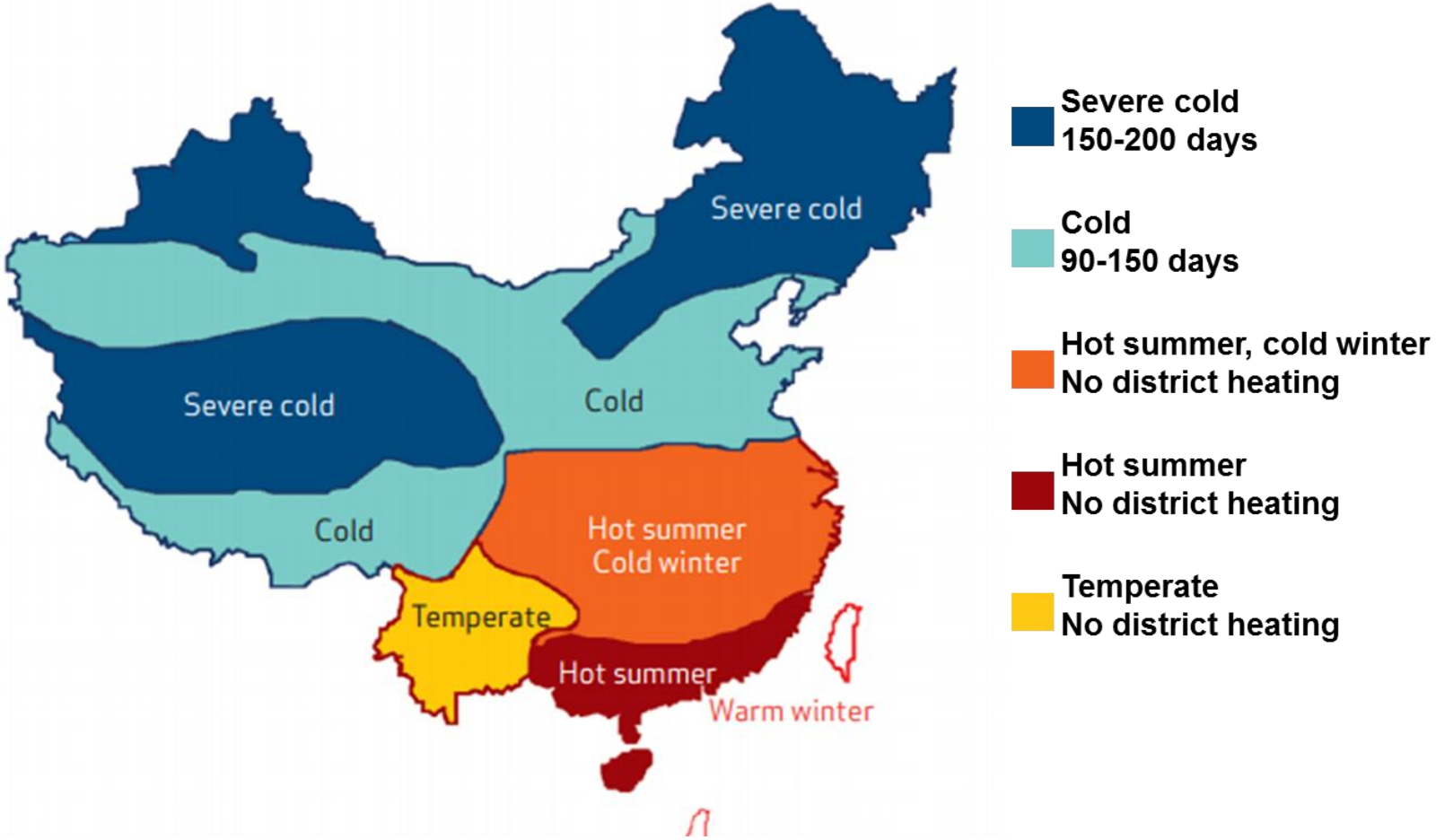
Overview of DH in China

- **Research Question:**
- How does China supply her district heating system in next two decades ?

- Could district heating contribute to ensuring the sustainability of China's energy system?

Overview of DH in China

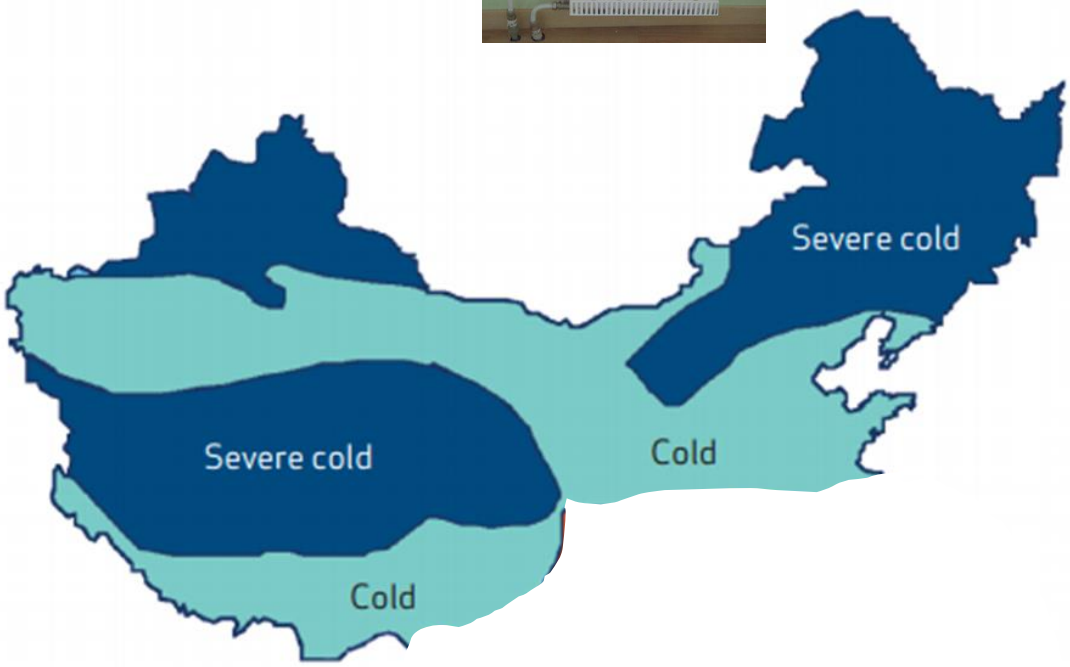
- **Huang river- legal boundary of district heating**

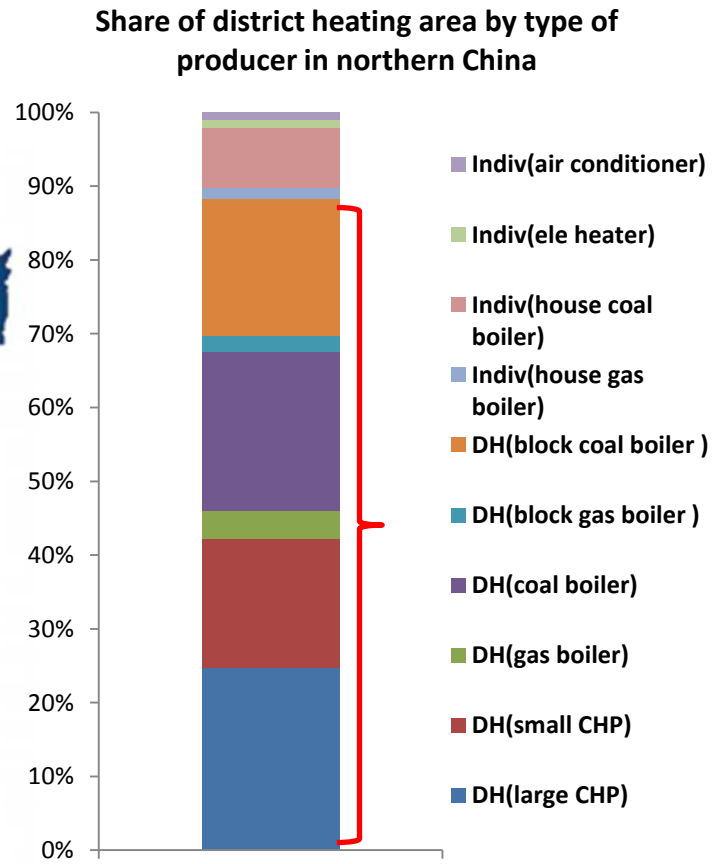


Data Source: IEA, 2007

Overview of DH in China

- **District heating covers 80% of building in Northern part**
  - All time
  - All space





Data Source: NBS 2010. MOC 2002-2010.Tsinghua,2011

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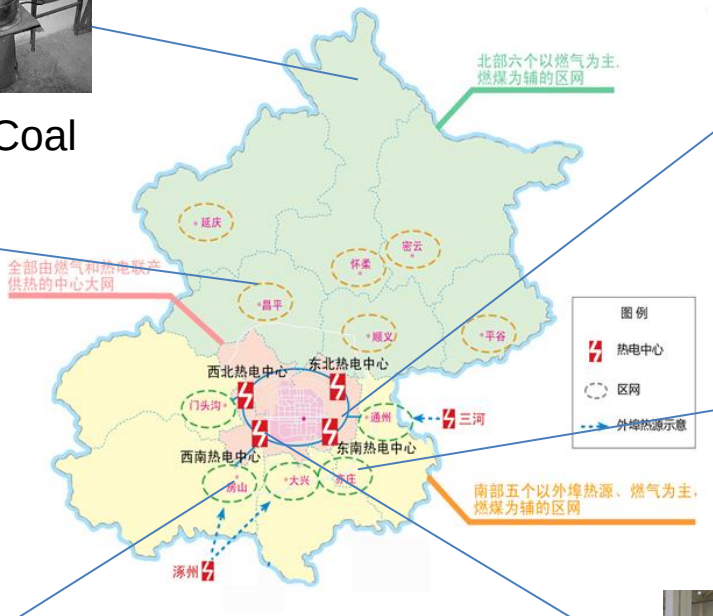
Overview of DH in China

- **Typical heating system in Northern cities**

Indiv. Coal

Large coal CHP: ＞ 300MW

Block Coal Boiler(3MW)



Small coal CHP: 50MW

DH Coal Boiler(100MW)

NG CHP(400MW)

Please do not cite or quote

Data Source: NBS 2010. MOC 2002-2010.Tsinghua,2011

Overview of DH in China

- **Southern China is dominated by individual heat units**
  - Part time
  - Part space

Electric radiator

Air conditioner

Gas heater

Data Source: NBS 2010. MOC 2002-2010.Tsinghua,2011

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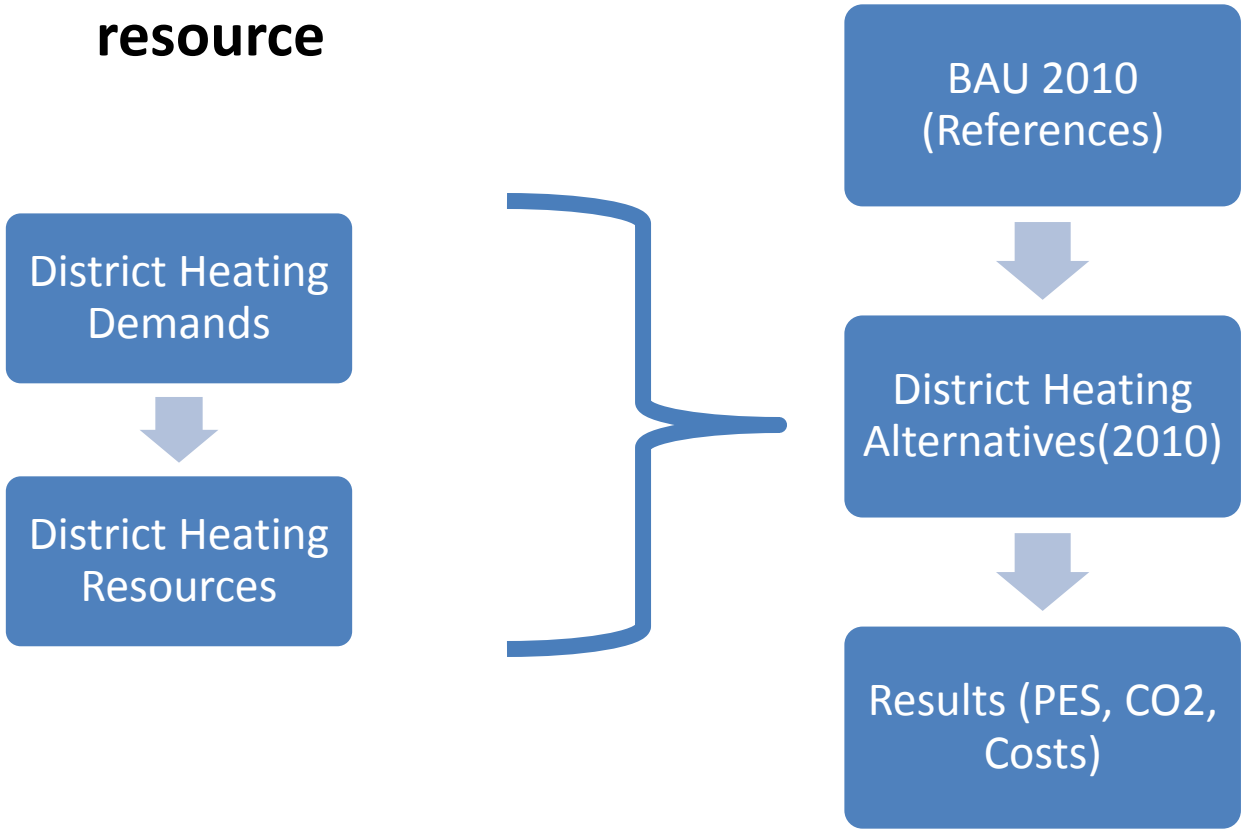
Methodology

Aggregation of demand and resource

Energy System Modelling



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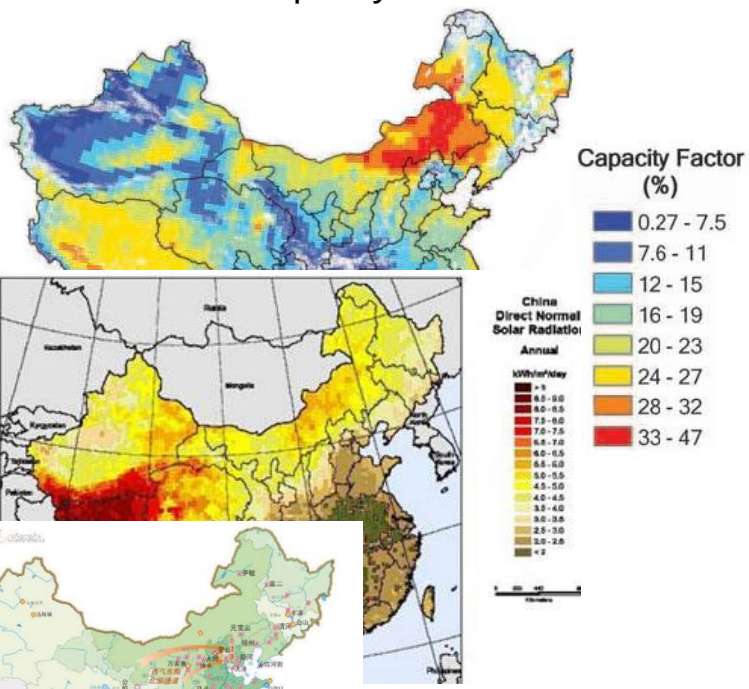
Methodology

- Urban areas and temperature (heating demands and variation)
- Power generation
- Wind/Solar potential(GIS)

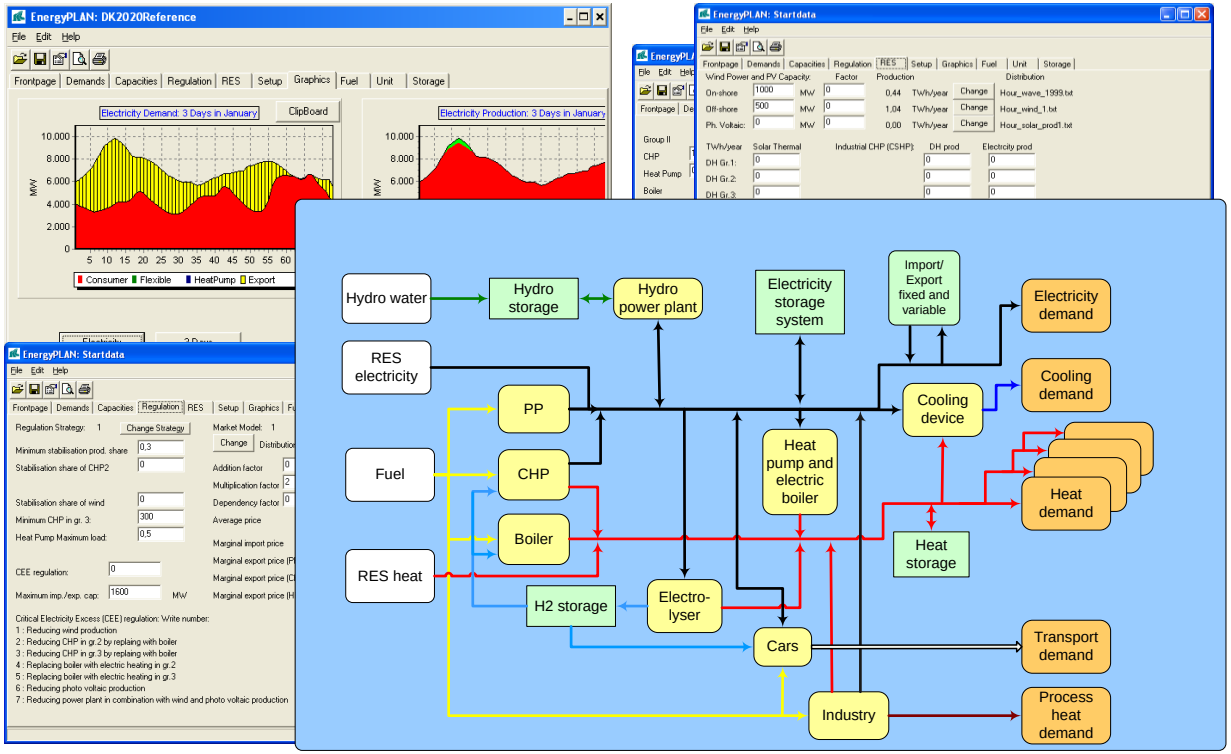
Wind capacity factor



Annual heat demand density(KWh/m2)

Methodology

- **Simulation of 2010 references scenarios for Chinese energy system in Energyplan**



Please do not cite or quote

Data Source: Tsinghua,2011

Modelling the reference scenario

- **Existing projections for China's energy system towards 2030:**
  - World Energy Outlook(IEA)
  - China Energy Pathways to 2050(Energy Research Institute, NDRC)
  - China's Energy and Carbon Emissions Outlook to 2050(LBNL)
  - International Energy Outlook (EIA, US)
  - China's future generation(WWF)
  - Research reports and academic journal articles

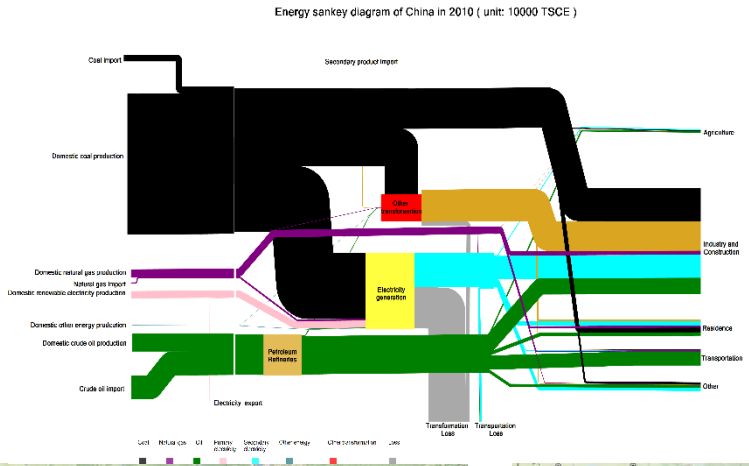
Modelling the reference scenario

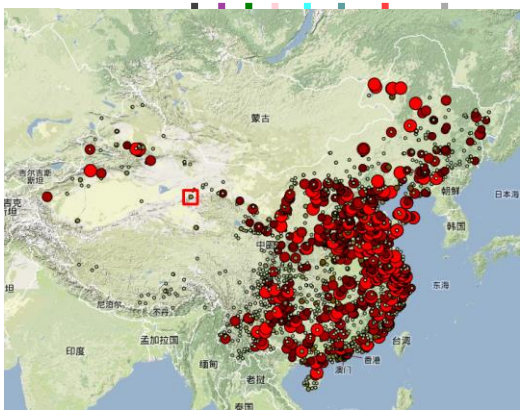
- **Lack of district heating in China for existing reports:**
  - Lack of district heating data overview after 2006
  - Lack of system analysis review combined with supply side and demand side
  - Assumption of high building standards and improvement of the efficiency of equipment towards 2030

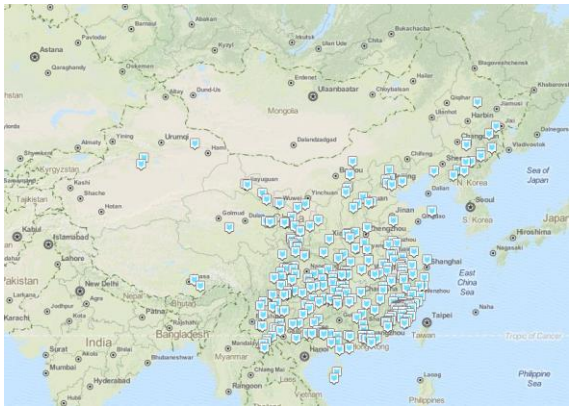
District heating is important energy saving methodology but fail to point how to implenment

Modelling the reference scenario

- **2010 Modelling of national energy system**







NDRC
2010

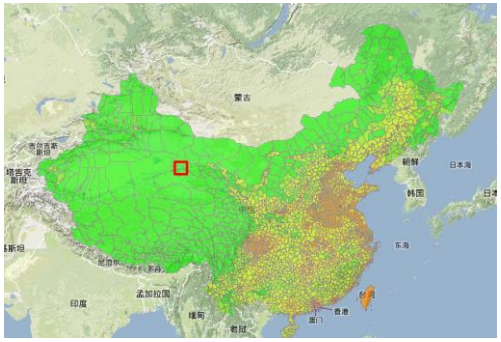
District Heating Alternatives

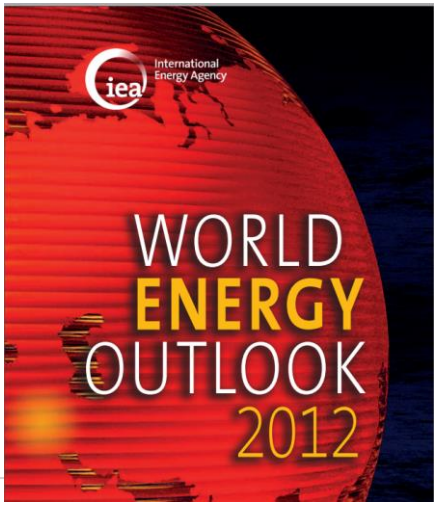
Results
(PES, CO2, Costs)

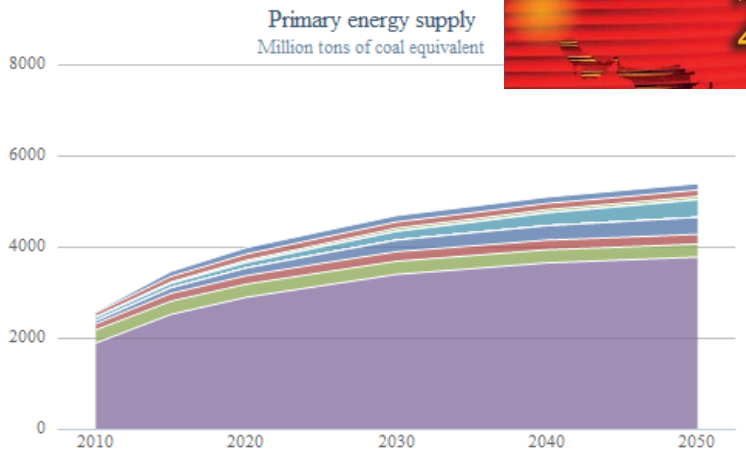
Please do not cite or quote

Modelling the reference scenario

- **2020,2030 Modelling of national energy system**







IEA, ERI

2020,2030

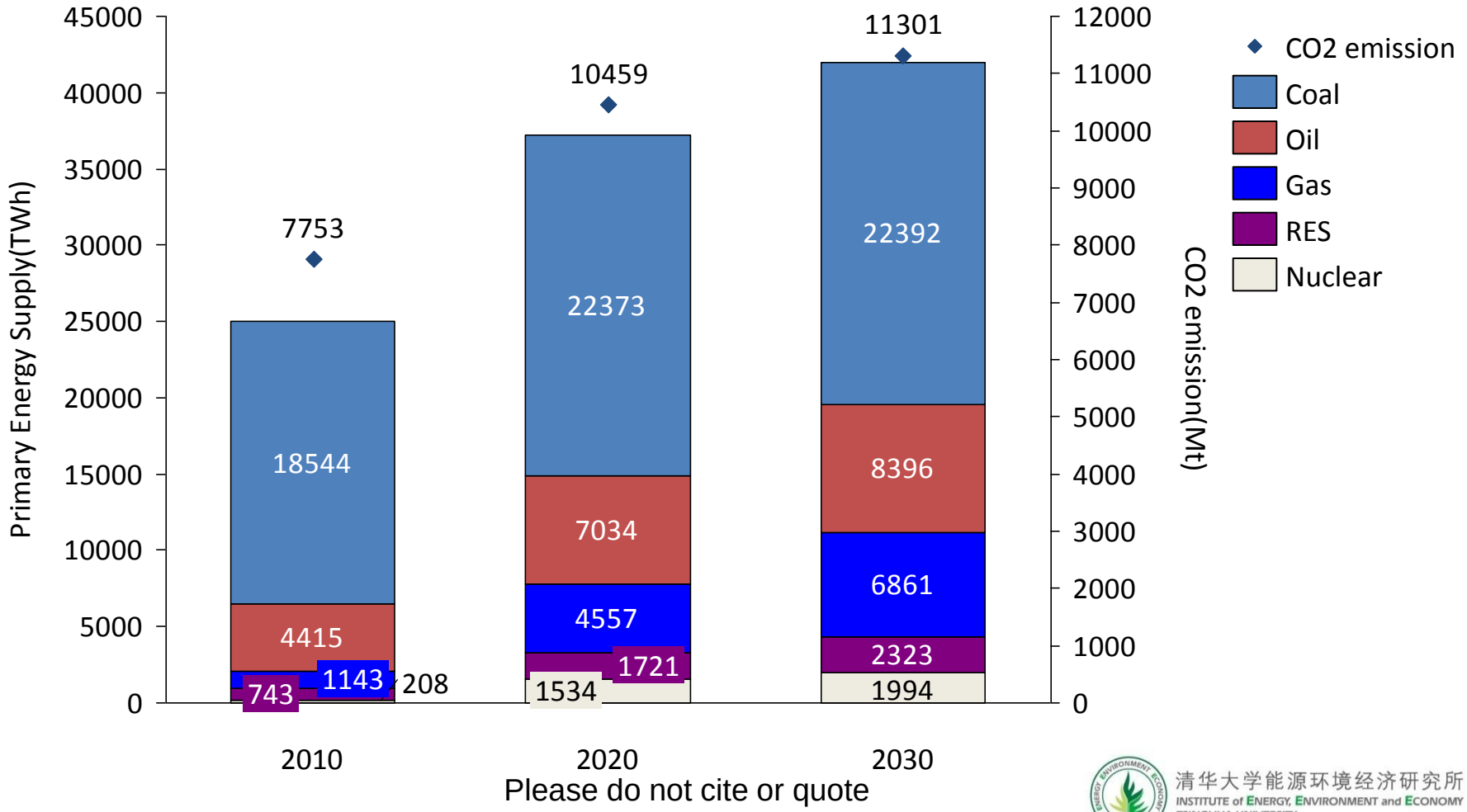
District Heating Alternatives

Results

(PES, CO2, Costs)

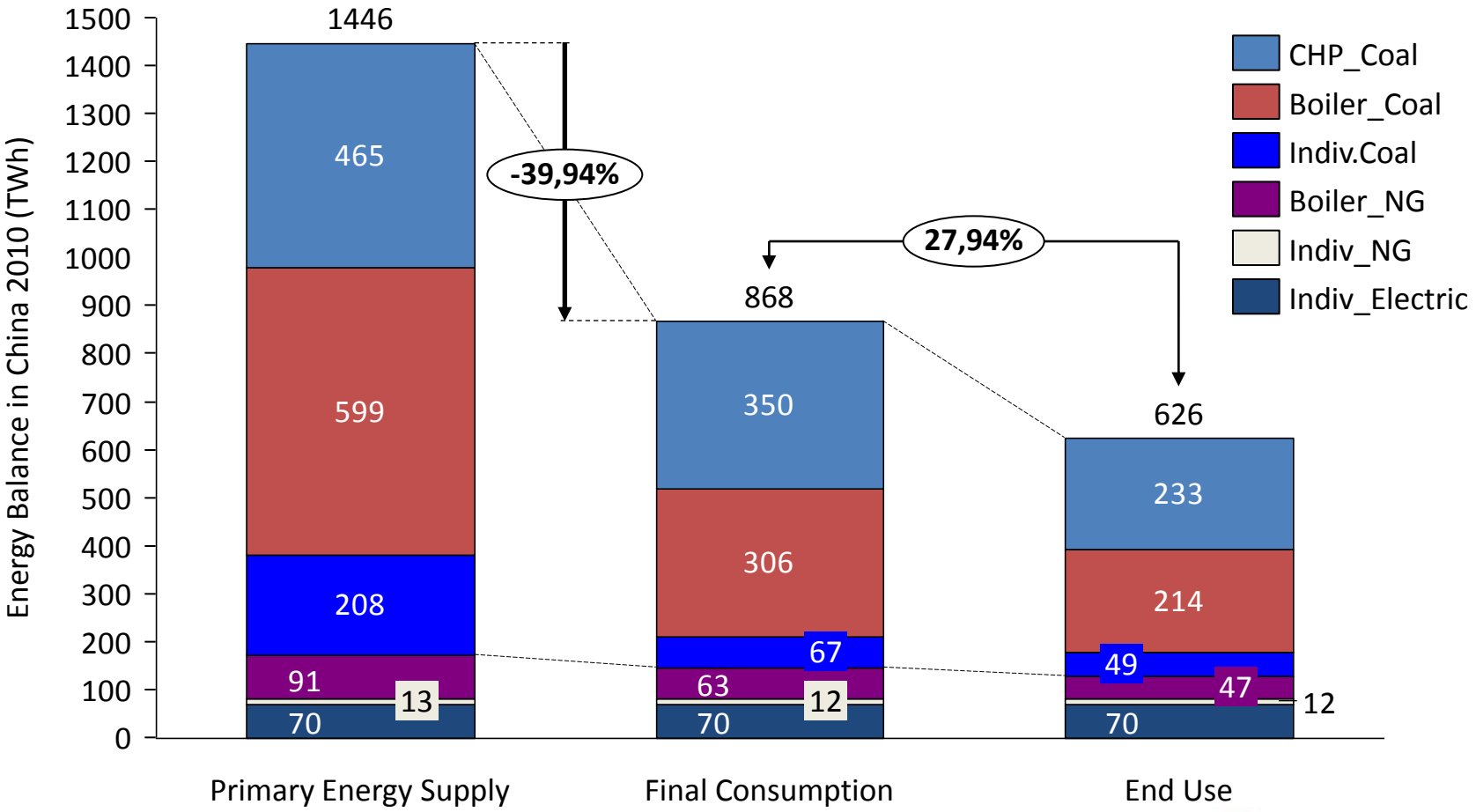
Modelling the reference scenario

- **Energy supply and CO2 emission in Reference scenarios**



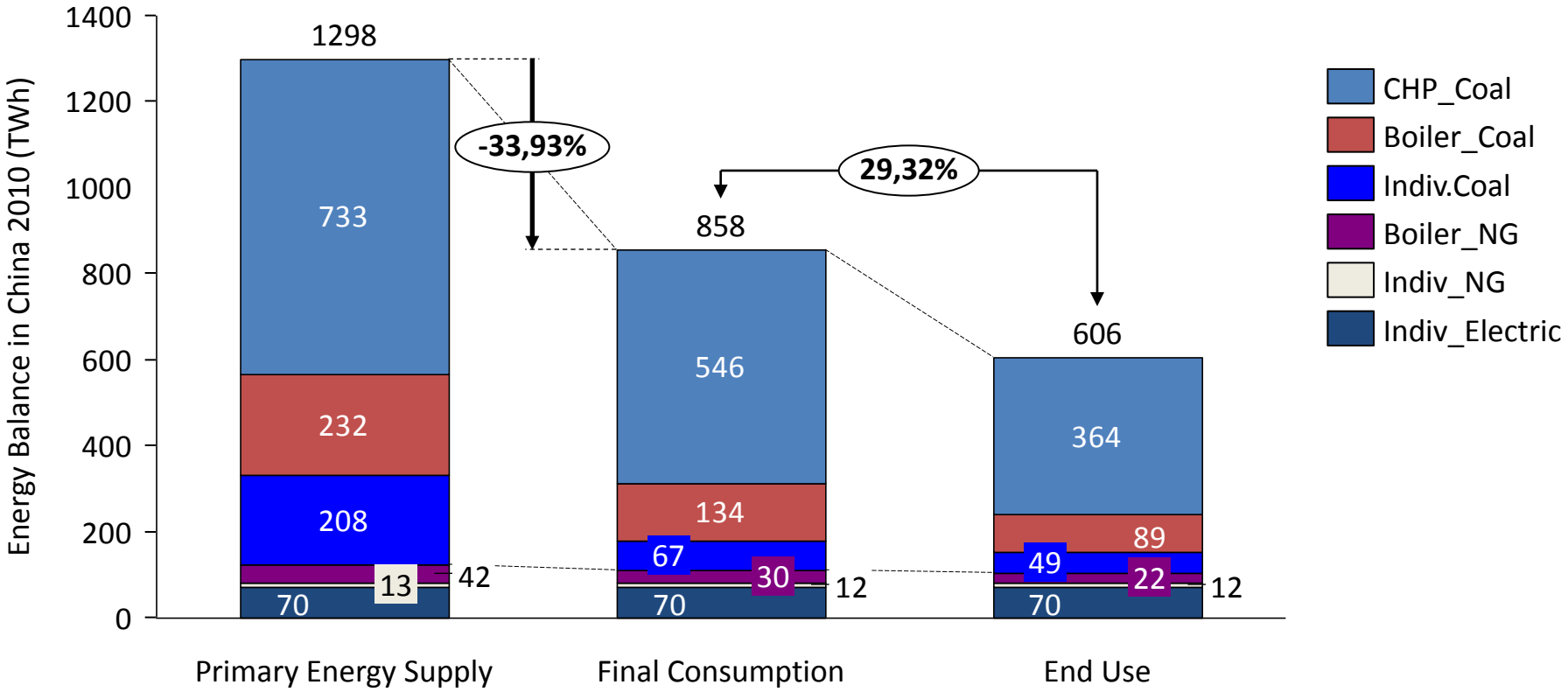
Modelling the reference scenario

- **Energy balance for heating building in three steps,2010**



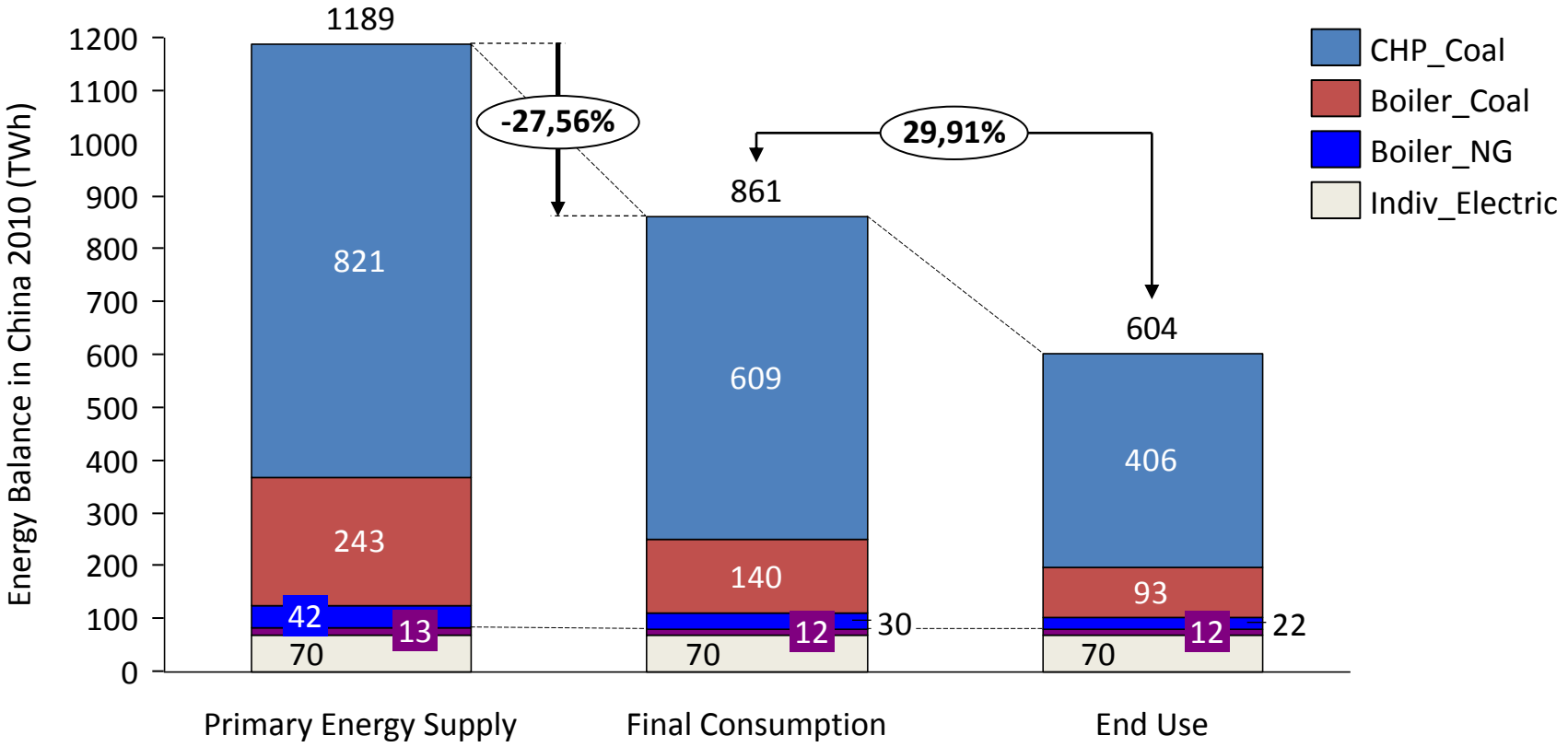
Modelling the reference scenario

- **Analysis of current heating energy system in 2010**
  - **Transfer from Coal boilers to existing CHP plants**



Modelling the reference scenario

- **Analysis of current heating energy system in 2010**
  - **Transfer from Coal Stove to DH**



Modelling the reference scenario

- **Results shows:**
  - Overproduction of existing CHP and boiler installation in Northern China
  - DH supplied by coal boilers could be connected to existing CHP plants
  - Transfer from Stove to DH could decrease system cost and CO2 emission
  - There are still tremendous potential for CHP change from PP

Designing the Heat Roadmap China

- **Key consumption different with Reference Scenarios**
  - Step1. Potential heat demand in Southern China
  - Step2. Industry surplus heat utilization
  - Step3. Coal boilers and stove to CHP
  - Step4. Renewable energy utilization
  - Step5. Price reform and energy saving

Designing the Heat Roadmap China

- **Step1. Potential heat demand in Southern China**

Current Building area (Million m^2)	7000
Building area in 2020	9850
Building area in 2030	13140
Current heat demand intensity (kWh/m^2)	5.6
Projected heat demand intensity (kWh/m^2)	30
Projected heat demand (TWh)	280
Infrastructure change to DH (RMB/m^2)	450

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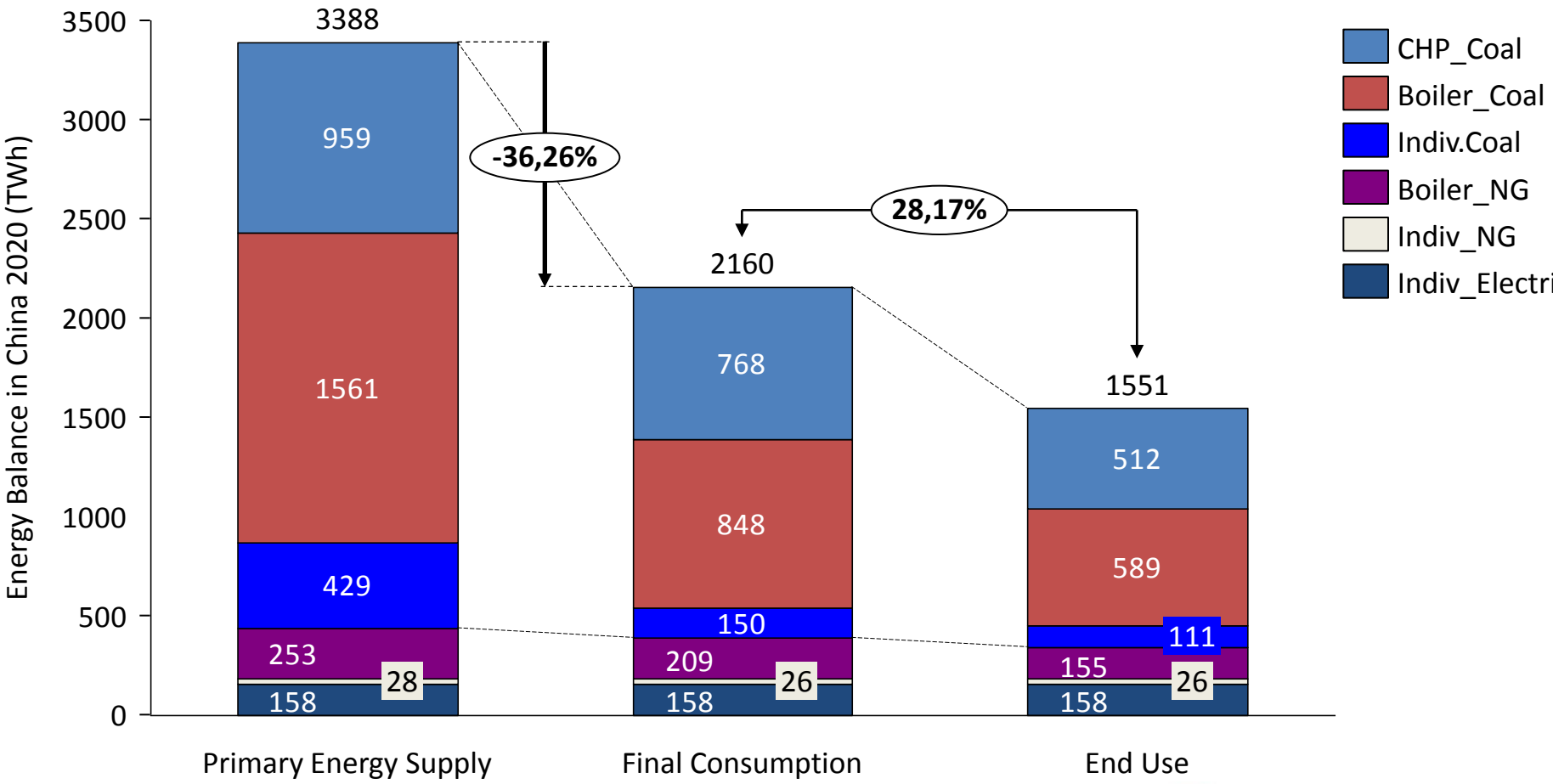
Designing the Heat Roadmap China

- **Step1. Potential heat demand in Southern China**



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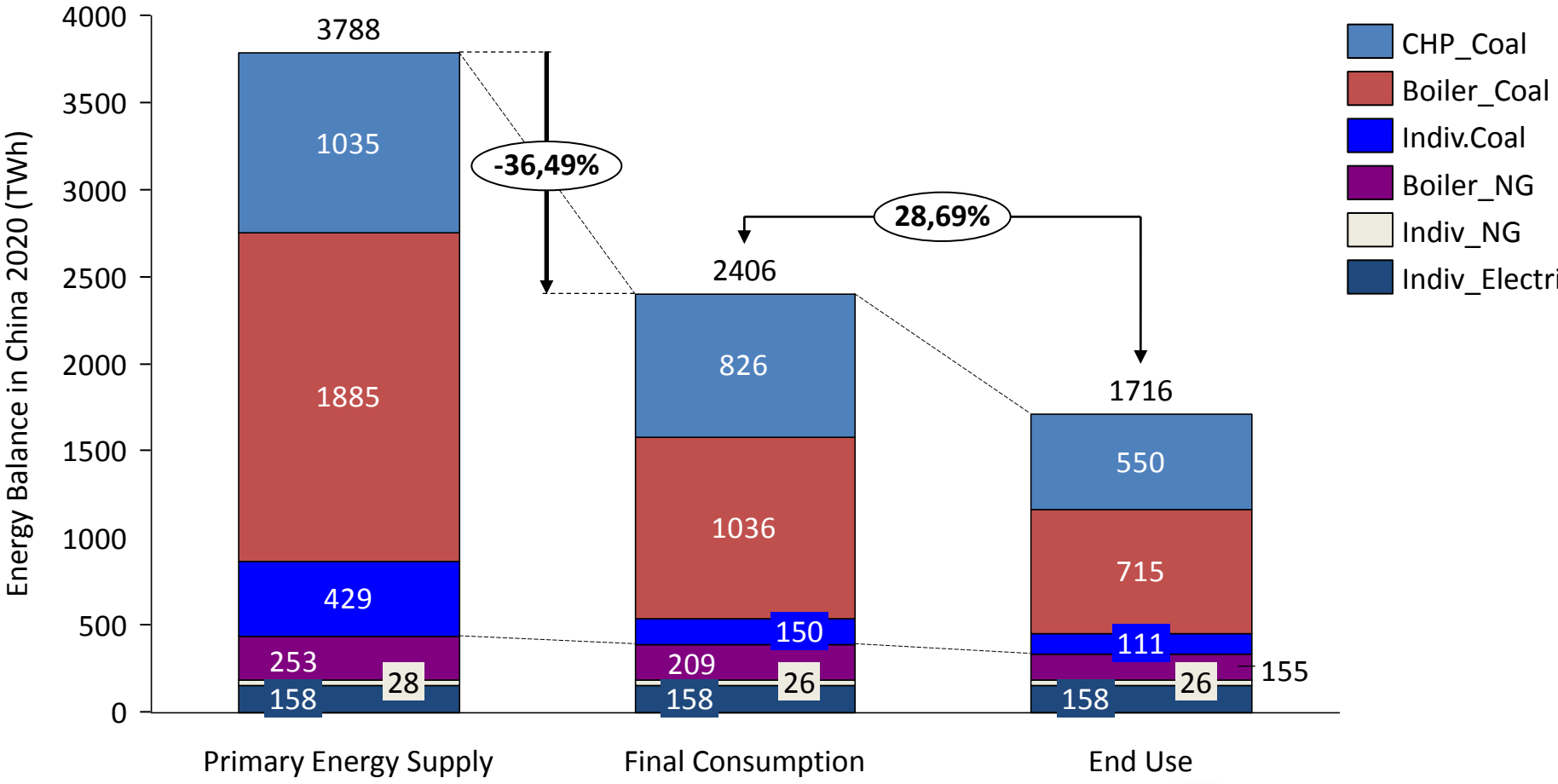
- **Step1. Potential heat demand in Southern China**



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Designing the Heat Roadmap China

- **Step2. Industry surplus heat utilization**
  - Industry boilers: 0.5 million units
  - Covers 64% of middle-size cities (5 million population level)
  - Theoretical heat potential: 2777 TWh/year

Heat resources	Potential (TWh/a)	2020(TWh/a)	2030(TWh/a)
Industrial excess heat	2777	555	1388
Heat resource	**Investment cost(M¥/TWh)**	**Annual fixed O&M(% of investment)**	**Lifetime**
Industrial excess heat	38.2	1	20

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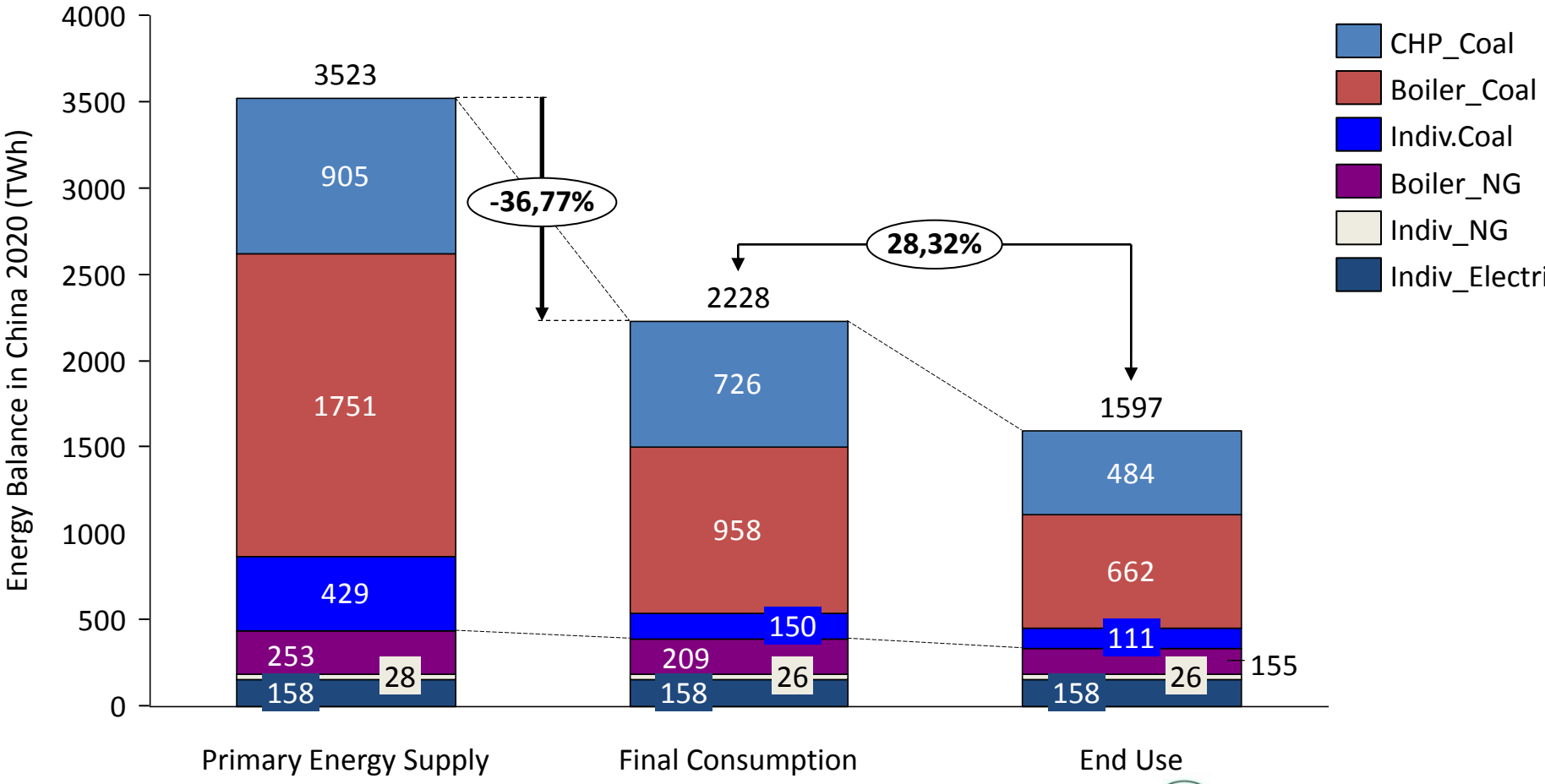
Designing the Heat Roadmap China

- **Step3: Industry surplus heat utilization**



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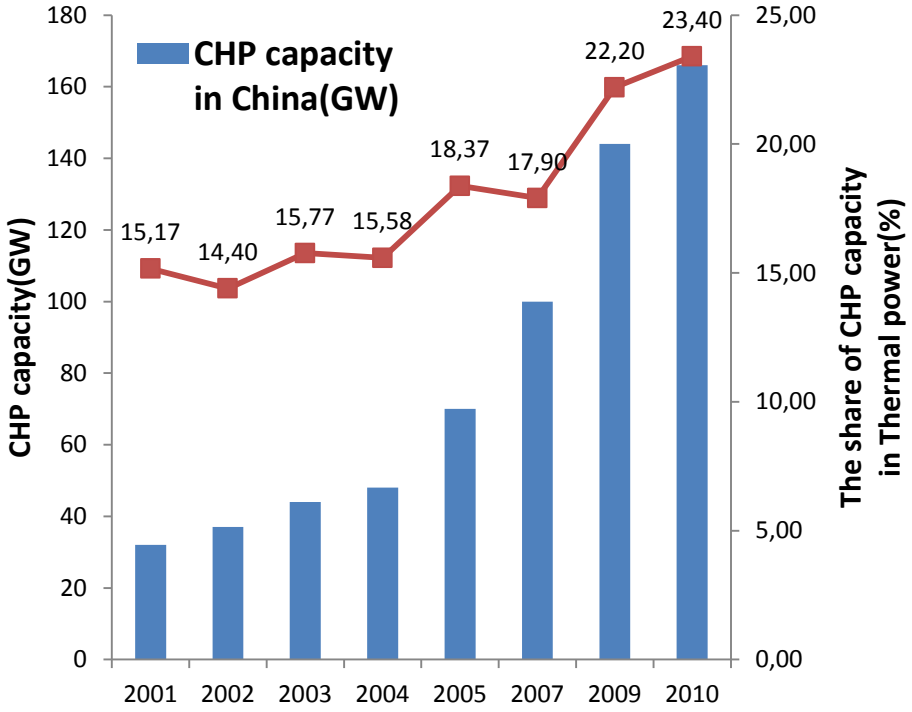
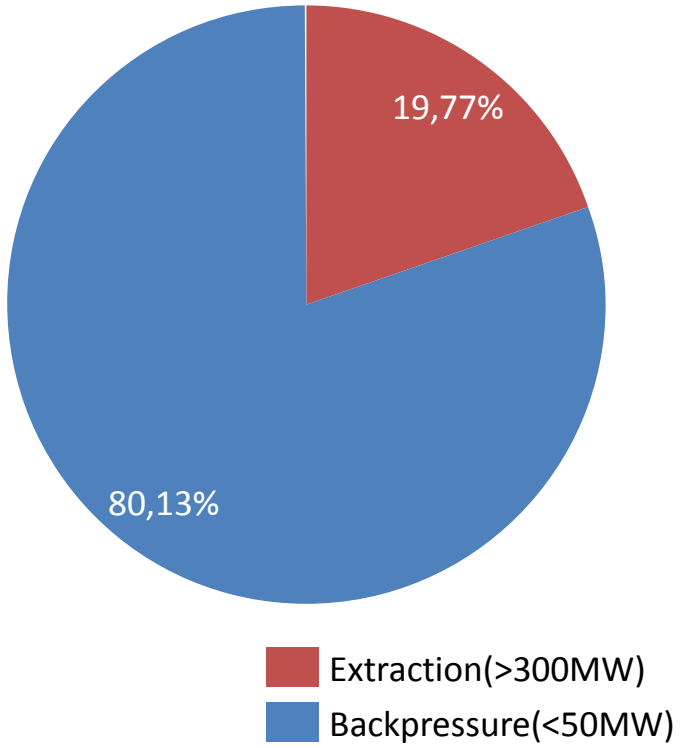
Designing the Heat Roadmap China

- **Step3.Switch from coal boilers and stove to DH**
  - **Heat loss in extraction CHP plants**





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Data Source: CEC,2001-2010

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Designing the Heat Roadmap China

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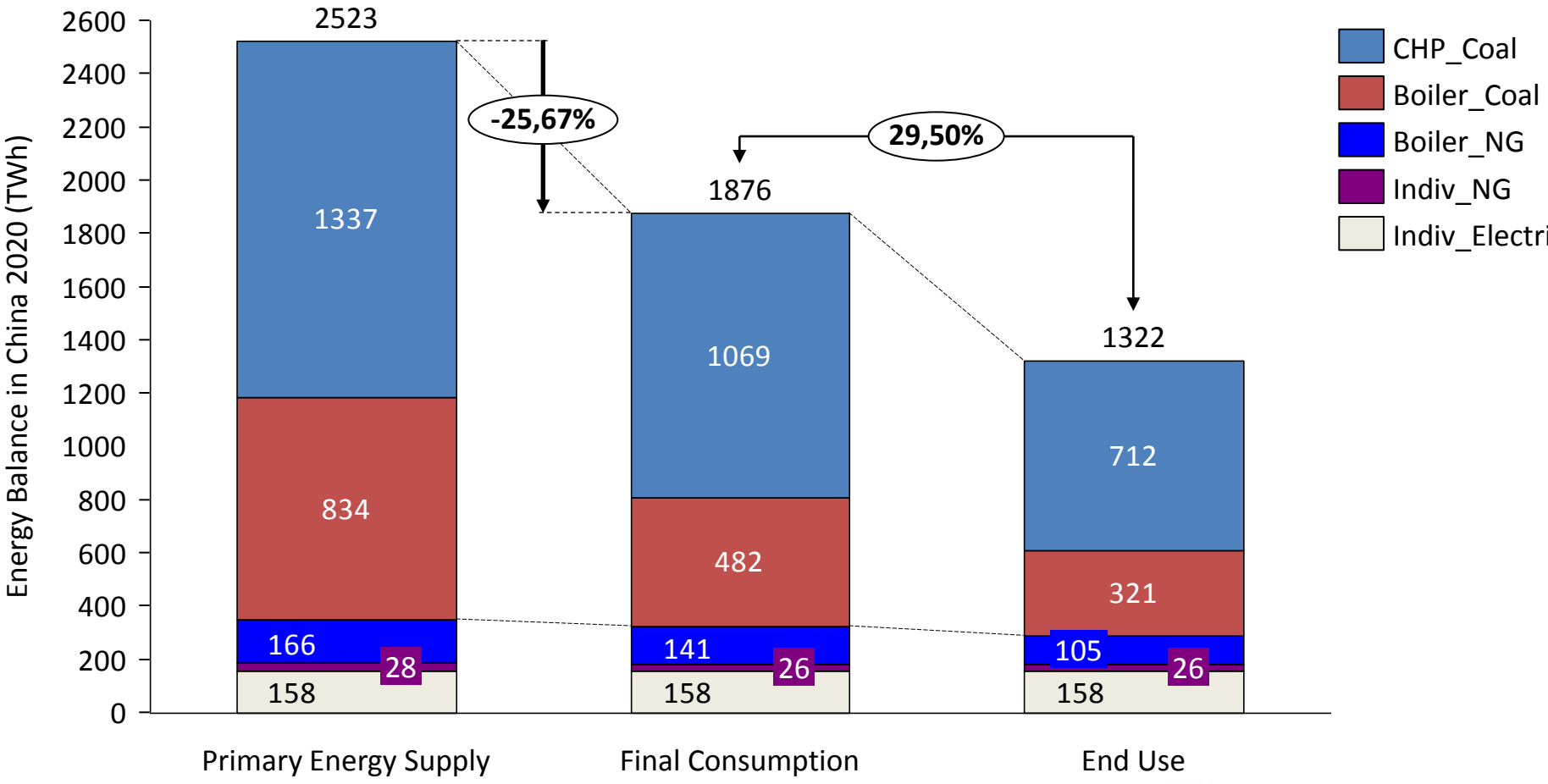

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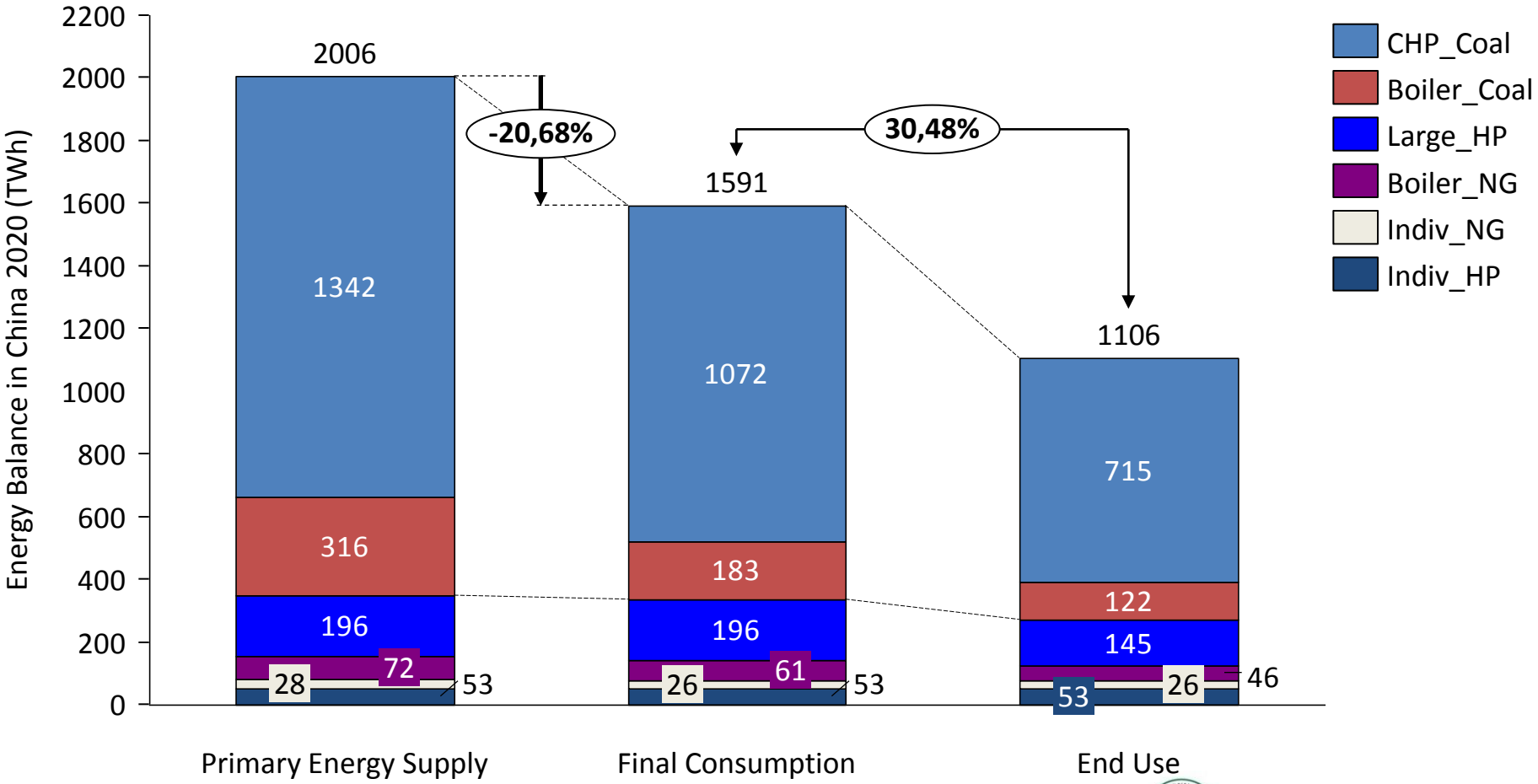
Designing the Heat Roadmap China

- **Step4.Renewable energy utilization in District heating**



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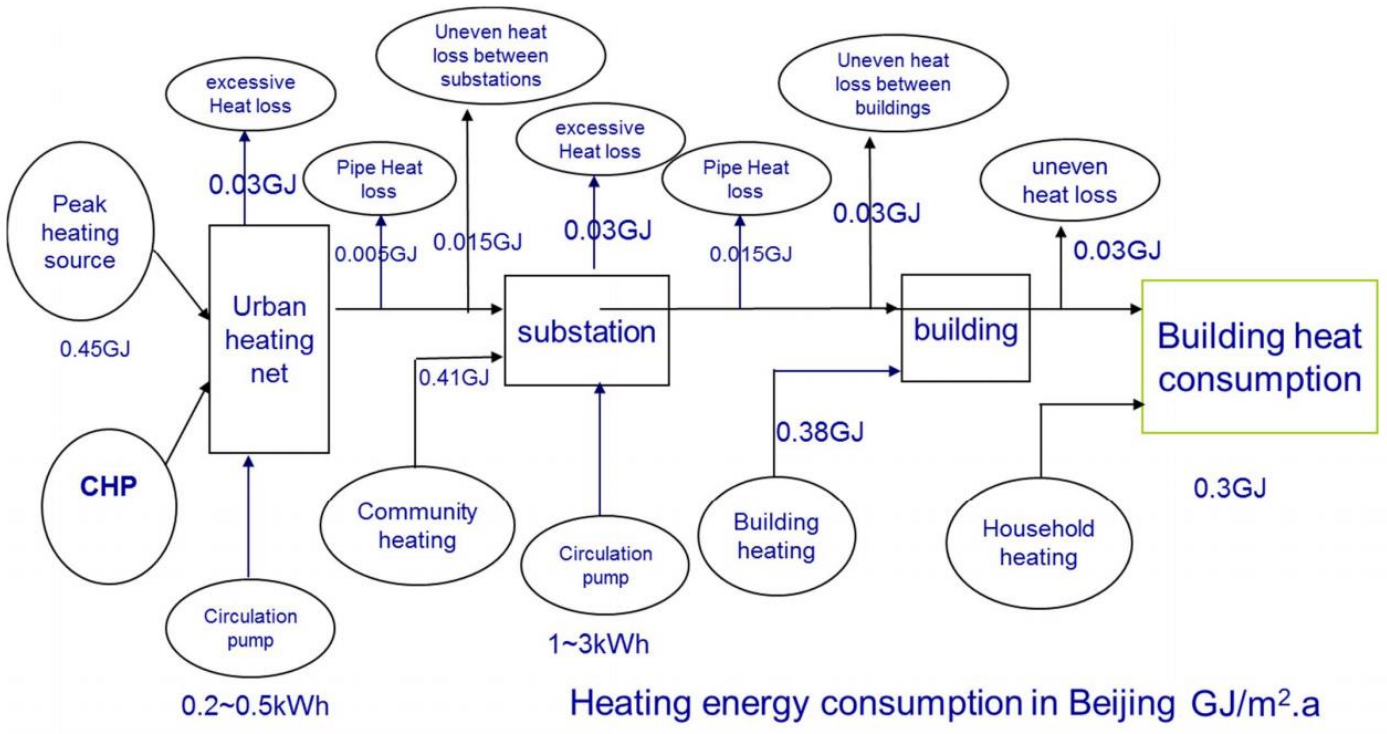
Designing the Heat Roadmap China

- **Step5.Price reform from area-based to energy-based**



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Designing the Heat Roadmap China

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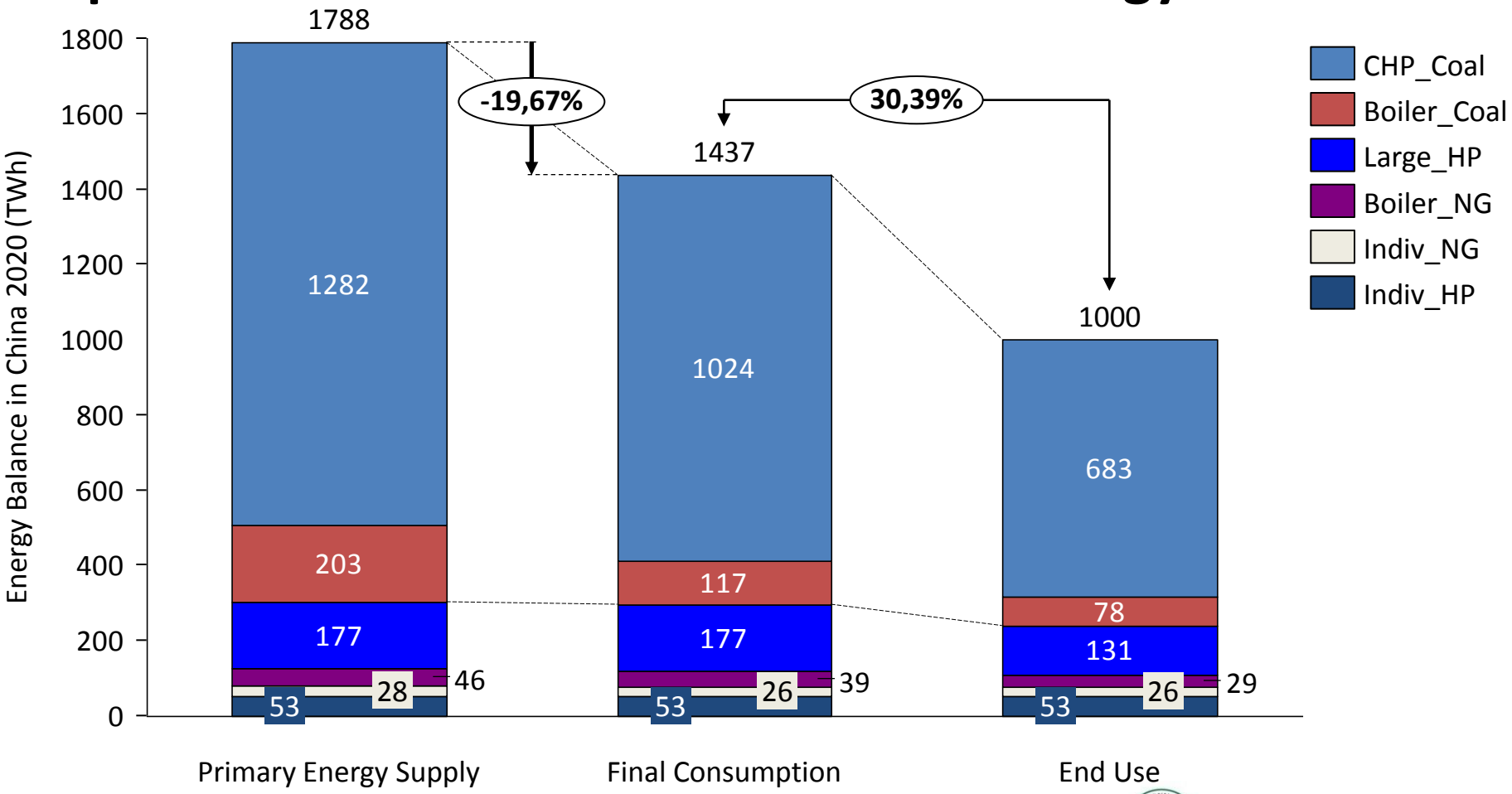

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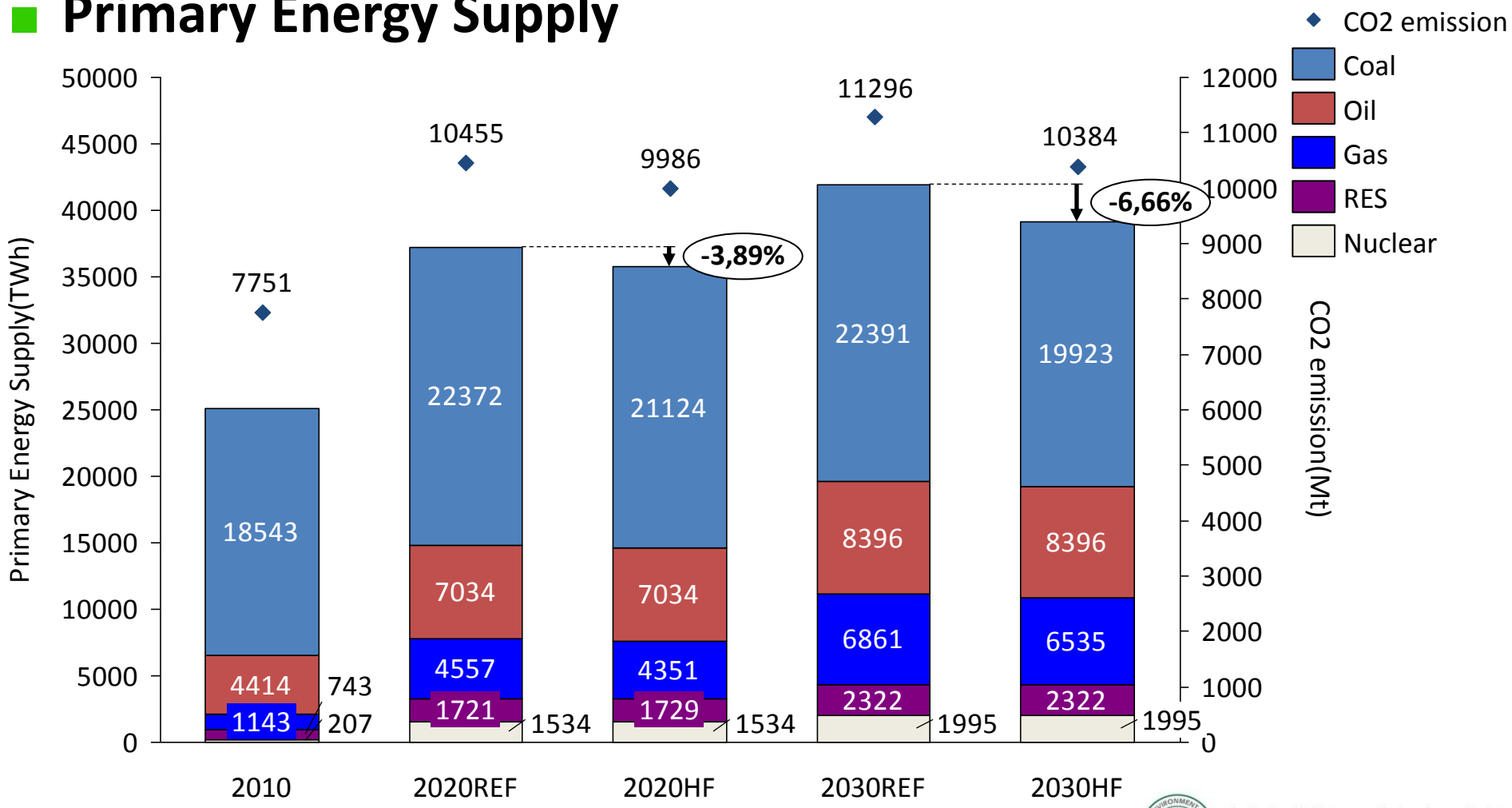
Results and Discussion

Primary Energy Supply



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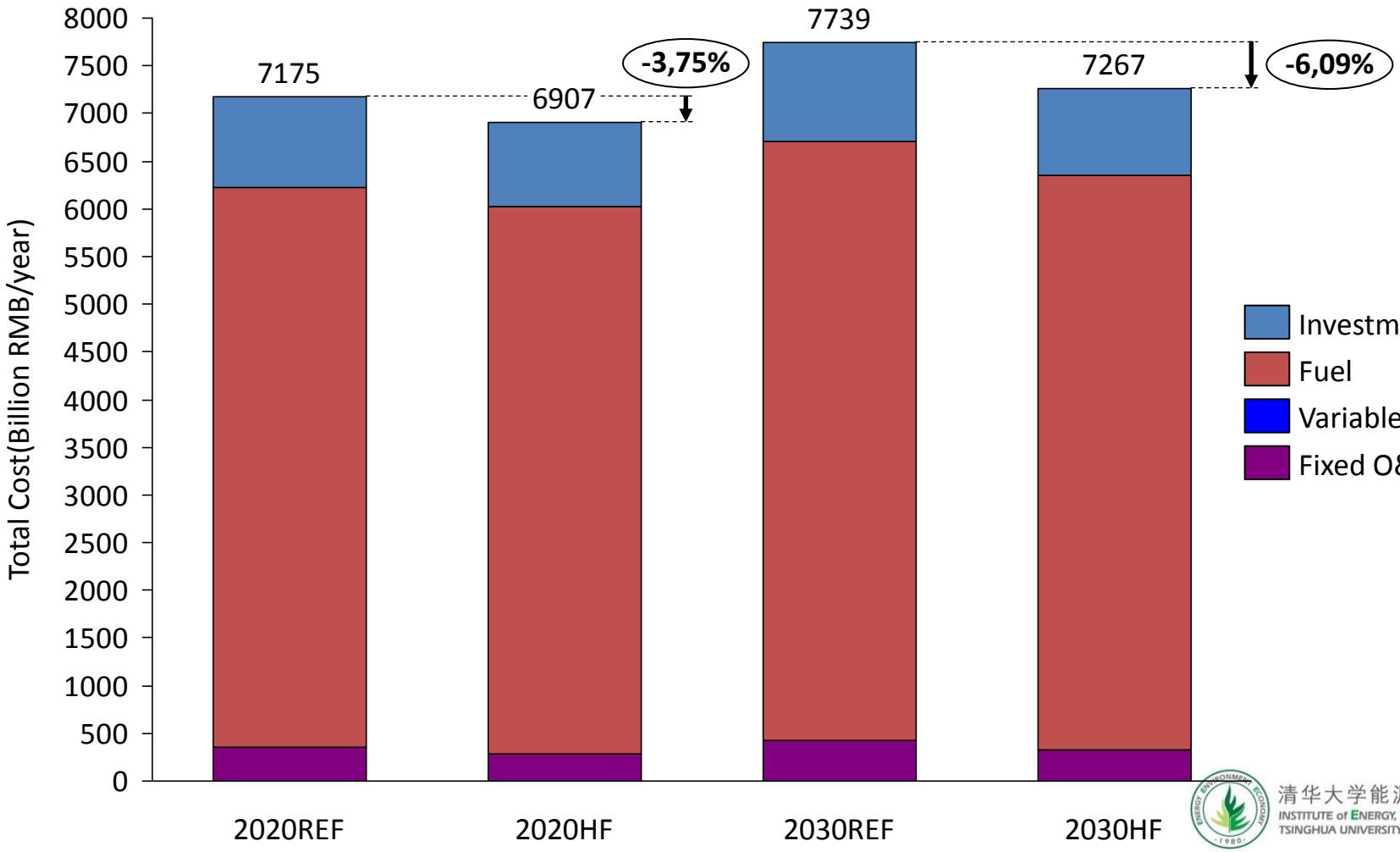
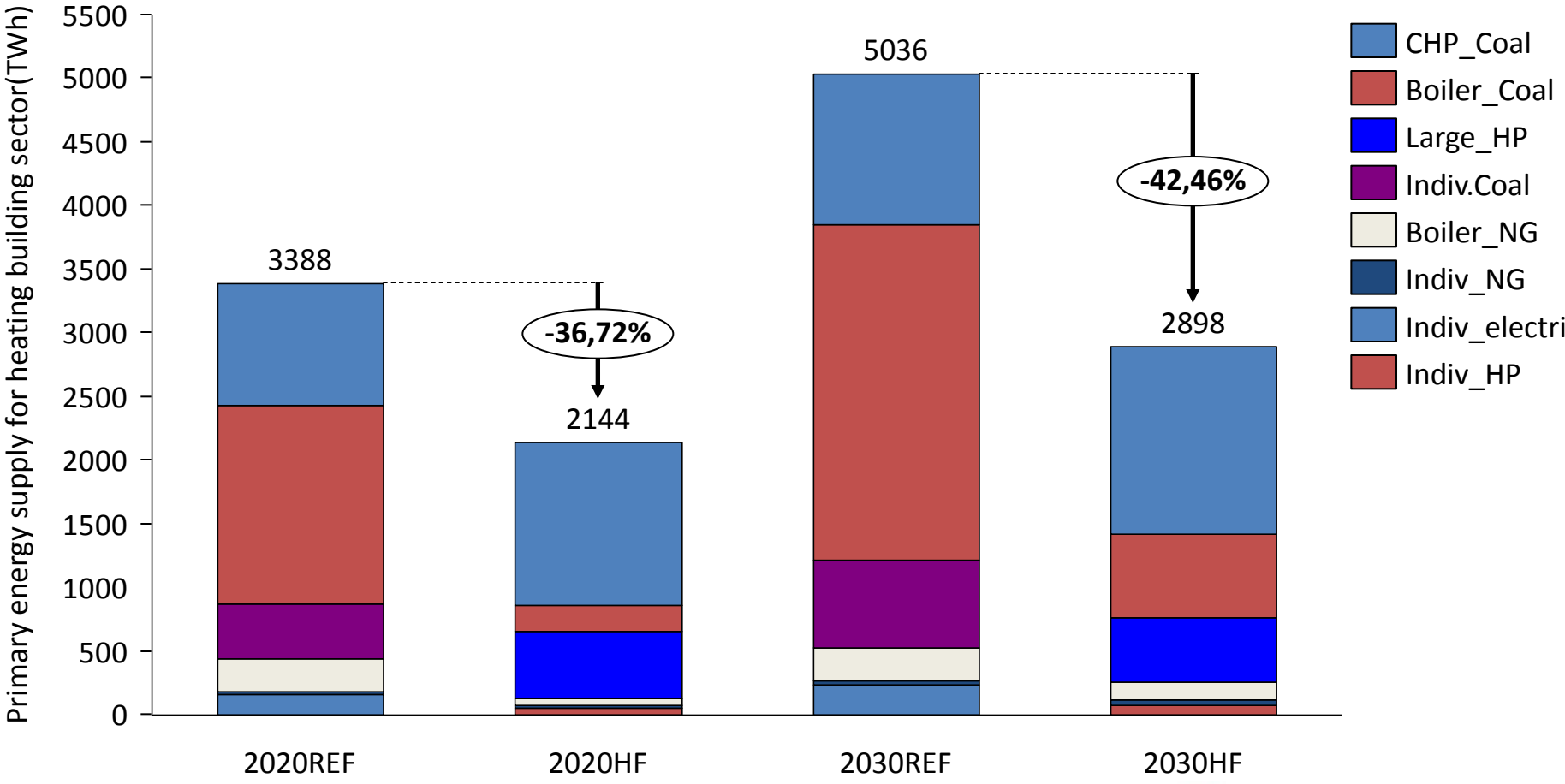
Results and Discussion

Total annual cost



Results and Discussion

- **Primary energy supply for heating in buildings**



Results and Discussion

- CHP dominated DH with surplus heat could save more than 30% of primary energy compare with current coal boiler dominated patent
- HRE-China decrease total national energy consumption and annul cost from system perspective
- Southern part of China could be supplied with DH in cost-efficient solution in the future
- HRE-China would cause curtailment of RES from national perspective

Results and Discussion

- **Questions and Discussion**
  - Uncertainty of fuel price in China?
  - Interaction between integration renewable energy and DH?
  - Urban development of heating demand in China?
  - Hot water should be connected to DH ?

Thank you !

Weiming Xiong (熊威明)

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