



清华大学能源环境经济研究所  
INSTITUTE of ENERGY, ENVIRONMENT and ECONOMY  
TSINGHUA UNIVERSITY



# Heat Roadmap China

– New heat strategy to reduce energy consumption  
towards 2030

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2014.08.18



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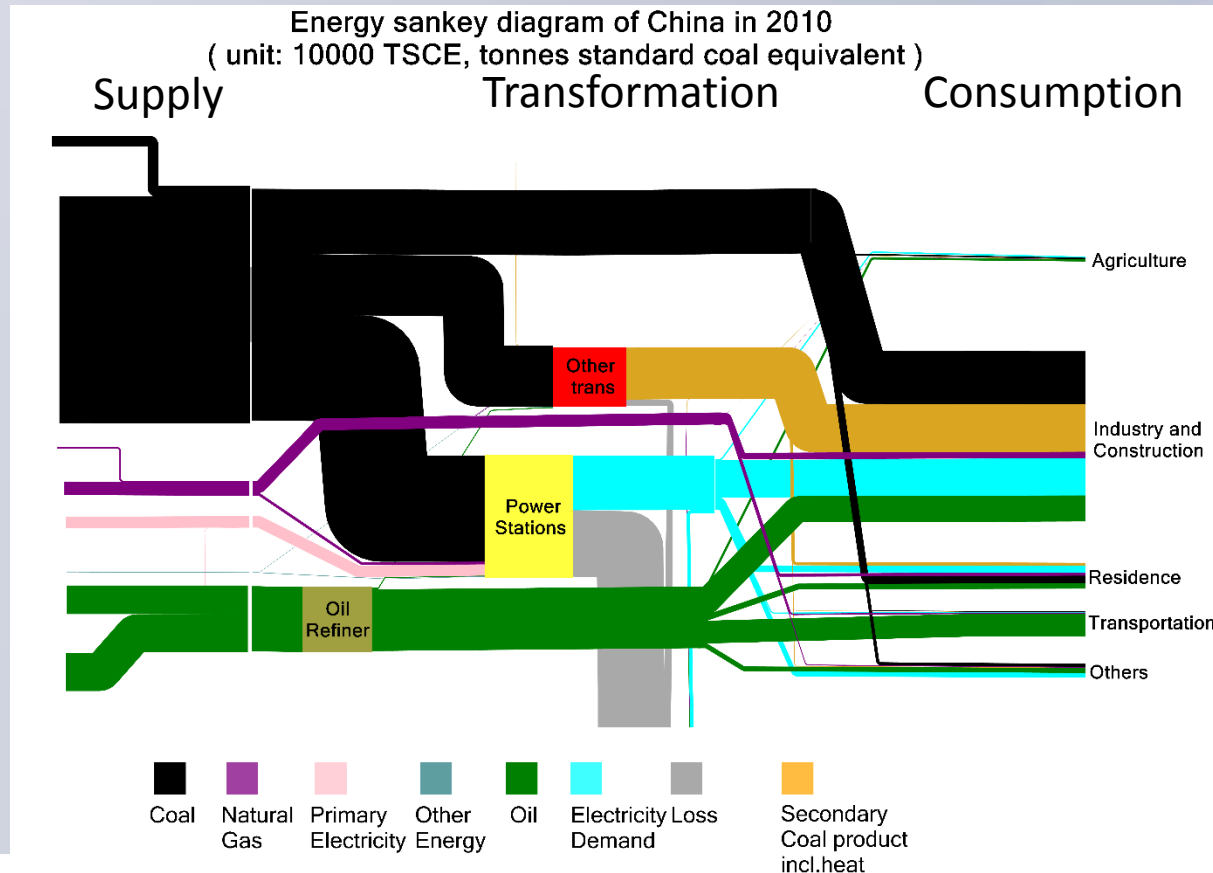
# Outlines

- ↳ Overview of China's heat sector
- ↳ Methodology
- ↳ Modelling the Reference scenario
- ↳ Designing the Heat Roadmap China
- ↳ Results and Discussion
- ↳ Conclusion and Future Plan



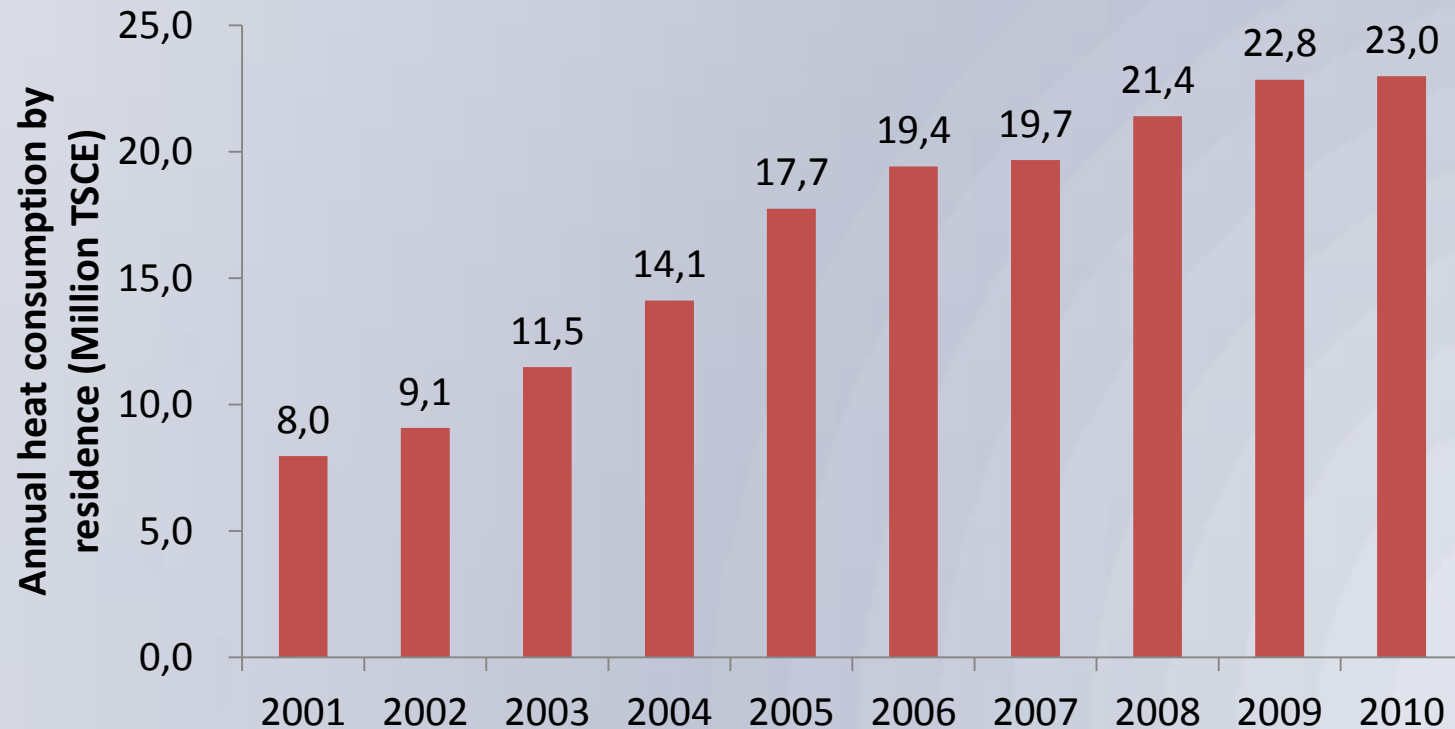
# Overview of China's heat sector

## → Coal-dependent energy system



# Overview of China's heat sector

↪ Increasing primary energy consumption for building heating in heavy-coal mix



Source: NBS 2001-2010, data after 2010 not available



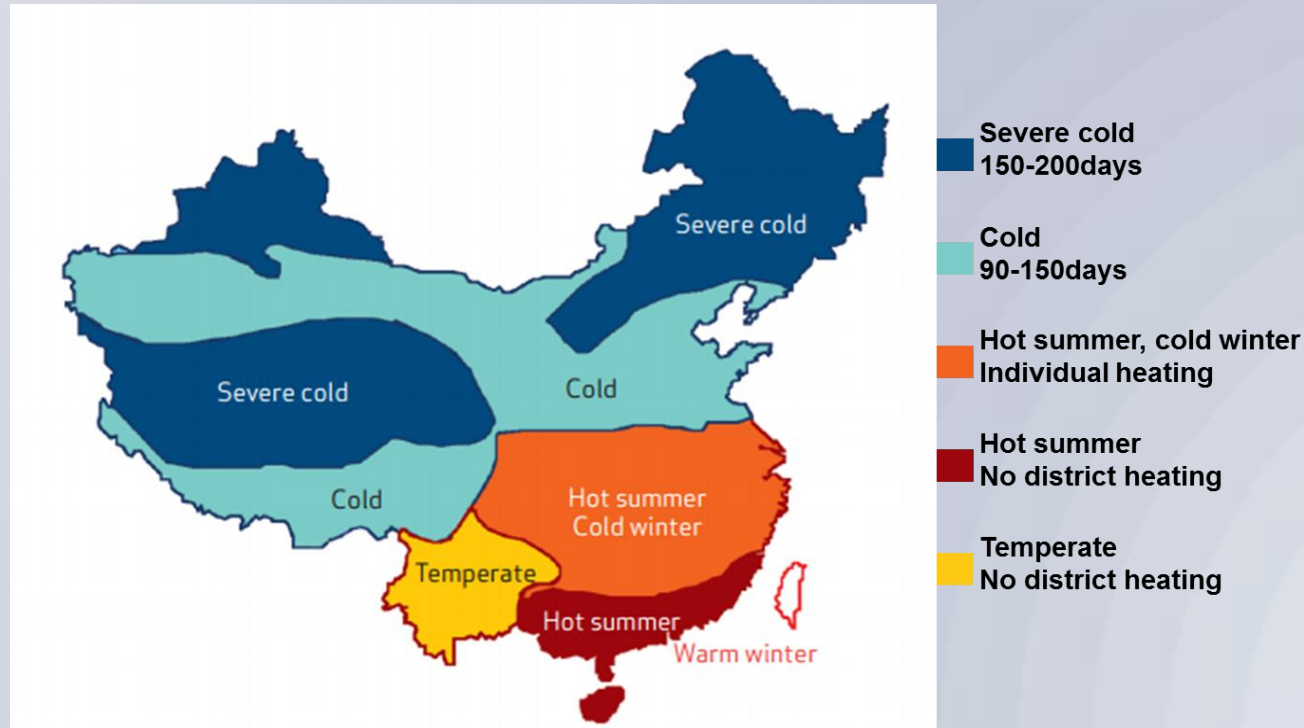
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# Overview of China's heat sector

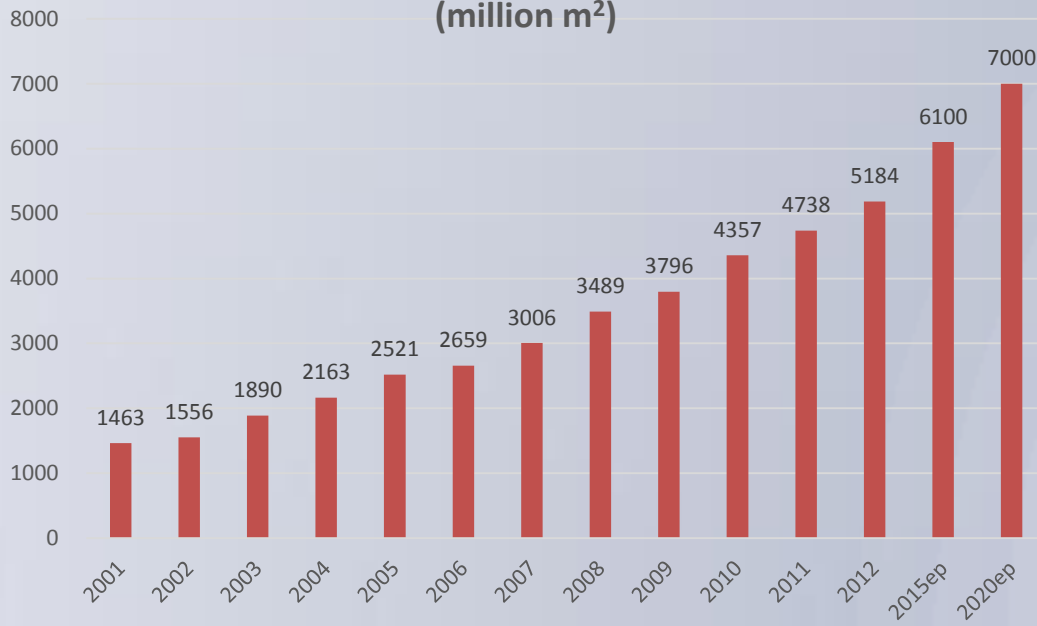
➔ District heating covers most of China's northern cities but is refused by law in southern cities



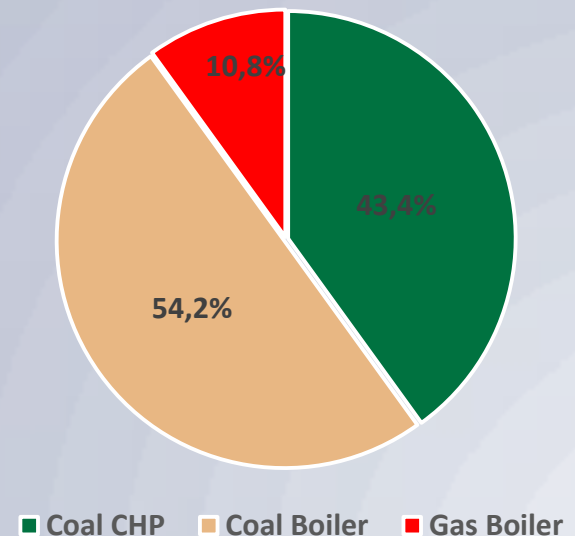
# Overview of China's heat sector

➔ Rapid growth of district heating but still dominated and “locked” by coal boiler

Building area served by district heating in China (million m<sup>2</sup>)

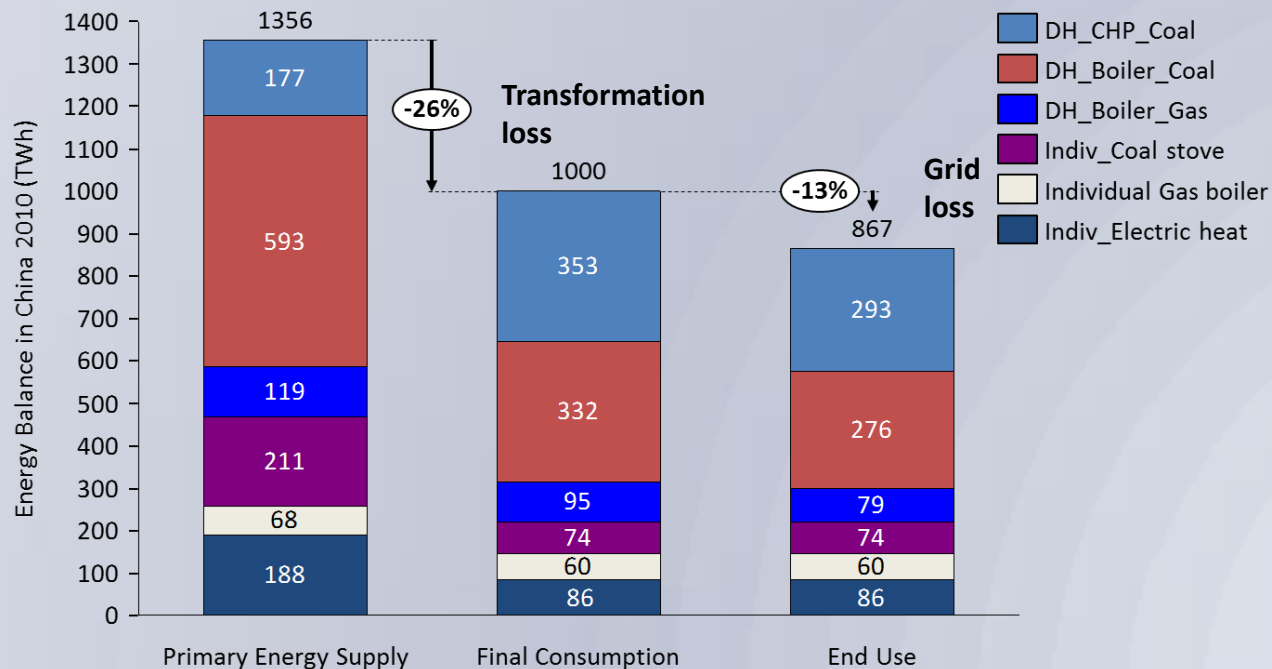


Share of heat production for different technologies in District heating in 2010

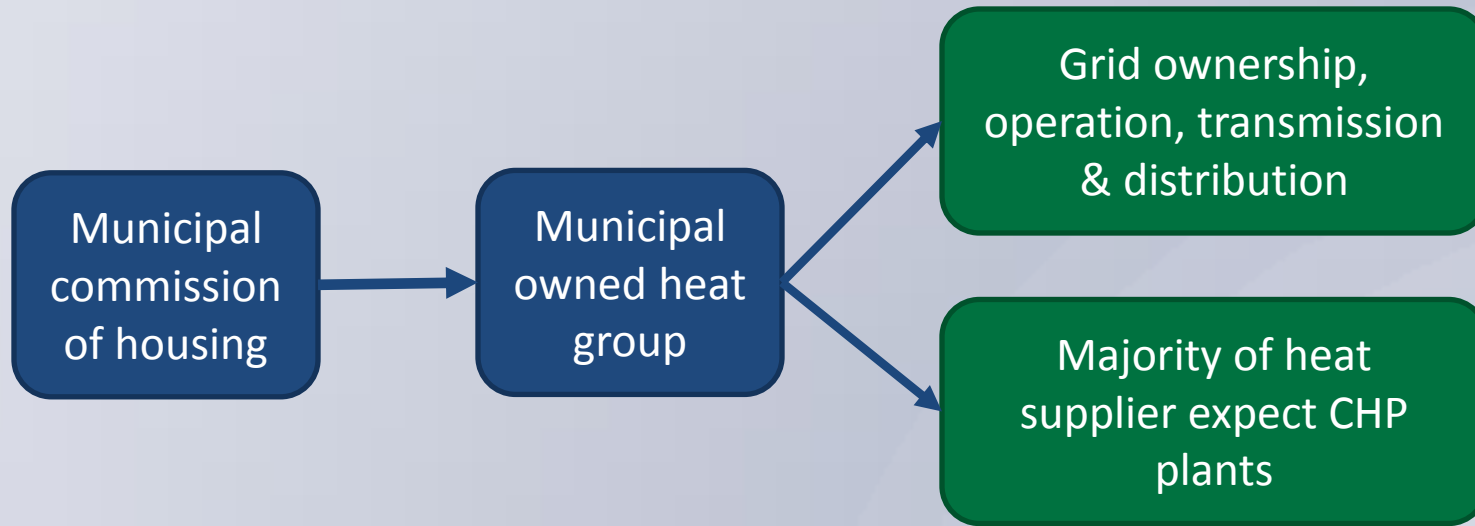


# Overview of China's heat sector

→ Energy is wasted mostly in coal boilers and individual coal stoves



# Research question



- ➔ **Disorganized heat strategies** due to institutional structure with significant autonomy
- ➔ How does China supply her heating system towards 2030 (inflection point of urbanization)?





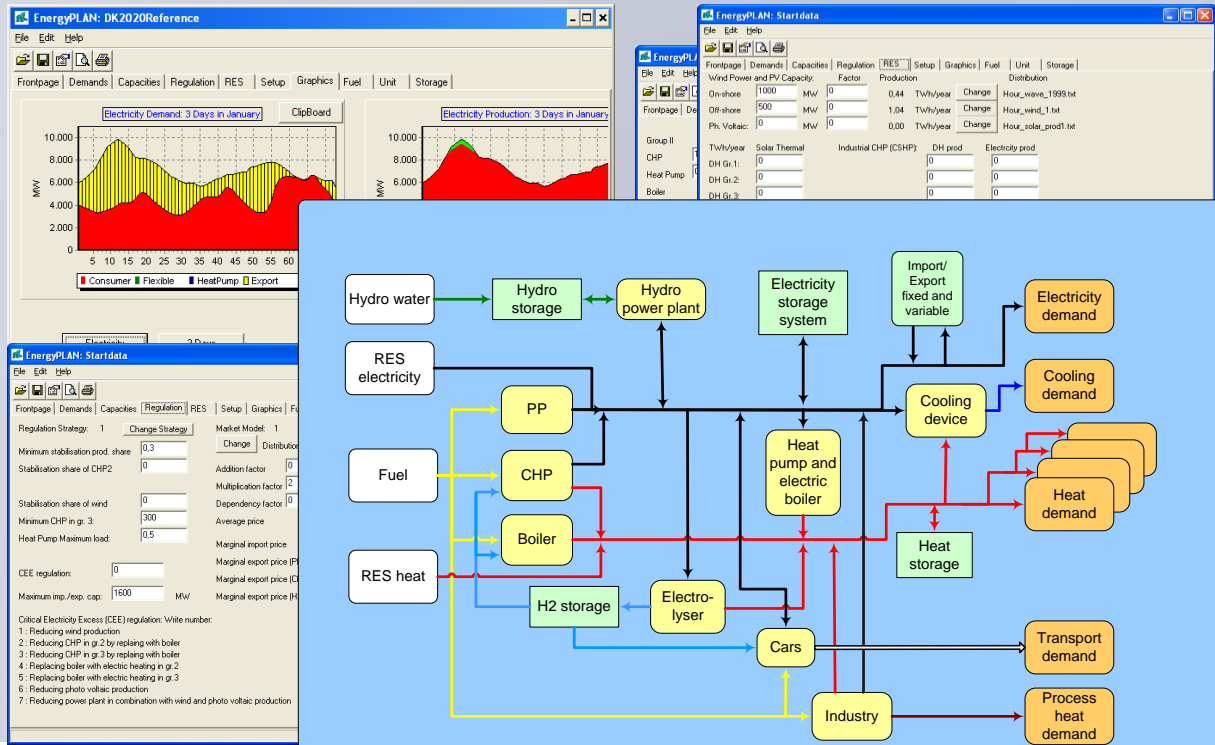
# Existing studies indicate...

- ➔ Focus on improving construction codes for buildings, rather than the fundamental issues in district heating system
- ➔ District heating and CHP are considered as key solutions but, are merely mentioned, without detailed analysis
- ➔ **Our goal: Quantitative analysis of energy supply, system cost and emissions, for improved heat strategies**



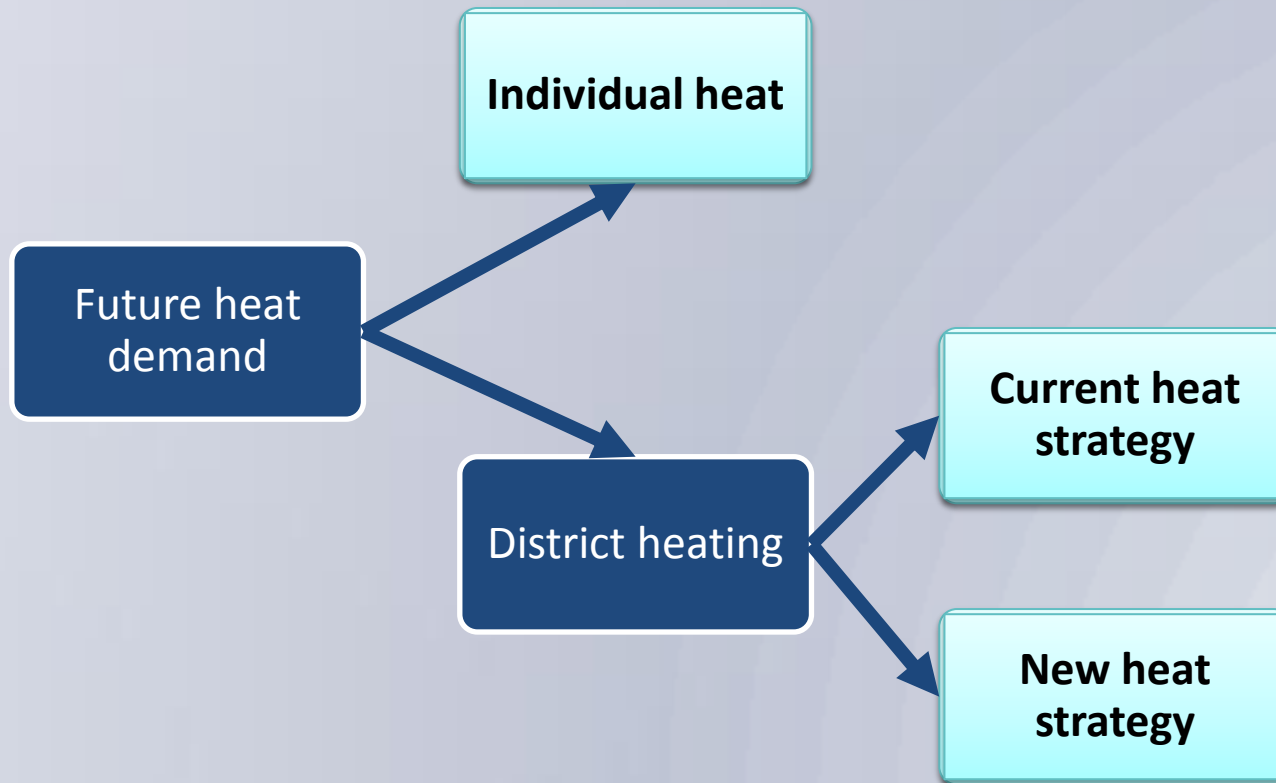
# Methodology

↪ Replication of heat strategies in energy system modelling tool EnergyPLAN



# Methodology

## → Comparison of different heat strategies



# Methodology

## Calculation of input data for heat sector

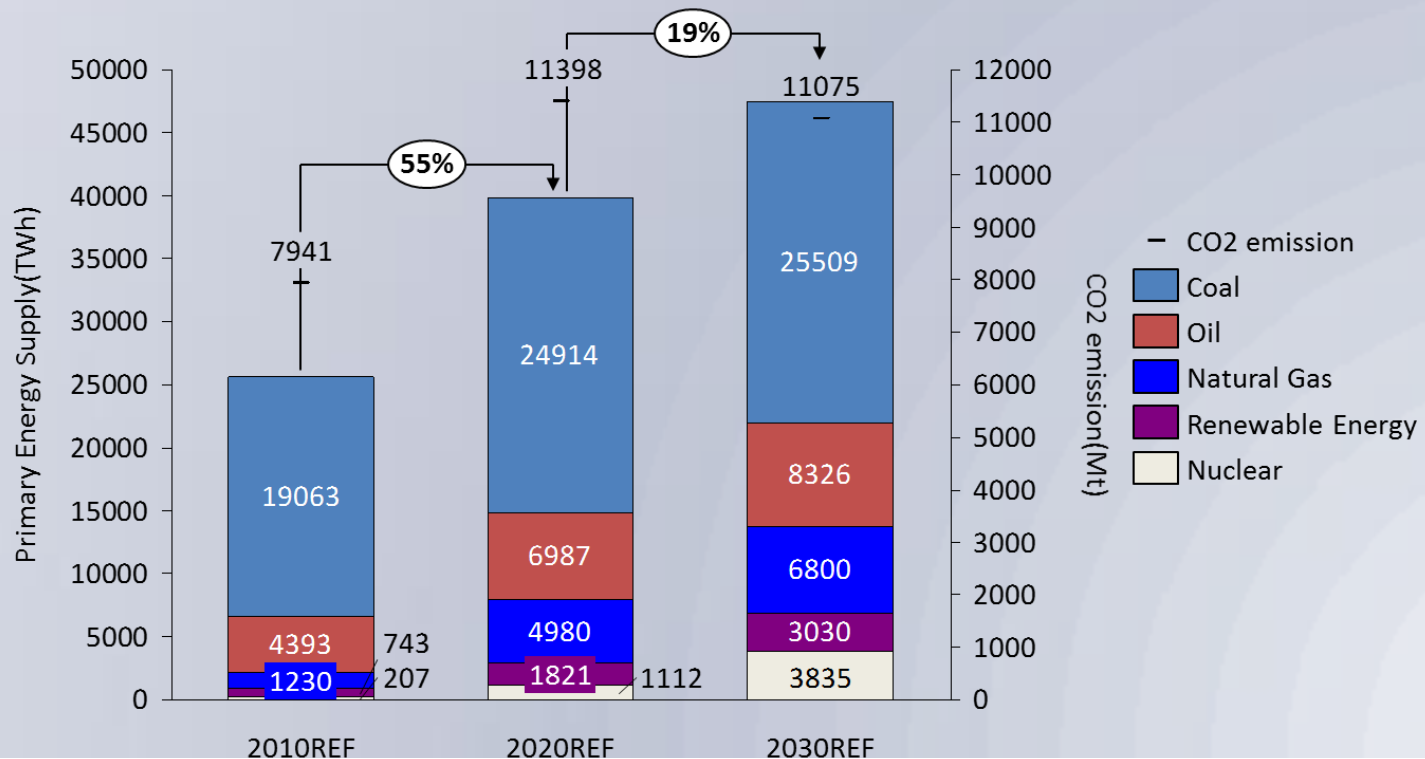


## Energy System Modelling



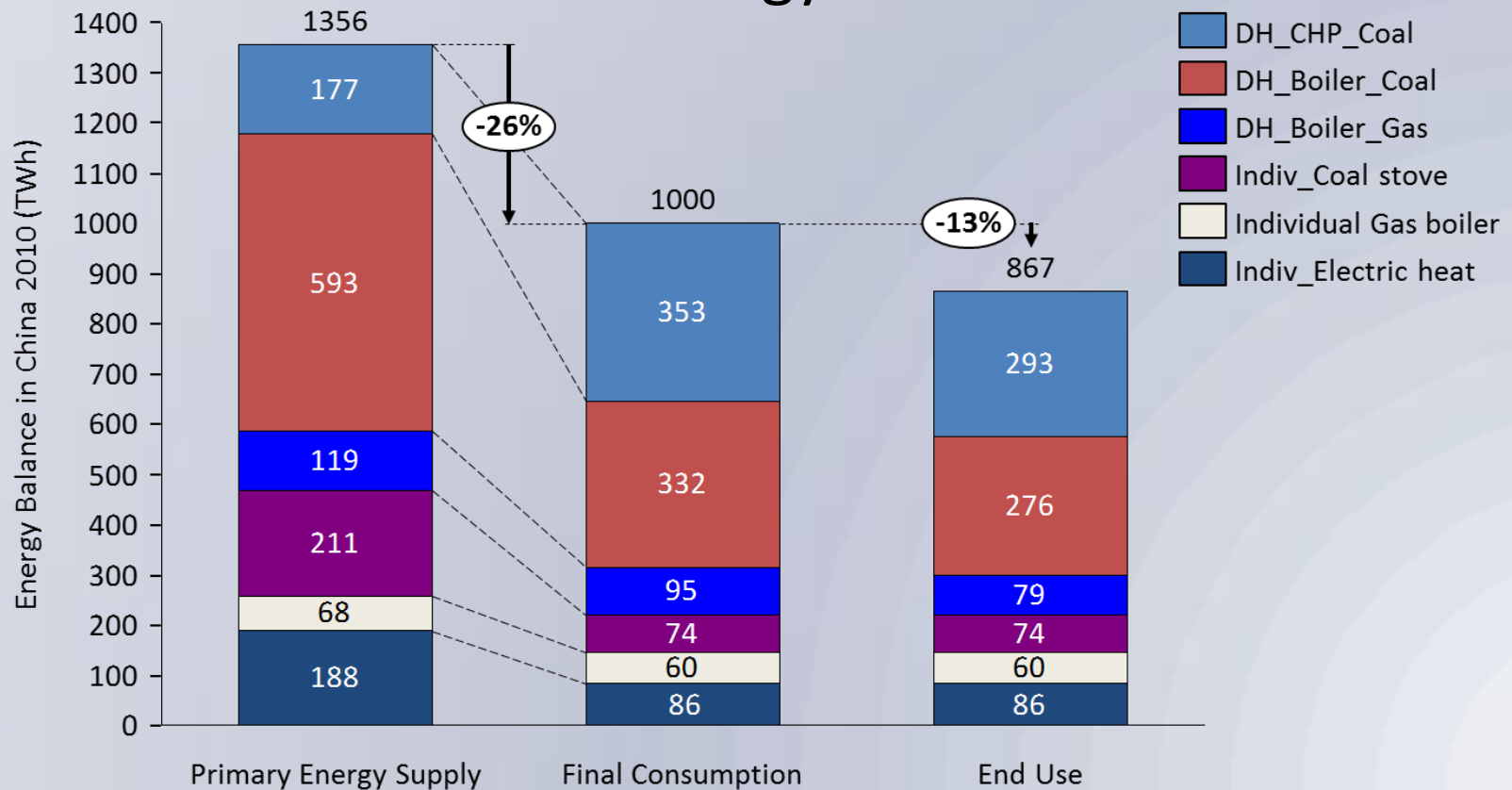
# Modelling the Reference scenario

- Energy consumption is expected to keep increasing towards 2030 (projections of entire energy system from IEA, technology mix consistent in heat sector with 2010 figures)



# Modelling the Reference scenario

Energy loss is mainly caused by coal boilers, in reference to the heat strategy...



# Designing China's Heat Roadmap

- ↳ **Implement Individual heat expansion strategy, whilst maintaining consumptions levels:**
  - ↳ Replacement of coal stove
  - ↳ Keep existing district heating grid
  - ↳ Expansion of electric heater and household gas boiler



Electric radiator



Gas heater



Air conditioner



# Designing China's Heat Roadmap

- ↳ District heating expansion strategy, with a goal to reduce coal boilers:
  - ↳ Energy saving for end users
  - ↳ Utilization of surplus heat resources
  - ↳ Cleaner heat suppliers than those of coal boilers

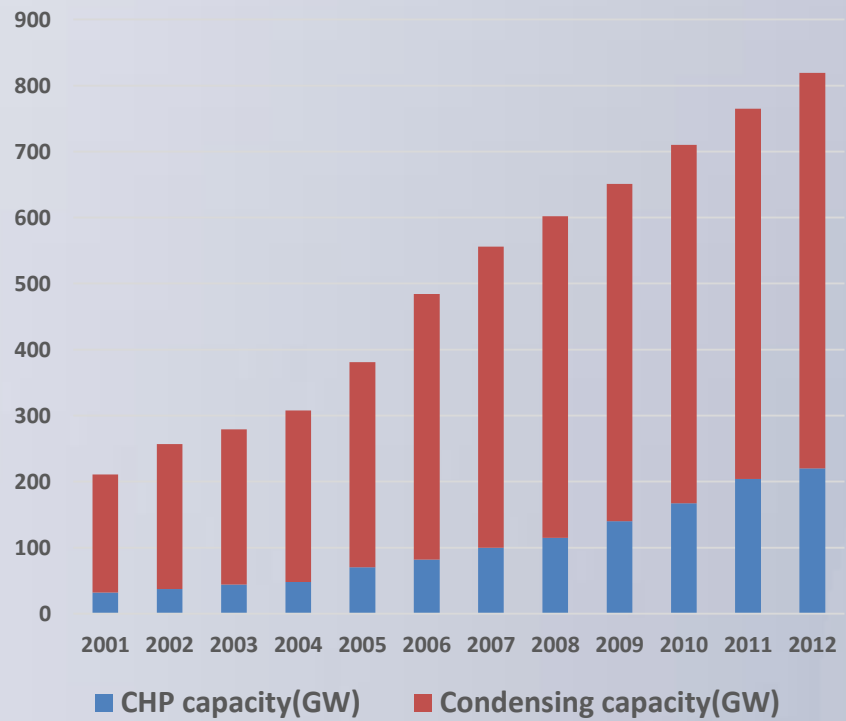




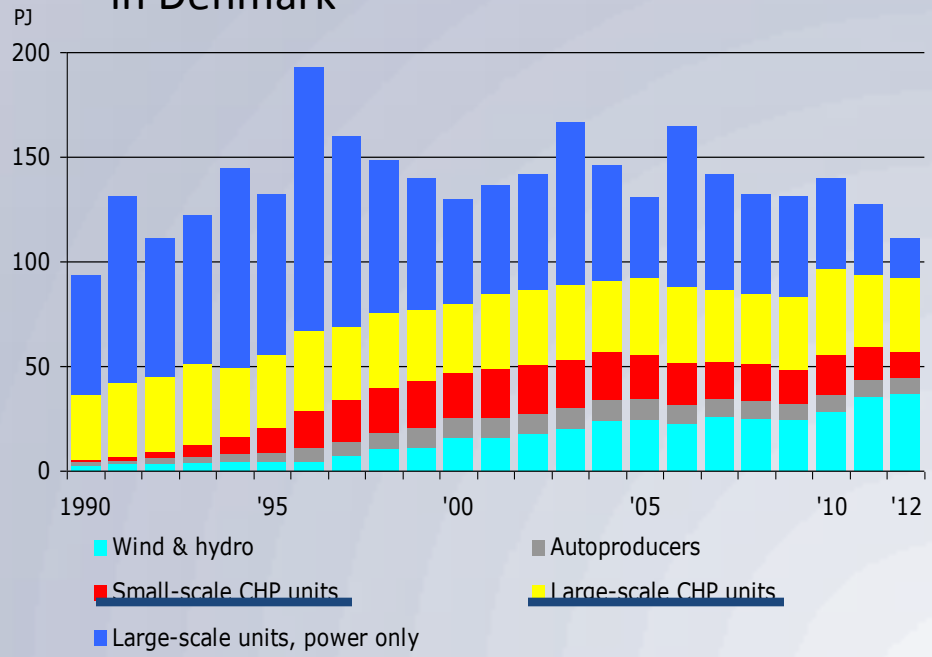
# Designing Heat Roadmap China

➔ Excess heat is wasted in coal-fired power plants

Thermal generation capacity (China)



Electricity generation and CHP's share in Denmark



Data Source: DEA, 2013. CEC, 2012.

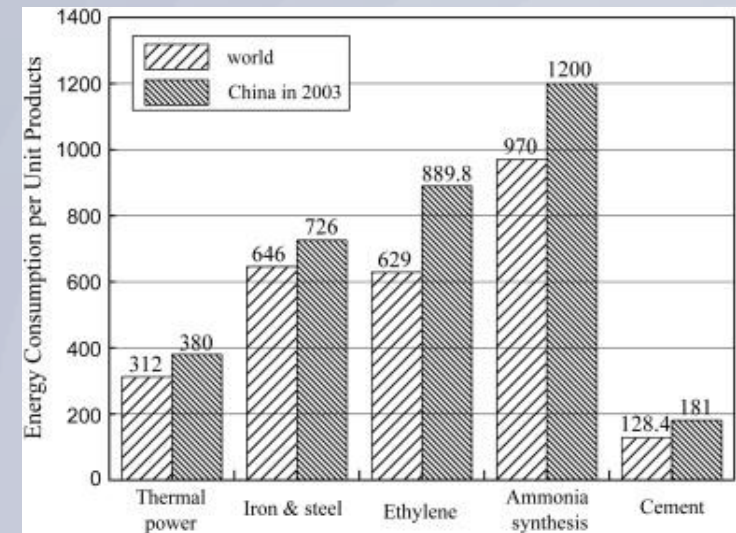


# Designing Heat Roadmap China

- ↳ Potential for industrial heat recovery
  - ↳ Low energy efficiency in current factories
  - ↳ Close to highly-populated areas

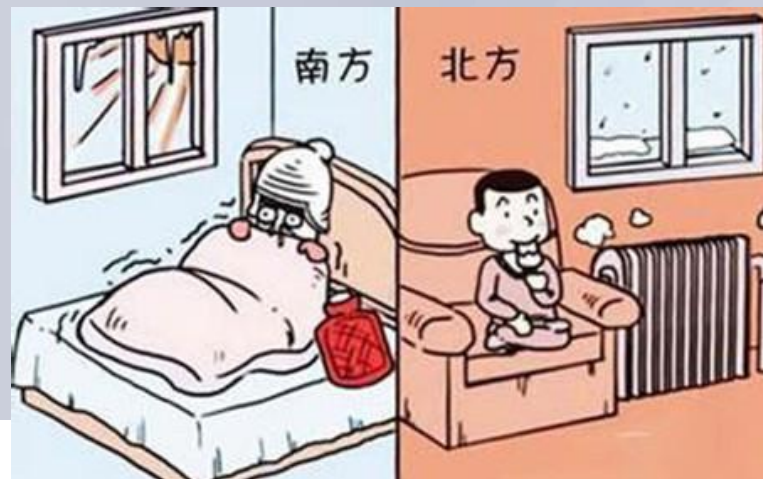


Energy consumption per Unit productions



# Designing Heat Roadmap China

- ↳ High heat loss due to unchangeable system
  - ↳ Heating bill calculated by building area including unit service, construction and energy consumption
  - ↳ No devices to change indoor temperature
  - ↳ **20% heat loss due to “open-window”**



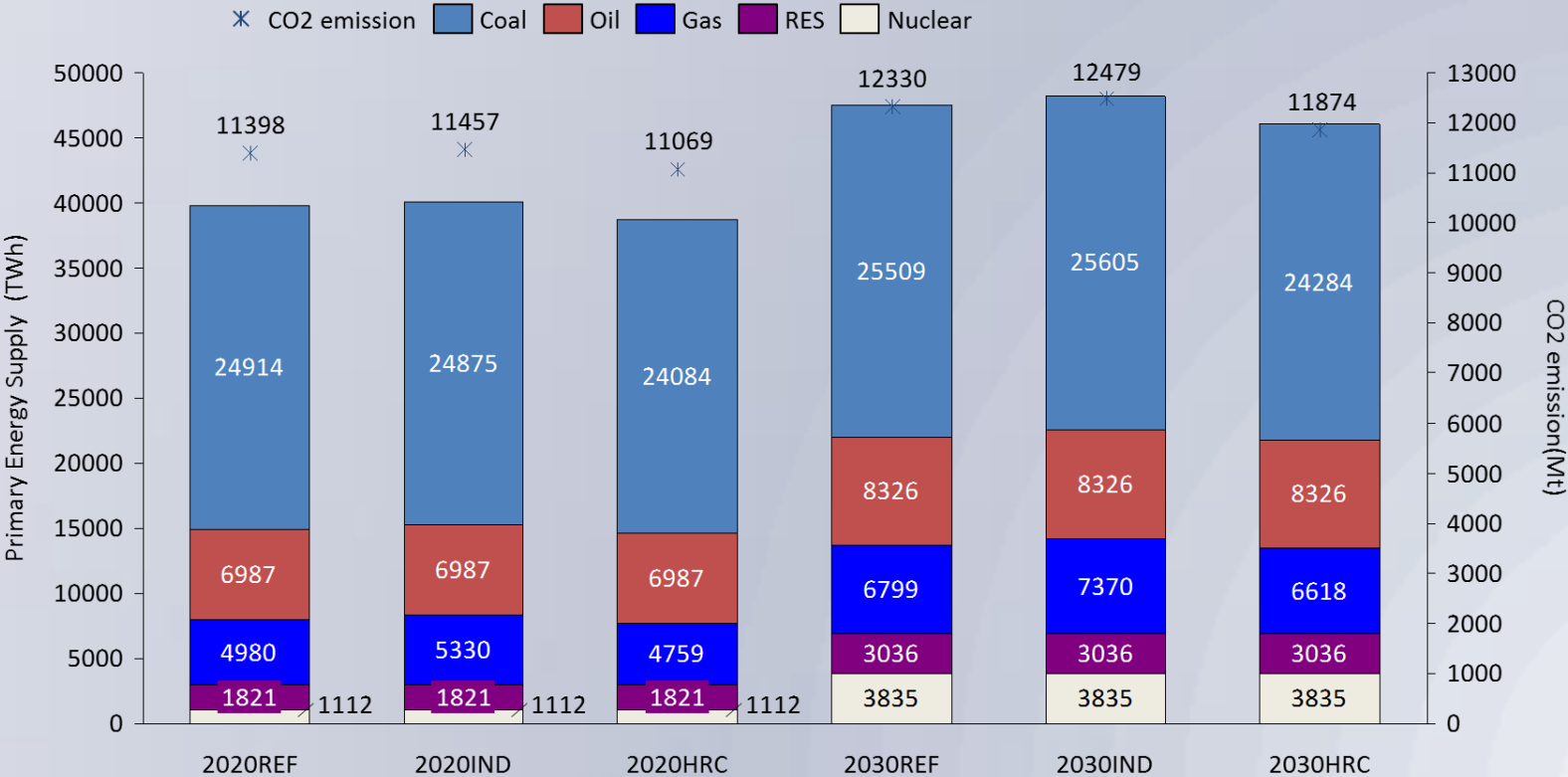
# Designing Heat Roadmap China

- ↳ Three steps to create a new heat strategy (Heat Roadmap China):
  - ↳ Implementation of heat metering devices (**energy saving**)
  - ↳ Industrial excess heat utilization (**waste recovery**)
  - ↳ Replacement of coal-boilers, increase of CHP (**replacement, more CHP**)



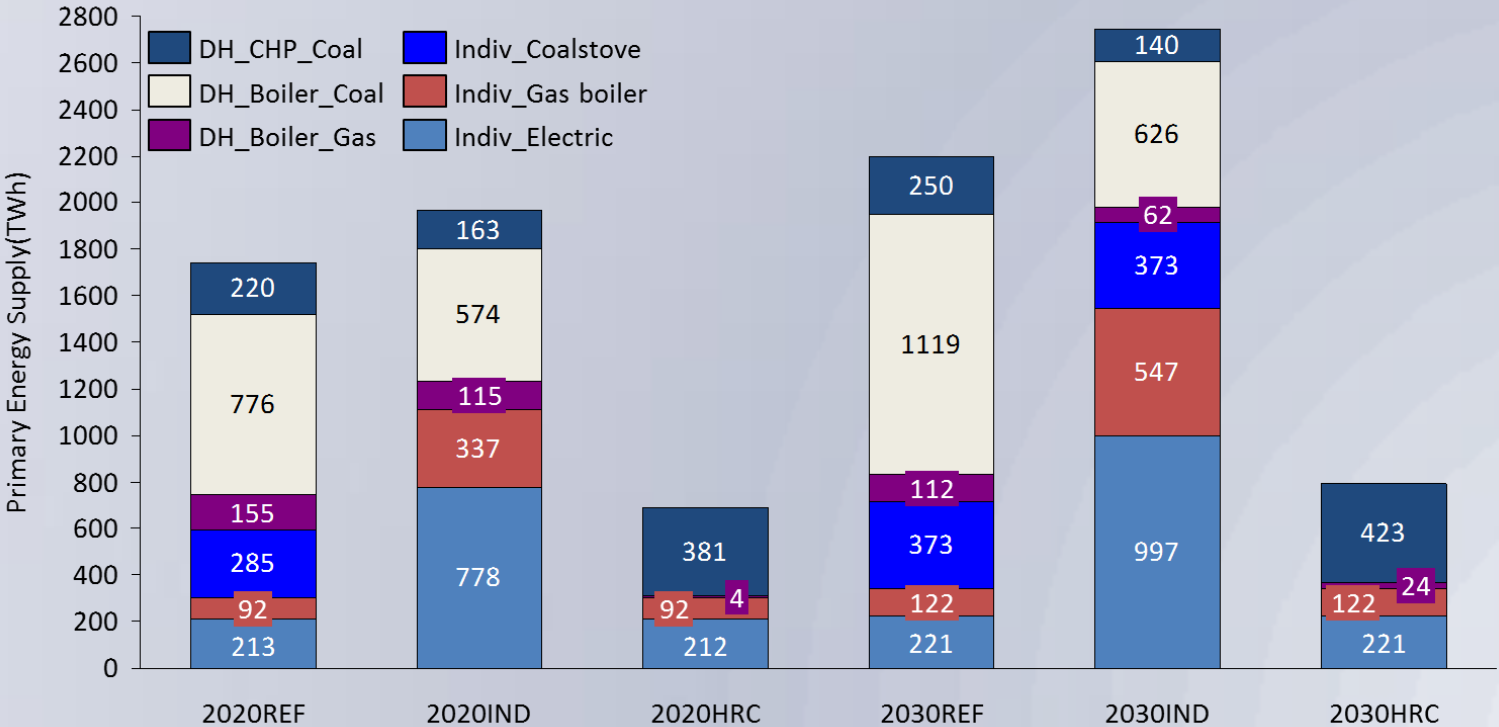
# Results and Discussion

## Primary supply for entire energy system



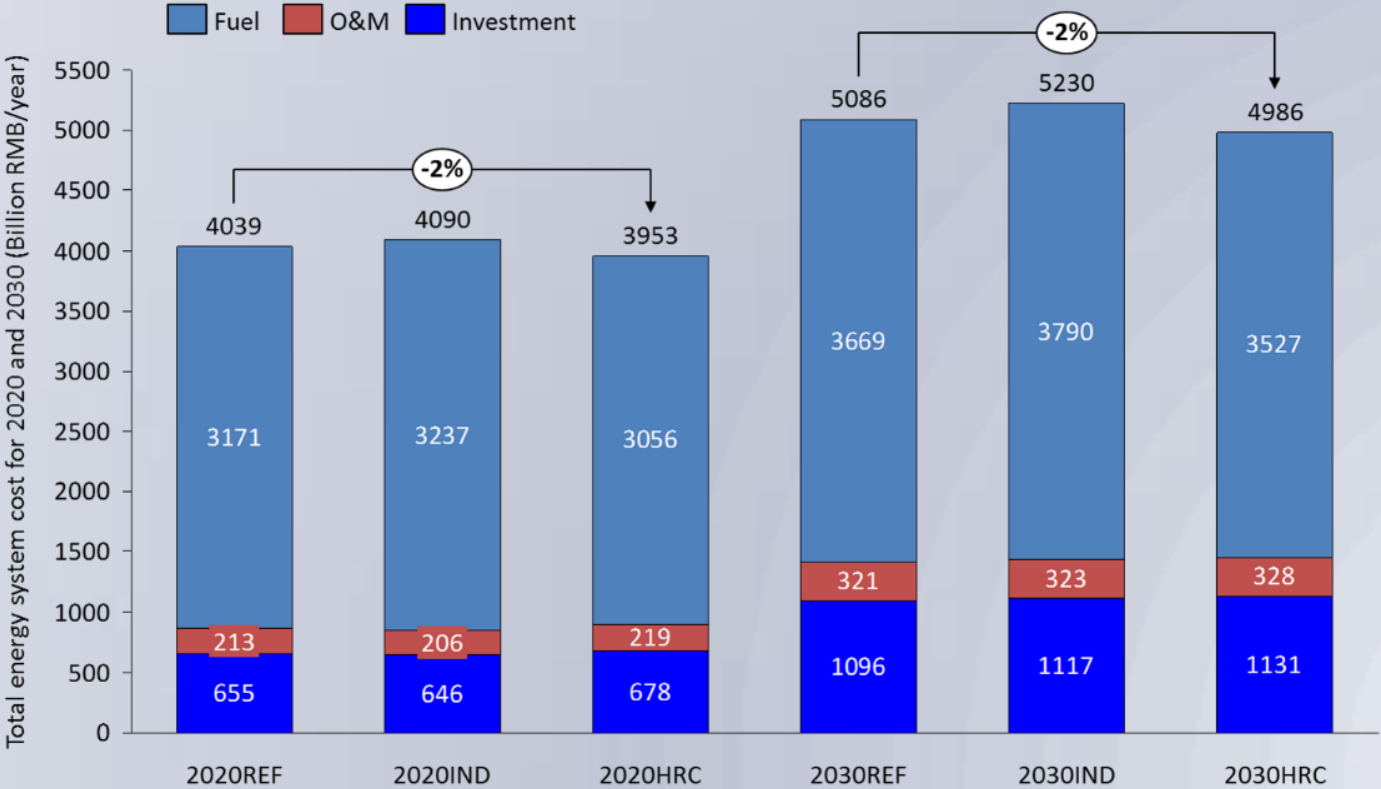
# Results and Discussion

## Primary supply for building heating sector



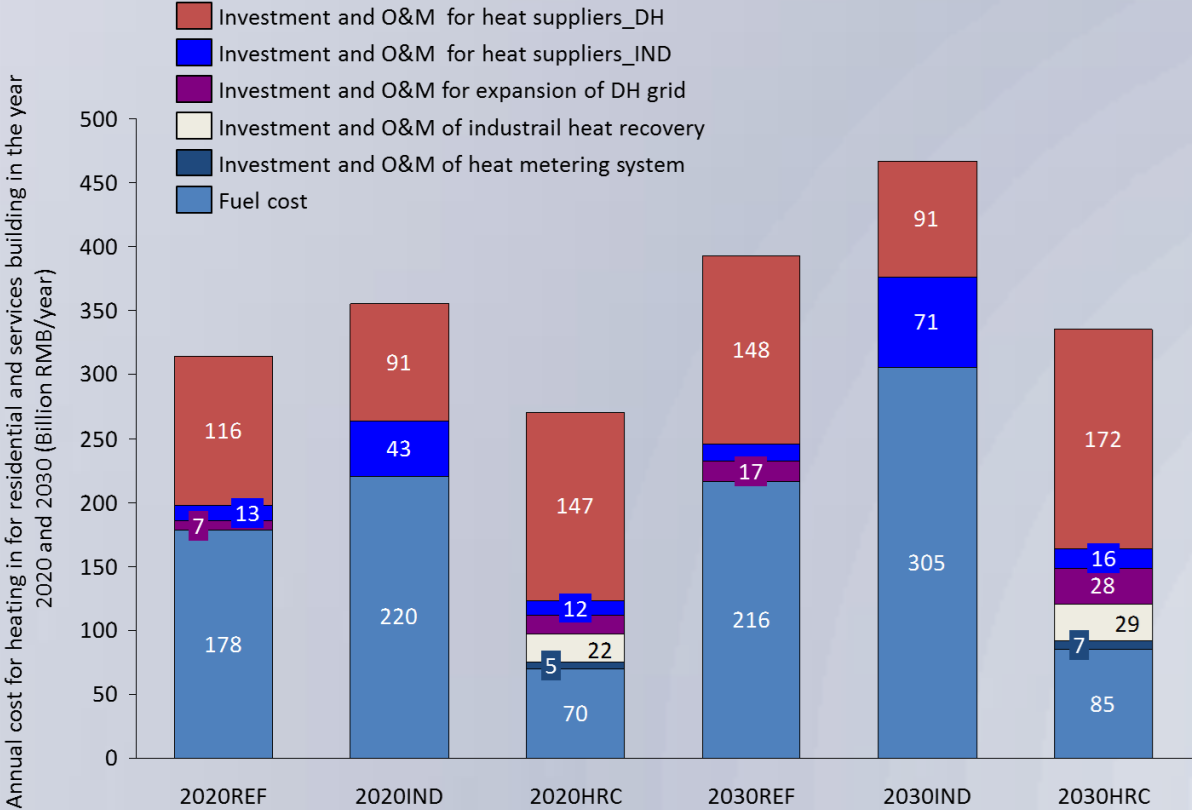
# Results and Discussion

→ Annual cost for the entire energy system



# Results and Discussion

## Annual cost for the building heating sector





# Results and Discussion

- ↪ Individual heat consumes more energy with a higher system cost
- ↪ District heating is an attractive solution, while the new heat strategy is cheaper and more energy-saving than the current strategy
- ↪ Improvements on the demand side and supply side are needed



# Conclusions

- **HRC(Heat Roadmap China) is more attractive than REF(reference scenario)**
  - Reduces the primary energy supply (~60% for building heating sector and ~3% for entire energy system )
  - Reduces the 3% ~ CO2 emissions
  - Reduces the costs of the energy system (~15% for building heating sector)
  - Uses more surplus heat (~4% of total industrial surplus heat)
  - Robust to fuel price uncertainty (20% fuel price uncertainty ~10% system cost uncertainty)



# Conclusions

- ↳ Other benefits of HRC strategy:
  - ↳ Ensures energy security (Individual heat replies on natural gas and oil)
  - ↳ Decreases air pollution during heating period
  - ↳ Provides opportunity to improve the interaction between electricity sector and heat sector



# Thank you

by



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