Drivers of Future Energy Demand in China

Asian Energy Demand Outlook
2014 EIA Energy Conference

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How to balance?

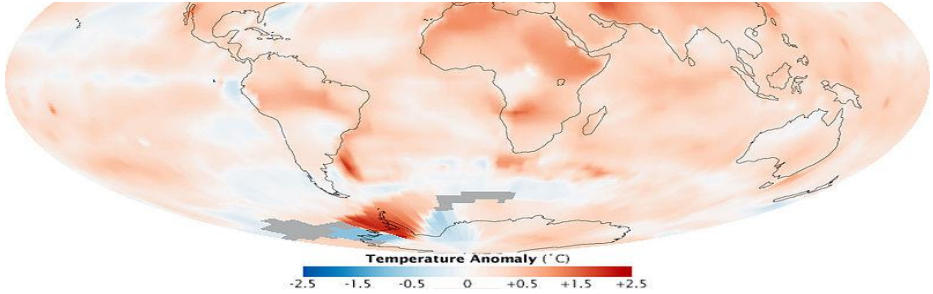
Human Development

globalchange.mit.edu

Industrial Development & Resource Needs

www.china.org.cn

Global Climate Change



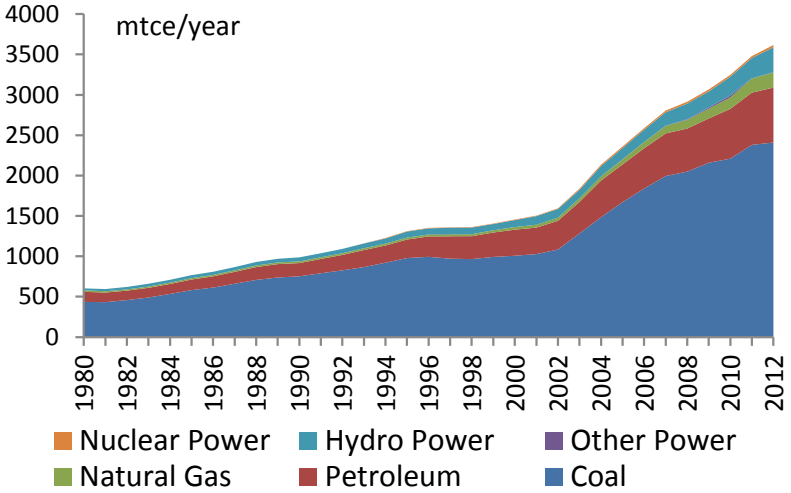
www.wikimedia.org

Local Pollution

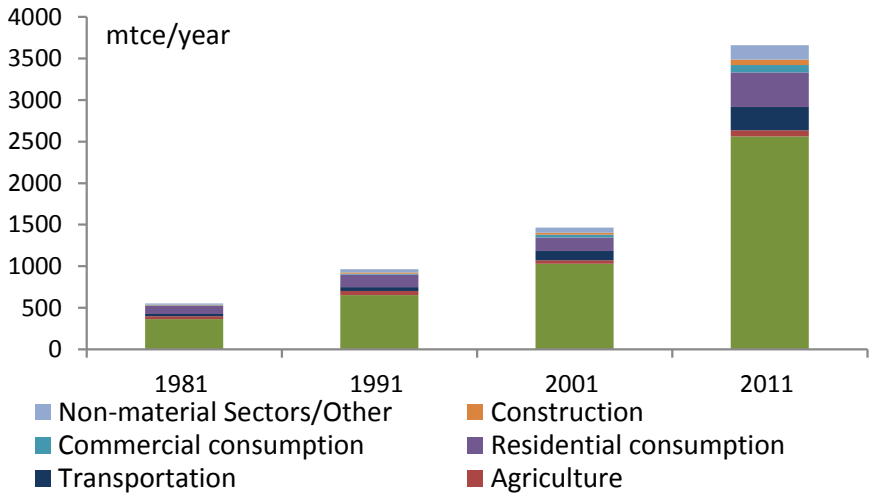
www.flickr.com

China's energy system: A snapshot

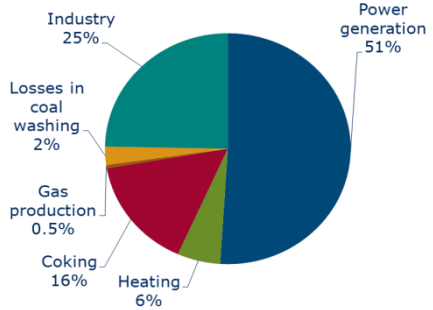
By primary energy type



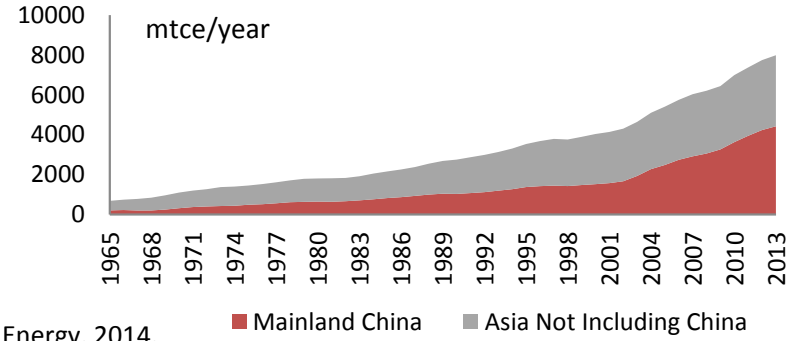
By end-use sector



Coal use by sector



Role in Asian energy demand



Source: China National Bureau of Statistics, 2013; BP Statistical Review of World Energy, 2014.

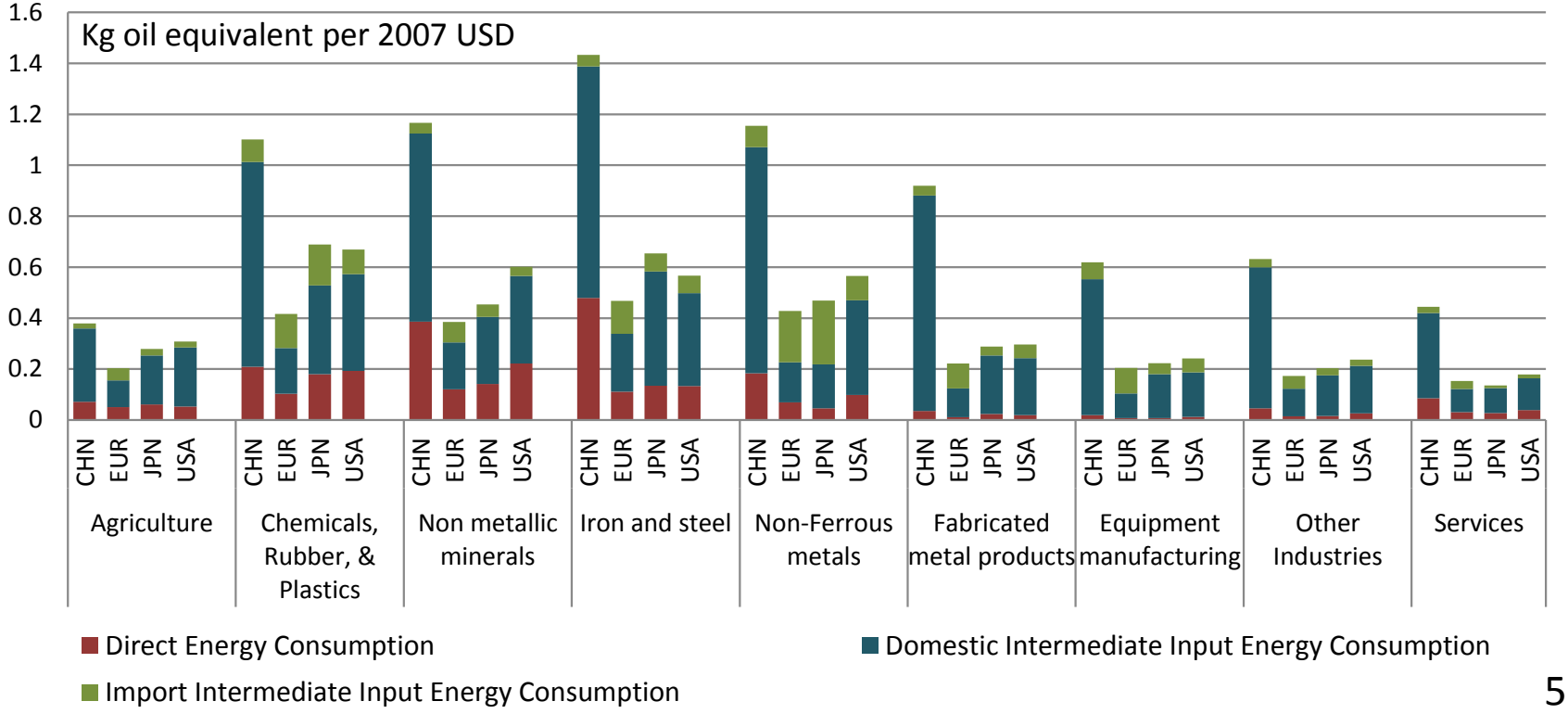
Drivers of Energy Demand in China

- Energy-economic system
  - Industrial energy intensity
  - Domestic consumption-investment shift
  - Export trends
  - Household income / migration / urbanization

- Policy: *China Energy Outlook*
  - Air pollution
  - Climate change

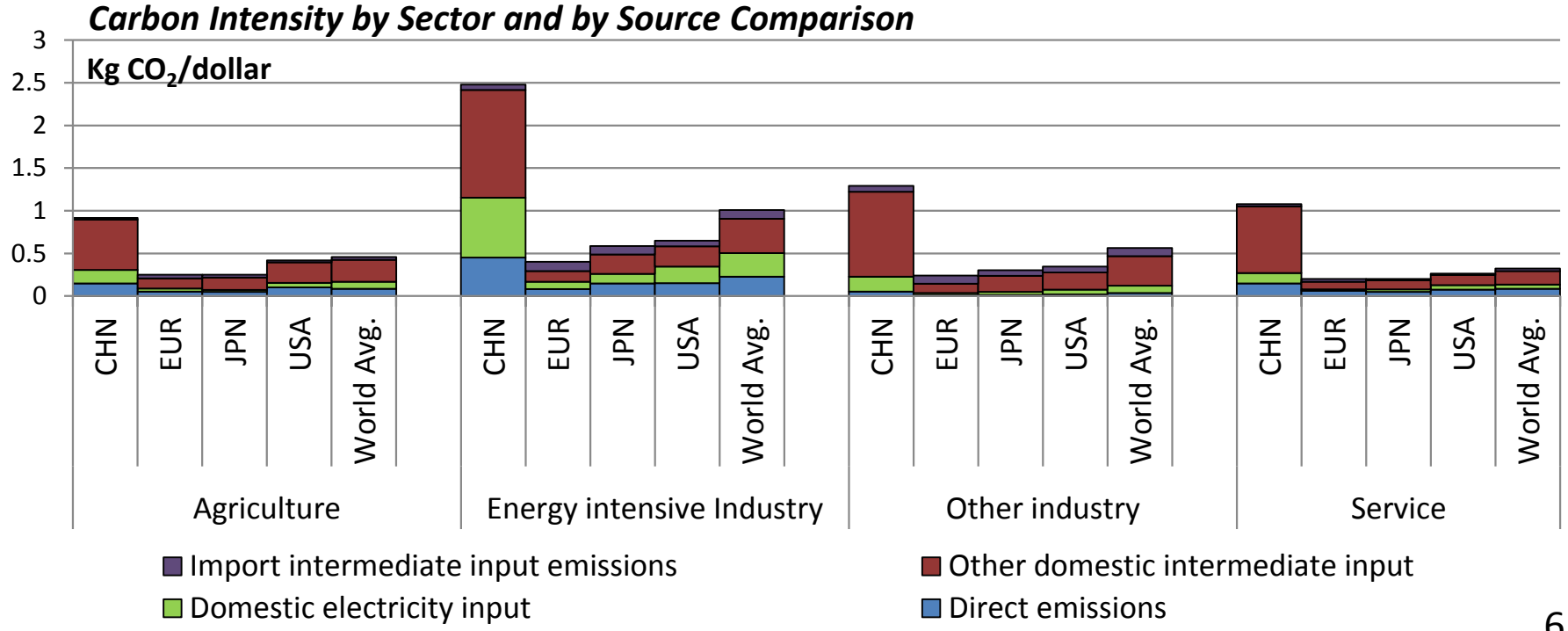
(1) Industrial energy intensity: The energy intensity of production is higher in China

Energy Intensity by Sector and Source: International Comparison



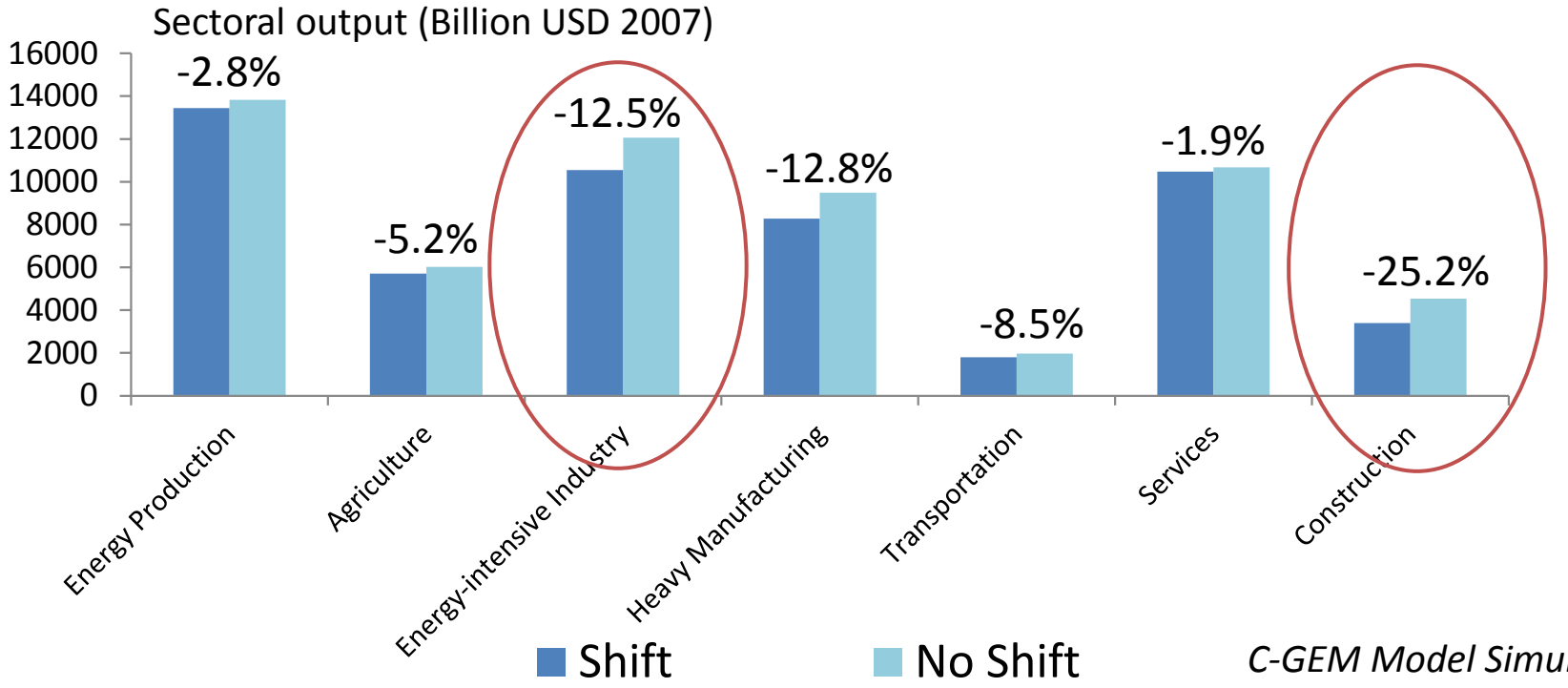
The carbon intensity of production is higher in China

- Significant room to improve especially in energy-intensive industries through efficiency/carbon intensity reduction in electricity and intermediate input sectors.



Source: Qi et al., 2013. *Energy Economics*.

(2) Investment-Consumption: Impact of shifting from an investment to a consumption-driven economy (2030)

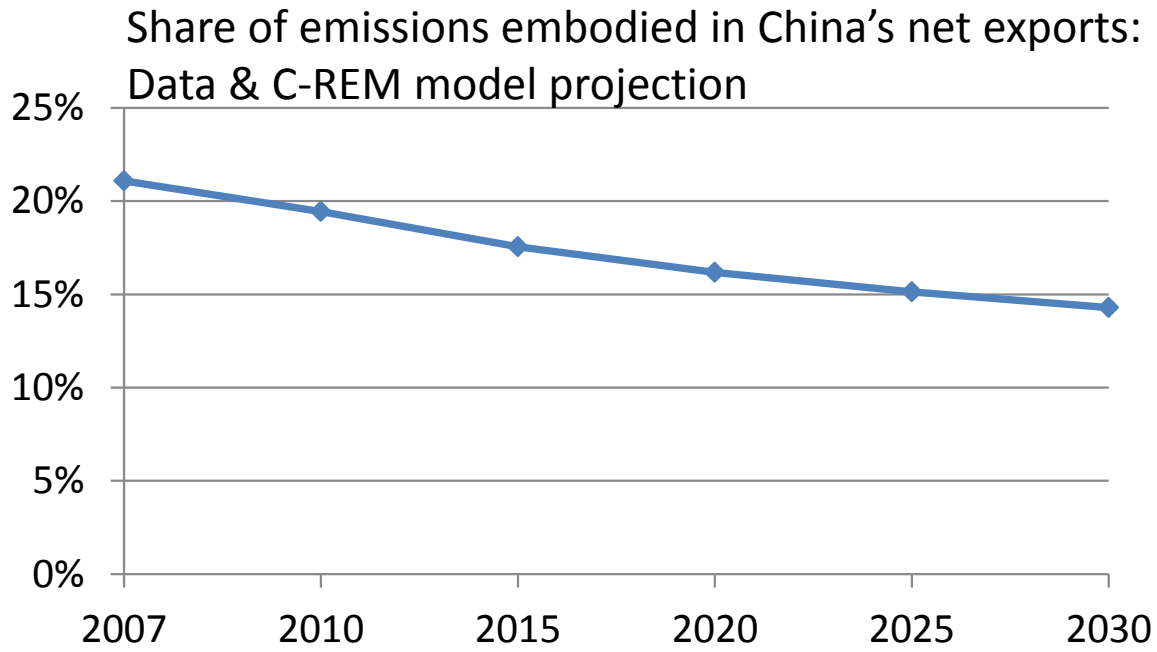


C-GEM Model Simulation

A gradual increase in consumption share of GDP from 52% in 2010 to 64% in 2030 reduces China's CO_2 emissions by 6% in 2030.

(3) Energy/CO_2 emissions associated with exports are expected to fall as exports account for a smaller share of production.

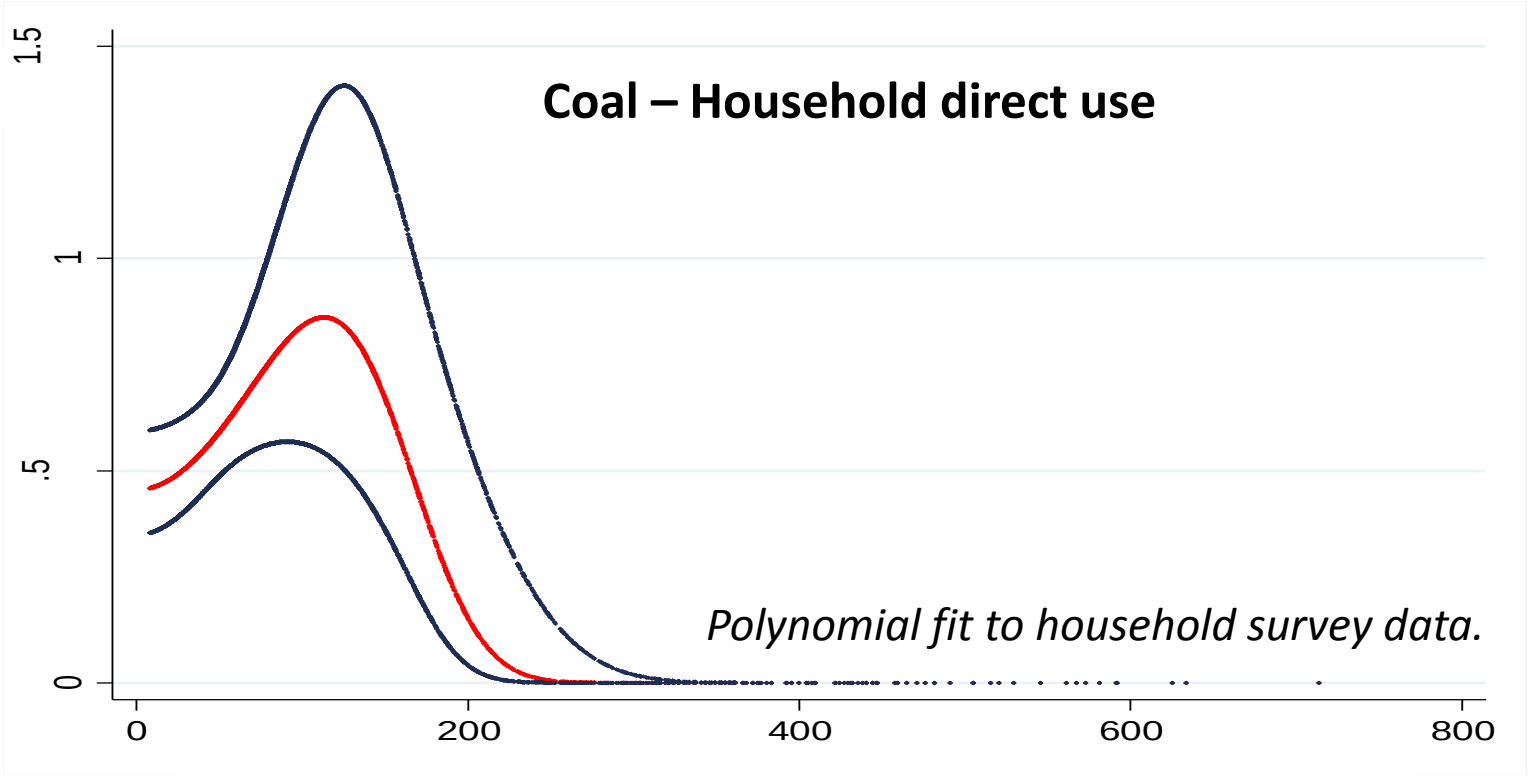
- In 2010, ~20% of China's domestic CO_2 emissions were associated with net exports.



- Projected share of China's domestic emissions associated with exports declines.
- But without policy China's total emissions still **more than double** between 2010 and 2030.

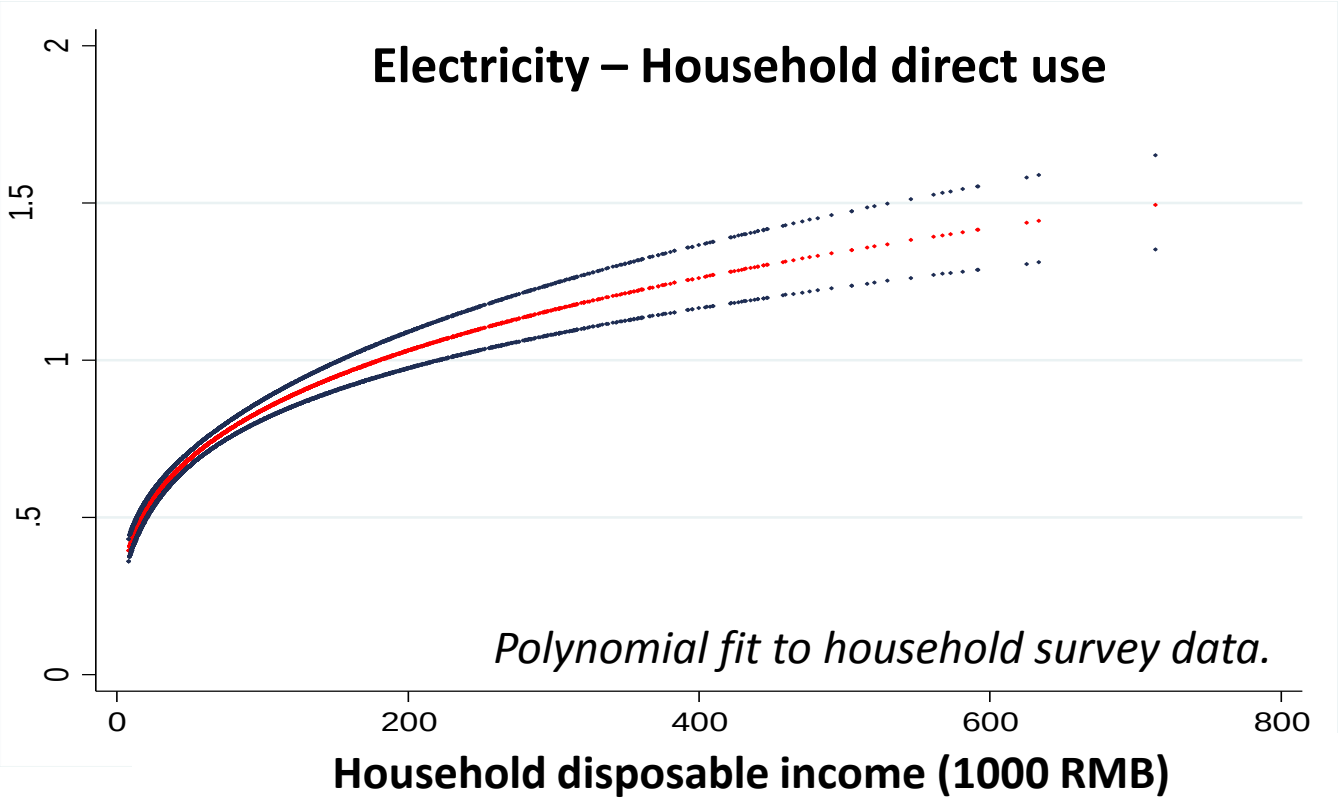
Forecast from China Regional Energy Model developed jointly by MIT and Tsinghua U.

(4) Household demand: Household direct use of coal initially substitutes for biomass but is replaced by electricity as income rises



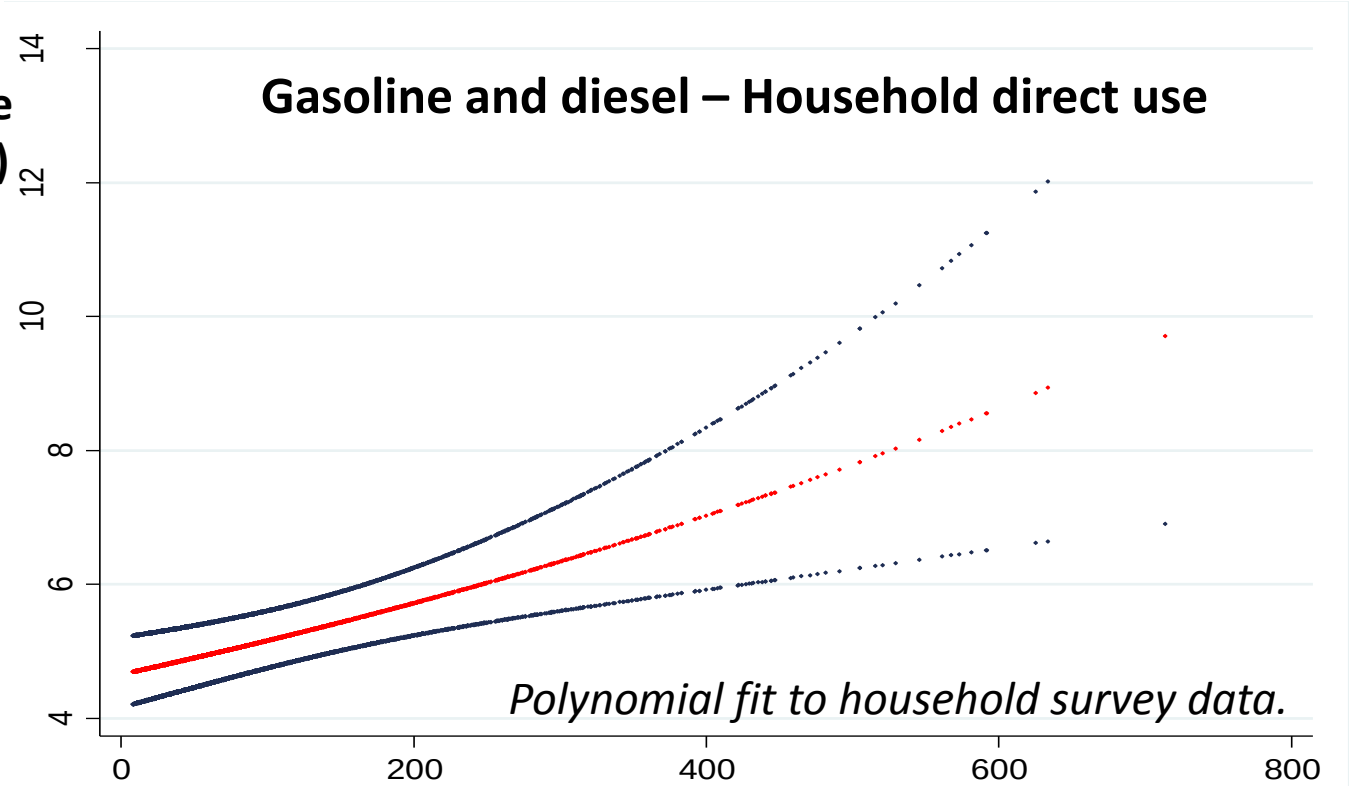
Data: Renmin University, 2014.

Household electricity use rises at a decreasing rate as income increases



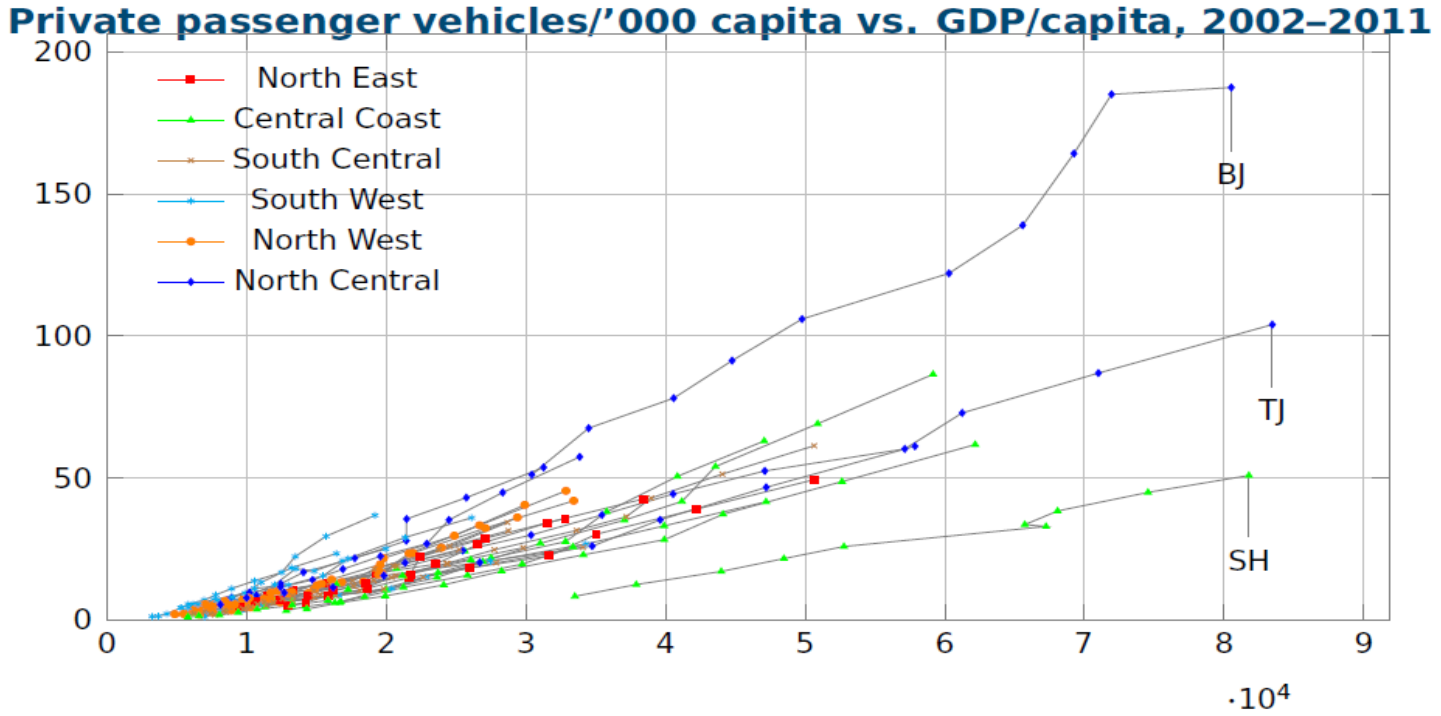
Data: Renmin University, 2014.

Household use of gasoline and diesel increases with income, vehicle ownership (and faces great uncertainty)



Data: Renmin University, 2014.

Household demand for passenger vehicle ownership and use has significant room to grow



If household vehicle ownership/use reached the level of Tianjin (TJ) nationwide **today**, household vehicle transportation energy use would roughly **double**.

CECP China Energy Outlook Context

Economic Reform and the Third Plenum (November 2013)

- Called for comprehensive deepening of reforms
- Emphasized "decisive" role of the market
- Environmental markets: energy, CO_2 emissions, air pollution, and water

National Air Pollution Action Plan (September 2013)

- Respond to severe pollution nationally, especially in the Beijing-Tianjin-Hebei, Yangtze River Delta, and Pearl River Delta regions
- Control the level of coal use nationwide

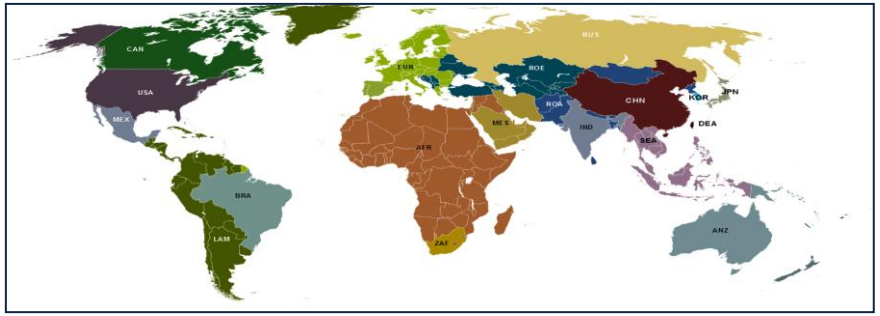
What will be the impact of implementing these policies?

- Economy
- Energy system
- CO_2 emissions

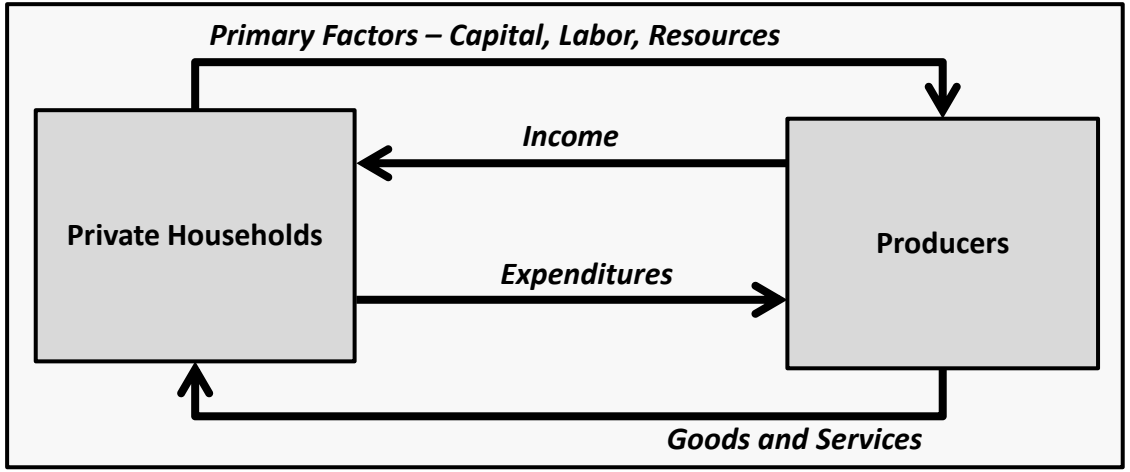
For this analysis we use the **China-in-Global Energy Model: C-GEM**

A new model for assessing the domestic and global impact of energy and climate policy in China

- 18 sectors from GTAP database & China national input-output and energy balance tables
- Detailed representation of energy-intensive sectors
- 19 countries/regions & trade linkages



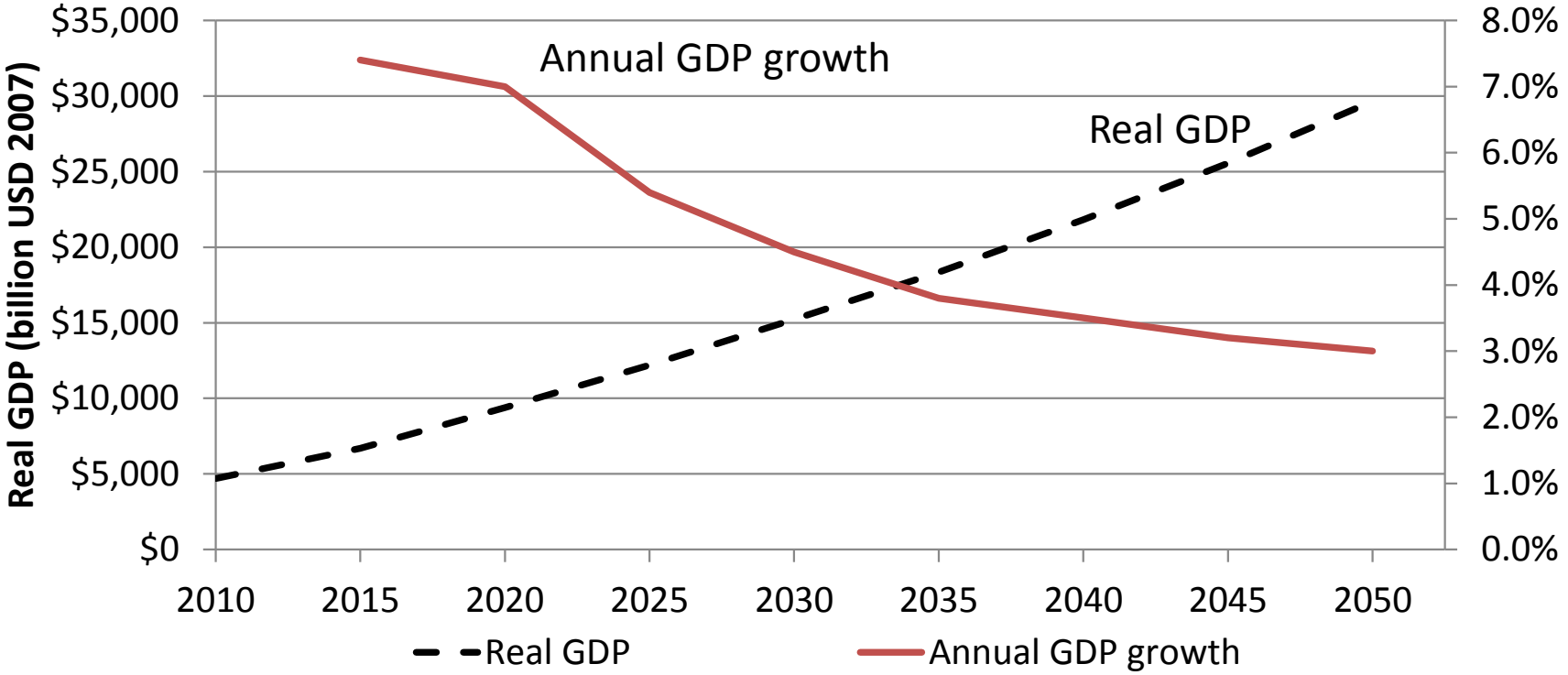
Basic model structure:



Key features:

- Detailed representation of the energy-intensive sectors (iron & steel, non-ferrous metals, non-metallic minerals, chemicals & rubber, and other ferrous manufactured products)
- China data: combined domestic economic and energy data source for China

Economic output in the ***No Policy*** scenario



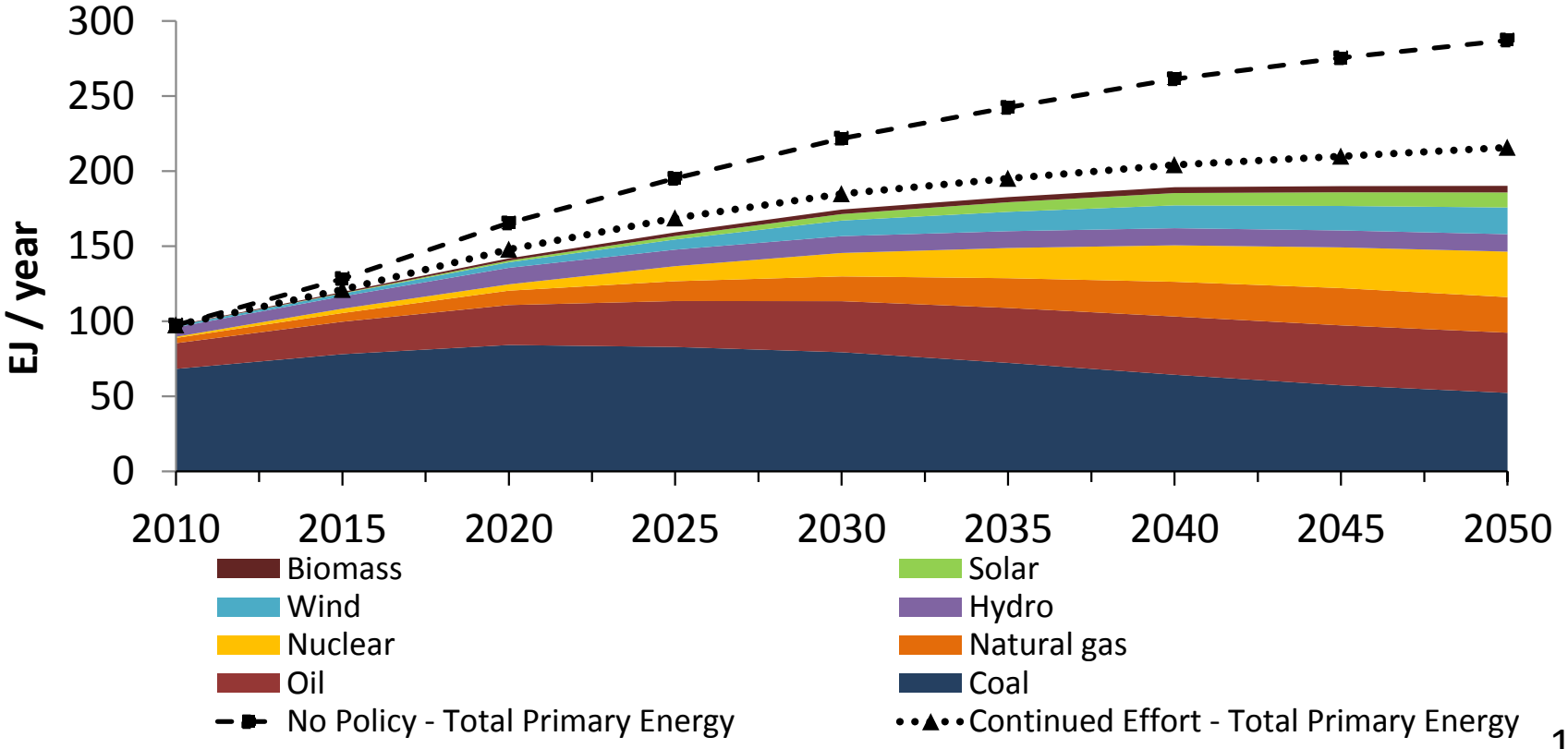
The size of China's economy (GDP) is projected to grow around four times in real terms between 2010 and 2050.

Three policy scenarios analyzed in the *Outlook*

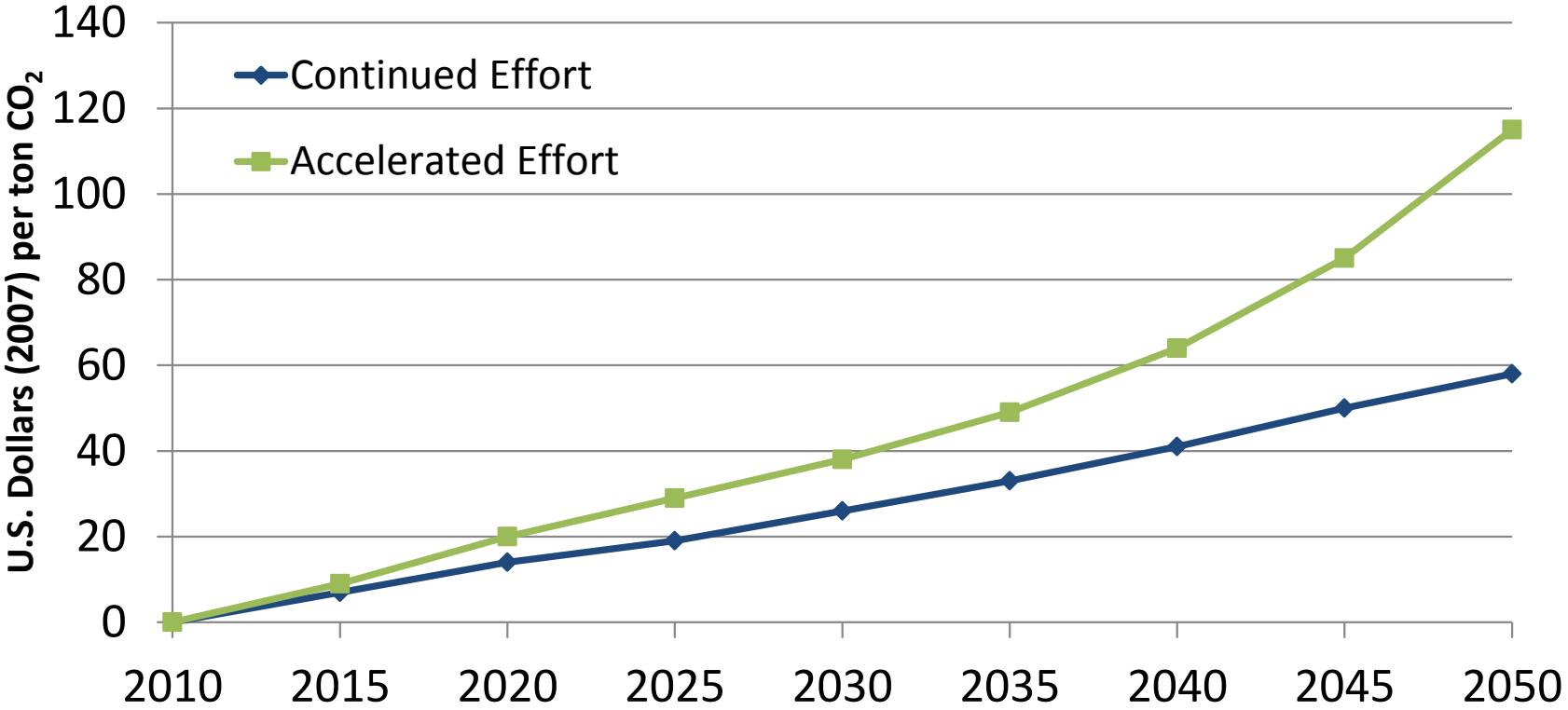
Measures	No Policy	Continued Effort	Accelerated Effort
Carbon tax	None	Carbon price required to achieve CI reduction (~3%/year, $30/ton in 2035 and $73/ton in 2050)	Carbon price rises to achieve CI reduction (~4%/year, $55/ton in 2035 and $126/ton in 2050).
Fossil resource tax	None	Crude oil/natural gas: 5% Coal: 8 CNY/ton (~$1.2/ton)	Crude oil & Nature gas: 8% Coal: 10%
Feed-in tariff (FIT) for wind, solar and biomass electricity	None	A 3.8% surcharge is applied to electricity prices to finance an FIT	A 6.5% surcharge is applied to electricity prices to finance an FIT
Hydro resource development	Only economically viable hydro resources are deployed with no policy constraint.	Achieve the existing target of 350 GW in 2020 and slowly increase to its economic potential of 400 GW by 2050.	Same as the Continued Effort assumption.
Nuclear power development policy	No targets or measures to promote nuclear energy development.	1) 40 GW in 2015 and 58 GW in 2020; 2) Assumes site availability of 160 GW.	1) Same as the Continued Effort assumption. 2) Assumes site availability of 400 GW.

Continued Effort and **Accelerated Effort** scenarios represent alternative levels of policy stringency.

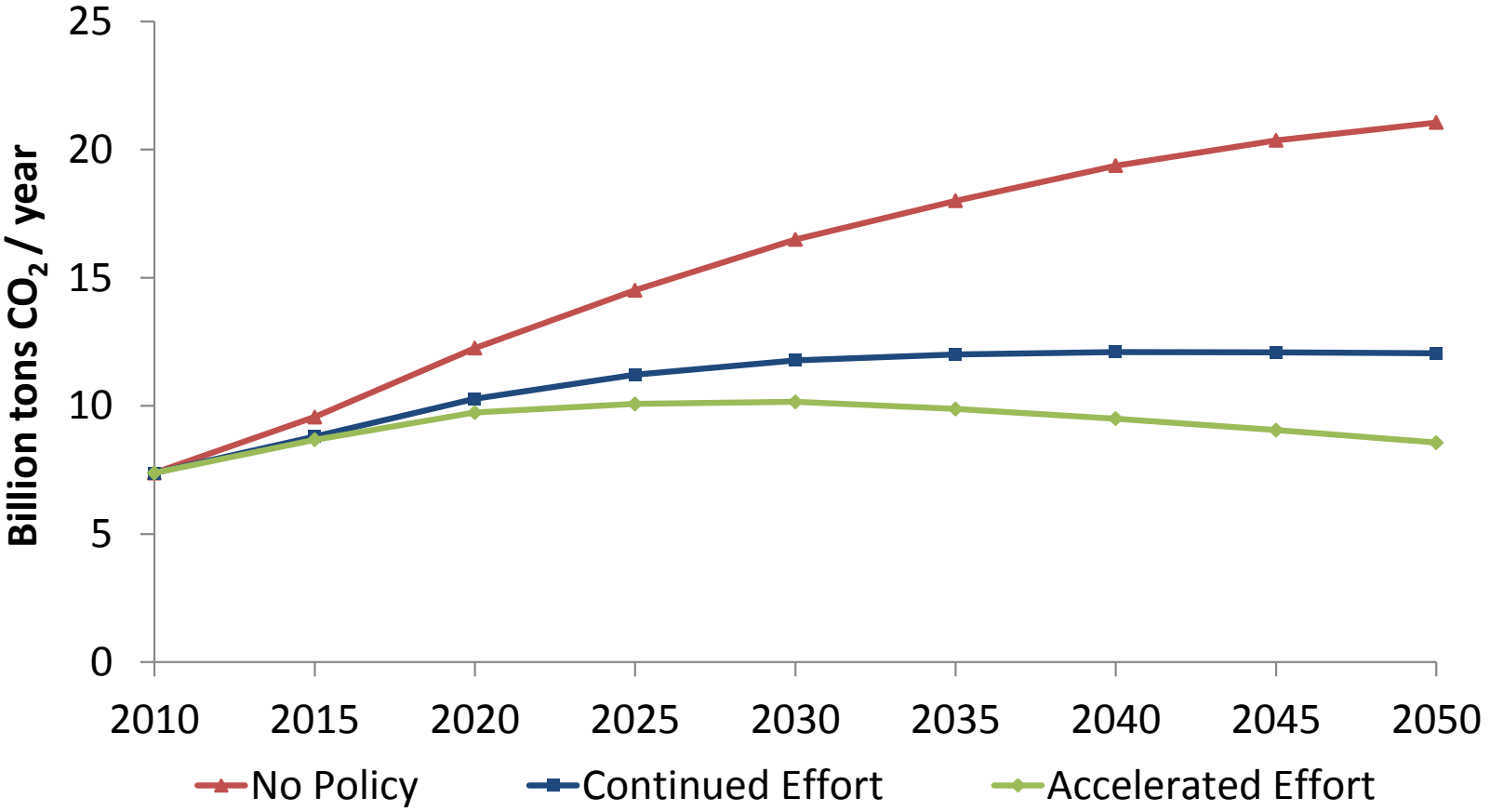
The **Accelerated Effort** scenario shifts away from coal toward cleaner low carbon energy sources



CO_2 price

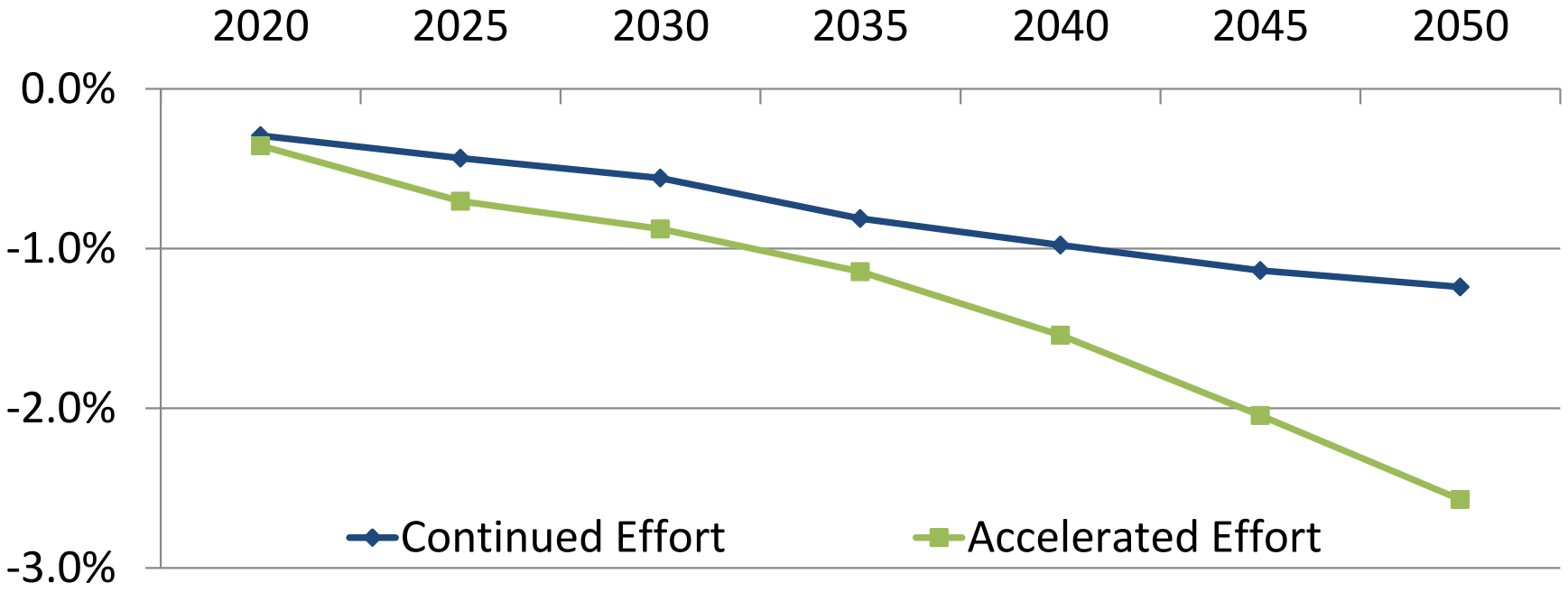

U.S. Dollars (2007) per ton CO_2
140
120
100
80
60
40
20
0
Continued Effort
Accelerated Effort
2010
2015
2020
2025
2030
2035
2040
2045
2050

CO_2 emissions



Economic impacts

- Change in consumption (relative to **No Policy**):



Total economic impact of both policies is modest.

- *Considering economic and health benefits of reducing pollution could offset losses!*

Insights

Significant CO_2 reductions can be achieved at modest cost—*with the right incentives*.

Domestic action on air pollution that reduces coal will also cost-effectively reduce CO_2.

Oil demand is the least sensitive to a CO_2 price given limited substitutes and rising household demand.

Even substantial nuclear deployment will only be a partial solution.

Solar, wind, and biomass will expand, raising grid connection and integration challenges.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