

# Growing CO<sub>2</sub> emissions in China: driving forces & impacts of the transportation sector

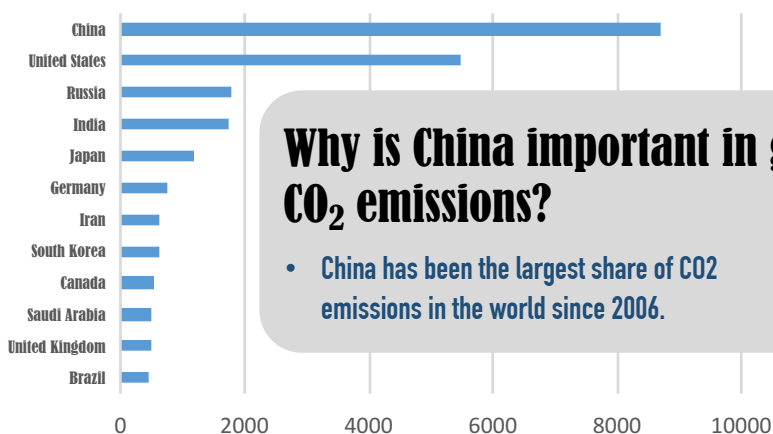
Qingyang Liu, Nov 2016



## What is CO<sub>2</sub> ?



- CO<sub>2</sub> is a long-lasting Green House Gas (GHG), which has irreversible impacts on the global climate change.



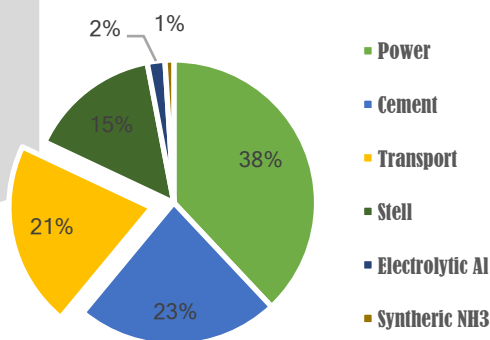
## Why is China important in global CO<sub>2</sub> emissions?

- China has been the largest share of CO<sub>2</sub> emissions in the world since 2006.

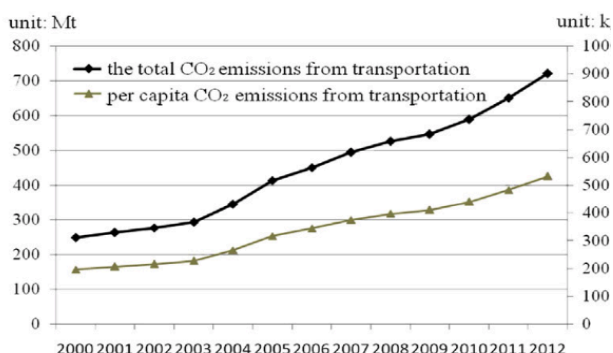
2011 Total Carbon Dioxide Emissions from the Consumption of Energy (Million Metric Tons)

## Why is transportation important in this situation?

- China's CO<sub>2</sub> emissions from transport are the highest share excluding the dominant but decreasing industry factor and have a trend to increase in the future.



CO<sub>2</sub> Emission Division in China 2013

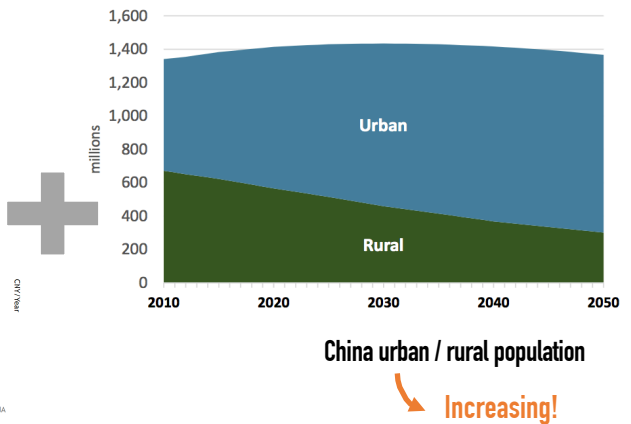


a. the growth of CO<sub>2</sub> emissions from transportation in China

**My research method:** the framework of DSPIR, which distinguishes driving forces, pressures, states, impacts and responses in an assessment of the environment (Kristensen, 2004).

# A. What are the main driving forces?

## 1. Rapid urbanization



Urban Density:

1% increase

Disposable income:

1% increase

Per capita CO<sub>2</sub> emission from transportation:

0.22% increase

0.43% increase



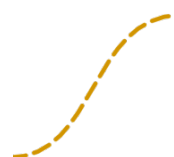
Urban transportation... sustainability... less CO<sub>2</sub>?  
Why would China have higher CO<sub>2</sub> emissions of transportation in cities?



## Reasons:

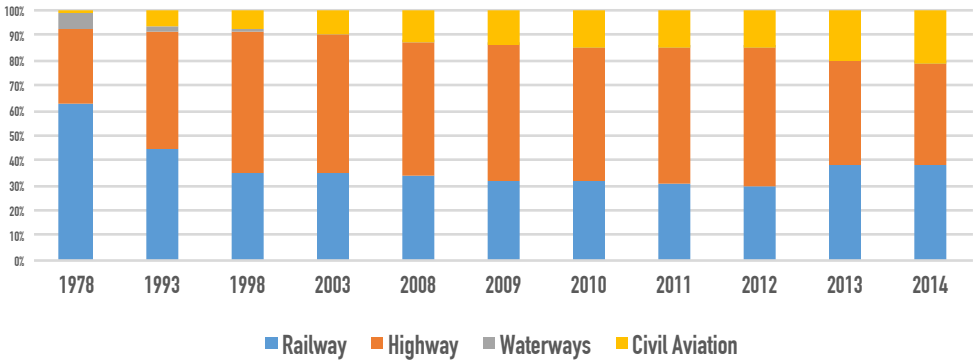
1. Rural Chinese residents' **low disposable income** (approximately 1500 US dollar in 2014) and their **farming lifestyles** determines their **low commute needs** and **limited travel opportunities**, which results in a low transport contributing sector. Urban Chinese are capable of purchasing automobiles, traveling for vacations, and have higher commute needs.

2. Urban Chinese have higher per capita expenditure on **indirect services** such as **road constructions** (Qu et al, 2015).



## 2. Change in transportation modes

China's Transport modes division in percentage



### Trends:

1. The share of Civil Aviation kept rising.



### Possible reasons

The Olympics, Expo, etc., transport missions & personal travels increased

2. The share of trips on road increases from 1978 to 2012 but decreases after 2012.



The completion of High-speed Rail (HSR) in 2012

3. The share of railway kept decreasing until 2012.



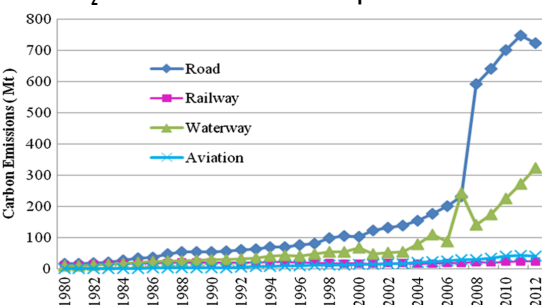
Original railway trip: low-speed, exhausting and time-consuming



HSR trip: high-speed, pleasant, time-saving

Won! More people choose to take HSR instead of driving on highways.

CO<sub>2</sub> emissions in China's four transport sub-sectors



- Road transportation takes up to 70% in all CO<sub>2</sub> emissions  
 - Rising railway and decreasing highway transportation lead to CO<sub>2</sub> mitigation.



# Innovative transportation modes

Uber: entered China in 2013



**Shared mobility:** including car sharing, personal vehicle, bike sharing, and many other on-demand ride services (Shaheen & Chan, 2015)

Didi: China's local company, found in 2012

## The bruising price battle between Uber and Didi



Heavy discounts \$\$\$ for Chinese riders and incentive awards for Uber and Didi drivers

- altered riders' transportation habits
- encouraged the use of idle vehicles
- reduced auto ownership and usage
- **mitigated carbon emissions**



Car2go: entered China in 2015

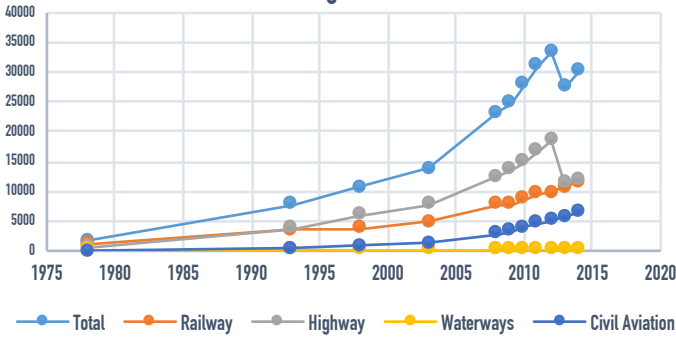


Car2go's substantive efforts on reducing carbon emissions are proven by a three-year study on five northern American cities by Martin & Shaheen (2016): car2go results in fewer private vehicles on the road, fewer VKT, and less carbon intensive travel behaviors

On the other hand, research also shows that such ride-sourcing services compete with public transportation and exacerbate congestion (Flegenheimer & Fitzsimmons, 2015). Overall, the complexity and lack of research on carsourcing services in Chinese market lead to an **uncertain effect** of carbon emission sourced back to those services. 😊

### 3. Change in travel length

Passenger-Kilometer



According to China Statistical Yearbook (2015), China has a generally increasing PKM from 1978.

#### Reasons:

##### 1. Increasing daily commute distance:

- Urban sprawl
- More long-distance commute and car usage
- More viaduct / highway— more cars— Jevon's paradox



##### 2. Increasing travel distance:

- Increasing in both inbound and outbound tourism due to a large number of favorable policies and the rising value of Yuan ¥



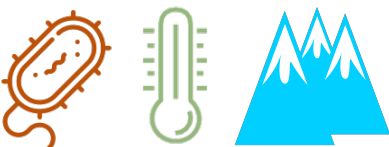
## B. How is the current state? What are the impacts?

China: the **current largest CO<sub>2</sub>** emitting nation :

- 8715.31 Million metric tons in 2011

But per capita emission is **less arresting**:

- 6.19 metric tons of CO<sub>2</sub> per capita in 2010 ( EU's average);



The increasing concentration of GHG such as CO<sub>2</sub> and methane is highly likely to invoke **tipping points**---irreversible changes such as **global temperature increase, glacier melting, disease propagation, etc.**, in human timescales (GE05, 2012, p37).

## C. What are the responses?

- Traditional: improve traffic management, promote fuel qualities, new technology and alternative energy sources, etc.



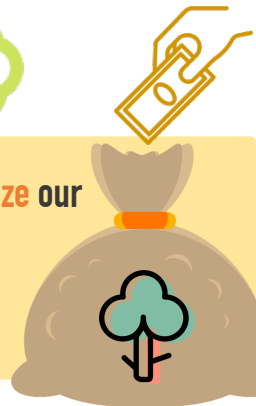
- Many cities have slapped limits on granting car plates to gasoline and natural gas-fueled cars to ameliorate pollution, carbon emissions and congestion; meanwhile, electric vehicles are awarded free car plates.

But innovative technologies might facilitate more travel!

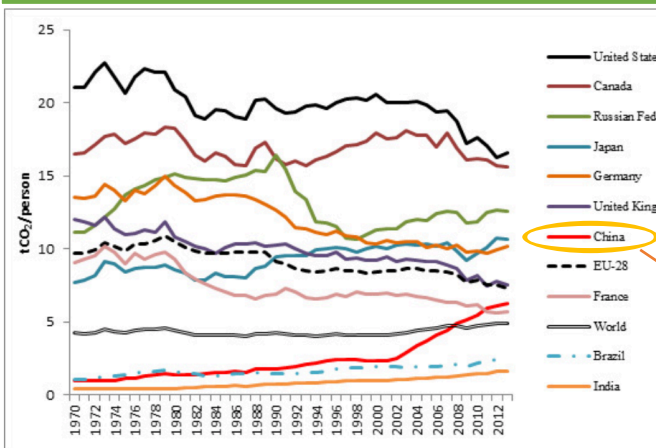


The real innovative way of responding: encouraging low-carbon urban planning is a favorable choice.

We should also internalize our currently externalized environmental costs!



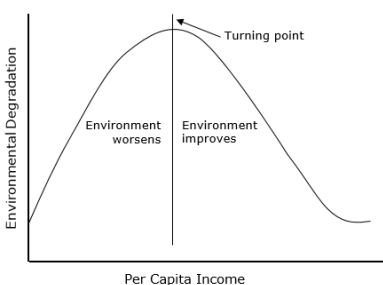
## D. Conclusion: What is the future trend?



Most major developed countries have reached its peaking point of CO<sub>2</sub> emission per capita and have declined ever since.

China's rising CO<sub>2</sub> emissions indicate that its economy is still dependent on manufacturing, which leaves endless pollution and GHG to itself.

Figure 4: CO<sub>2</sub> emissions per capita of major emitters in 1970-2012. China's emissions data is calculated by the author, the emissions data of other countries are cited from the international dataset, EDGAR.<sup>3</sup>



Even with interference, China has a long way to go before reaching its turning point.



Despite all the efforts China has done to regulate its carbon emissions, accompanied by rapid economic development, the vehicles ownership (have increased annually 23.7% for two decades) and using frequencies would unavoidably increase in the future, which would further enhance carbon emissions.