Mind the Gap:
New Developments and Outlook for China’s Transport Sector to 2030

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Why transport in China?

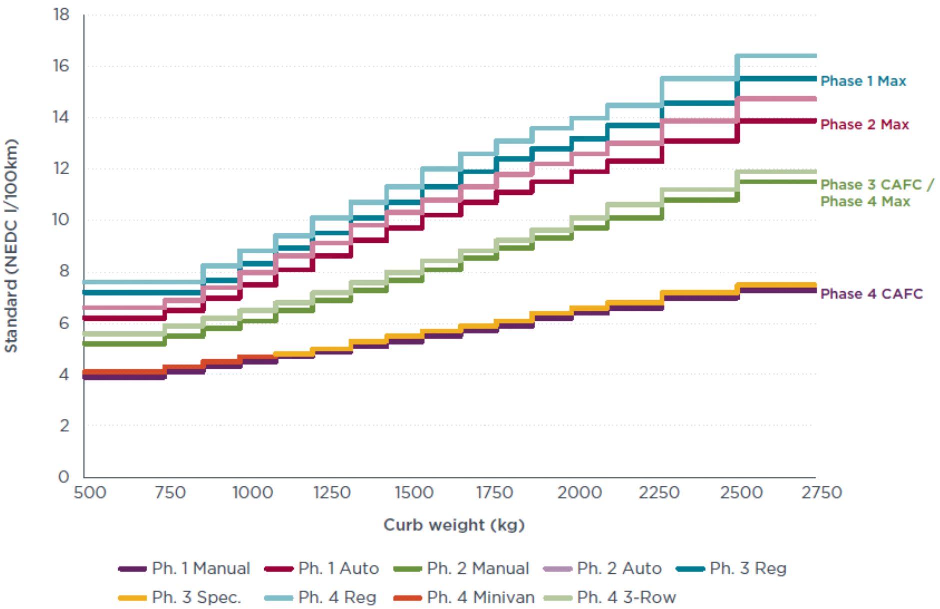
- China has set reduction targets for 2015 and 2020:
  - Energy/GDP: 16% from 2010 by 2015
  - CO_2/GDP: 17% from 2010 by 2015, 40-45% from 2005 by 2020
- China recently set targeted CO_2 peak of 2030 or earlier in joint US-China announcement
- Transport only accounts for ~10% national energy use, but China already imports 60% of its oil use
- Tremendous growth in transport sector since 2000:
  - 7x increase in total passenger vehicles to 89 million in 2012
  - 8% annual growth in passenger transport activity
  - 4x increase in freight transport activity

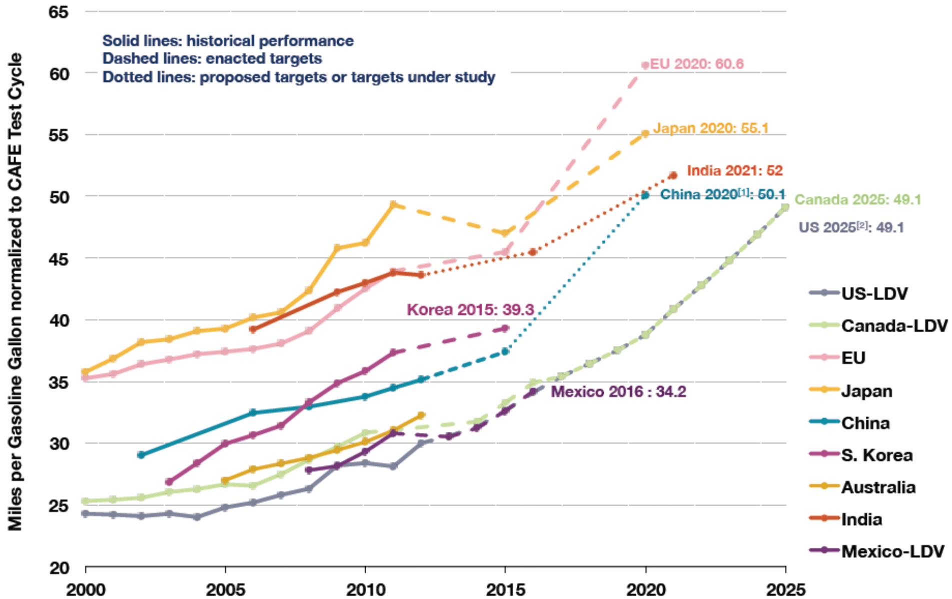
What is the outlook for transport given China's recent commitments to reduce its energy and carbon intensities?

Presentation Outline

- Progress and challenges of China's most recent policies:
  - Fuel economy standards
  - Hybrid and electric vehicle pilots
  - Efficient vehicle subsidies
- China's transport outlook to 2030
  - Modeling methodology
  - Transport drivers
  - Energy and emission outlook and implications
- Oil supply-demand gap outlook
- Scenario analysis and implications
- Key findings and conclusions

China's proposed standards would make it one of the more stringent standards internationally





[1] China's target reflects gasoline vehicles only. The target may be higher after new energy vehicles are considered.
[2] US , Canada, and Mexico light-duty vehicles include light-commercial vehicles.
[3] Supporting data can be found at: http://www.theicct.org/info-tools/global-passenger-vehicle-standards.

Source: ICCT 2014

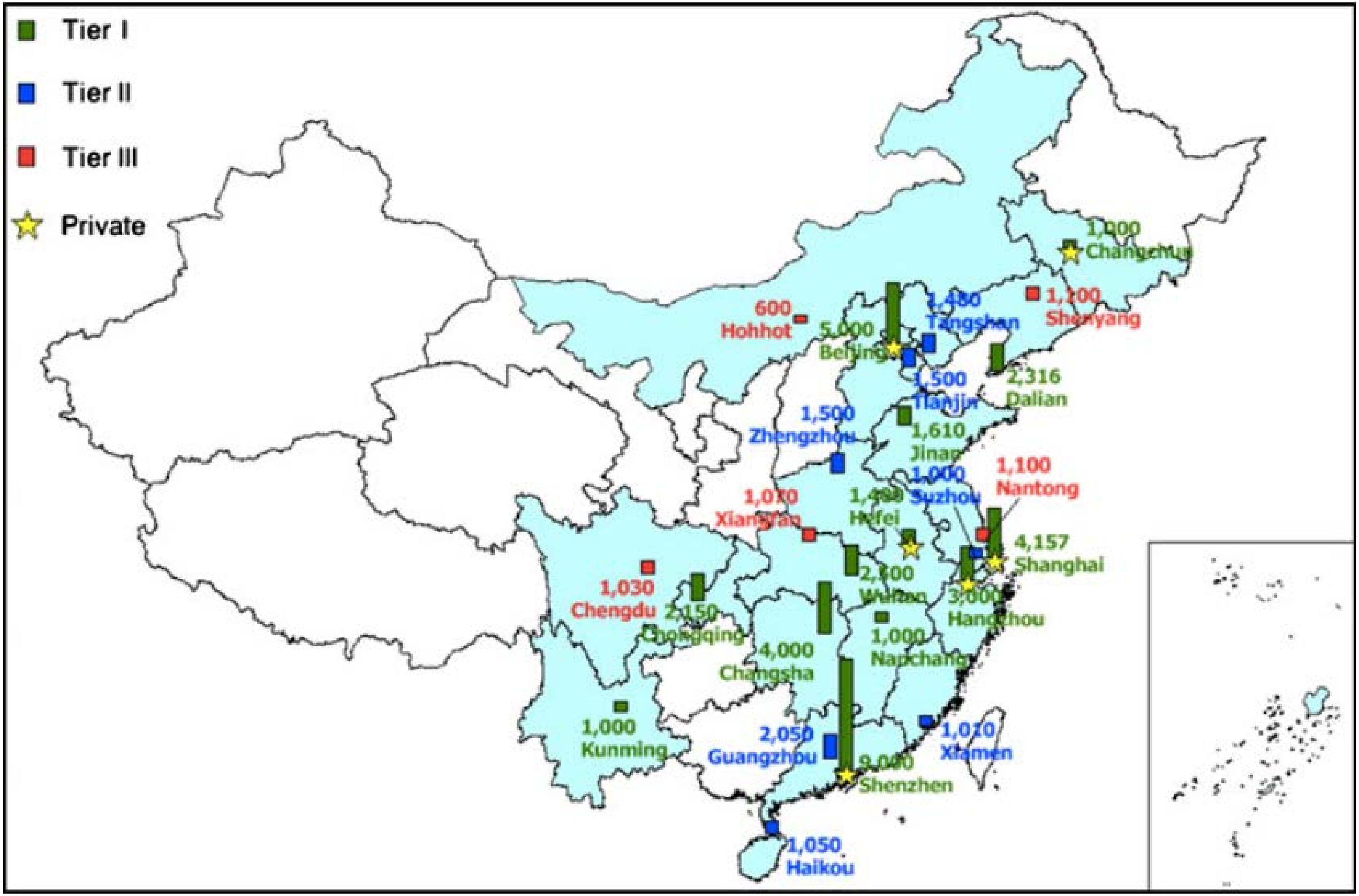
- Fuel economy standards:
  - Phases 1 and 2 set maximum fuel consumption limits per vehicle
  - Phase 3 (2012) adopts corporate average fuel consumption approach, sets overall target of 7 L/100 km for passenger vehicles in 2015 (EU = 5.6 L/100 km petrol)
  - Proposed Phase 4 (2016-2020) announced in 2014 with target of 5 L/100 km (EU = 4.1 L/100km petrol)

Thousands of Vehicles, Tens of Cities program to promote demonstration of NEVs in public municipal fleets

- Jan. 2009: 13 cities (Tier 1) approved by national government to launch New Energy Vehicles*(NEV) demonstration programs in municipal fleets
  - Cities originally asked to introduce 1000 NEVs per year for 3 years
- 2010: 7 more (Tier II) cities and 5 more (Tier III) cities added for NEV demonstration
- Program provides financial support for NEVs:
  - National subsidies for higher purchase costs (4,000-50,000 RMB** for hybrid EV, 60,000 RMB for EVs, 250,000 RMB for fuel cell)
  - Local subsidies partially for purchase cost, but also infrastructure development and vehicle maintenance
- Total of 343 models from 70 makers certified as NEV models, eligible to receive subsidies

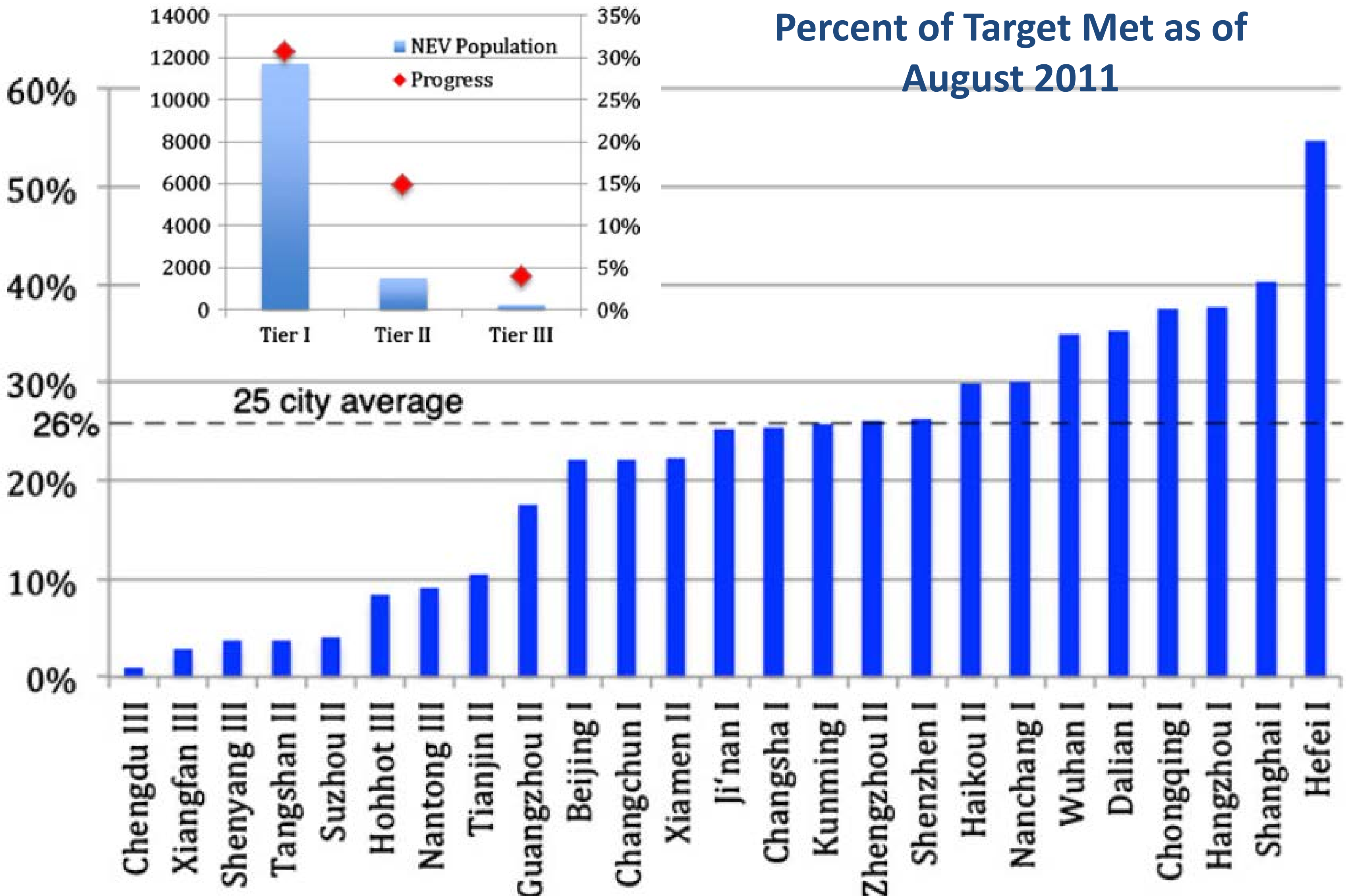
*New Energy Vehicles officially defined as hybrid, plug-in electric, battery electric, and fuel cell and hydrogen vehicles in 2007; but recent emphasis only on electric vehicles
** 1 RMB = 0.15 Euro

NEV fleet targets of all 25 pilot cities total 52,623 vehicles by end of 2012



Source: Gong et al. 2013

By the end of 2012, only 7 out of 25 pilot cities reached the 1000 vehicle fleet target but none reached 100% of target



Source: Gong et al. 2013

Greater NEV deployment face technological, market and EV infrastructure challenges

- High costs of NEVs despite subsidies
- Technology choices and performance
  - Subsidies do not differentiate between technologies with inferior performance (e.g., lead-acid batteries) and more advanced technologies (e.g., lithium-ion batteries), or hybrid EVs vs. full EVs for public vehicles
  - Some technologies still immature, with poor performance
- Concentrated NEV production and local protectionism
  - Top 5 makers of electric and hybrid cars account for 99% of total production
  - Local governments have prioritized local NEV makers through local subsidies and government vehicle purchases, limiting competitiveness
  - Relatively new standardization of EV charging stations
- Limited local participation in developing EV charging infrastructure, particularly for private vehicles

2012 Development Plan for Fuel Efficient and New Energy Vehicles set additional 2015 and 2020 transport-related goals

- Production targets of 500,000 plug-in hybrid and electric vehicles by 2015, 2 million by 2020; total of 5 million NEV by 2020
- New Energy Vehicle subsidy program extended to 2015 in late 2013, expanded to 40 cities total and set to continue past 2015 in Feb. 2014
- More detailed requirements for pilot cities to correct problems observed in Thousand Cars program:
  - Deploy 10,000 NEVs (mega-cities) or 5,000 NEVS (smaller cities) from 2013-2015, meet 70% local manufacturing limit, give priority to civil fleets and meet 30% NEV requirement for new public vehicles
  - Provide detailed incentive policies for purchase and fleet operation, and feasible plans for infrastructure construction
  - Simplified subsidy amounts, excludes conventional hybrids
  - Performance targets for battery electric and plug-in hybrids

Energy-saving car subsidy has also been extended, but with continually tighter requirements

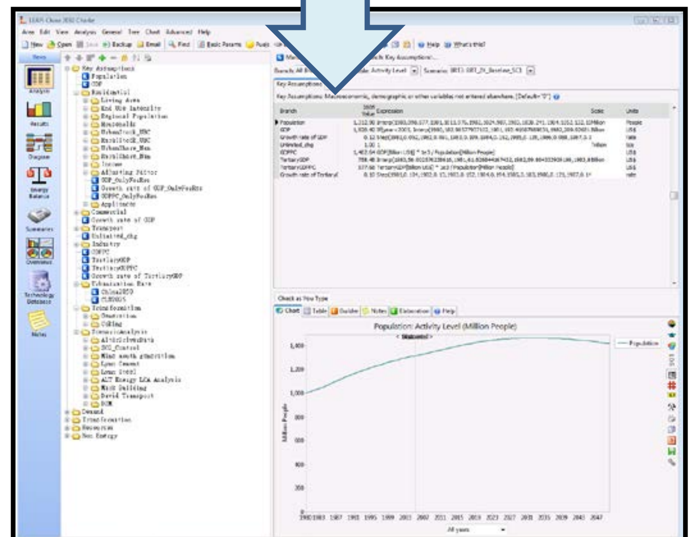
- 2010: 3000 RMB (450 Euro) per vehicle direct reduction from sales prices for new cars that can meet Phase 3 fuel consumption limit for 2015 earlier time
- Renewed in October 2011 with more stringent requirements
- Renewed in October 2013:
  - o Fuel consumption limits tightened by 2-14% across every vehicle weight class, with greater stringency for heavier vehicles
  - o Vehicles < 1.6L must meet China 5 tailpipe emission requirements released in Sept. 2013

Source: ICCT, 2013

We used a bottom-up energy end-use model to evaluate the outlook for transport through 2030

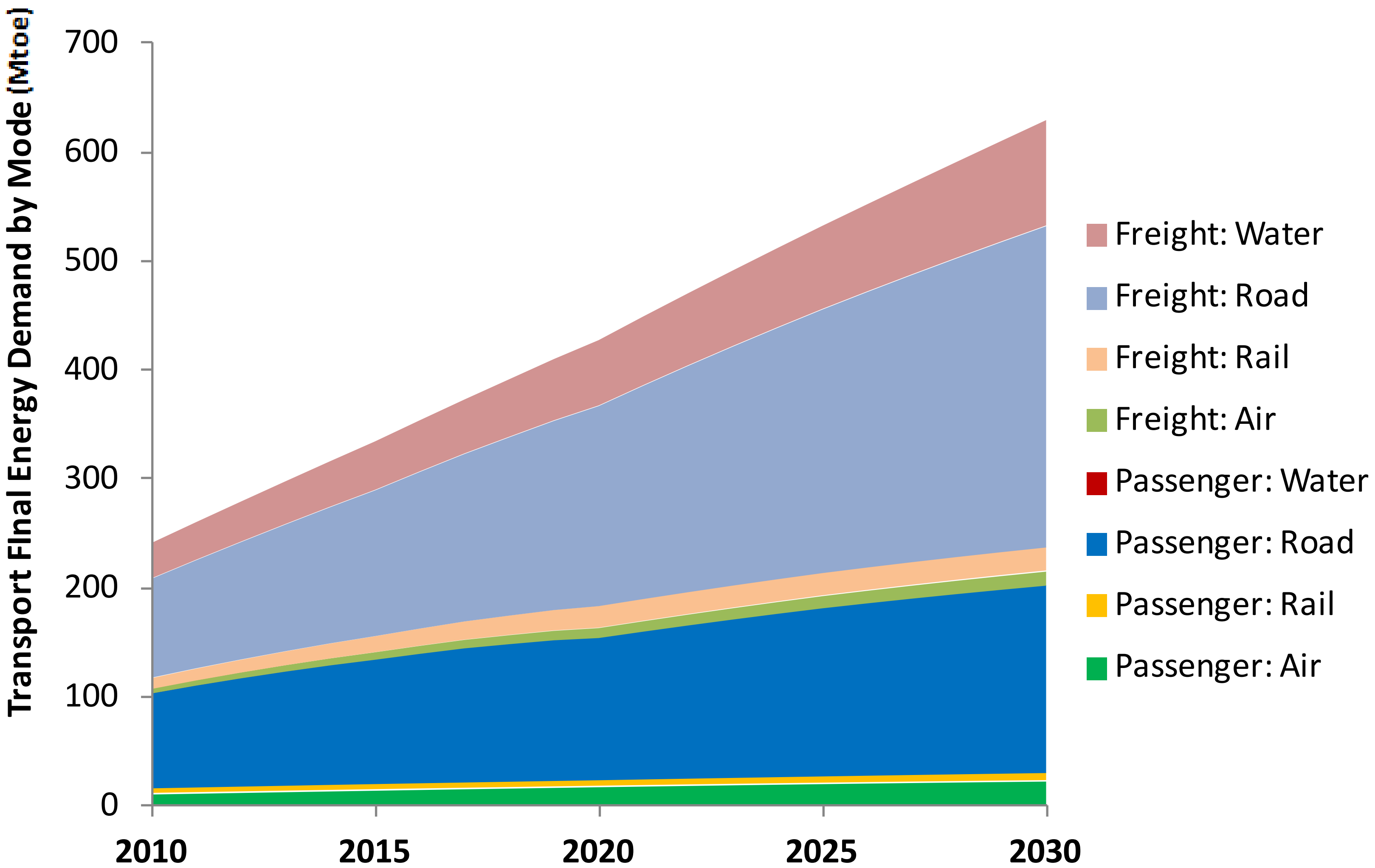
- Study used LBNL's China 2050 DREAM (Demand Resources Energy Analysis Model)
- Macroeconomic and physical drivers determine energy demand outlook for:
  - Passenger transport
  - Freight transport
- Model parameters and assumptions derived from published statistics, extensive literature review of Chinese and English publications, and interviews with Chinese experts
- Reference scenario: pathway of continuous efficiency improvement consistent with moderate pace of "market-based" improvements

Inputs
Macroeconomic data, demand drivers, technologies, scenarios

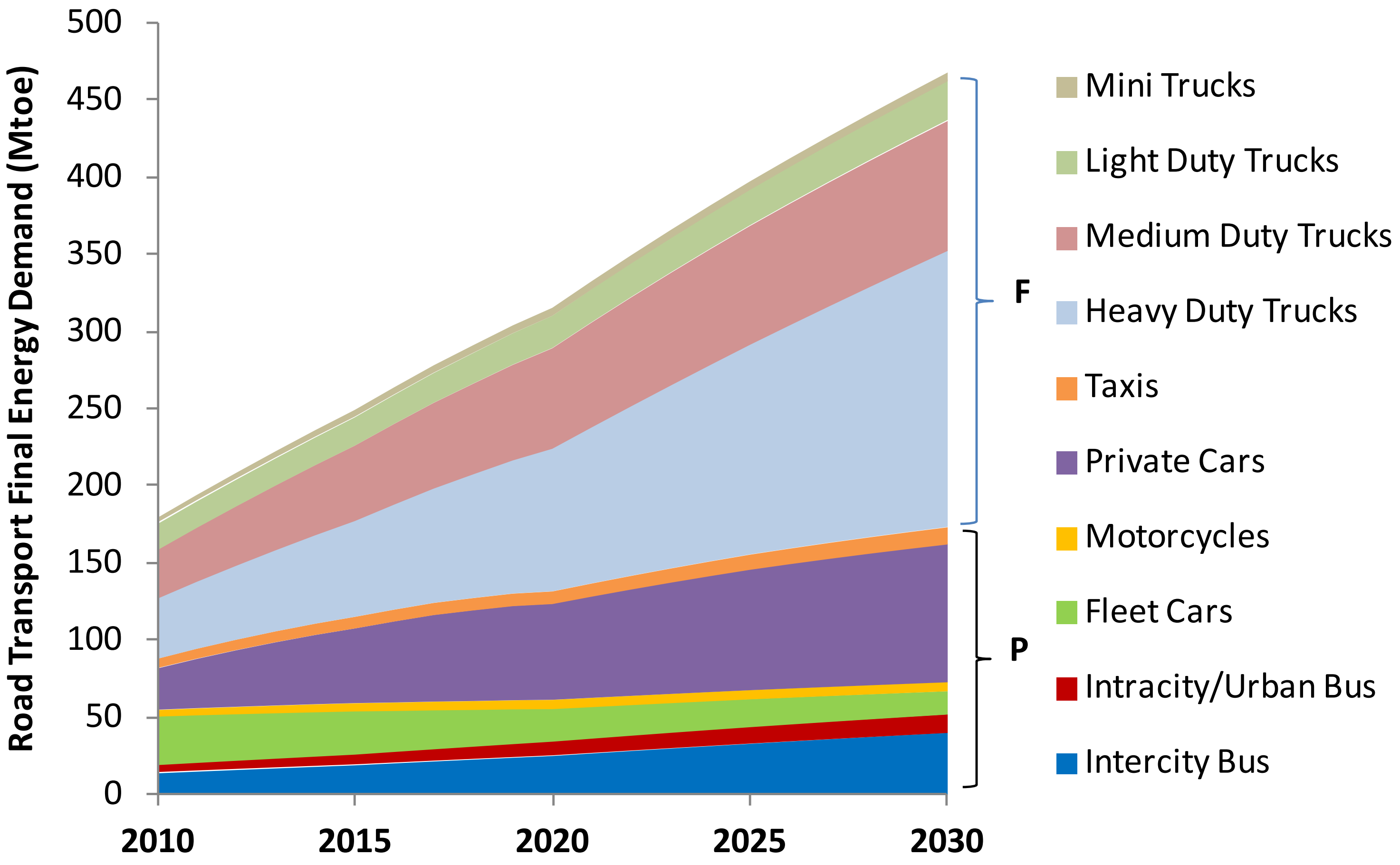


Outputs
Primary and final energy, emissions, savings potential

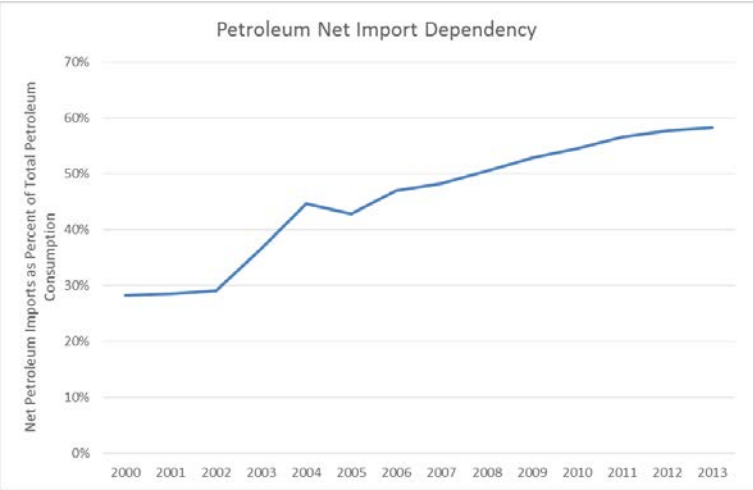
Road transport, particularly for freight, will be the largest driver for future transport energy demand

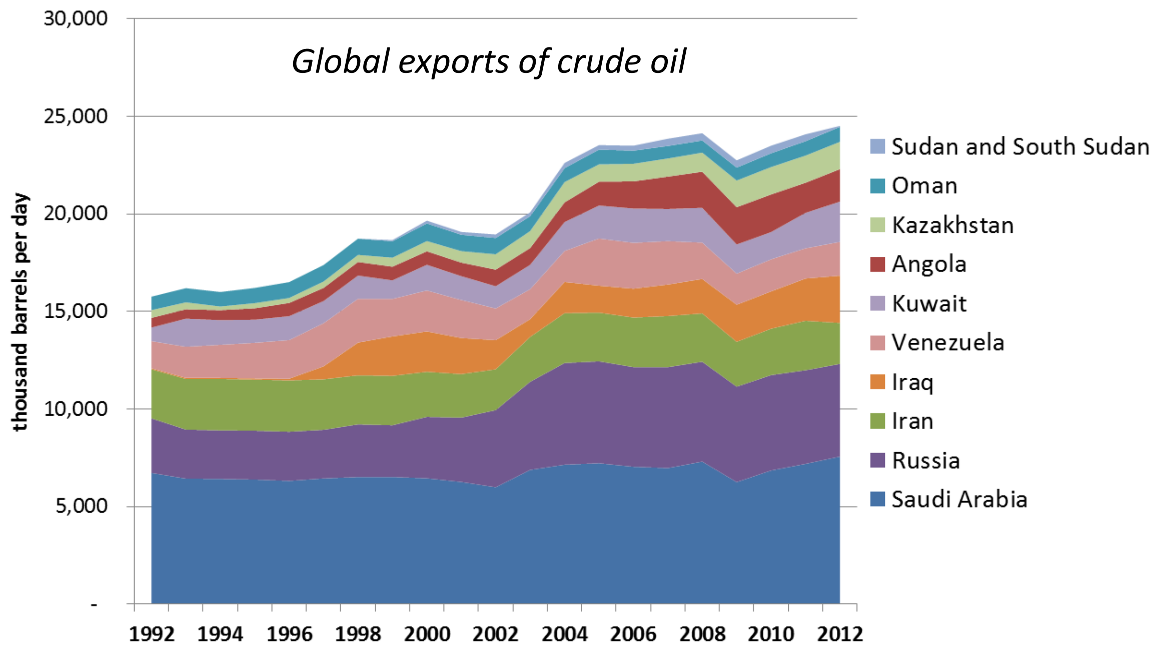


By 2030, energy consumption by heavy-duty trucks alone exceed that of all passenger vehicles

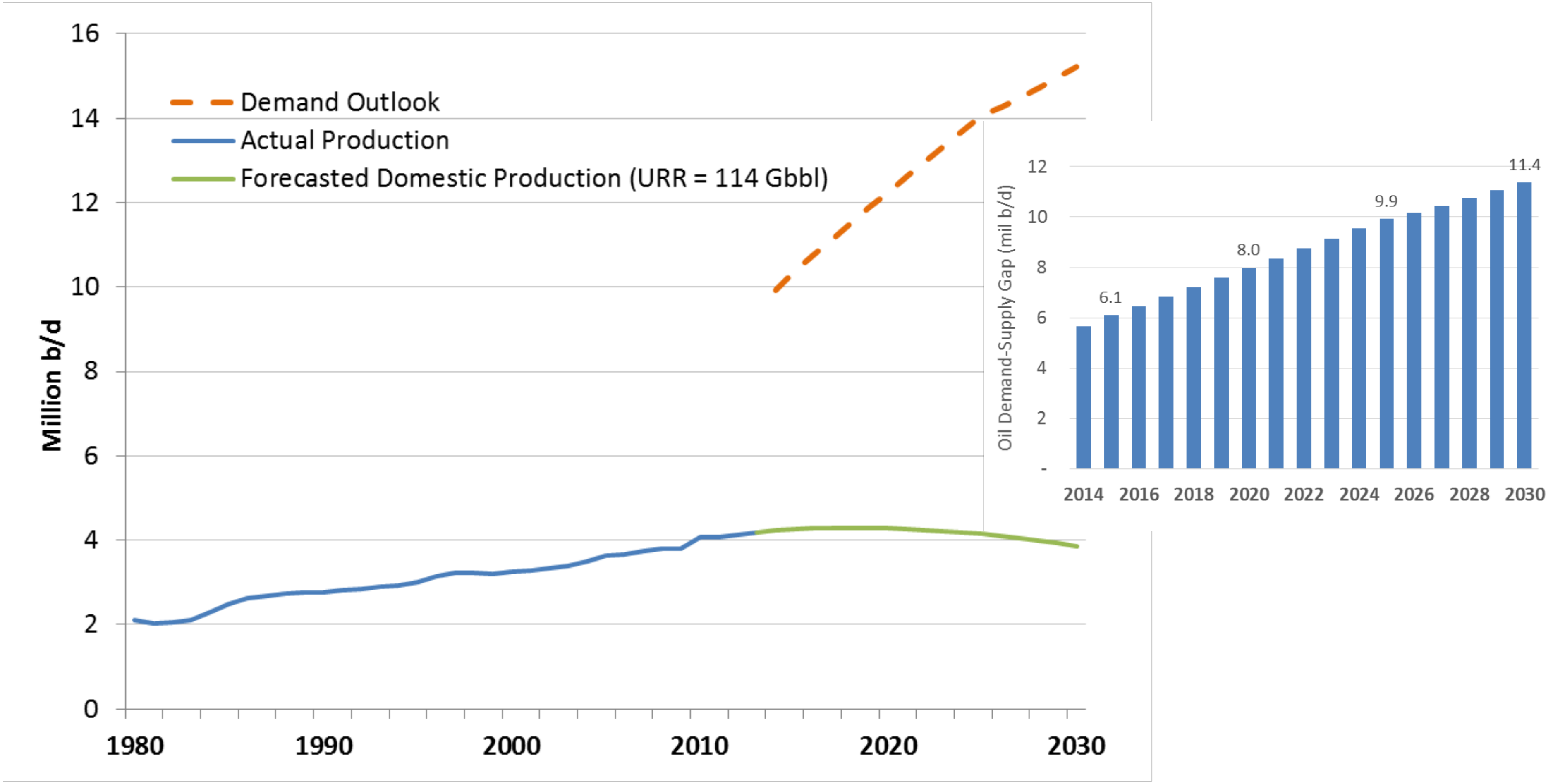


China's Top Ten Crude Oil Suppliers account for 60% of Global Crude Oil Exports and 81% of China's Crude Oil Imports

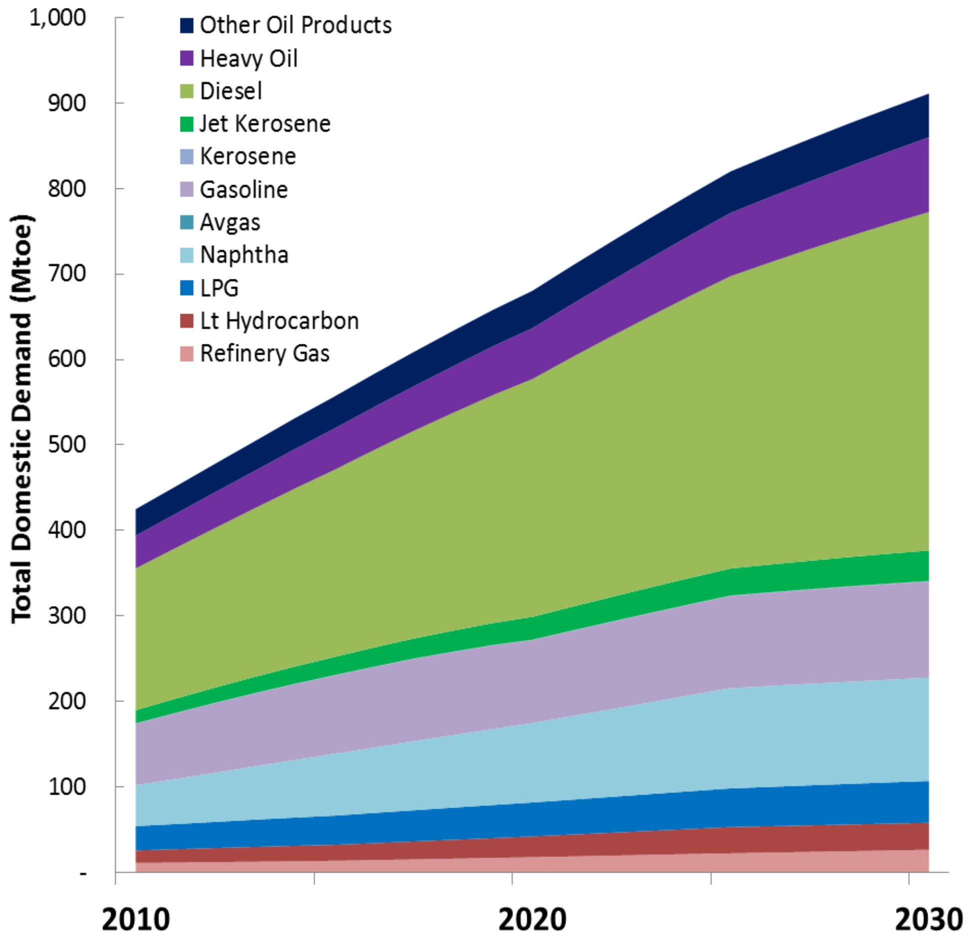


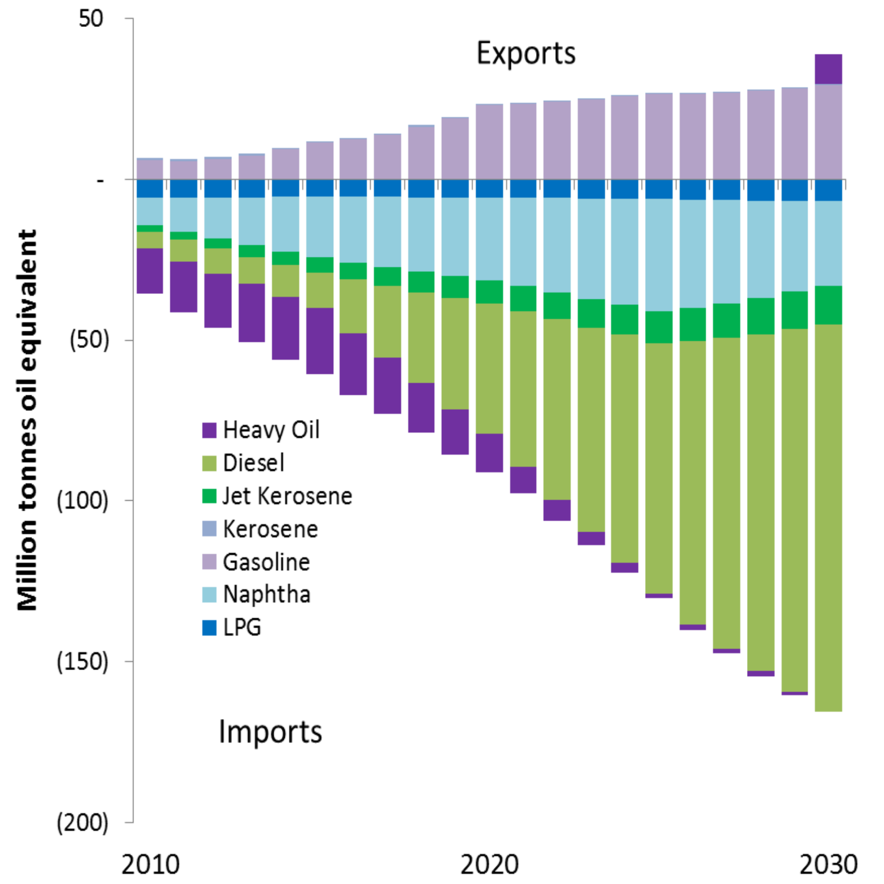


China's supply-demand gap for crude oil could nearly double – with 11.4 million barrels per day needed annually - by 2030



China's future demand for oil products will be dominated by diesel, which will increasingly need to be imported

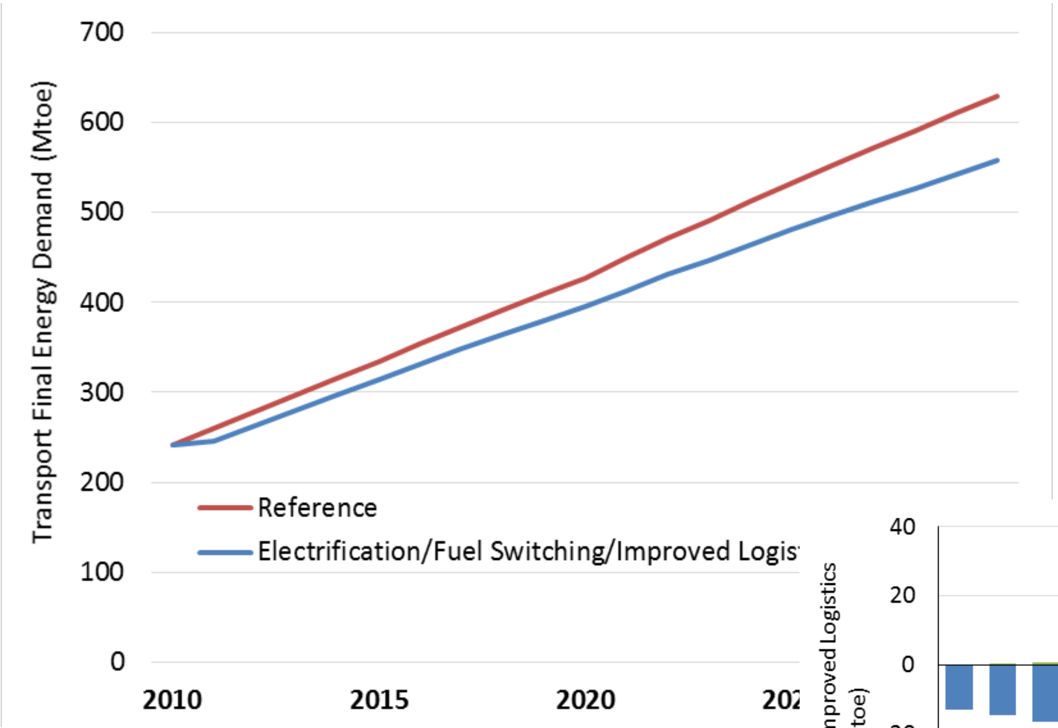


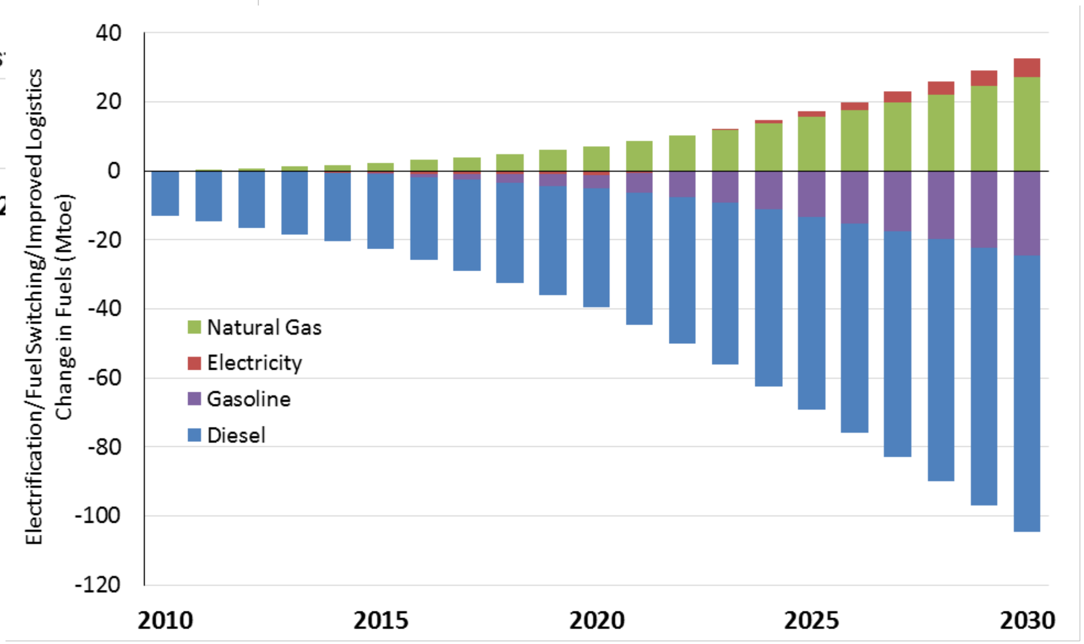


Alternative scenario developed to consider accelerated electrification and fuel switching in the transport sector

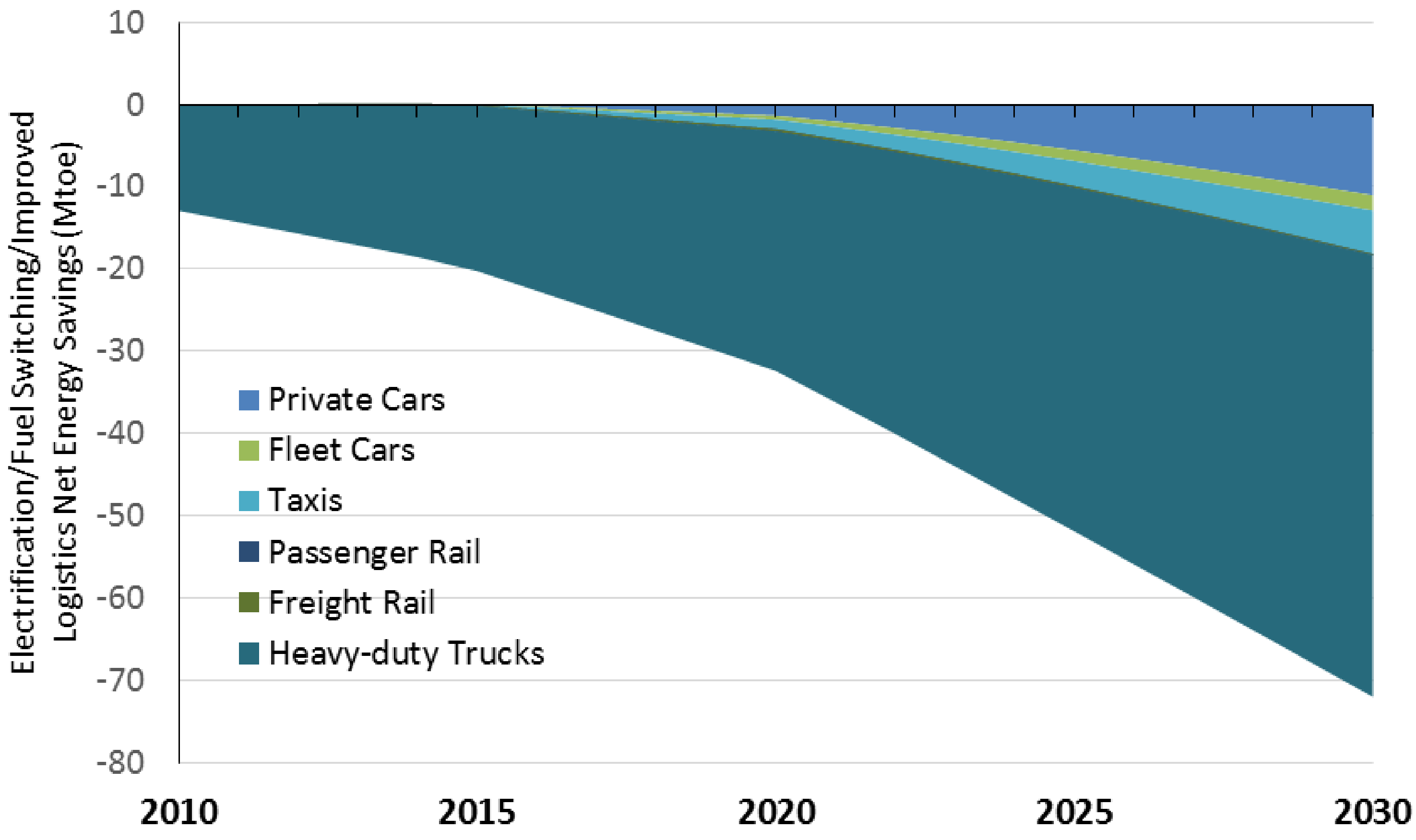
	Reference Scenario	Alternative Scenario
Private and Fleet Car Electrification	0% in 2010 to 7% in 2030	0% in 2010 to 20% in 2030
Taxi Electrification	0% in 2010 to 25% in 2030	0% in 2010 to 50% in 2030
Rail Electrification	44% in 2010 to 48% in 2030	44% in 2010 to 60% in 2030
Heavy-duty Trucks VKT	52,139 km/yr	35,000 km/yr (due to improved logistics)
Heavy-duty Trucks Fuel Mix	Diesel: 100% in 2010 to 80% in 2030 Natural Gas: 0% in 2010 to 20% in 2030	Diesel: 100% in 2010 to 50% in 2030 Natural Gas: 0% in 2010 to 50% in 2030

Electrification and fuel switching can reduce transport energy by 776 Mtoe cumulatively through 2030, with significant oil savings

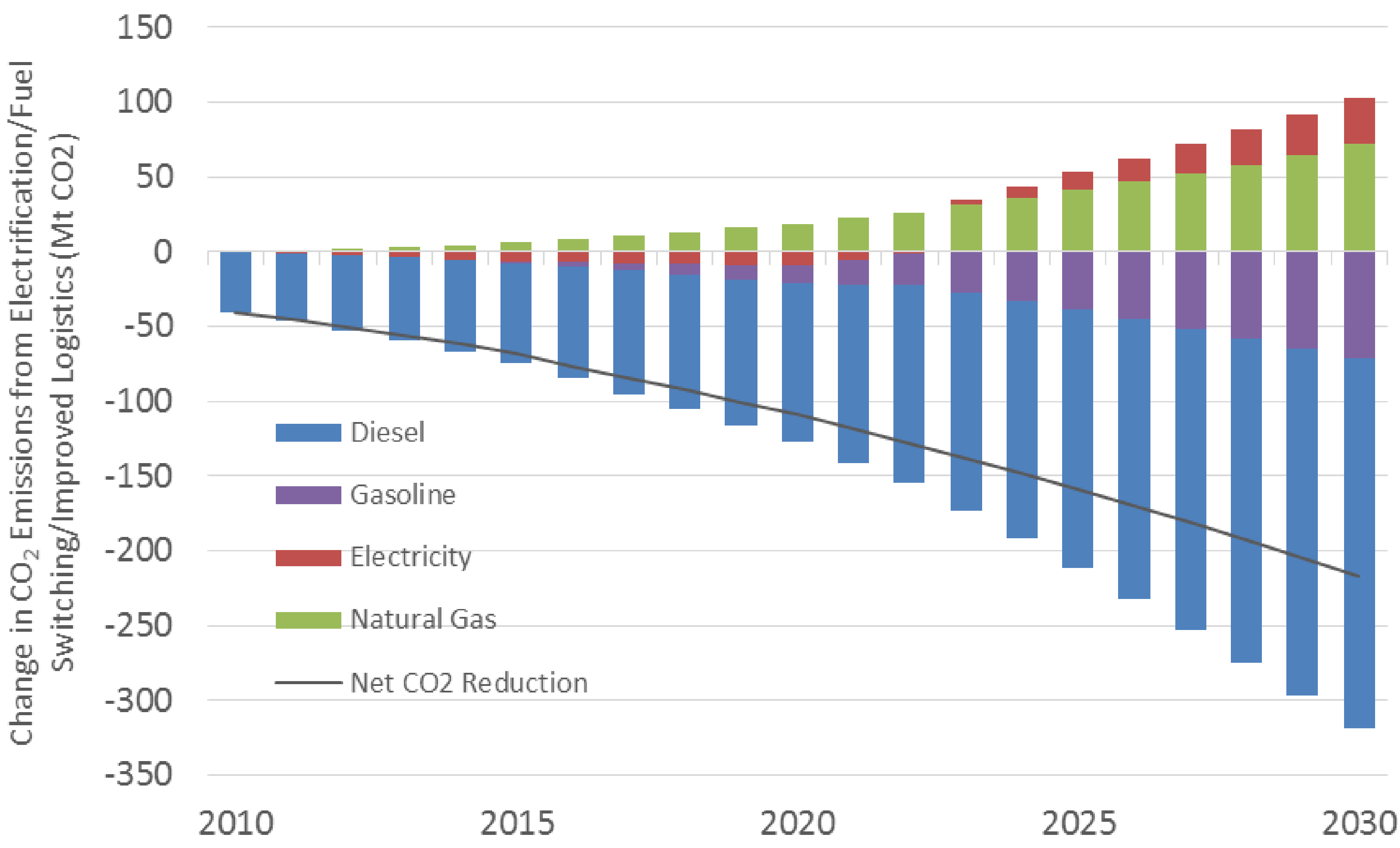




Most of the net savings will be from heavy-duty trucks, with smallest savings in rail



CO_2 reductions from displaced gasoline and diesel will offset small increase in CO_2 from greater electricity and natural gas consumption, with net CO2 reduction of 216 Mt CO_2 in 2030



Key findings and conclusions

- Recent transport policies focused on **improving fuel economy through standards and subsidies**, with greater focus on "New Energy Vehicles (NEV)"
- NEV pilots faced **economic, technological and infrastructural barriers** to mass deployment of electric vehicles; some of which are addressed in 2012 NEV Development Plan
- Fast-growing transport to 2030 is **driven by road transport** (particularly **freight)** and will **double national demand for oil and oil products** (particularly **diese**l)
- China could see **domestic oil supply-demand gap of 11.4 mil bbl/day** by 2030 (~25% of today's global oil exports)
- More **aggressive efficiency** improvements, **fuel switching and electrification** are crucial strategies to meet China's rising transport energy demand <u>and</u> manage its import dependency and energy security risks

Acknowledgments and Contact Information

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