

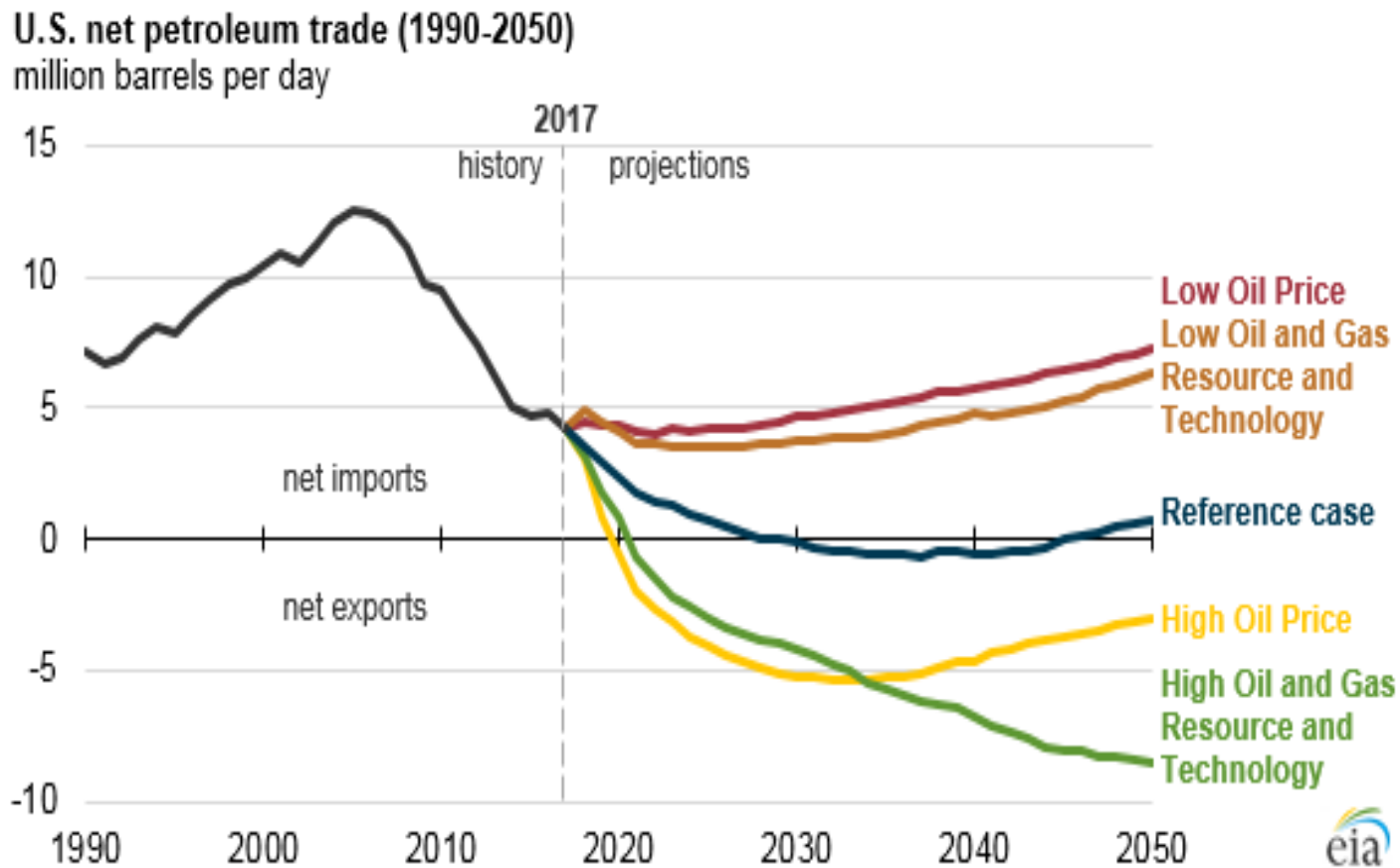


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Global Transportation Transformation and Geopolitics

APERC Annual Conference 2018
Tokyo, Japan

Changed energy security balance gives U.S. geopolitical advantages



China is responding to its disadvantaged energy security condition

China's interests include improving access to regional energy resources

- *Caspian pipelines
- *Myanmar pipelines
- *Russian energy cooperation, pipelines, loans, acquisitions
- *Military moves in South China Sea
- *Military moves in Greenland
- *East Timor gateway?

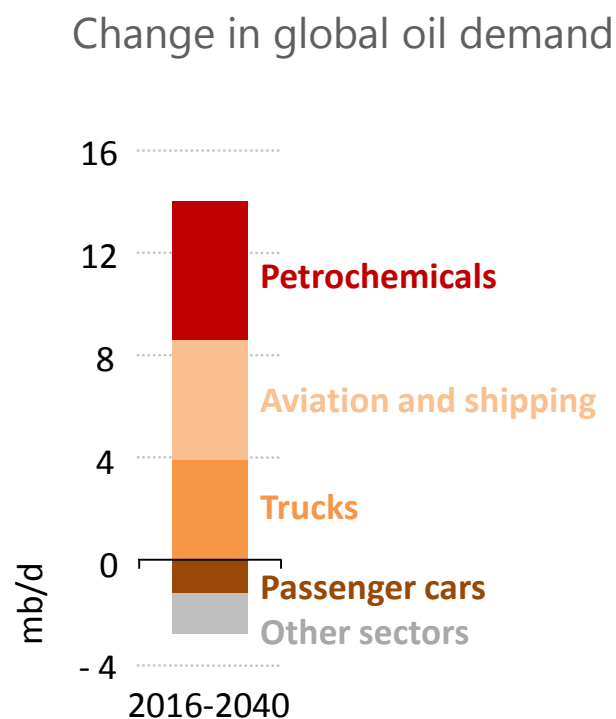
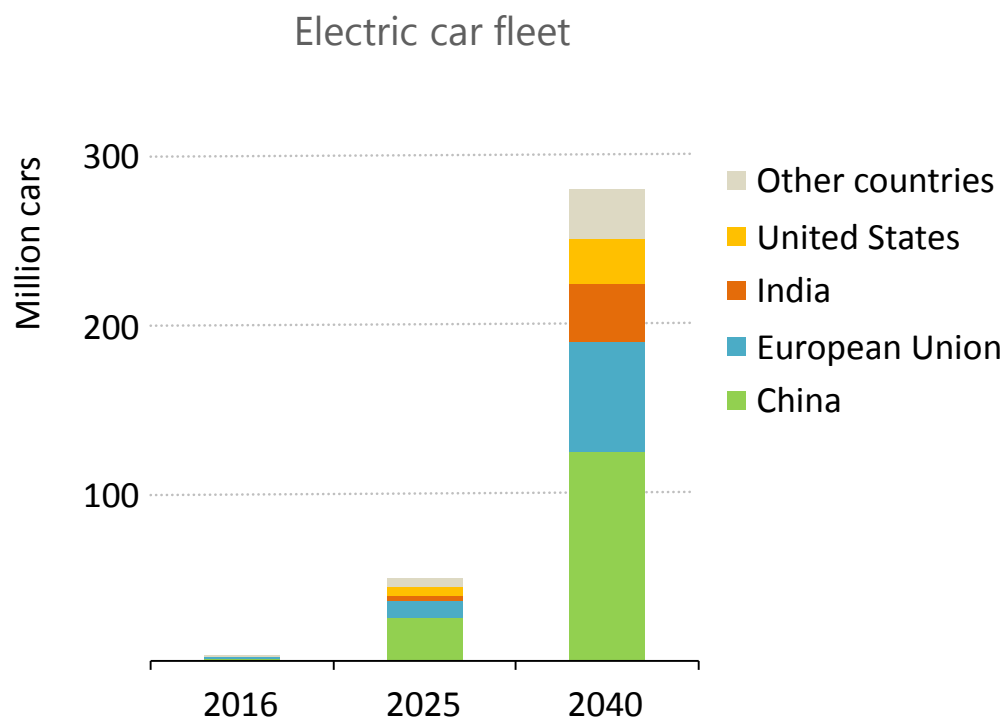
China 2025 is also in part a response to its disadvantaged energy geopolitical situation

Trillion plus \$ bet on batteries, advanced vehicles

- Considering ICE engine ban
- Belt and Road exports
- Rise as a renewable energy market superpower



By far, China is expected to be the largest market for electric vehicles



Electric cars are helping to transform energy use for passenger cars, slowing the pace of growth in global oil demand.

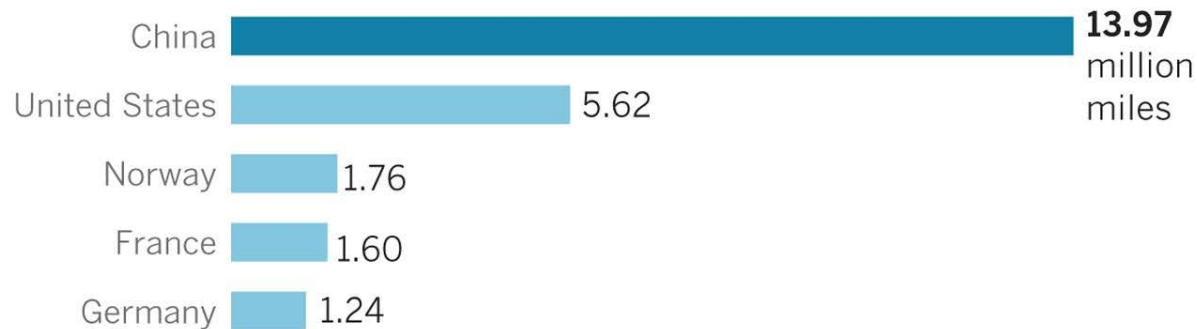
SOURCE: IEA

China has announced its intention to impose a ban on ICE engines

China racks up the miles

E-range is the number of vehicles sold times the maximum electric range for each one. It accounts for different range levels to give a clearer picture of electric vehicle progress than unit sales alone.

E-range of vehicles sold in second quarter of 2017



Source: AlixPartners Automotive-Electrification Index

@latimesgraphics

Scenario Study: ICE Sales Ban

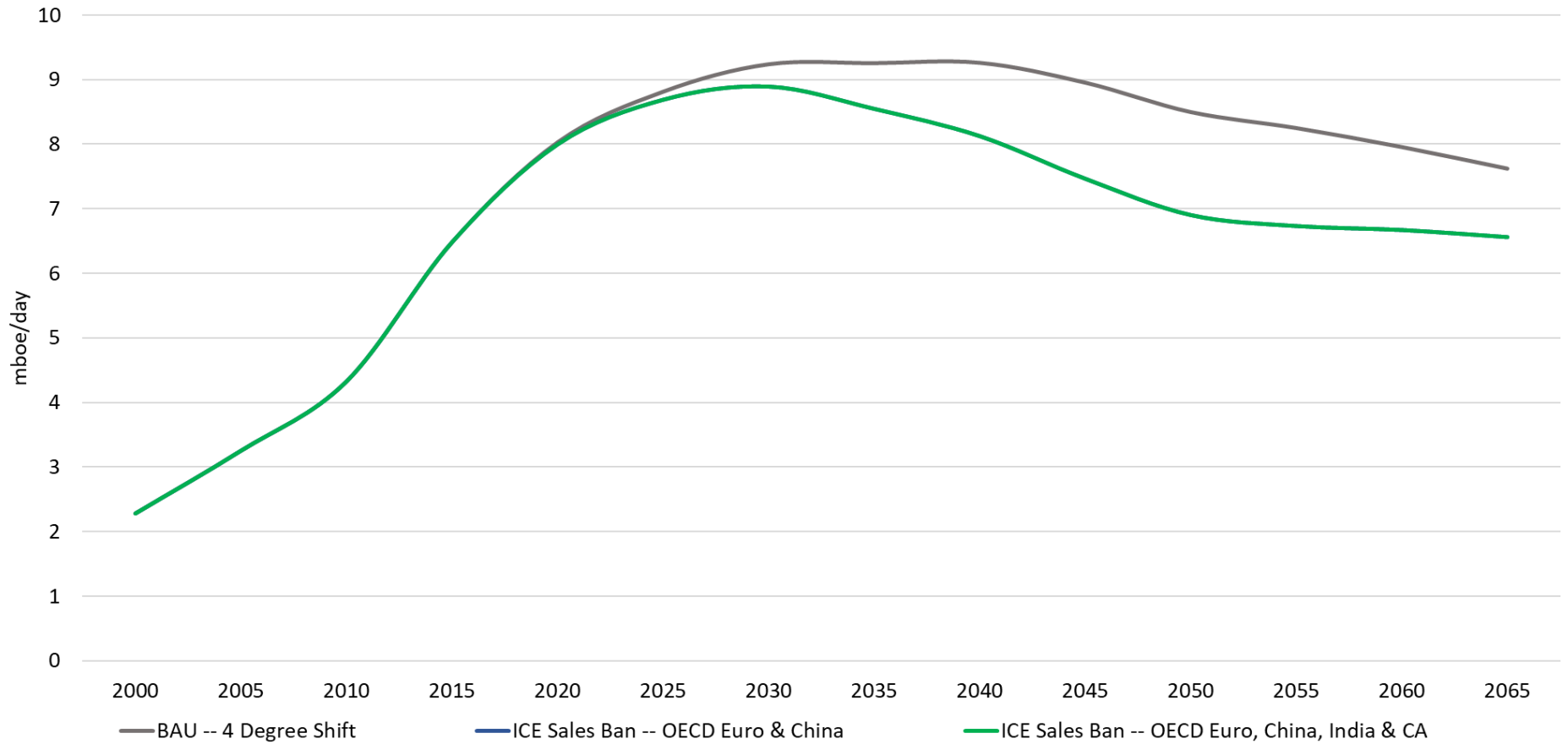
- Reference Case
- OECD Europe & China
- OECD Europe, China, India, & CA

Source: CFR/ITS Davis Research Study

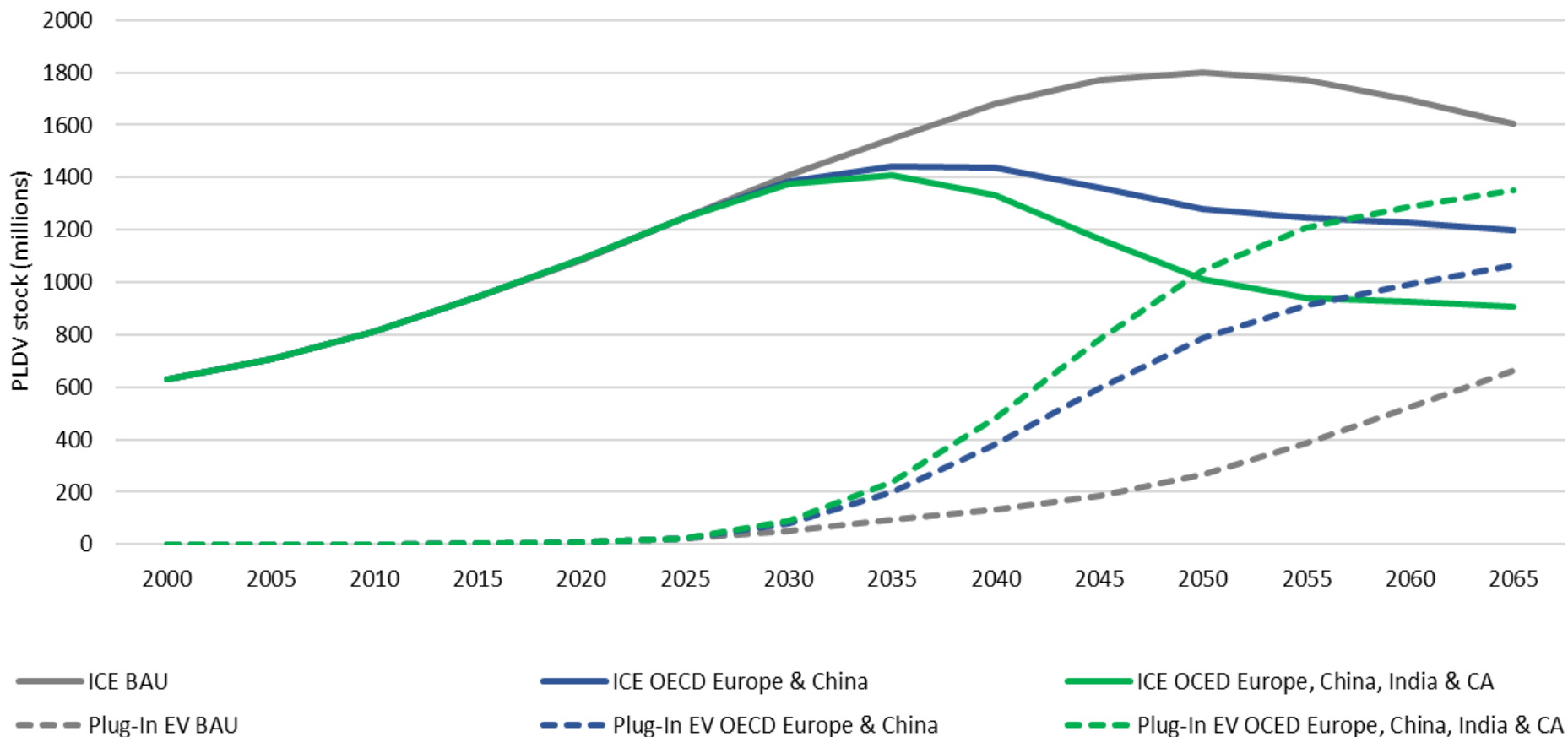
ICE Sales Ban Defined

- Ban of sale of pure gasoline or diesel ICE passenger vehicles as well as both gasoline and diesel non plug-in hybrids
- Plug-in hybrids are exempt from the sales ban
- The sales market begins to react in 2030
- Full ban on ICE sales takes effect in 2040
- Scenarios:
 - OECD Europe and China
 - OECD Europe, China, India, and CA
- Mobility and vehicle ownership is conserved across scenarios – sales are shifted between drivetrain technologies
- Urban and non-urban areas are affected by policy

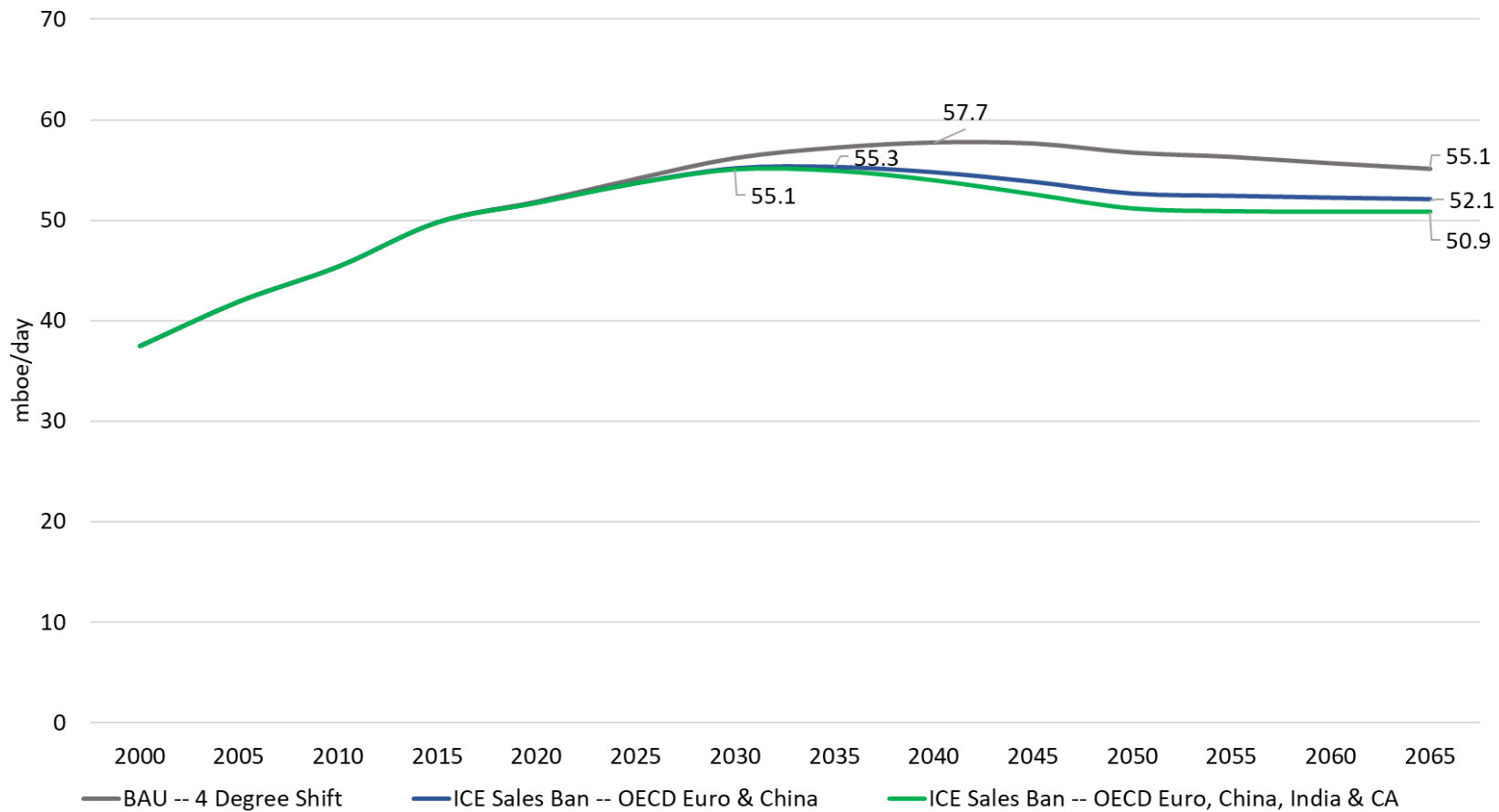
Total Transportation Oil Consumption – China



Global ICE and Plug-in PLDV stock



ICE Engine Ban Reduces Global Transportation Oil Consumption But Deeper Cuts Take Time To Scale



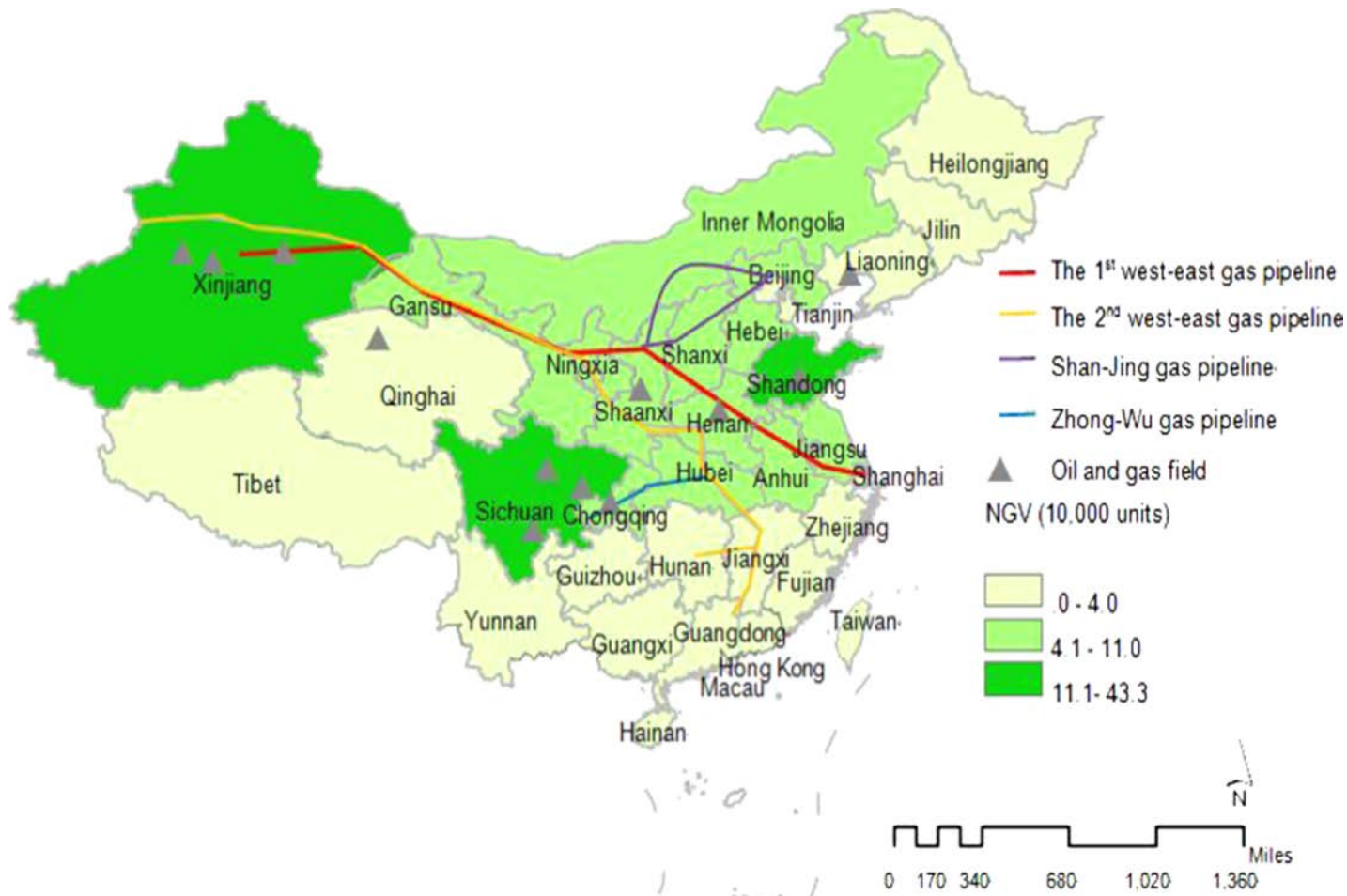
***Data labels indicate peak and final oil consumption per scenario*

Source: Jaffe, McDonald, Fulton.
CFR/ITS DAVIS Research Study

Scenario comparison vs BAU: Global Transportation Oil Consumption

Year	BAU	ICE Sales Ban				Carfree City Centers			
		Global Transportation Oil Demand (mboe/d)		Change from BAU (mboe/d)		Global Transportation Oil Demand (mboe/d)		Change from BAU (mboe/d)	
		China & EU	China, EU, India & CA	China & EU	China, EU, India & CA	3% Carfree	45% Carfree	3% Carfree	45% Carfree
2035	57.2	55.27	54.9	-1.92	-2.27	56.2	53.9	-1.01	-3.33
2040	57.7	54.75	54.0	-2.96	-3.74	56.5	53.5	-1.22	-4.21
2045	57.6	53.80	52.6	-3.80	-5.02	56.3	52.9	-1.31	-4.67

China's push for natural gas vehicles for freight increasing LNG demand



NGV market share

Xinjiang

16.5%

Ningxia

10.7%

Sichuan

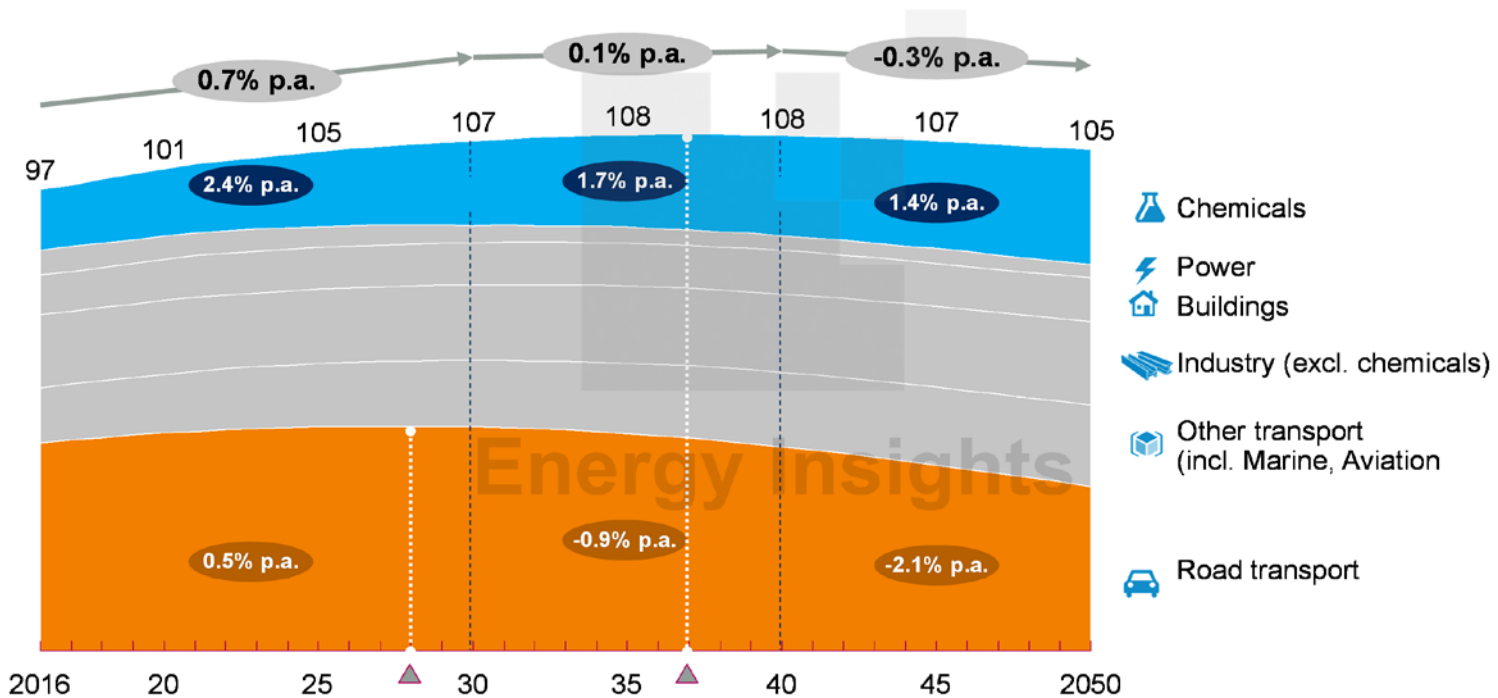
4.8%

Shandong

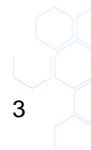
4.2%

McKinsey sees a peak in global oil liquids demand by 2037, based on variety of sectors. Suggests road transport could peak earlier by 2028.

Global oil demand, Million barrels per day



SOURCE: McKinsey Energy Insights' Global Energy Perspective, July 2017



Peak Oil Demand: Implications for Middle East

1. Mideast exporters actively trying to diversify economies, lower internal oil use through renewables, nuclear power but with mixed success
2. All eyes on Saudi Vision 2030 and Aramco IPO as key example
3. Pressures will cause greater instability in the future
4. Escalating regional conflicts a symptom of increased pressure, growing pessimism among populations