

Transportation Seminar Series: #1

*Green Vehicles Overview: Where is the Opportunity for  
Plug-In Hybrid Electric Vehicles (PHEV)?*

**US-China Green Energy Council (UCGEC)**

JUNE 22, 2009



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# Speaker Topics

- 
- **Mr. Cliff Nakayama, UCGEC, Mostwell International LLC**
- **Enabling Battery & System Technologies:**
  - Professor Andrew A Frank, Efficient Drivetrains Incorporated
- **Electric Recharging Infrastructure & Business Models:**
  - Mr. Saul Zambrano, PG&E
- **Market for Electric Vehicles in China:**
  - Dr. Peng Zhou, Electric Vehicle Technologist
- **Policies, Incentives & Regulations:**
  - Mr. Matthew Crosby, California Public Utilities Commission



# U.S.- China Green Energy Council Transportation Seminar Series

## Green Vehicles Overview

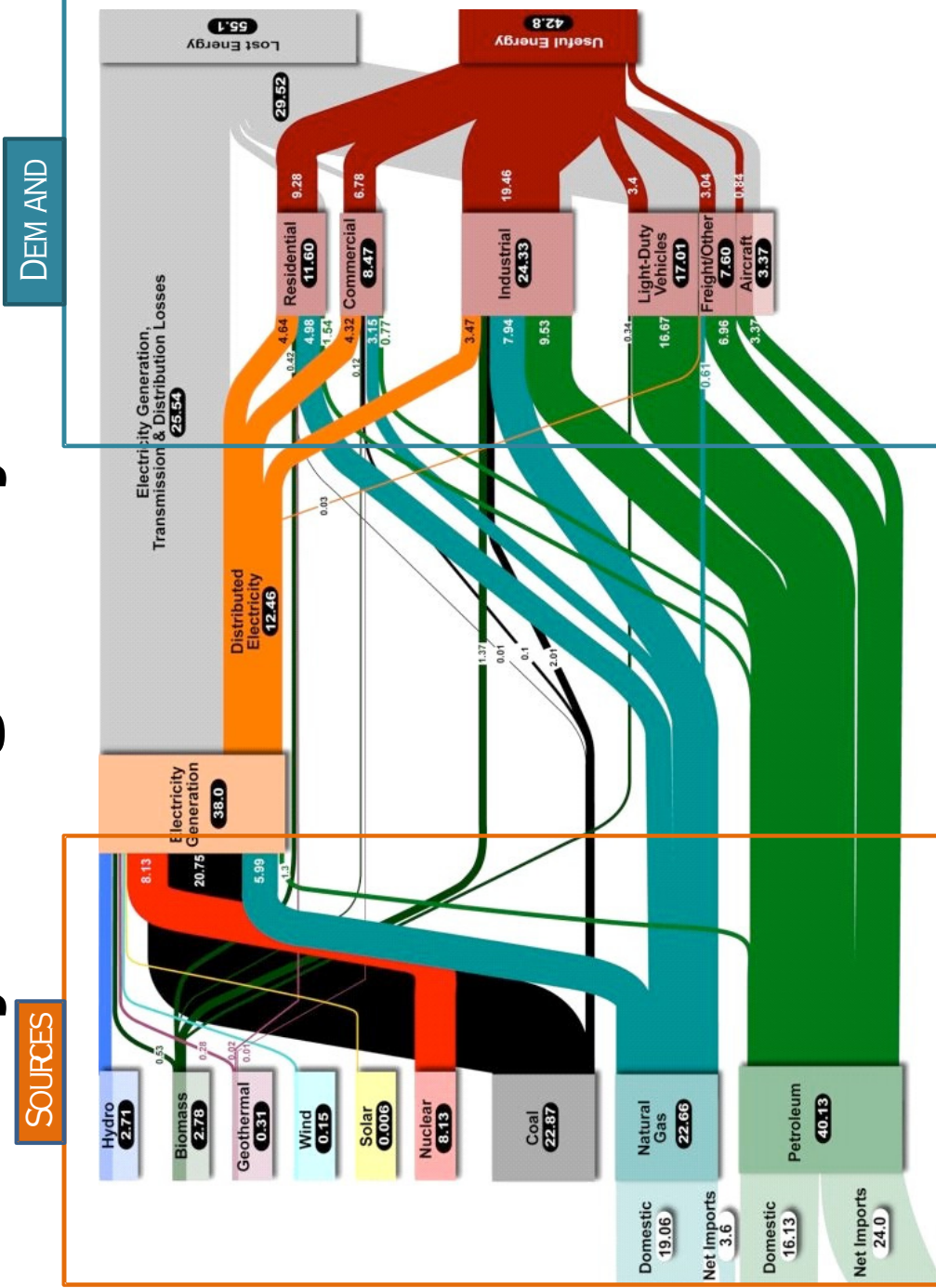
### “Where is the opportunity for Plug-in Hybrid Electric Vehicles”

Cliff Nakayama

UCGEC Transportation Working Group

June 22, 2009

# U.S. uses 8.7+M Barrels of Oil Daily for Light Duty Vehicles

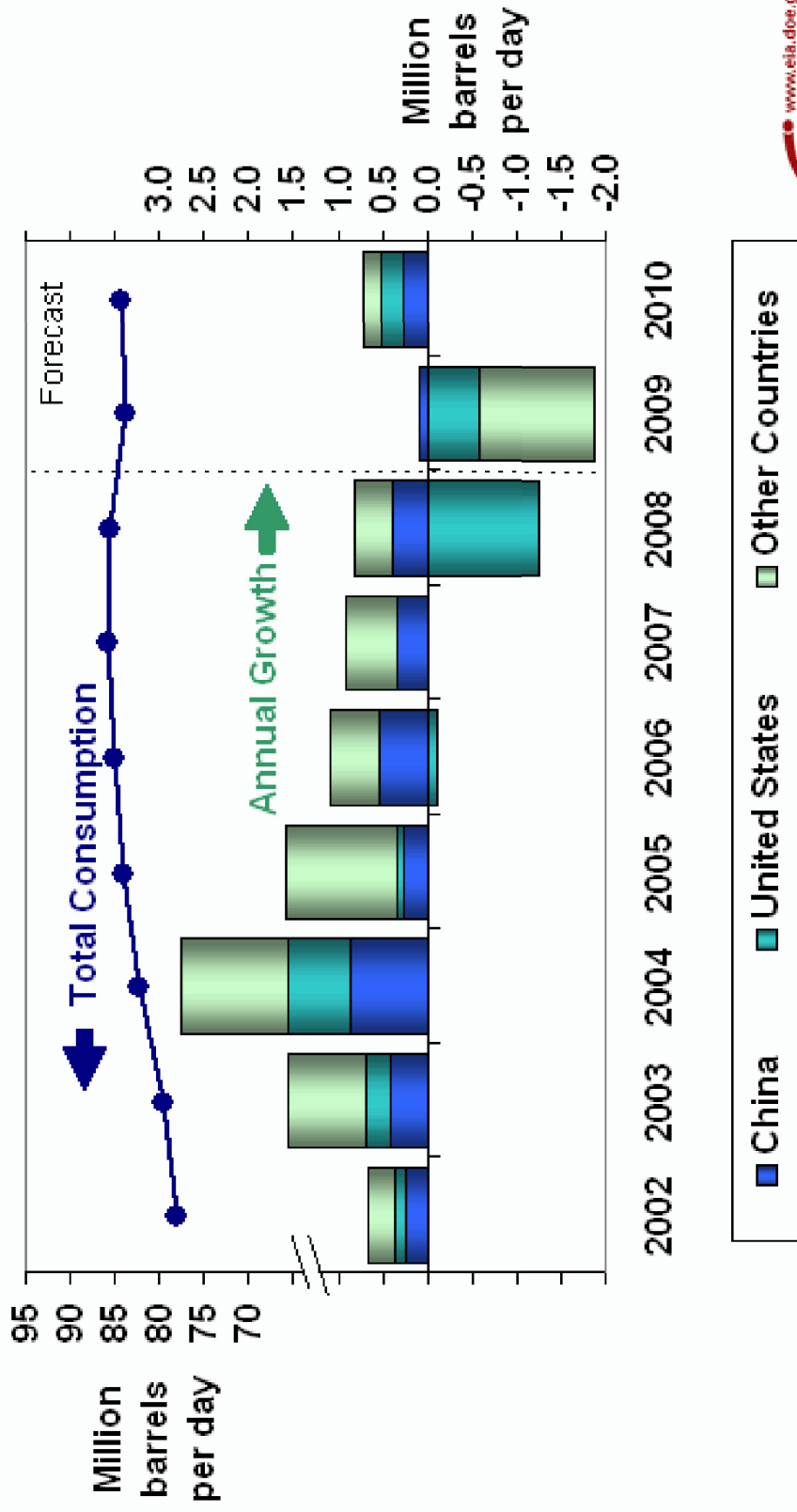


SOURCE: MAM JUNDAR-GLOBALENERGY PRESENTATION, LAWRENCE BERKELEY

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# China's Consumption of Fuel Oil Will Grow vs. USA....

World Liquid Fuels Consumption



Short-Term Energy Outlook, May 2009

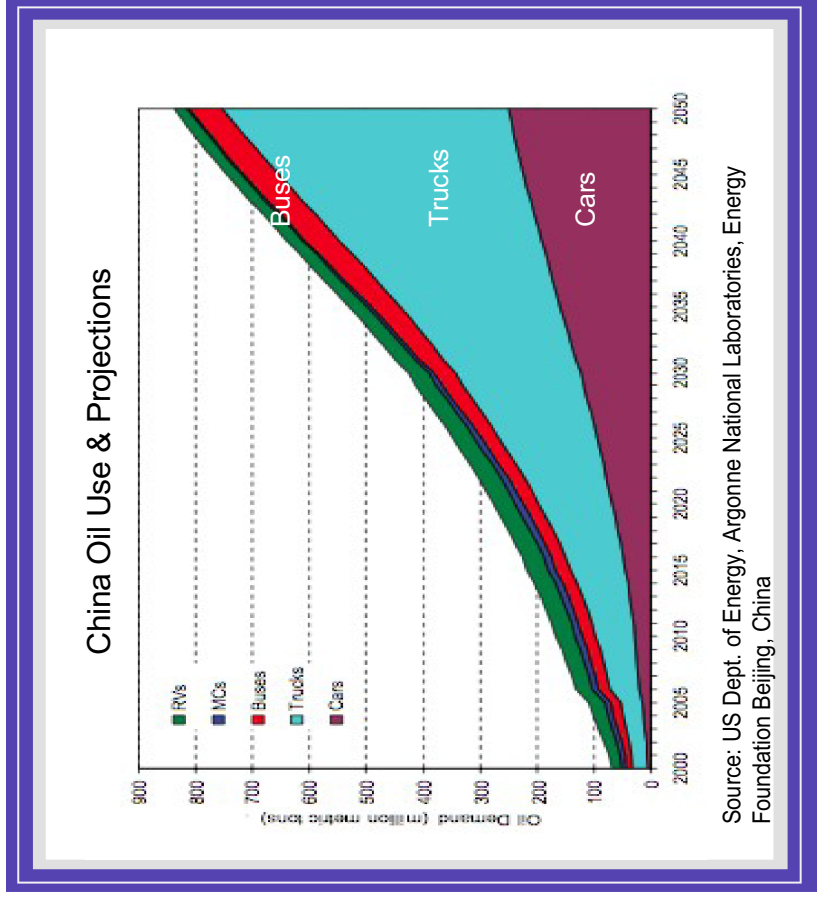
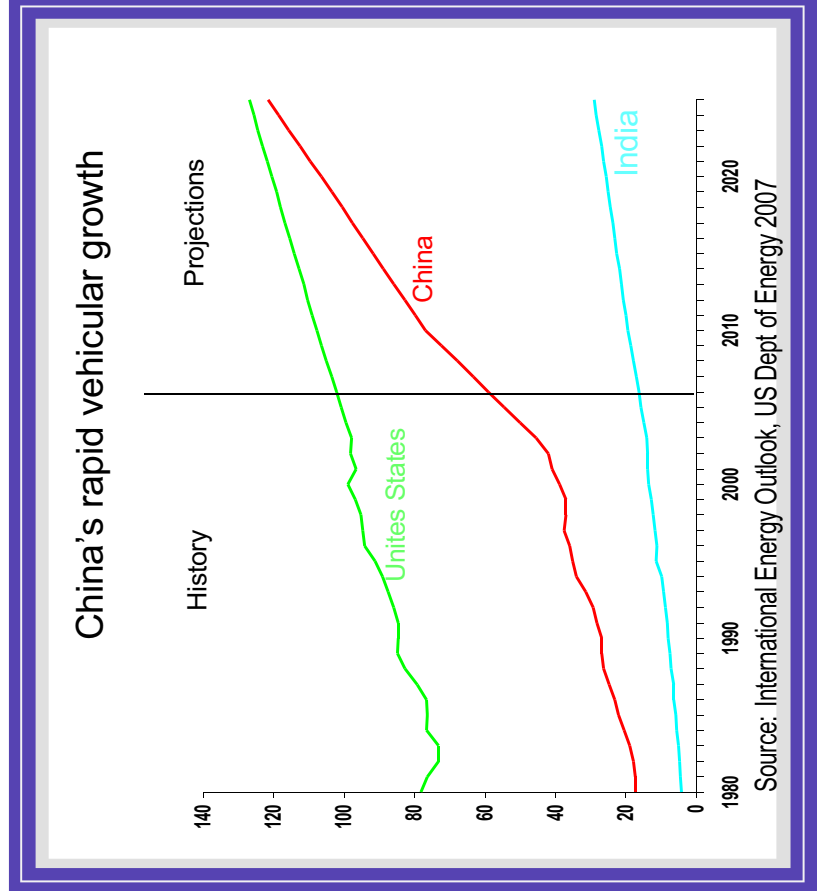


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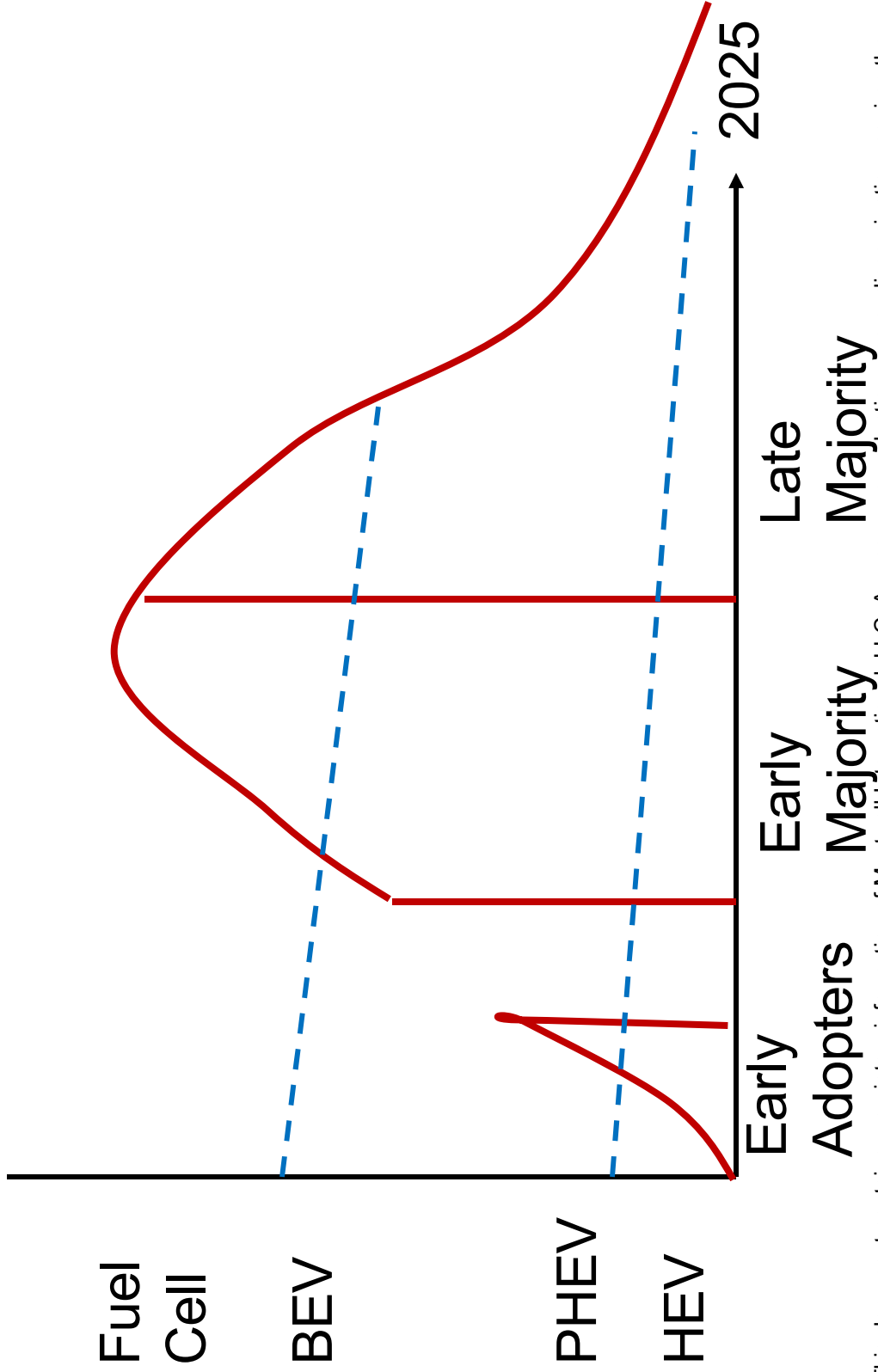
# Putting Pressure on Availability of W/W Oil Supplies (~83M Barrels/Day)



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# Mostwell's HEV Adoption Prediction – U.S. + China + India



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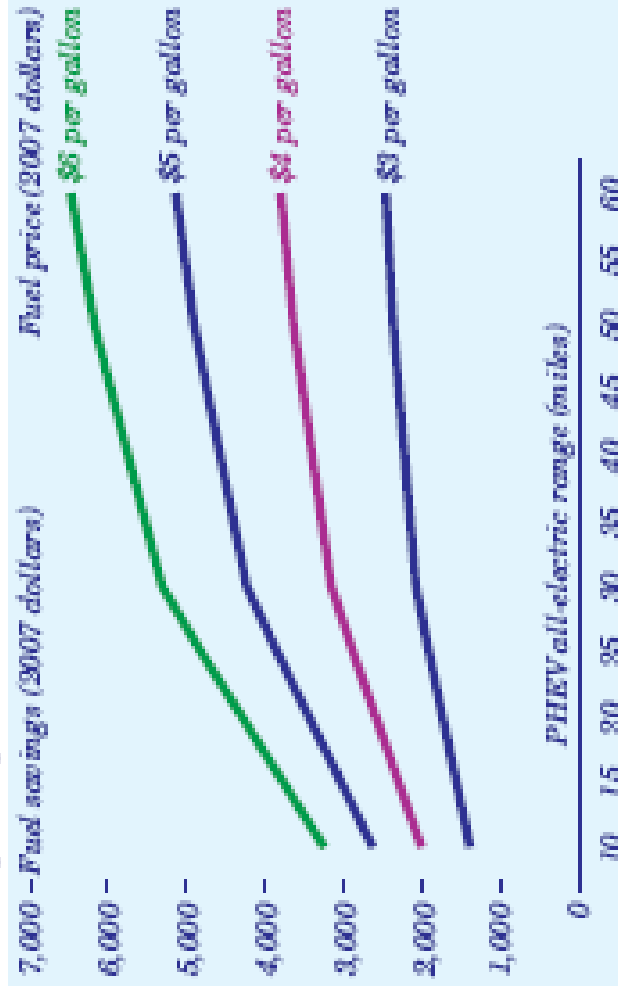
# Movement Towards PHEV in U.S.

“PHEVs are particularly well suited...to reduce petroleum consumption both through fuel economy gains and by substituting electric power for gasoline use.”

“On a gasoline-equivalent basis a PHEV’s charge depleting battery system gets on average about 105 mpg, well above even the most efficient petroleum-based ICE.”

– DoE-EIA Annual Energy Outlook, March 2009

*Figure 7. Value of fuel saved by a PHEV compared with a conventional ICE vehicle over the life of the vehicles, by gasoline price and PHEV all-electric driving range*



# U.S Legislation Subsidizes PHEVs

**Table 7. Conventional vehicle and plug-in electric hybrid system component costs for mid-size vehicles at volume production (2007 dollars)**

Vehicle component	Conventional ICE	PHEV-20
Engine/exhaust	2,357	1,370
Transmission	1,045	625
Accessory power	210	300
Electric traction	40	1,542
Starter motor	40	—
Electric motor	—	893
Power inverter	—	528
Electronics thermal	—	121
On-vehicle charging system	—	460
Other battery/storage costs	90	809
Fuel storage (tank)	10	10
Accessory battery	20	15
Pack tray	—	170
Pack hardware	—	500
Battery thermal	—	114
<b>Total</b>	<b>3,682</b>	<b>5,106</b>
<b>PHEV incremental cost</b>	<b>—</b>	<b>1,424</b>

- 2008 Energy Improvement & Extension Act provides up to \$7,500 tax credit thru 2014
- 2009 American Recovery & Reinvestment Act increases the total number of qualified HEVs per manufacturer for tax credit eligibility
- The breakeven point between PHEV cost increase verses fuel savings is estimated to be \$6 per gallon of fuel
- CAFÉ 2020 > 35 mpg standard
- California Low Carbon Fuel Standard to reduce Greenhouse Gases by 10% by 2020

# HEV Standards Progress

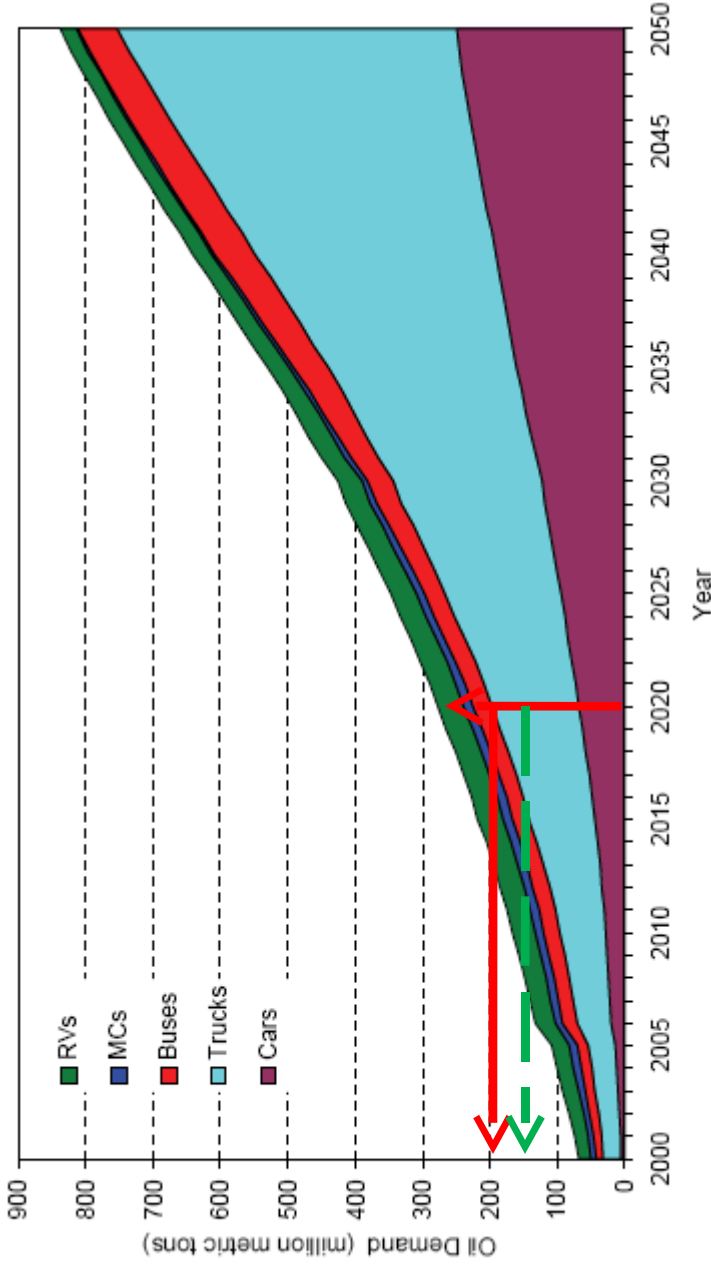
## US

- Society of Automotive Engineers > 16
  - Various topics

## China

- China Automotive Technology & Research Center > 4 (2006)
  - 3 for advanced batteries
  - 1 for ultracapacitors

# Is It Enough?



- Vehicles by 2020:
  - China > ~200M Trucks & Cars
  - 20% PHEV fleet
  - Reduce demand by ~40 M tons

Annual Chinese Oil Demand by Chinese Motor Vehicle Type  
 Mid-vehicle Growth Scenario, Moderate Fuel Economy Improvement  
 Source: Argonne National Lab

## References

- DoE Annual Energy Outlook, March 2009
- Short Term Energy Outlook, May 2009, DoE Energy Information Administration
- Projection of Chinese Motor Vehicle Growth, Oil Demand, and CO<sub>2</sub> Emissions Through 2050, Argonne National Lab report ANL/ESD/06-6, May 2006.
- 2007 Automotive Industry in China, China Automotive Technology & Research Center, China Association of Automobile Manufacturers.

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