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Sandia National Laboratories

ENG 505 - ENERGY SURETY AND SYSTEMS

Capstone Project:

"US Leverage Points for Global Emission Policy"

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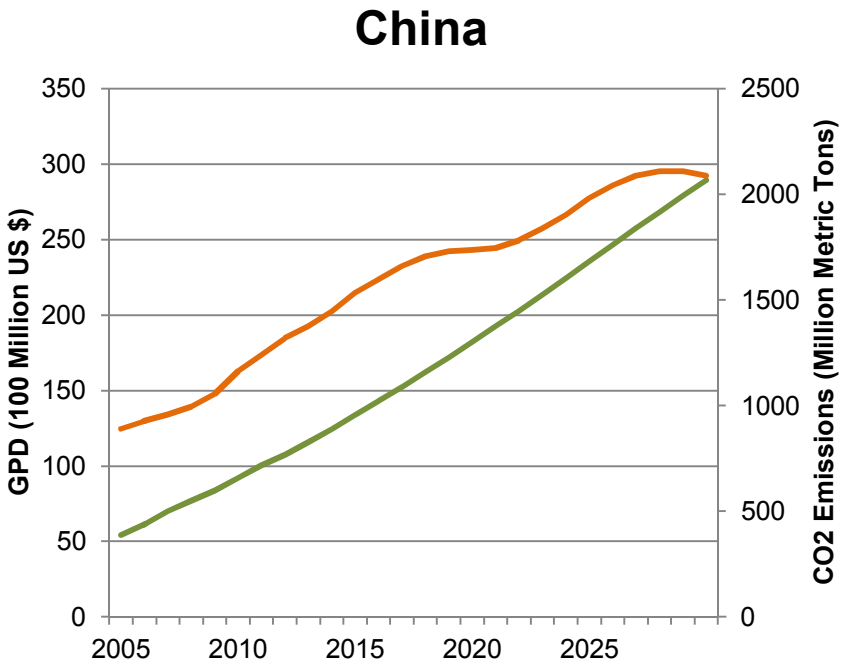
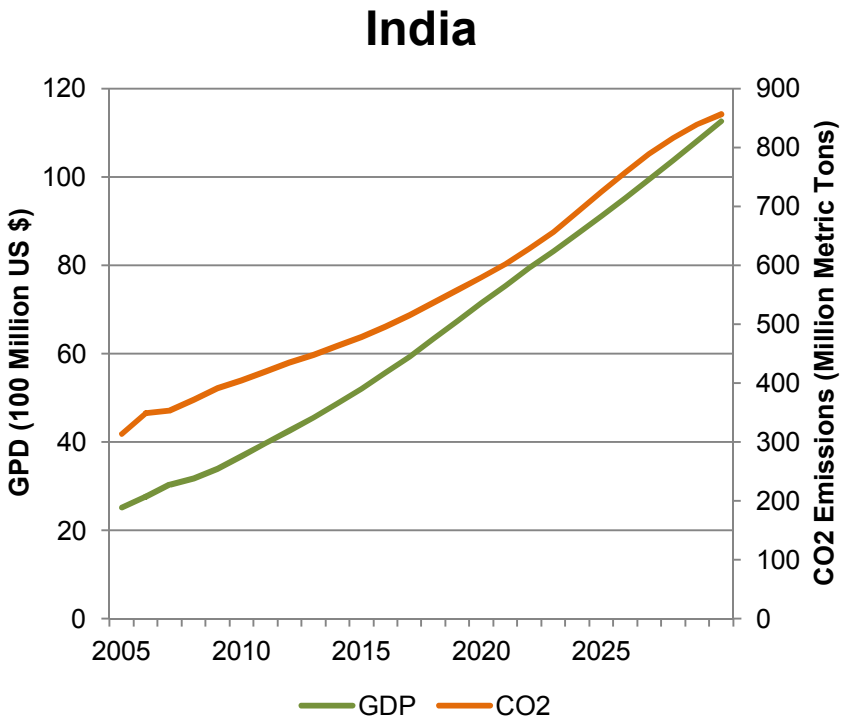
Question:

- Identify leverage points within the global transportation fuels system for U.S. energy/pollution policies.

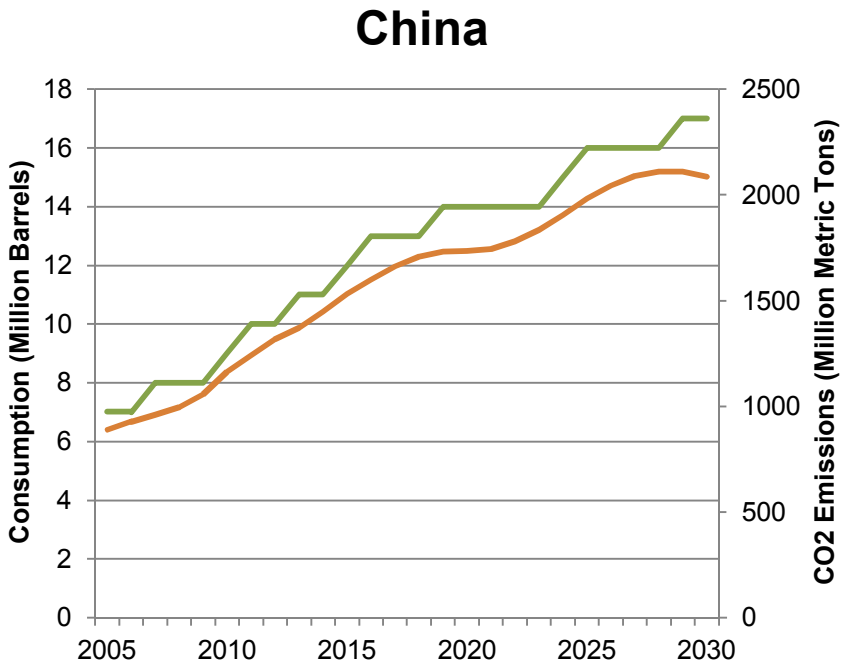
- Reduce pollution from transportation fuels by:
  - Encouraging and improving emission controls/systems
  - Decrease the global consumption of fossil fuels

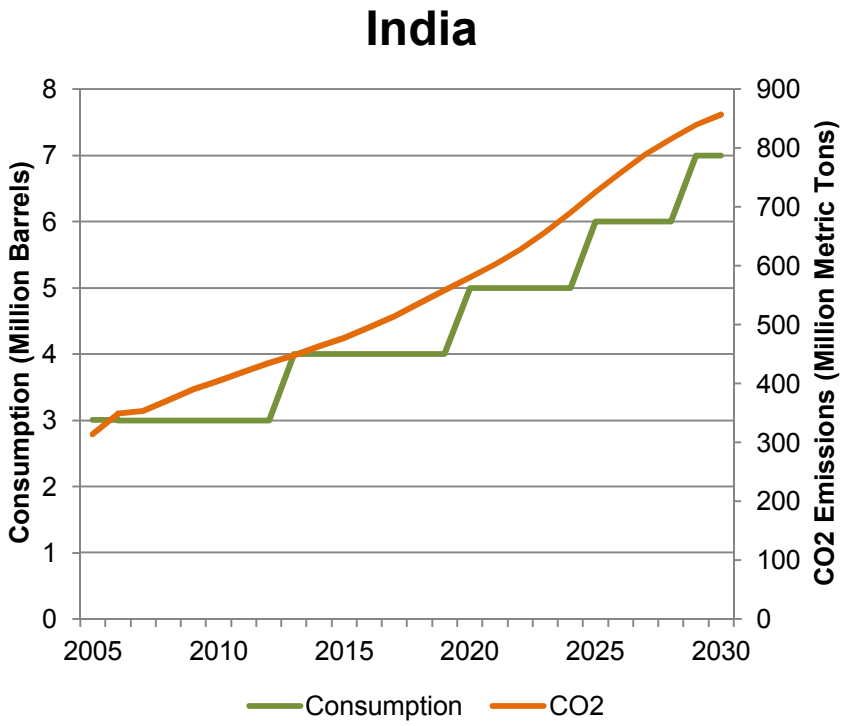
GDP vs. Emissions



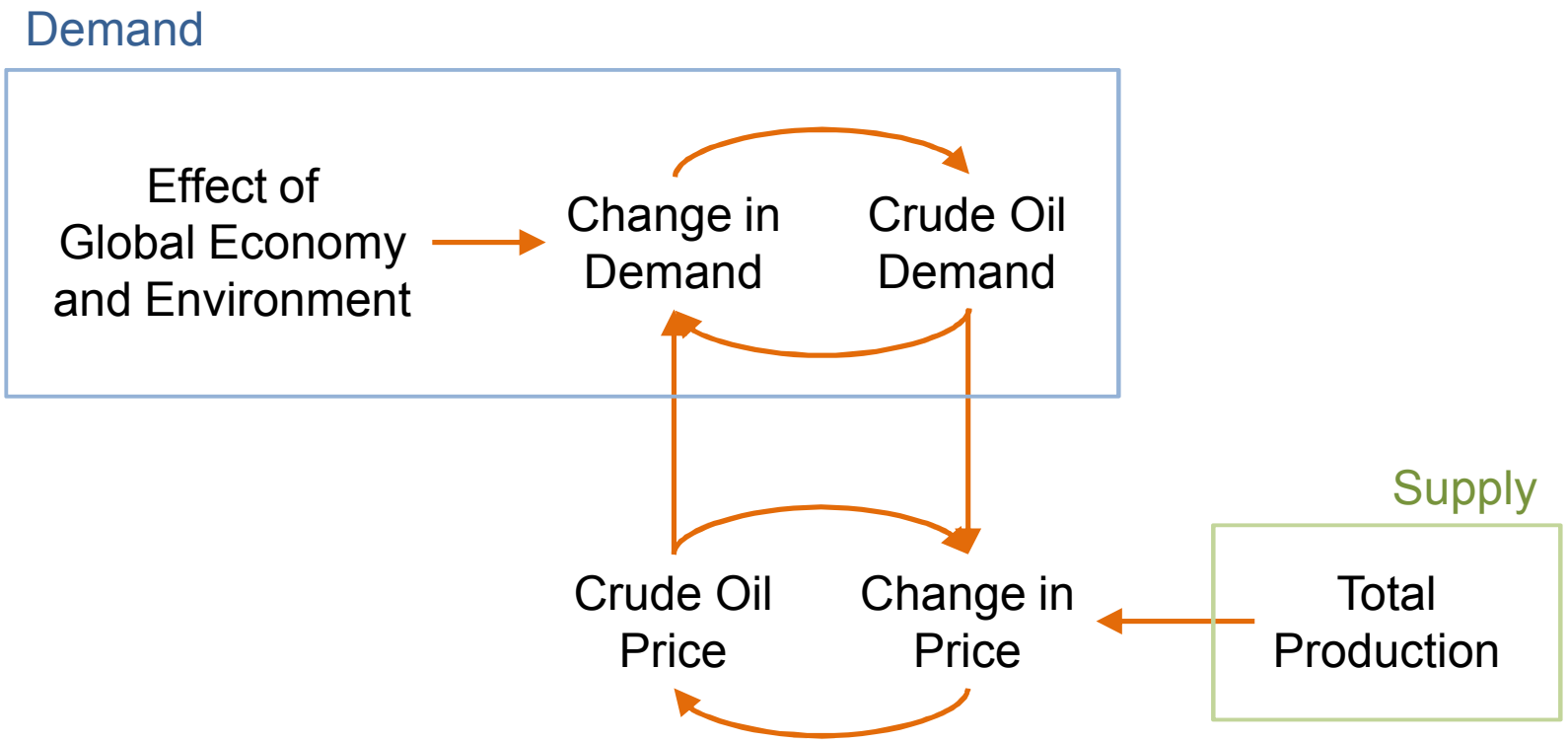


Consumption vs. Emissions



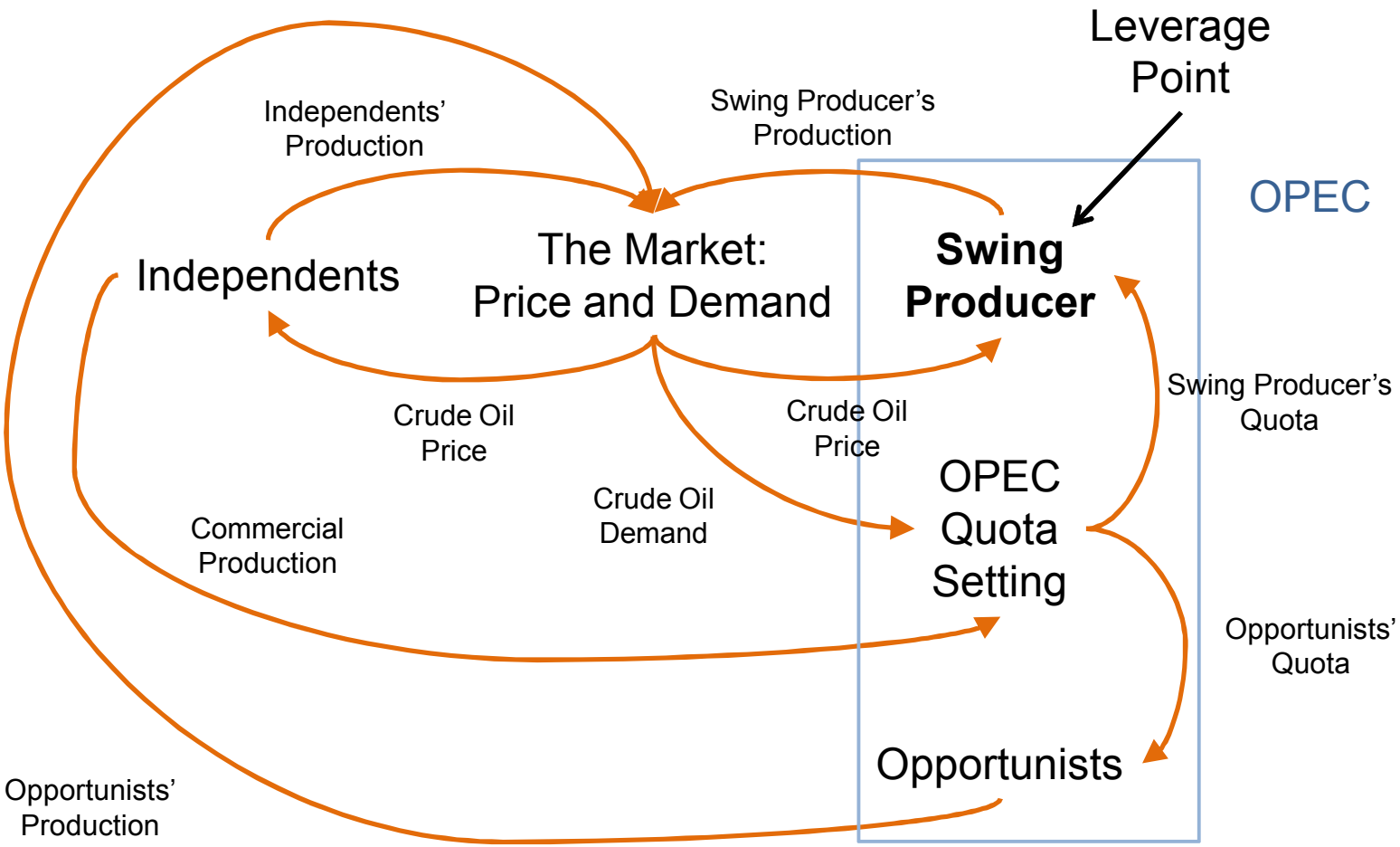


Modeling: Crude Oil Price



Morecraft, John. “Strategic Modelling and Business Dynamics: A feedback system approach.” John Wiley and Sons Ltd. 2007. 270p.

Global Oil Producers



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Domestic Leverage Points

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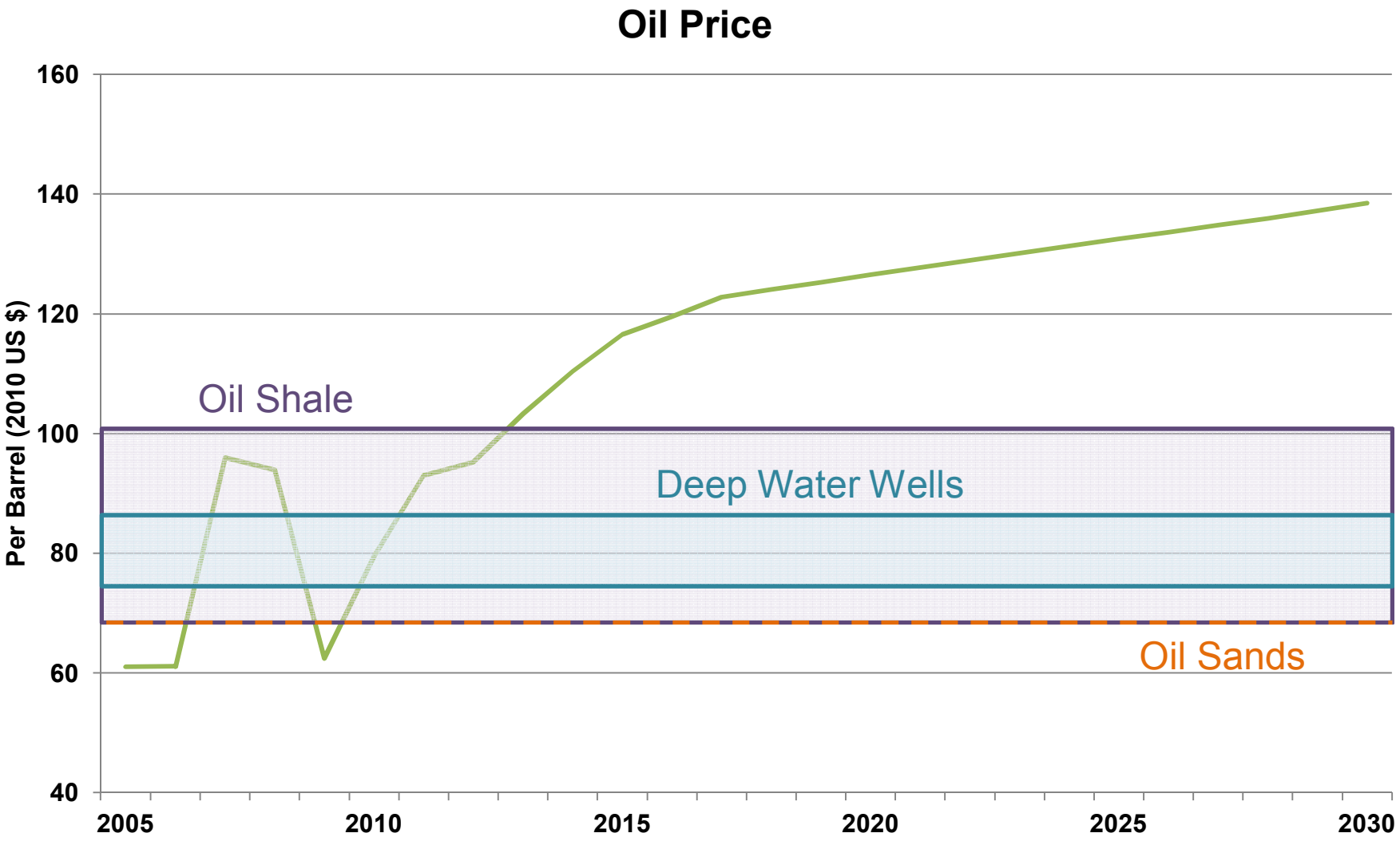
- Increase crude oil (fossil fuels) supply
  - Deep water oil wells in Gulf of Mexico
  - Oil wells in Artic
  - Extraction from Shale formations
  - Conversion of Tar Sands
- Decrease crude oil (fossil fuels) demand:
  - Increase alternative fuels
    - Biofuels
    - Electricity
  - Increase conservation/efficiency
    - CAFÉ Standars
    - Mass Transit Systems

Increase Crude Oil Supply



Increase Alternative Fuels

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- Corn Ethanol
  - Pros: renewable, plentiful, 20% fewer GHG emissions
  - Cons: 30% less energy than gasoline, drives up food costs, water/land intensive, may increase smog
- Cellulosic Ethanol
  - Pros: renewable, plentiful, much lower cost, much lower GHG emissions, doesn't compete with food
  - Cons: unproven in mass production
- Biodiesel
  - Pros: renewable, greater energy than gasoline, can be used in standard diesel engines, lower GHG emissions
  - Cons: may increase other pollutants

Increase Alternative Fuels (con't)

- Electric
  - Pros: 90% efficient vs. 20% efficient (overall fuel cycle is 34% efficient vs. 14% efficient), can be provided by renewables, fewer stops to refuel
  - Cons: little infrastructure for charging stations, limited range, only some vehicles are cost competitive, most likely powered by coal
- Bioalgal Diesel
  - Pros: renewable, high energy productivity per unit area (50X more productive), can use non-potable water, doesn't compete with food
  - Cons: nascent technology, research cost

Improved Fuel Efficiency

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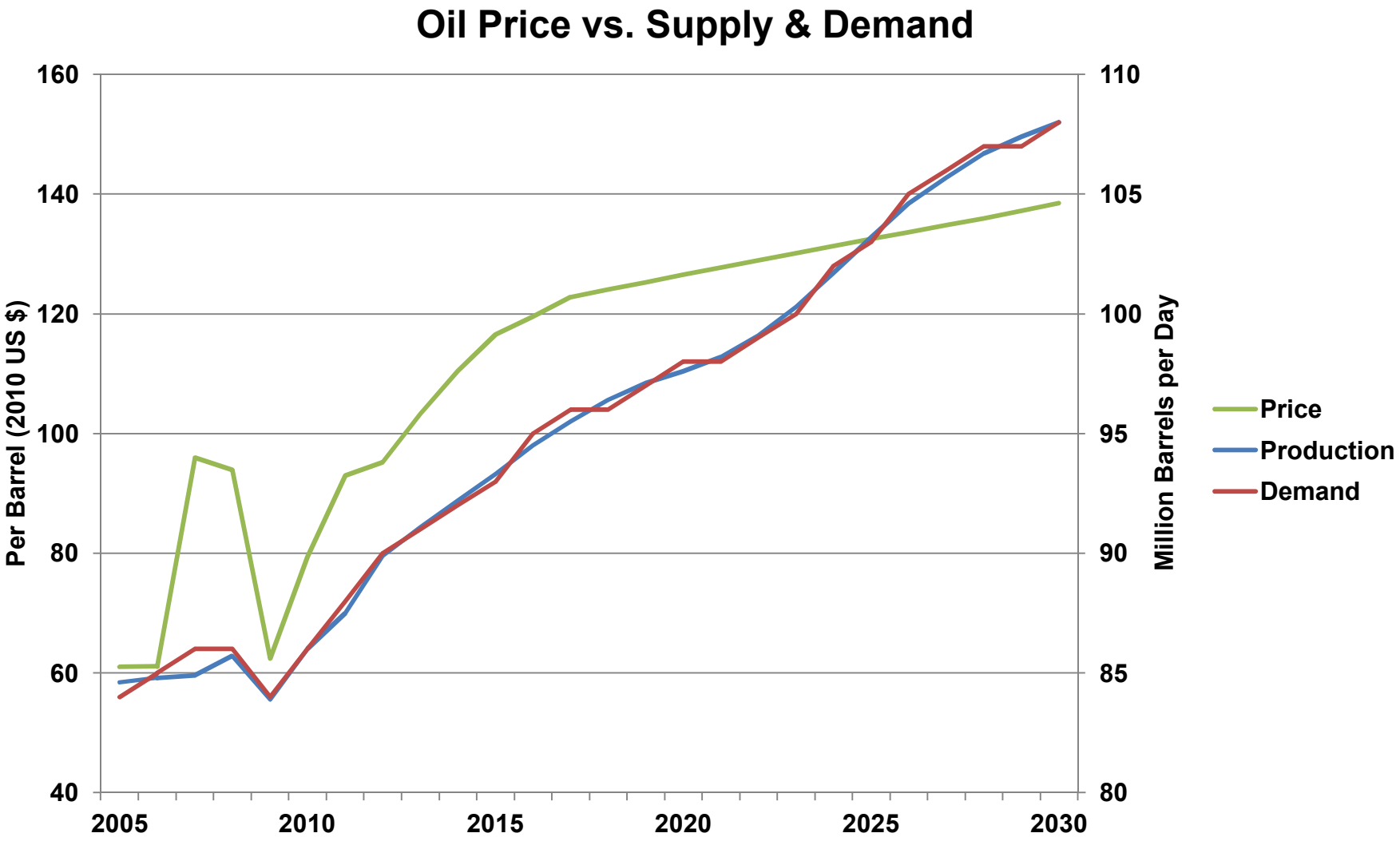
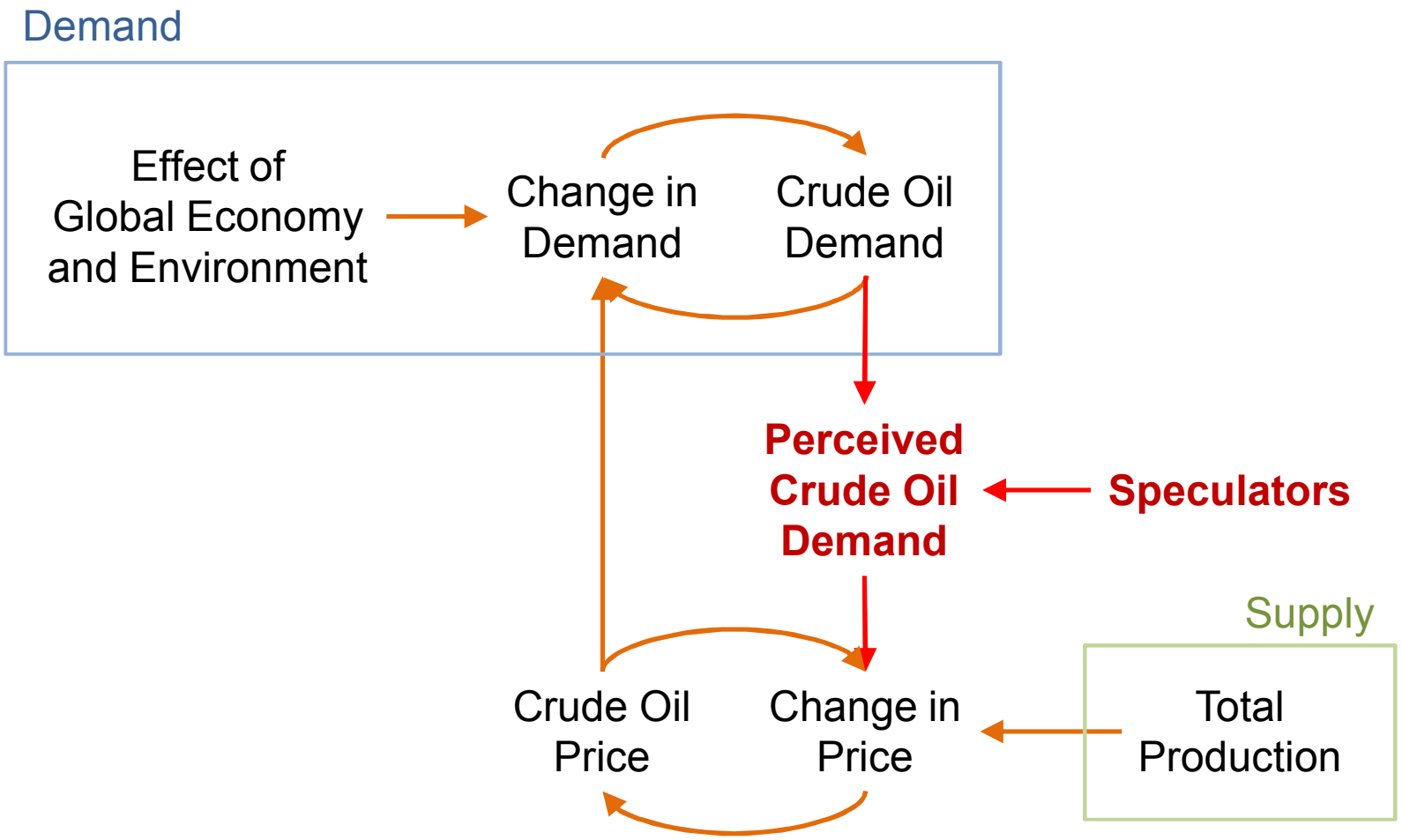
- Increase the CAFE (Corporate Average Fuel Economy) standard
  - 35.5 mpg by 2016, 54.5 mpg by 2025
- Over the life of the program:
  - Consumers will have saved $1.7 trillion on gas (average of $8000 per vehicle in 2025)
  - US will save 12 Billion barrels of oil
  - Will eliminate 6 billion metric tons of CO2 pollution
- Source: www.whitehouse.gov

Speculation



Modeling: Crude Oil Price



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Summary:

- Speculators distort the relationship between demand, supply, and price
- Swing producer is the key leverage point for setting crude oil price and in turn possible consumption
- Alternative transportation fuels and conservation would be two possible leverage points for mitigating the impact of crude oil price on domestic consumption