2011 UCLA Lake Arrowhead Symposium

The End of Oil?
Arguments For and Against

Donald L. Paul, Ph.D.
University of Southern California
Executive Director, USC Energy Institute and
William M. Keck Chair of Energy Resources

16 October 2011

Themes

- Issues for consideration
- System fundamentals: complexity, scale, and time
- Global demand and supply outlooks
- The end of oil? For and Against
- Q&A

The end of oil? Some considerations

- The hydrocarbon resource base and “peak oil”
- Peak oil vs. peak fuel
- Peak demand
- The evolution of “auto-mobility
- Government vs. private capital investment
- Geopolitics and regulation

Complexity and interactions

Science and Technology

+

Economics and Business

+

Policy and Government

+

Behavior and Society

Understanding petroleum supply

- Geological endowment
- Technically recoverable resources
- Reported reserves
- Production

Understanding petroleum supply

- Geological endowment
- Technically recoverable resources
- Reported reserves
- Production

1990 Global Reserves:	1.1 Trillion BBL
Production 1990 to 2010:	0.6 Trillion BBL
2010 Global Reserves:	1.2 Trillion BBL

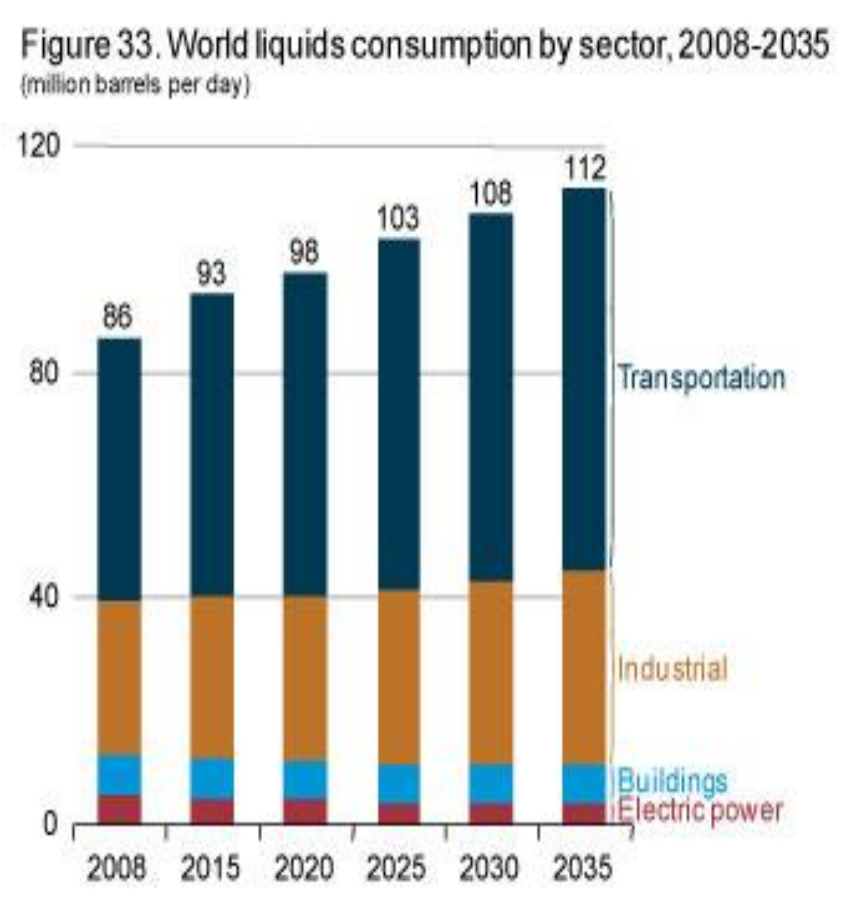
Understanding petroleum supply

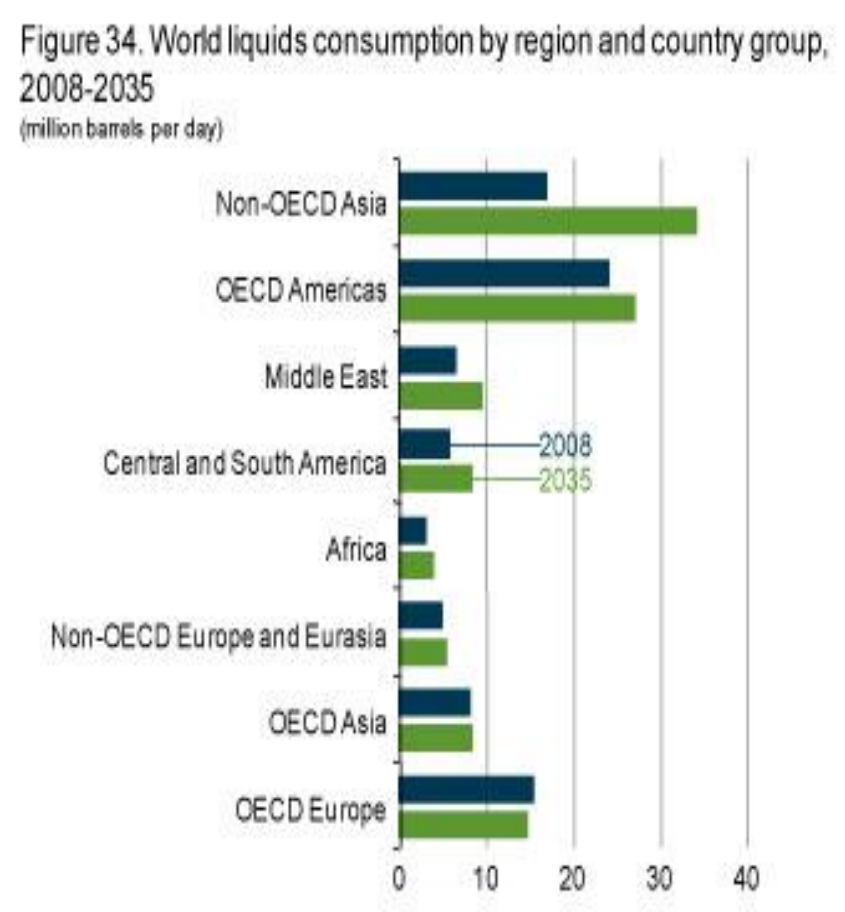
- Geological endowment
- Technically recoverable resources
- Reported reserves
- Production

- Controlling factors :
  - Geological knowledge and technology
  - Price (both near and long-term) and return on capital
  - Geopolitics and regulation

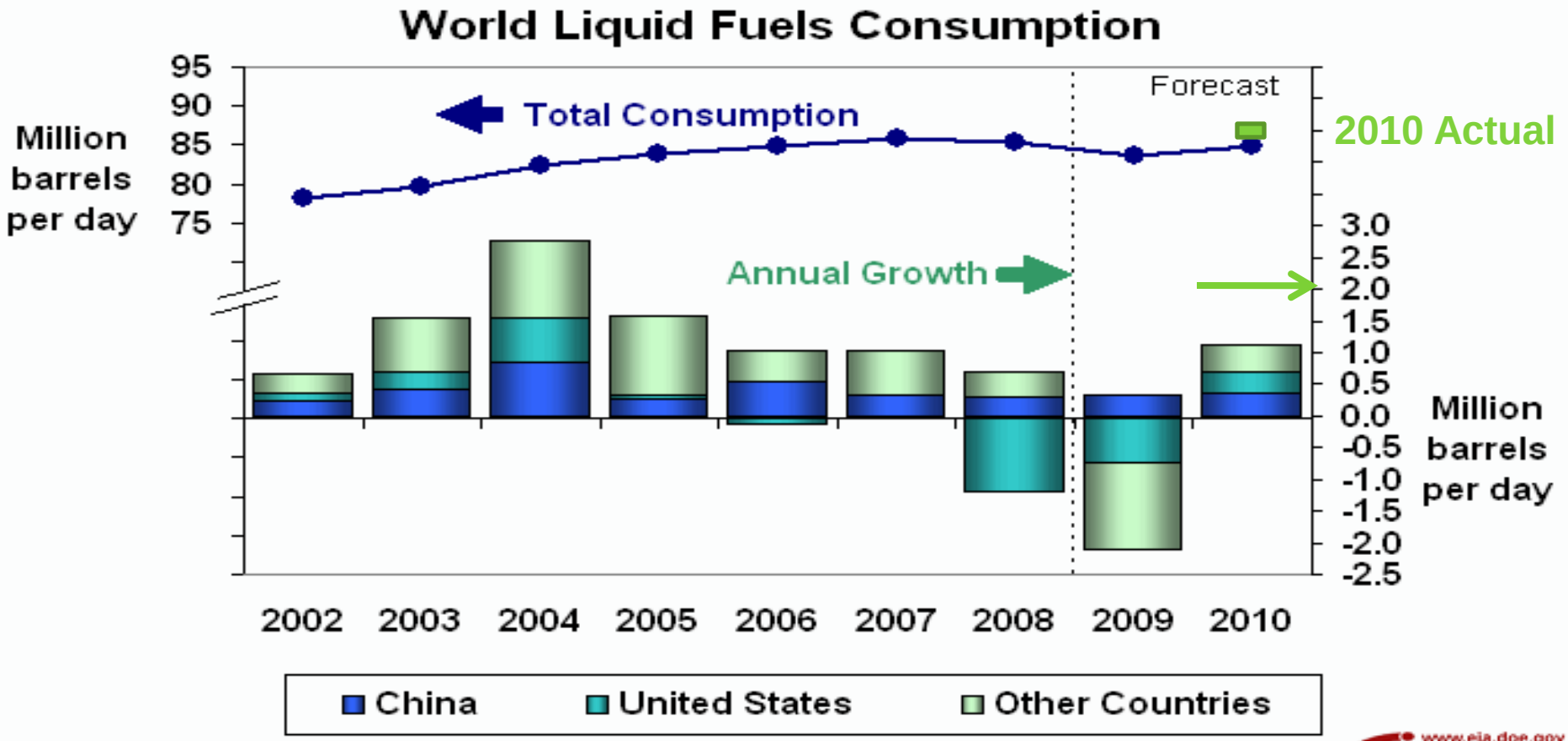
Globalization of demand: Liquids / Fuels

EIA International Energy Outlook 2011





The Great Recession dampened global demand, but . . . . we are now back on trend

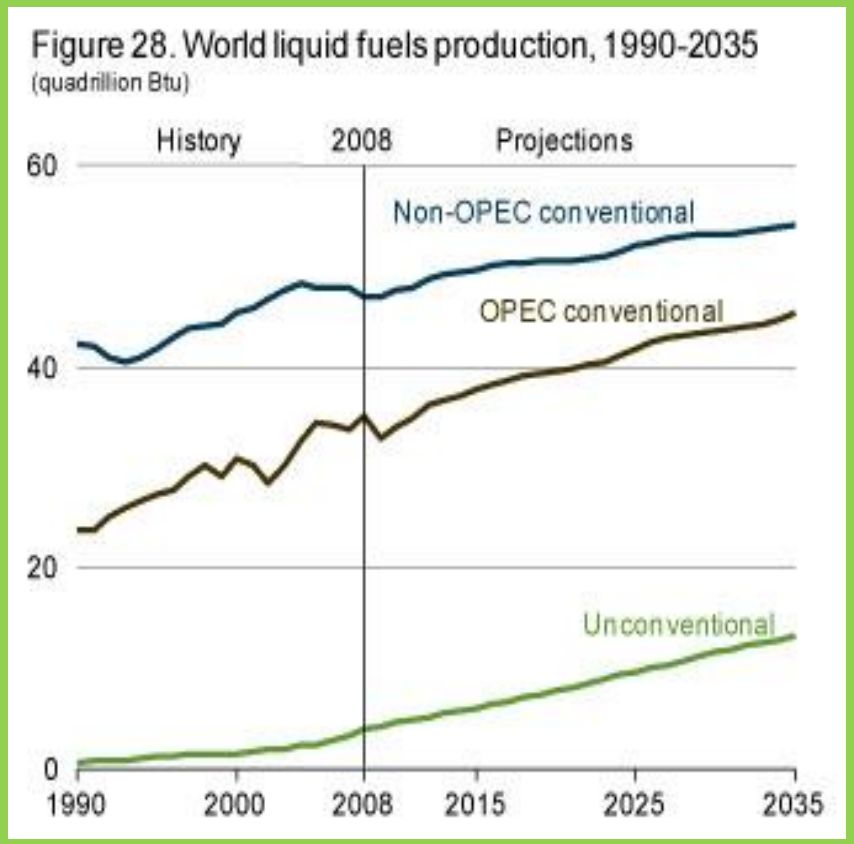


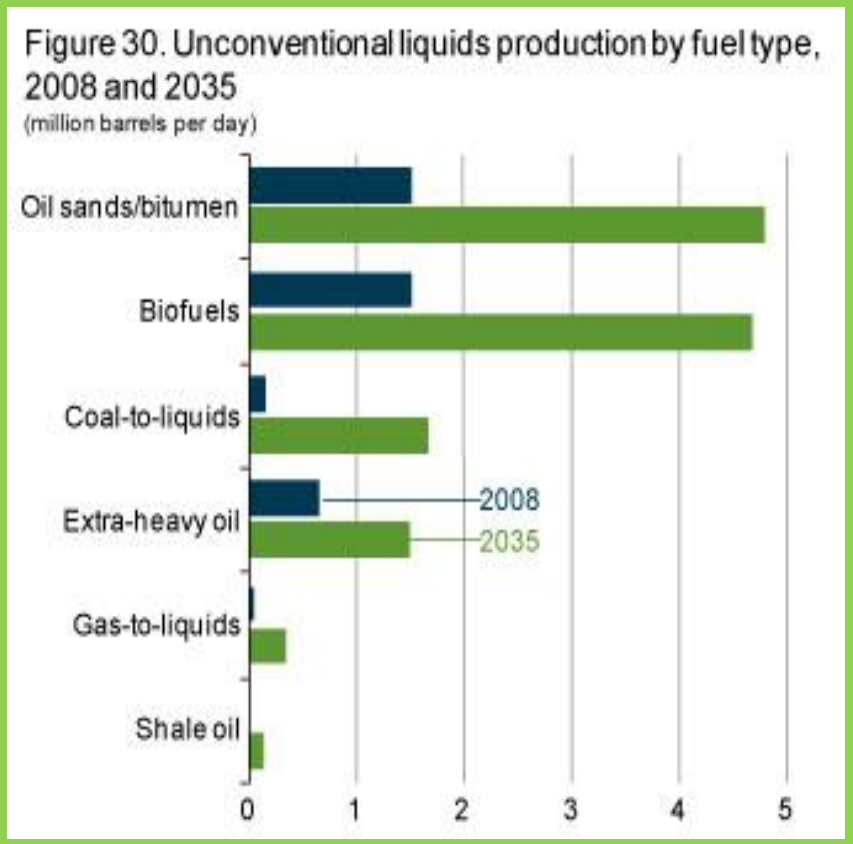
Short-Term Energy Outlook, October 2009

www.eia.doe.gov

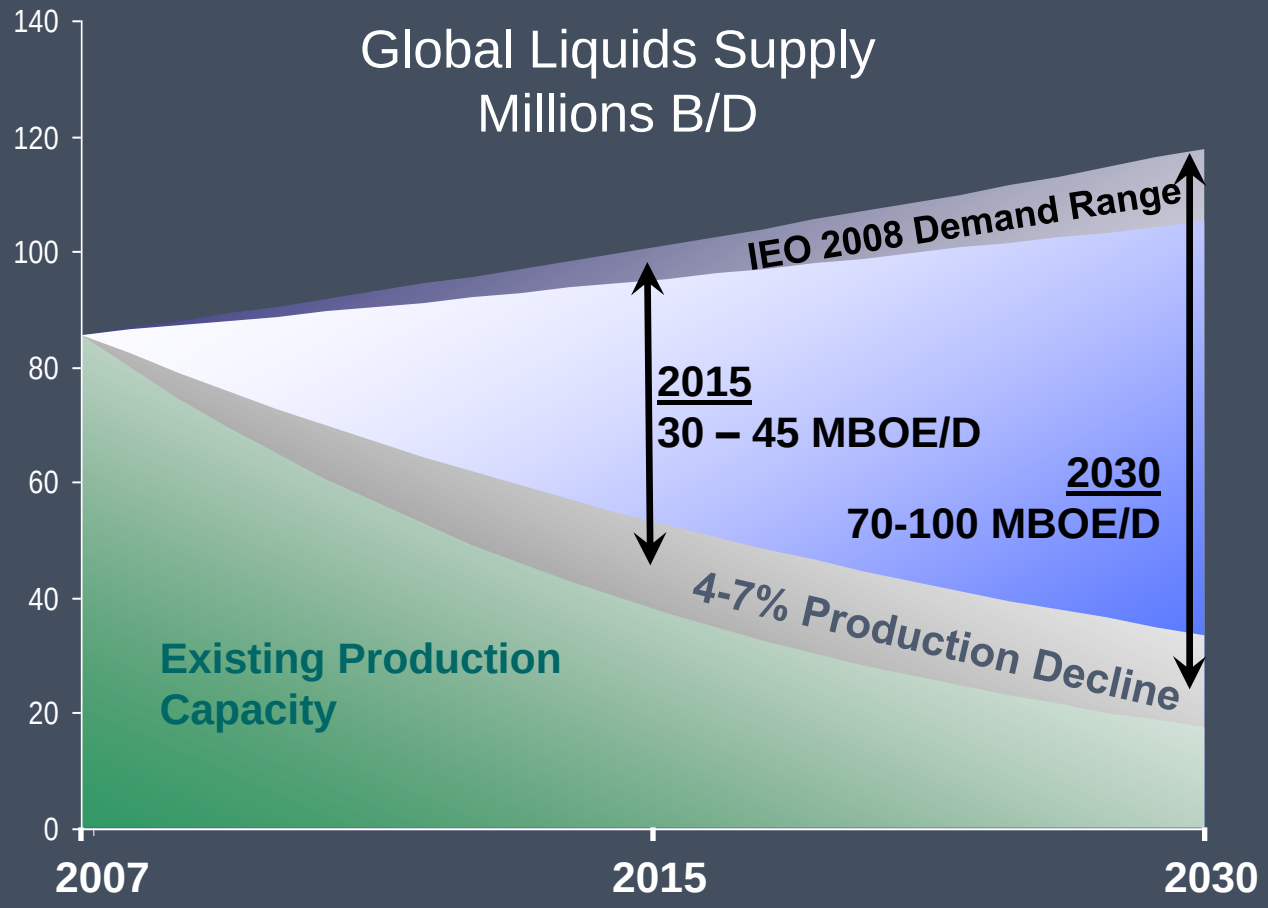
Global supply: Liquids / Fuels

EIA International Energy Outlook 2011



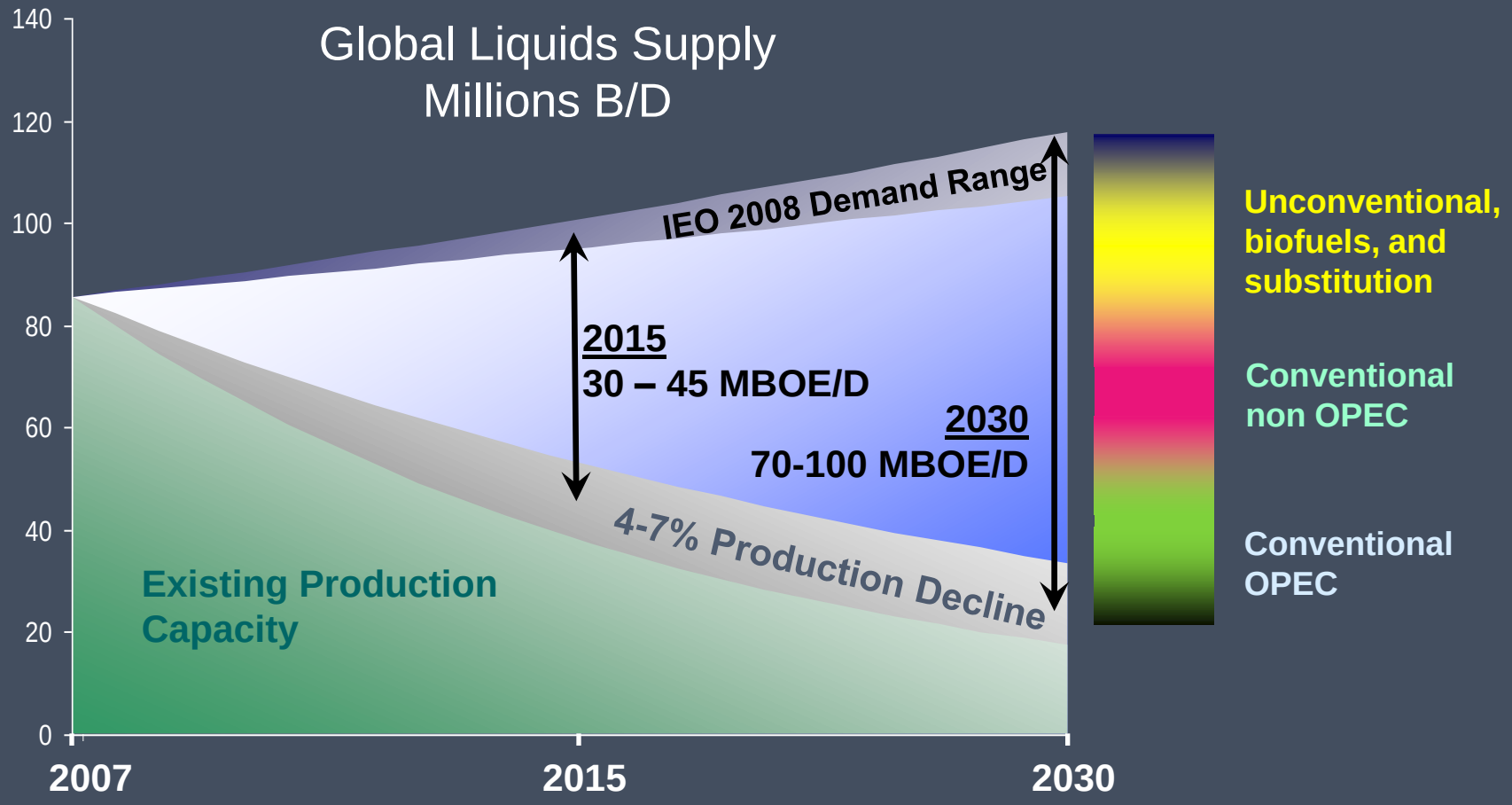


The challenge for fuel supply



Source: NPC 2007 Report – The Hard Truths" - One Year Later

The challenge for fuel supply



Source: NPC 2007 Report – The Hard Truths" - One Year Later

Global liquids supply outlook

- Conventional resources
  - Finding and developing the next trillion barrels
  - Increasing recovery factors from existing fields
- Diversifying supply
  - Developing unconventional reservoirs
  - Converting biomass and unconventional hydrocarbon resources to conventional hydrocarbon fuels

Trillion-barrel scale resources exist –
all have challenges and all will have constraints

The end of oil? Arguments For

- The conventional oil resource systems are at or near their peak production capacity
- Unconventional feed stocks and frontier oil resources cannot or will not be developed at sufficient scale nor in time
- Demand will peak due to a combination of much higher oil prices, new transportation technologies, and a significant change in societal values of auto-mobility
- Major global political interventions will directly limit hydrocarbon use to achieve economic, security, and environmental objectives

The end of oil? Arguments Against

- Technology advances will continue to materially expand the scale of the hydrocarbon resource base
- Technology advances will continue to materially expand the feed stock options for the production of liquid transport fuels
- Significant and continuing non-OECD growth will spur continued global investments in oil development and hydrocarbon infrastructure
- Severely weakened sovereign finances of the major OECD countries can limit the rate of transition of the fuel and transport system
- Conflicting national objectives will limit the ability to achieve global-level agreements on oil-related policies

Thank you…..Questions ?