ISSUES IN ASSESSING LONG-TERM LIQUID FUEL AND NATURAL GAS SUPPLIES

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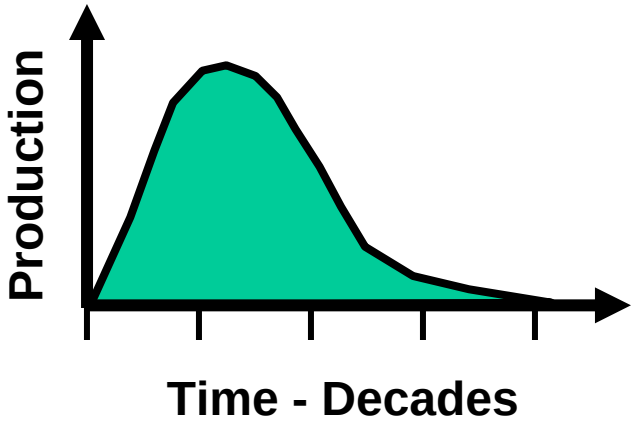
THIS PRESENTATION

- Is peak oil “nonsense”?
- Oil supply and demand trends
- Oil supply forecasts
- Oil peaking and natural gas
- Natural gas forecasts: Past and current
- Future natural gas shortfalls?
- New paradigm for natural gas pricing?
- Summary

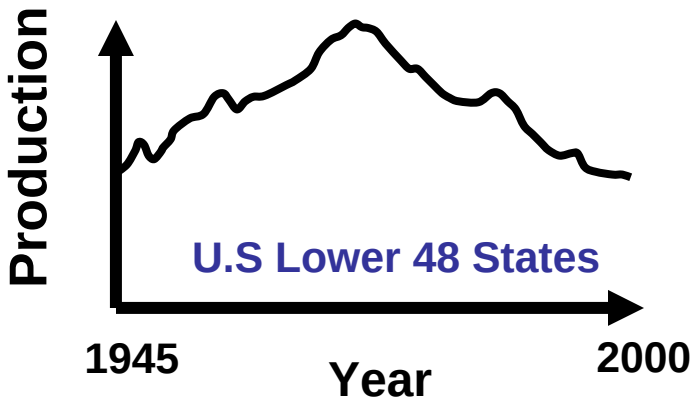
IS PEAK OIL THEORY "NONSENSE"?

- **World oil demand is huge & growing**
- **Peaking is maximum production of *conventional oil*, not "running out;" beware of red herrings**
- **Most past peaking predictions were wrong.**
  - Hubbert was right on the U.S. Lower 48
  - Recent predictions may be right
  - Wrong isn't forever
- **Why reconsider peaking now?**
  - World oil consumption outstripping new discoveries
  - CAPEX for new energy projects is large and growing
  - Extensive drilling worldwide - large database
  - Advanced technology: Modern geology, 3D seismic, etc.
  - Many experts are pessimistic
  - The economic consequences are huge

WHY WILL CONVENTIONAL OIL PRODUCTION PEAK?



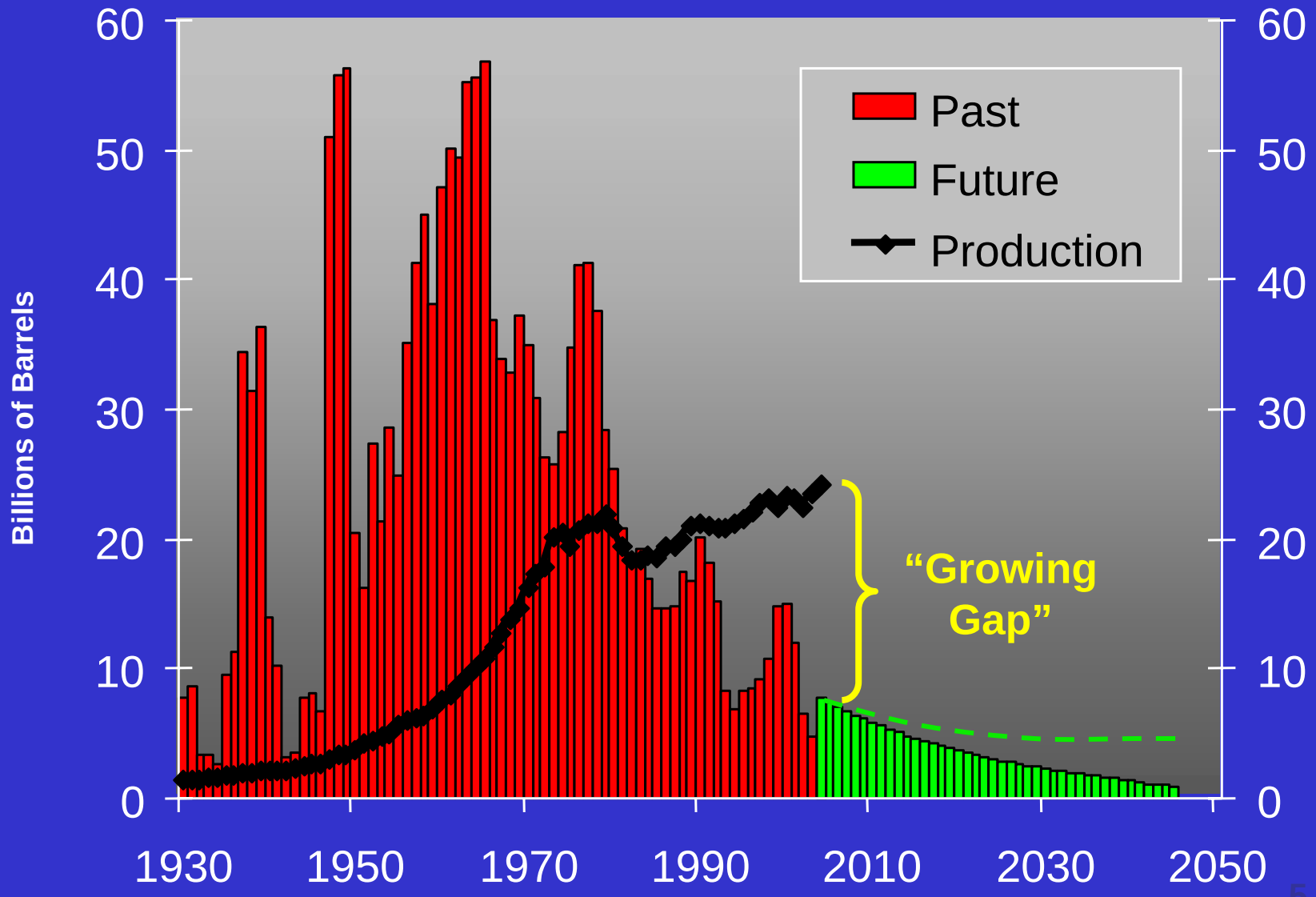
Oil fields peak



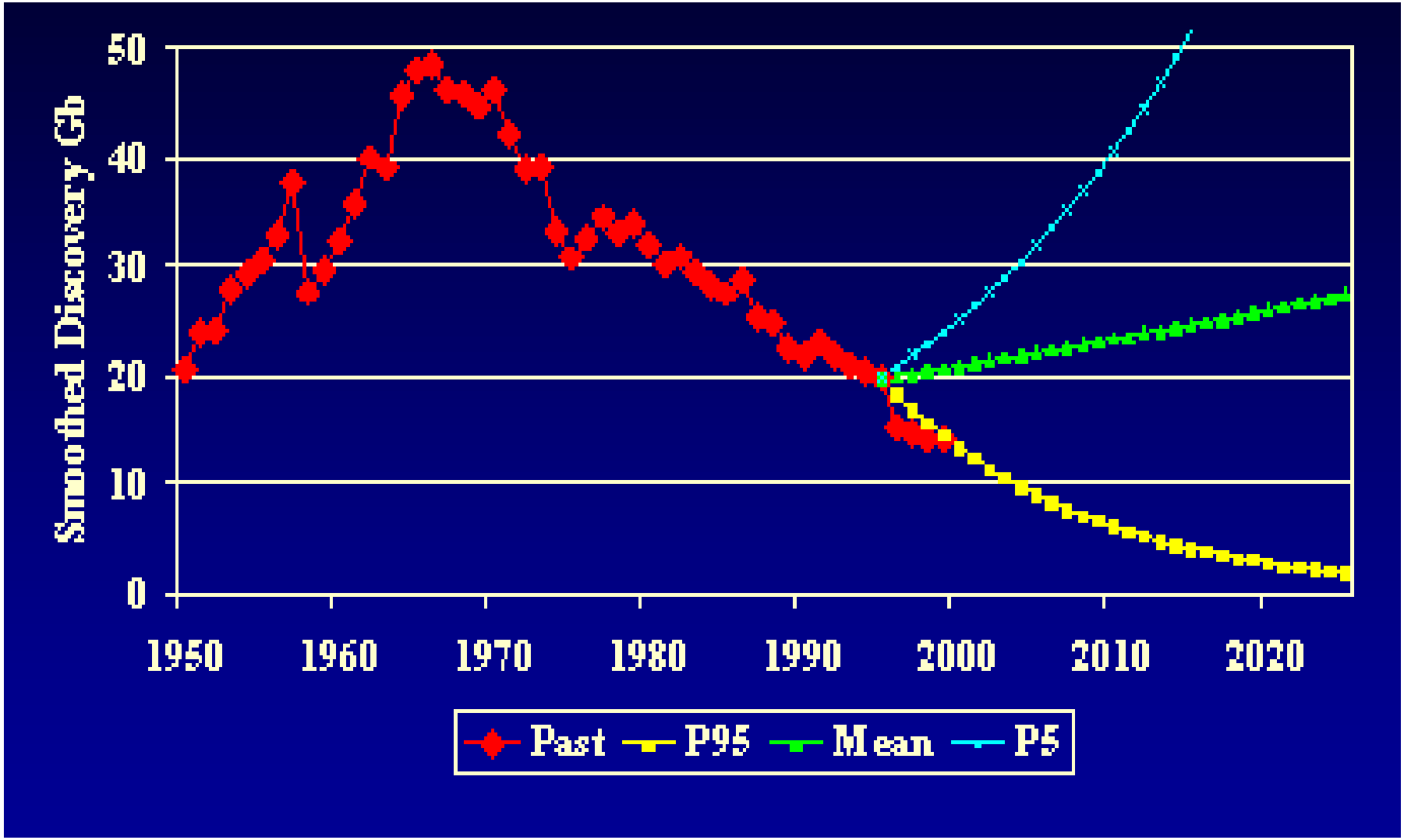
Regions (Many fields) peak

The world (All regions) will peak

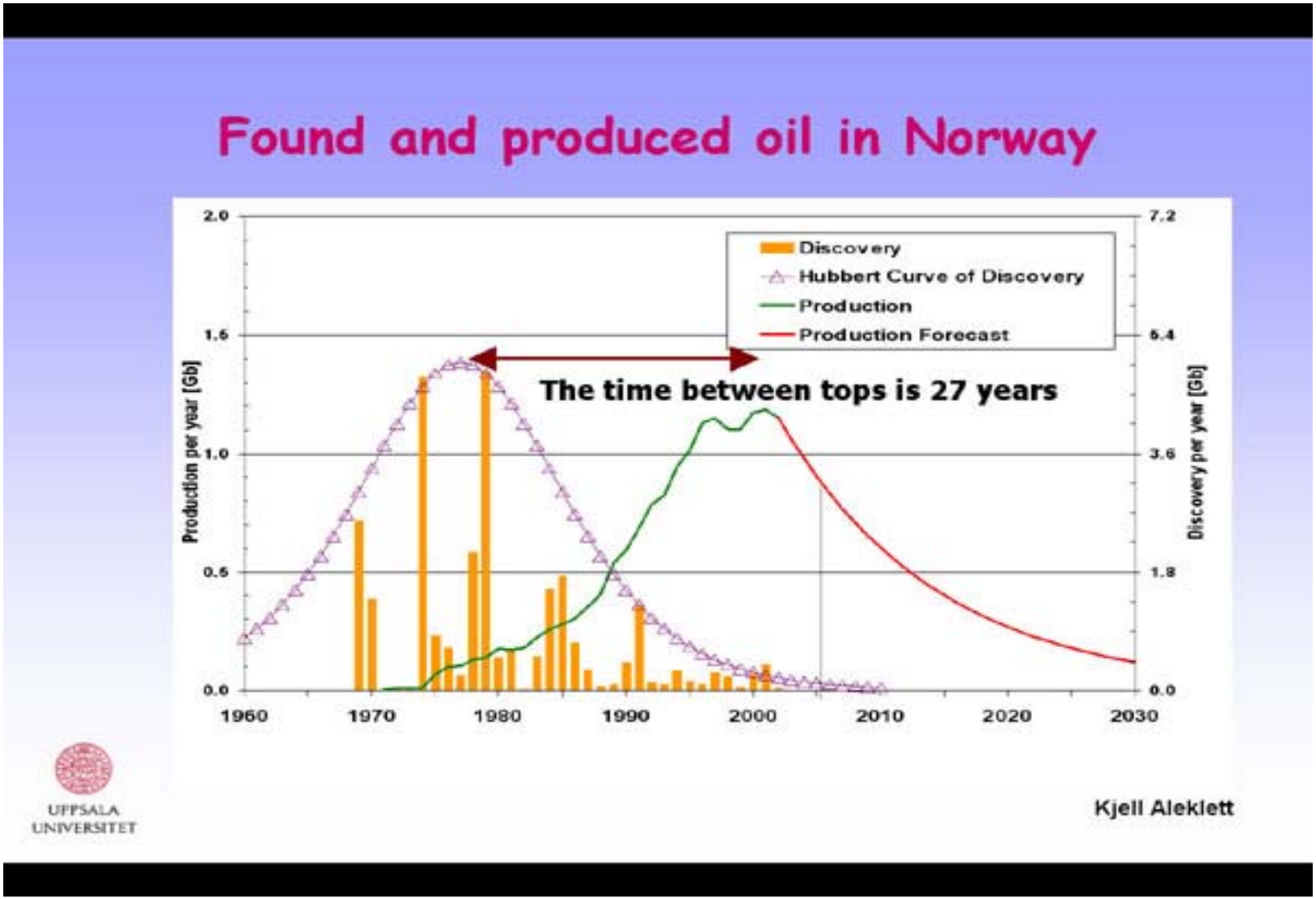
WORLD IS CONSUMING MORE OIL AND FINDING LESS



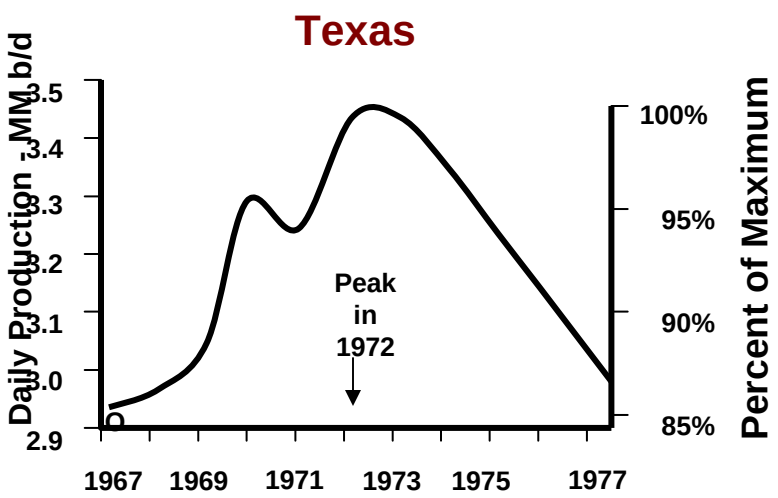
WORLD OIL DISCOVERY HISTORY & THREE PATHS FOR USGS RESERVES ESTIMATES

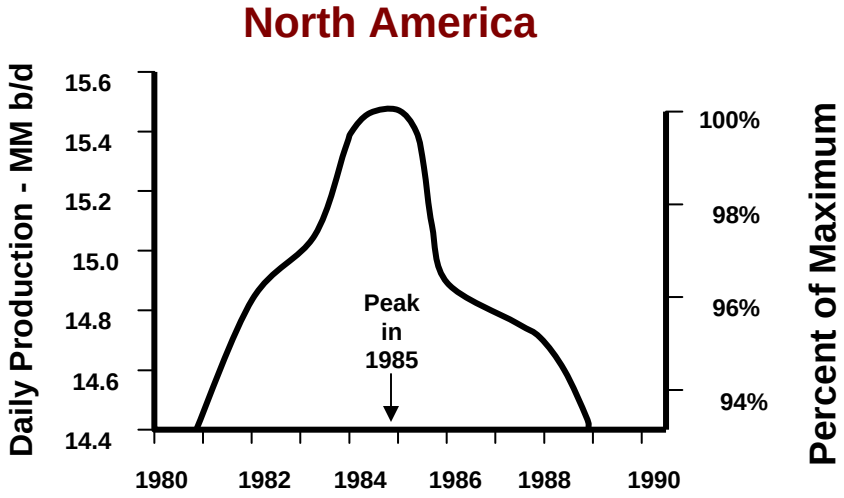


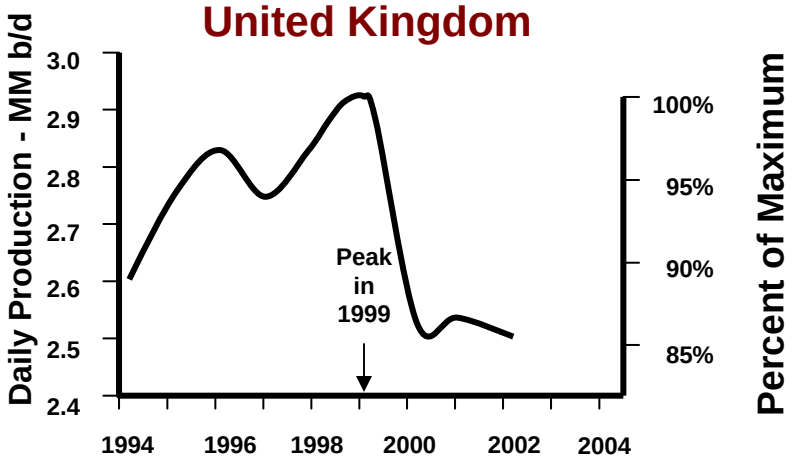
WHEN DISCOVERY DECLINES, PRODUCTION ALWAYS DECLINES LATER -- NORWAY

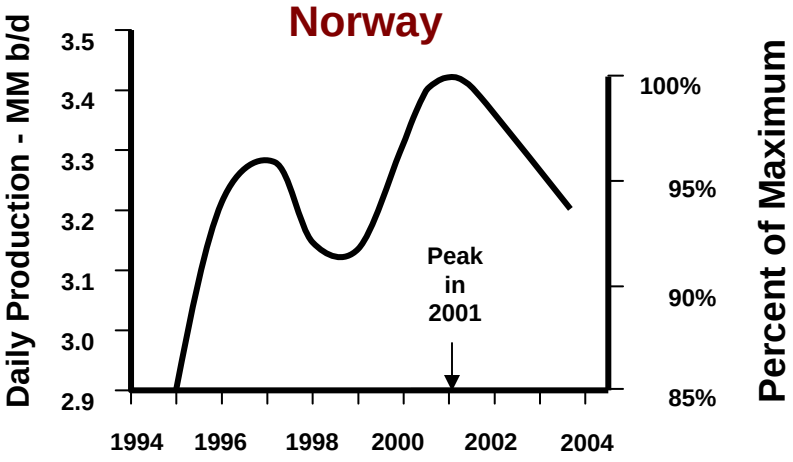


PEAK PRODUCTION CAN BE SUDDEN & SHARP





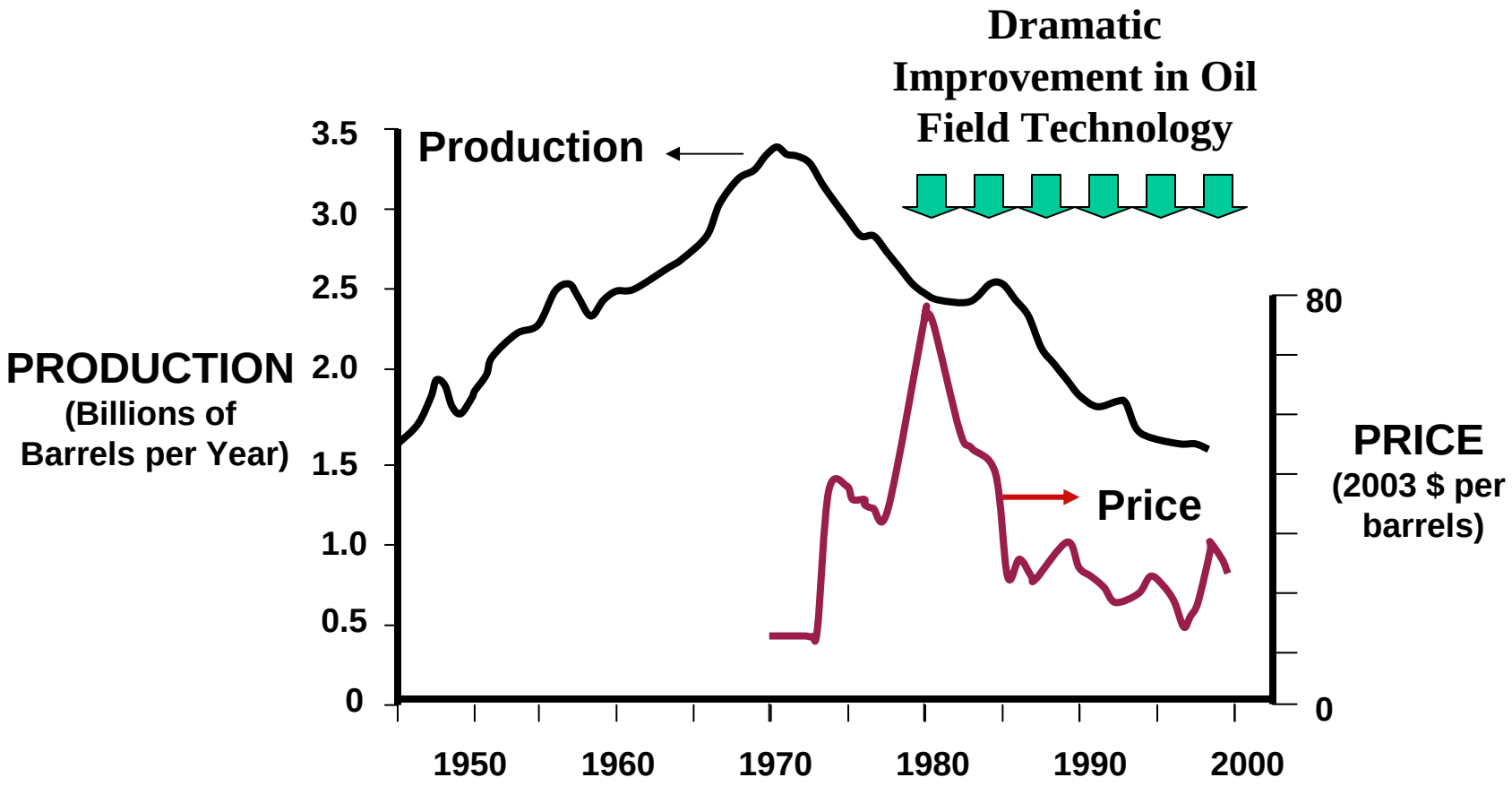




Will the world behave like this?

TECHNOLOGY & PRICE MAY NOT SAVE US

U. S. Lower 48 Oil Production



Trends were not reversed, and continued decline is forecast

WHEN MIGHT PEAKING OCCUR?

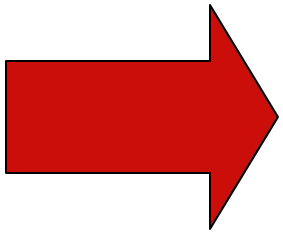
Different Approximations Lead to Different Forecasts

Forecast	Source	
December 2005	Deffeyes (U.S.)	Already
2006-2007	Bakhitari (Iran)	5 years
2006-2007	Simmons (U.S.)	
2010 +/-	Skrebowski (U.K.)	
2010	Campbell (Ireland)	
Before 2010	Goodstein (U.S.)	
After 2010	World Energy Council	5-15 years
2012	Weng (China)	
2016	Doug-Westwood (U.K.)	
After 2020	CERA (U.S.)	
2030 or later	EIA (U.S) / Exxon Mobil	> 20 years

PEAKING FORECAST RELATIVELY INSENSITIVE TO RESOURCE ESTIMATES

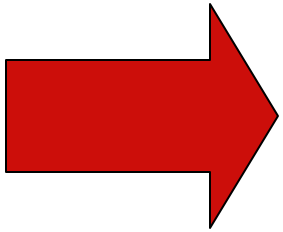
Already consumed worldwide: ~ One Trillion Barrels

Some estimates of remaining world reserves = One Trillion Barrels



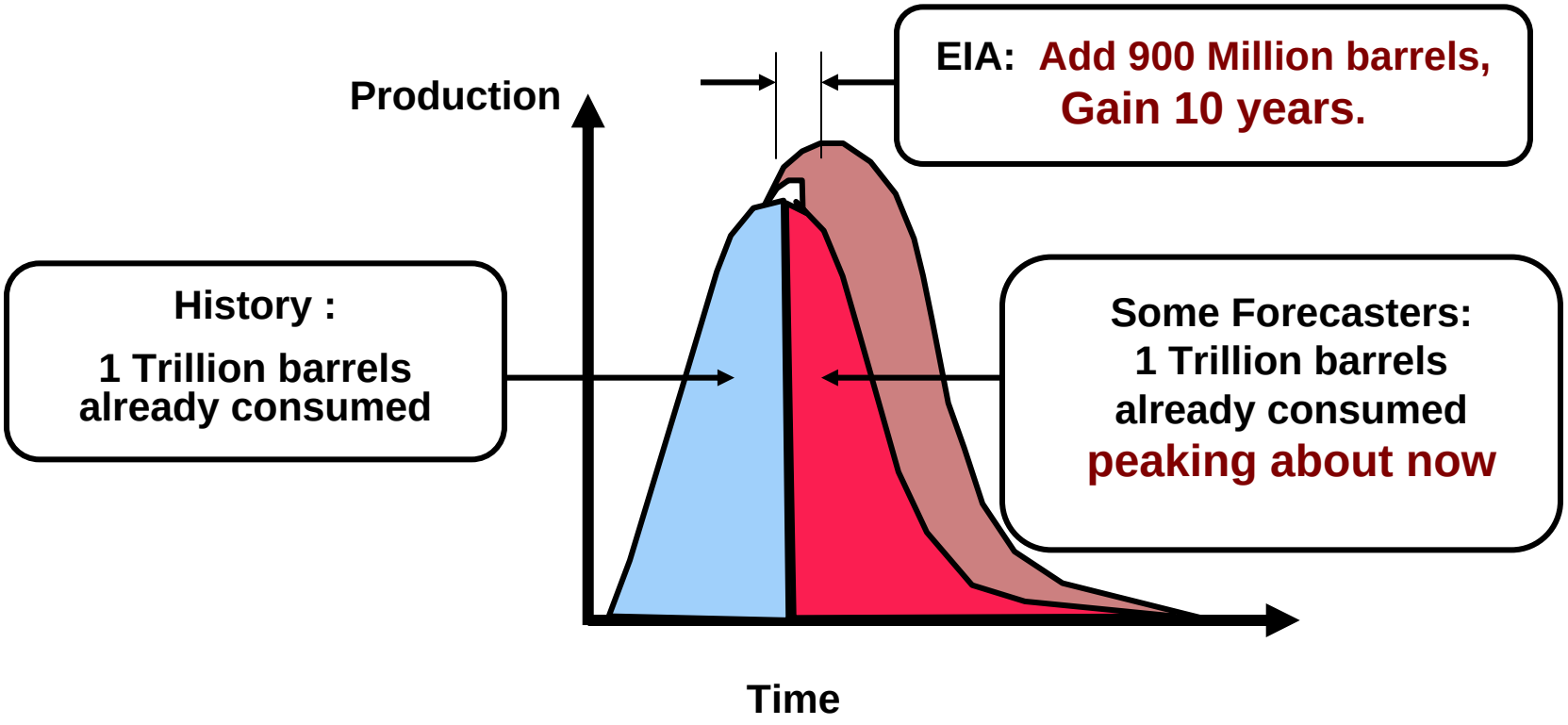
If so, world oil peaking is about now.
[50% of total]

Others estimate remaining world reserves = Two Trillion Barrels



EIA: "(Our) results are remarkably insensitive to … alternative resource base estimates… **adding 900 Bbbl** more oil …**only delays the estimated production peak by 10 years."**

ADDING ALMOST A TRILLION BARRELS GAINS ONLY 10 YEARS



PEAK OIL AND NATURAL GAS

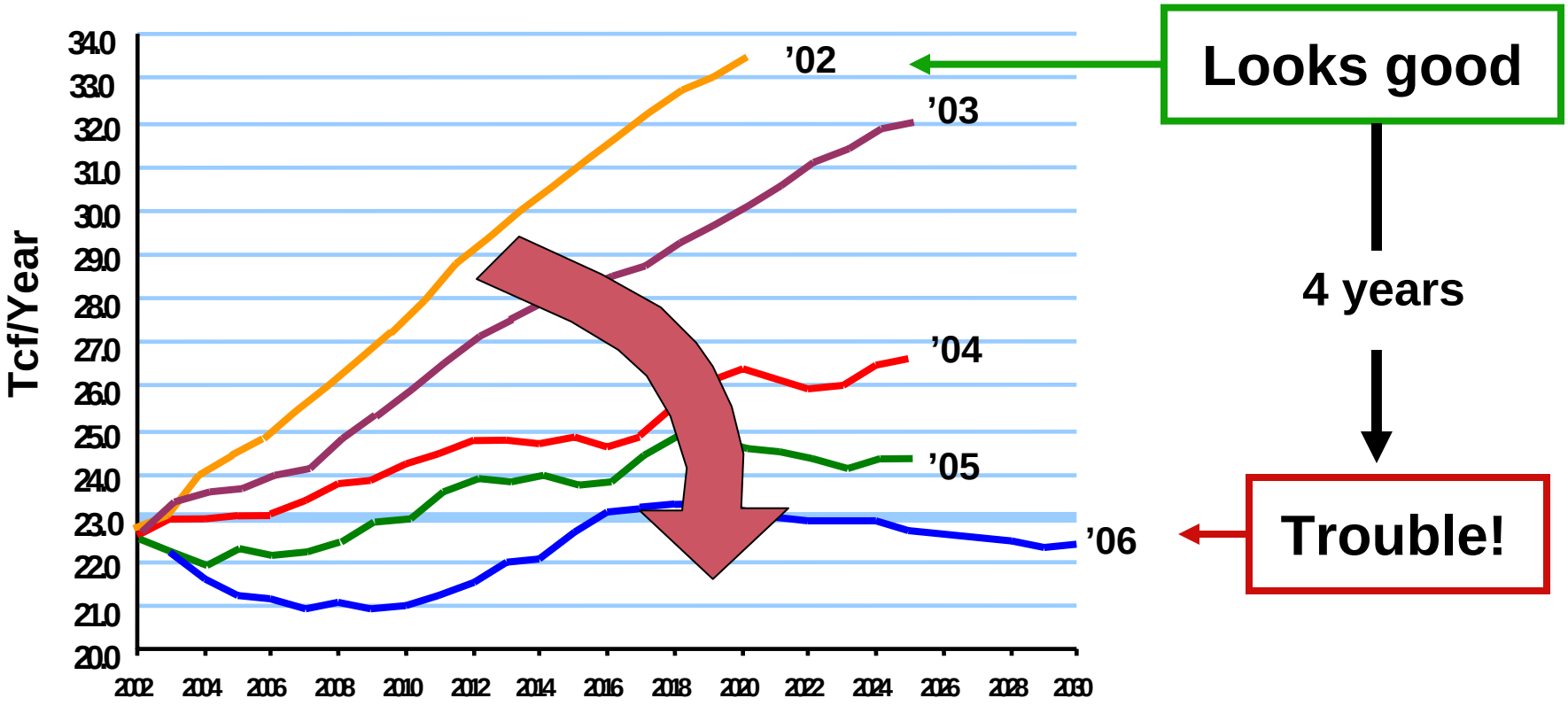
- Peak oil – properly defined – must be seriously considered
- Prices, technology, and new supplies are important, but world demand is simply outstripping supplies of conventional oil
- Even an additional 1 trillion barrels of oil only buys us 10 years
- Mitigation options (transportation efficiency, alternate fuels, etc.) will require decades and trillions of $
- Consequences of failure to anticipate peak oil can be severe

NATURAL GAS TO THE RESCUE?

- Some analyses rely on natural gas to fill the gap
- Many have erred on U.S. and North American NG production, and past NG forecasts have been revised downward
- More recent NG forecasts need to be assessed
- Estimating techniques have improved, but difficulty of estimating future supply & demand has increased
- Adverse impacts could be severe

RECENT NG SUPPLY FORECASTS REVISED DOWN

DOE EIA Forecasts of N. American Natural Gas Supply to U.S.

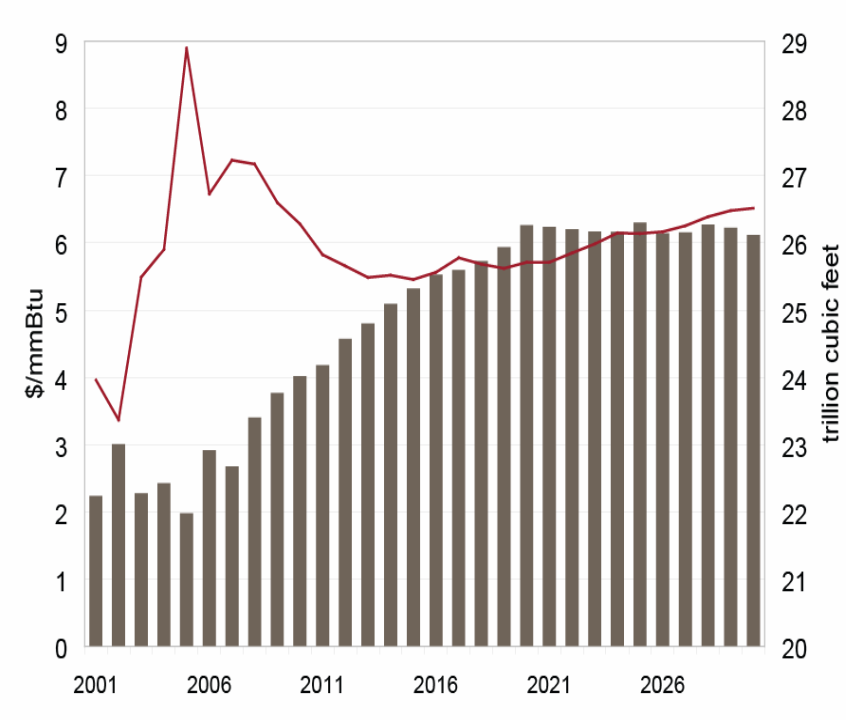


Forecasting Oil & Gas Supply Is Difficult!

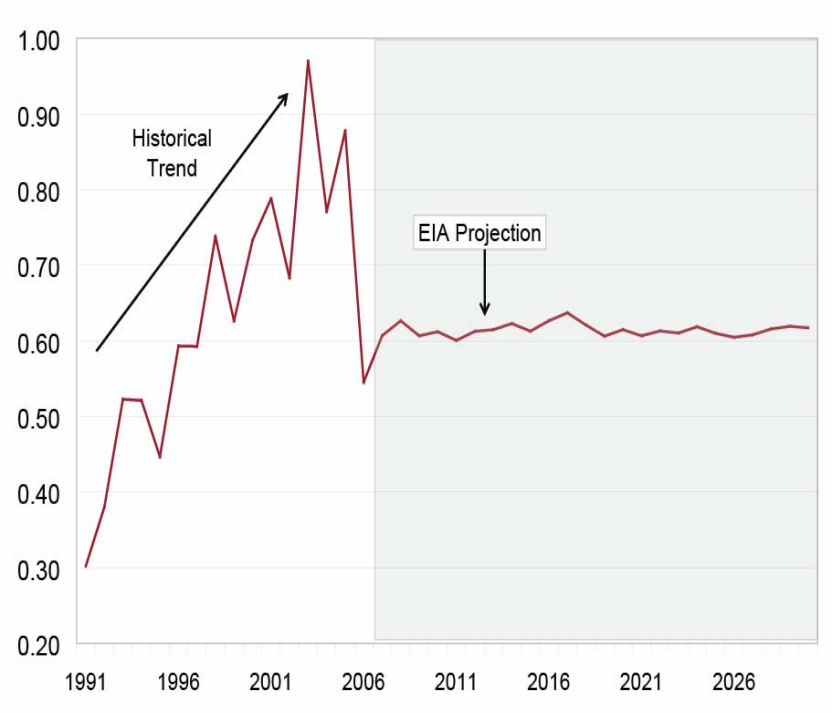
ASSUMPTIONS NEED TO BE ASSESSED

- NG prices forecast to decline but: 1) U.S. production increases for next 15-18 years, then stabilizes; 2) Demand increases modestly
- Assumes that, in a tight global market for petroleum, U.S. can increase LNG imports at prices 40% below oil-equivalent

Henry Hub Cash Price (left axis) vs. U.S. Total Natural Gas Consumption

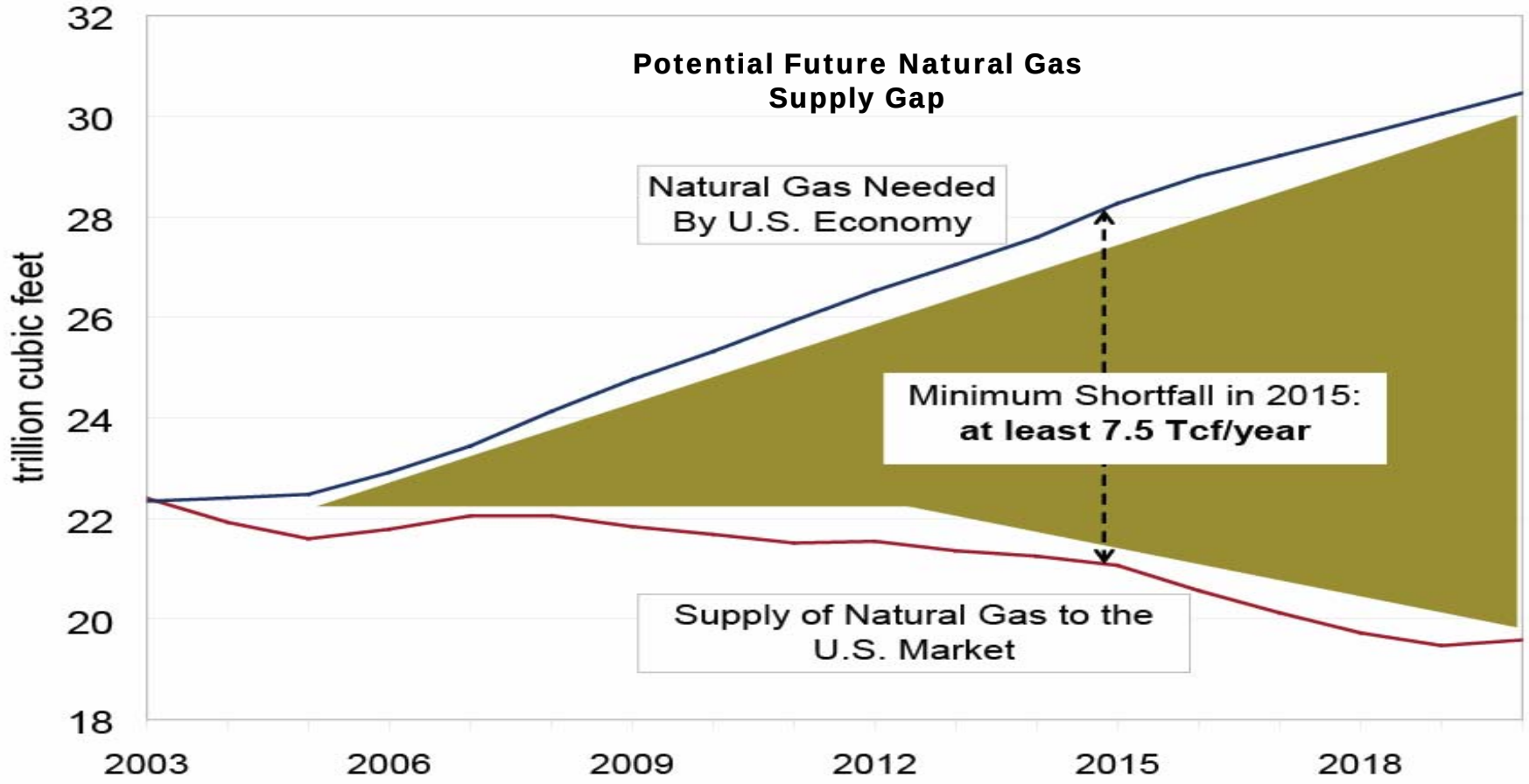


Natural Gas-Crude Oil Price Ratio ($/mmBtu), AEO 2007 vs. historical



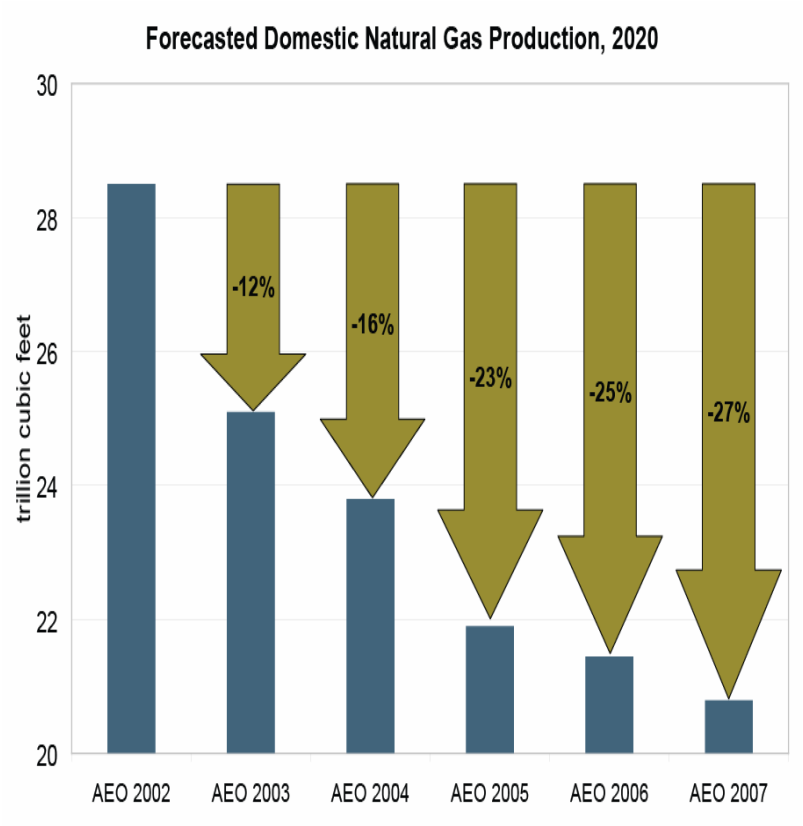
FUTURE U.S. NATURAL GAS PROBLEMS?

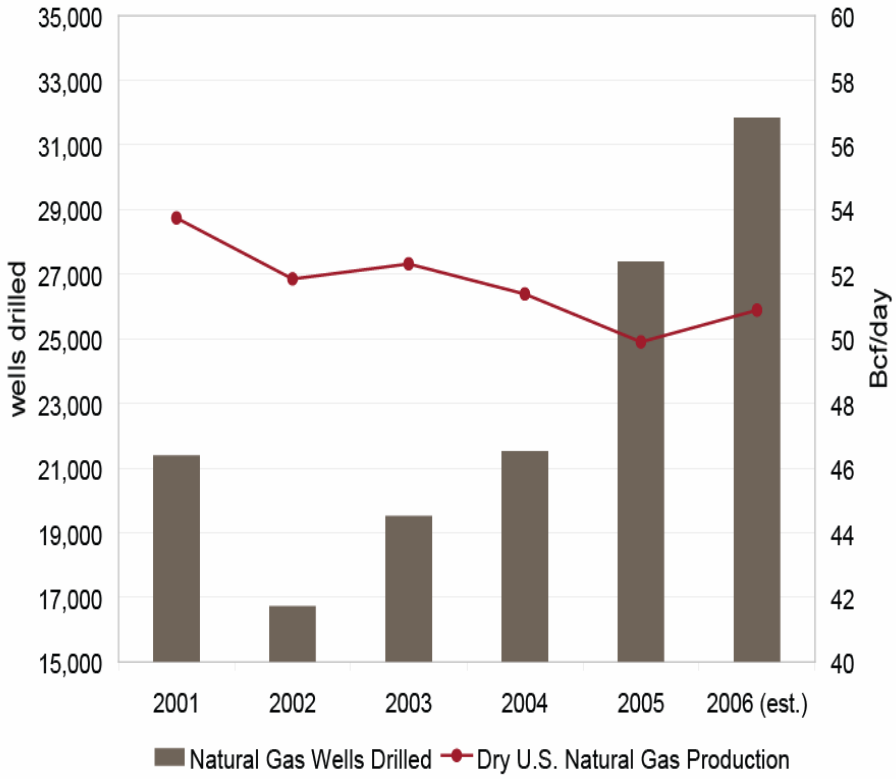
- Risk that NG needed by U.S. economy may exceed forecasts
- Price increases may be required to balance supply and demand



U.S. NG PRODUCTION HAS HIT A WALL

Past 6 years, U.S. drillers have greatly ramped up drilling, with little impact on production





- EIA has reduced estimate of future production every year
- Are further reductions warranted?

CANADIAN NG PRODUCTION

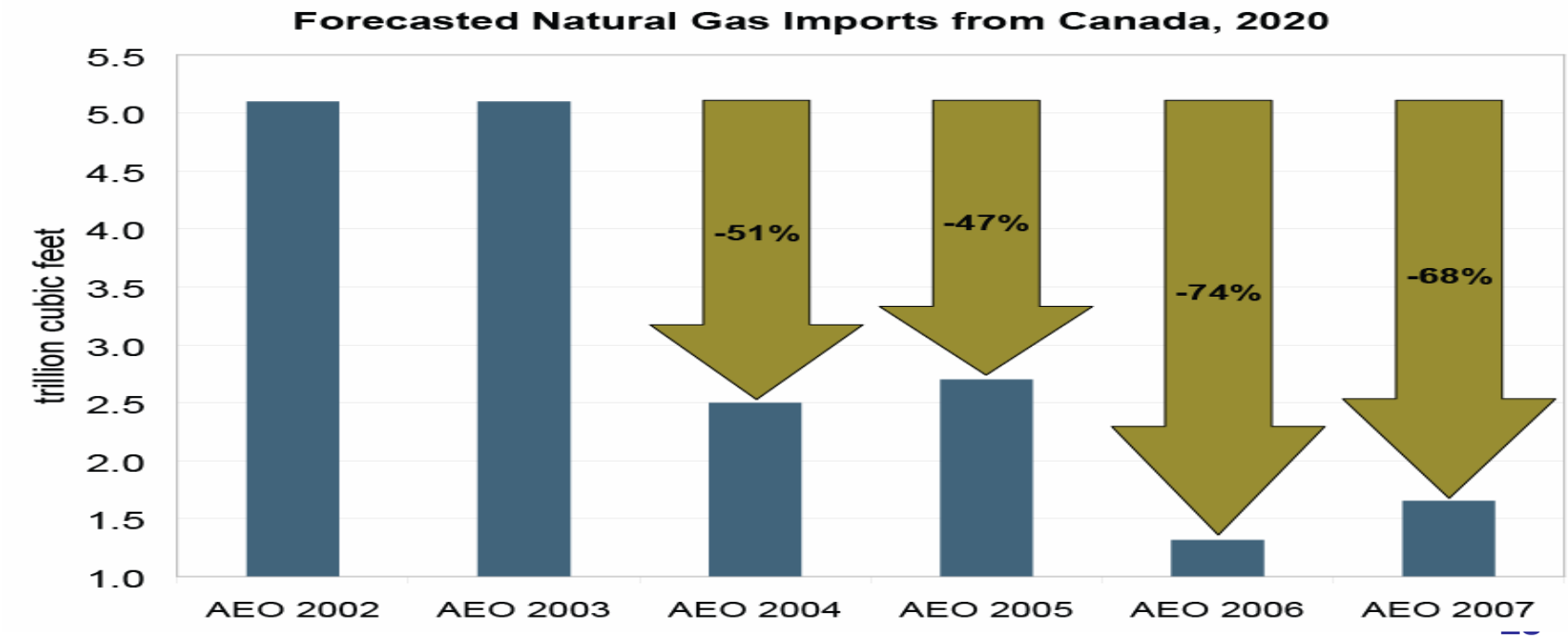
Canadian imports likely to decline precipitously -- single greatest problem facing U.S. market

Production already falling rapidly:

-- Production in Western Canada has plateaued

-- Decline in Canadian drilling rate

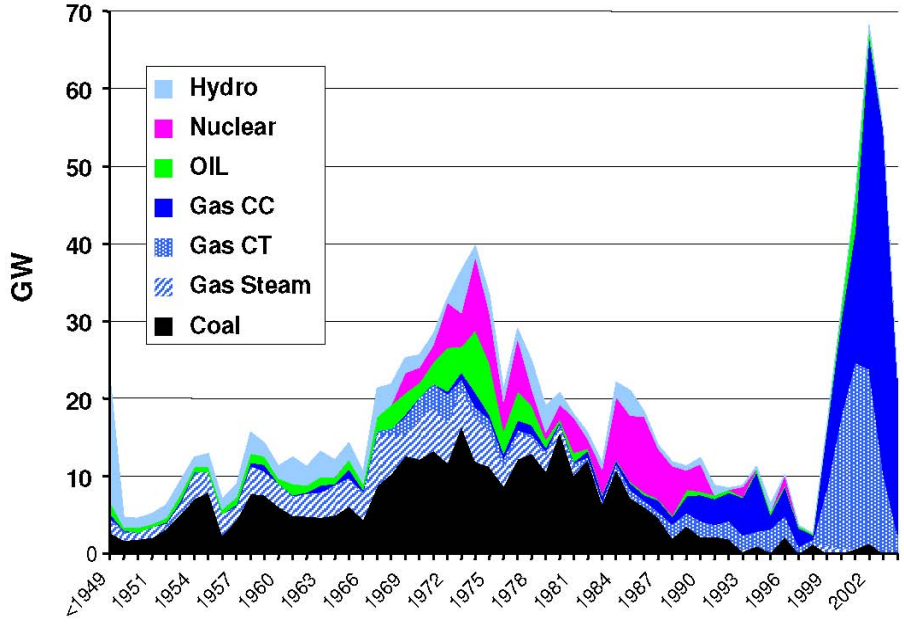
-- Increased demand for oil sands production



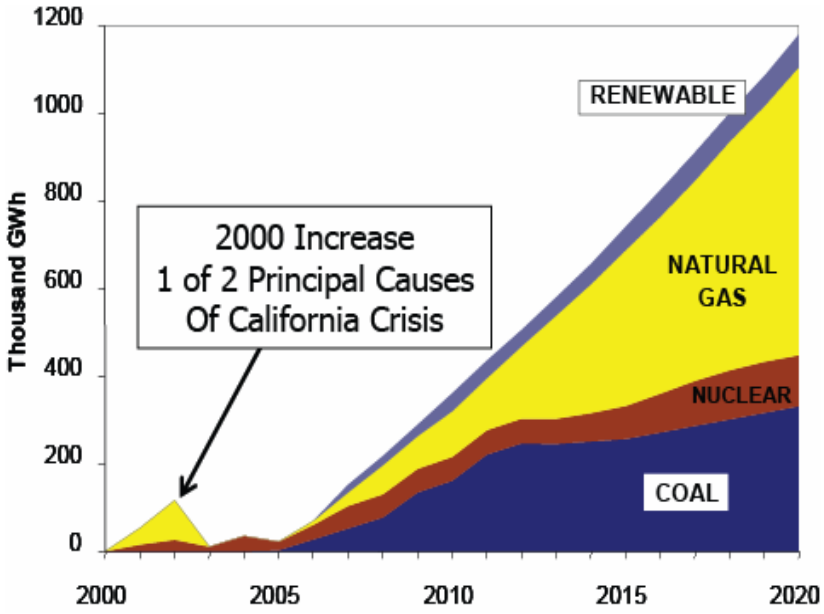
POWER SECTOR IS THE KEY

- U.S. dependent on gas-fired generation to meet high percentage of incremental power demand
- Are we underestimating likely growth in power sector demand?

Electric Generation Capacity Additions by Fuel Type



Dependence Upon Gas-Fired Generation Likely to Continue to Grow



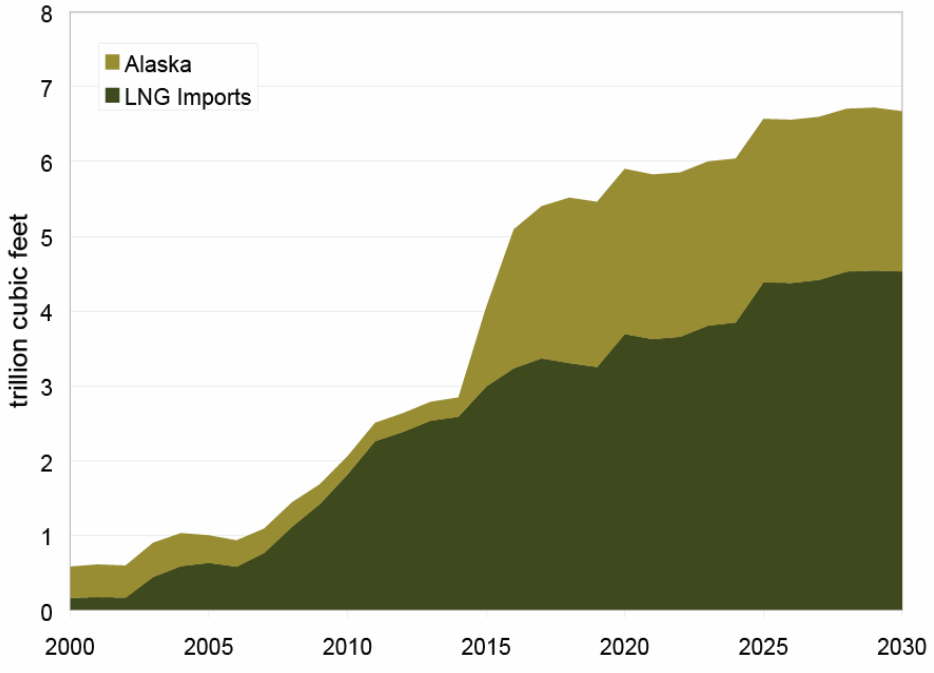
A ROSY SCENARIO?

Nearly all of incremental U.S. supply is expected to come from just two sources: 1) Alaskan NG pipeline by 2018; 2) Massive increase in LNG imports

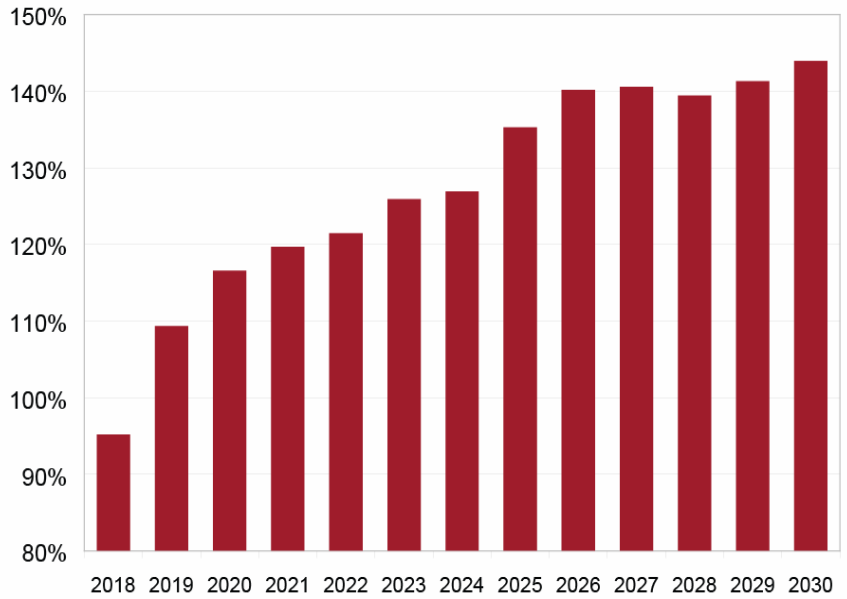
-- But there are serious risks and uncertainties to both

-- Until Alaska NG pipeline, **we are dependent on imported LNG**

Total Supply to U.S. from LNG Imports and Alaska



Projected Incremental Supply from Alaska Pipeline and LNG, as percentage of Increase in Total Projected Natural Gas Supply

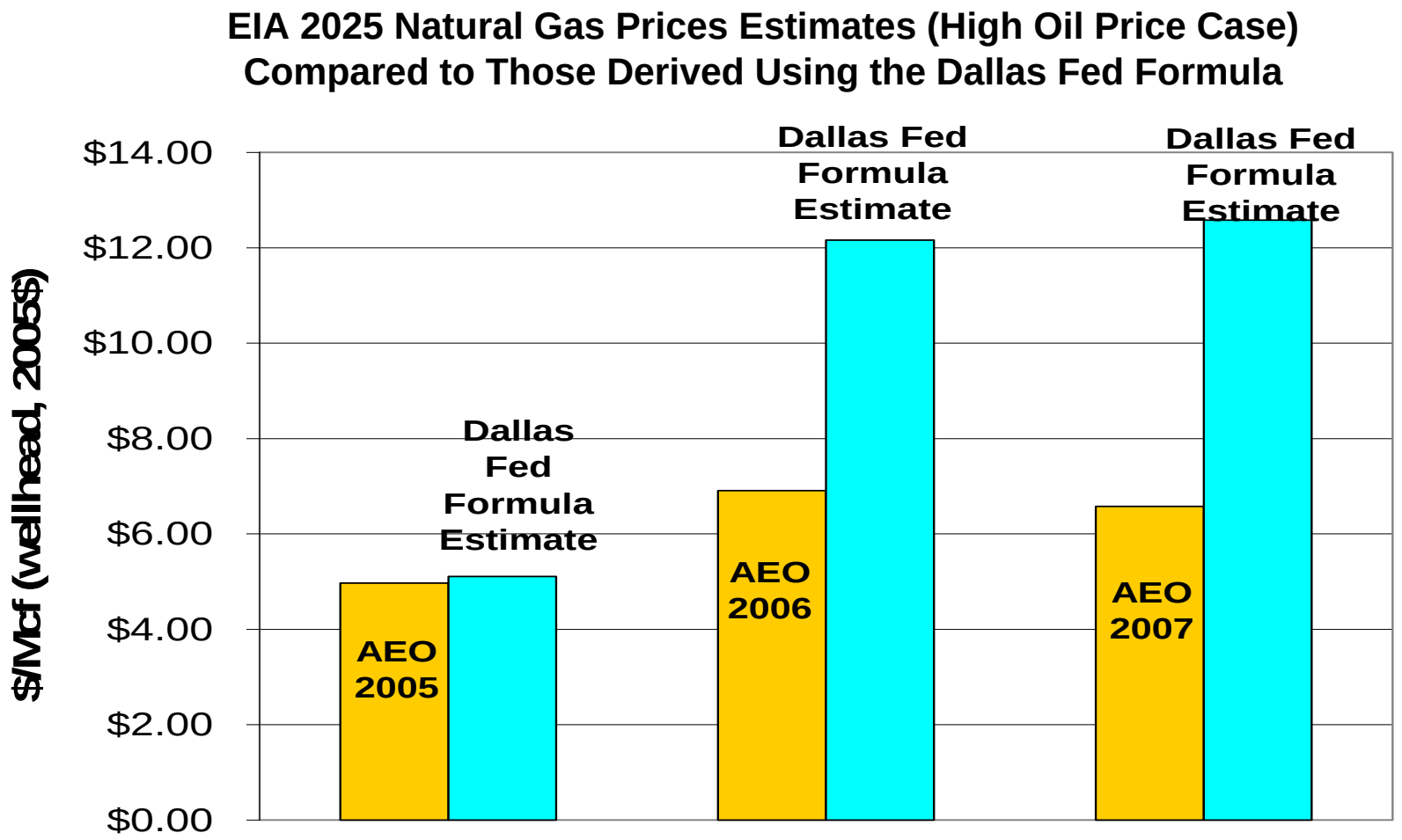


DO EIA'S NG PRICE FORECASTS NEED TO BE EVALUATED?

- **Beginning with AEO 2006, EIA implicitly decoupled the forecast relationship between oil and natural gas prices**
- If it had not decoupled the relationship, the forecast NG prices in AEO 2006 and AEO 2007 would be much higher
- **This could have important consequences for energy markets and infrastructure**
- Using regression analysis and monthly data, the Dallas Federal Reserve Bank estimated the historical relationship between natural gas prices
- Use of the Dallas fed regression formula yields higher forecast NG prices

IMPLICATIONS OF DECOUPLED NG AND OIL PRICES

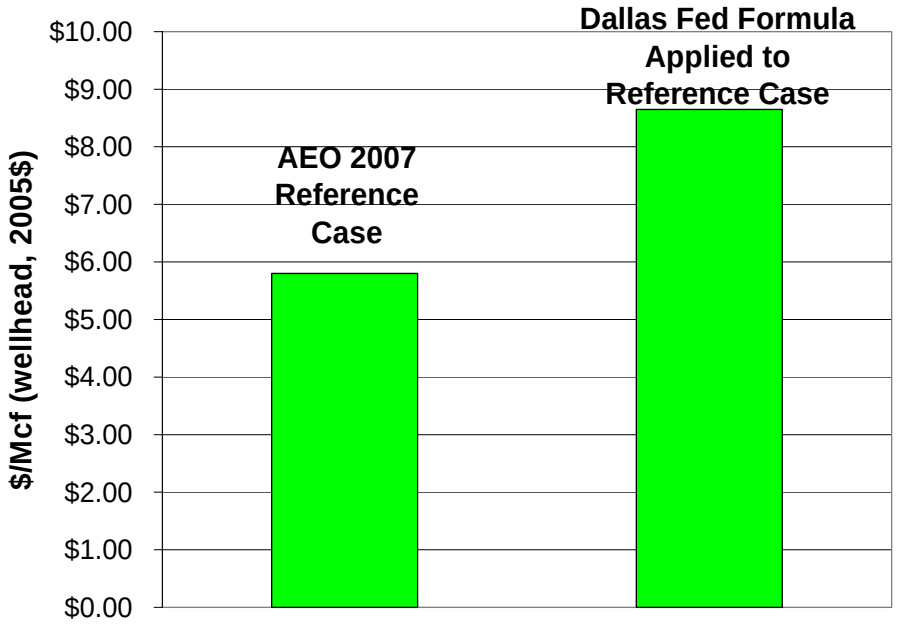
If prices had not been decoupled, AOE 2006 and AEO 2007 forecast NG prices would be higher



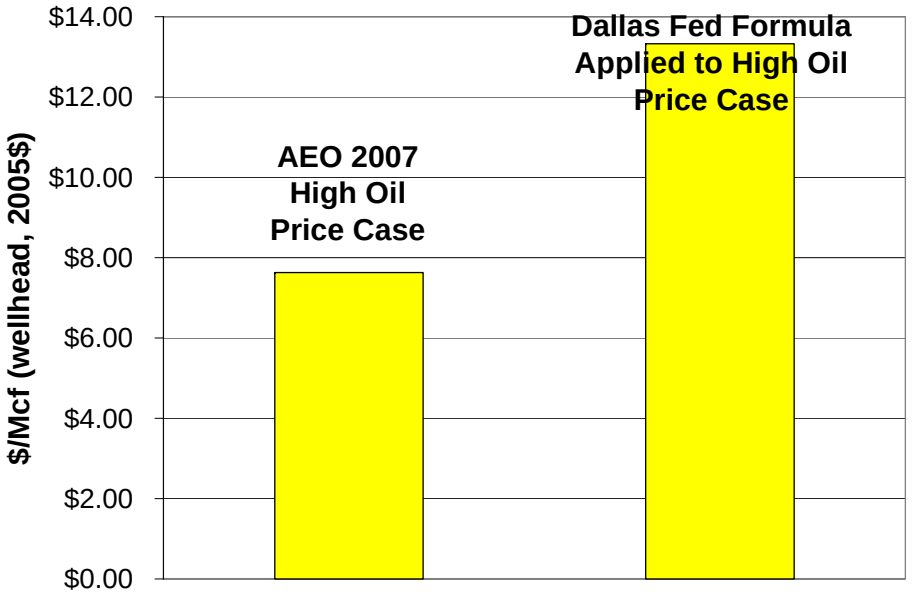
IMPLICATIONS FOR FORECAST 2030 NG PRICES

Applying the Dallas Fed formula to the **AEO 2007 reference case** oil price indicates that there is a **50% difference in the implied NG price**
Applying the formula to the **AEO 2007 high oil price case** oil price indicates that there is a **75% difference in the implied NG price**

Discrepancy in Potential AEO 2007 2030 Natural Gas Price Forecasts
(Reference Case)



Discrepancy in Potential AEO 2007 2030 Natural Gas Price Forecasts
(High Oil Price Case)



SUMMARY

- **EIA work is critical**: They have large resources and a huge responsibility
- Planning for our economic well being is dependent on them covering the range of variables and risks at this very challenging time in our energy development
- **We cannot afford to ignore, ridicule, or downplay the possibility and the consequences of peak oil** – risks are too great
- When oil does peak, there are no silver bullet solutions
- Reliance on adequate future supplies of NG at moderate prices is unwarranted and risky
- **U.S. NG production has peaked and this has implications as significant as those of U.S. oil peaking four decades ago**

THANK YOU!

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