

# Modeling Supply: Capturing Above- and Below-Ground Factors



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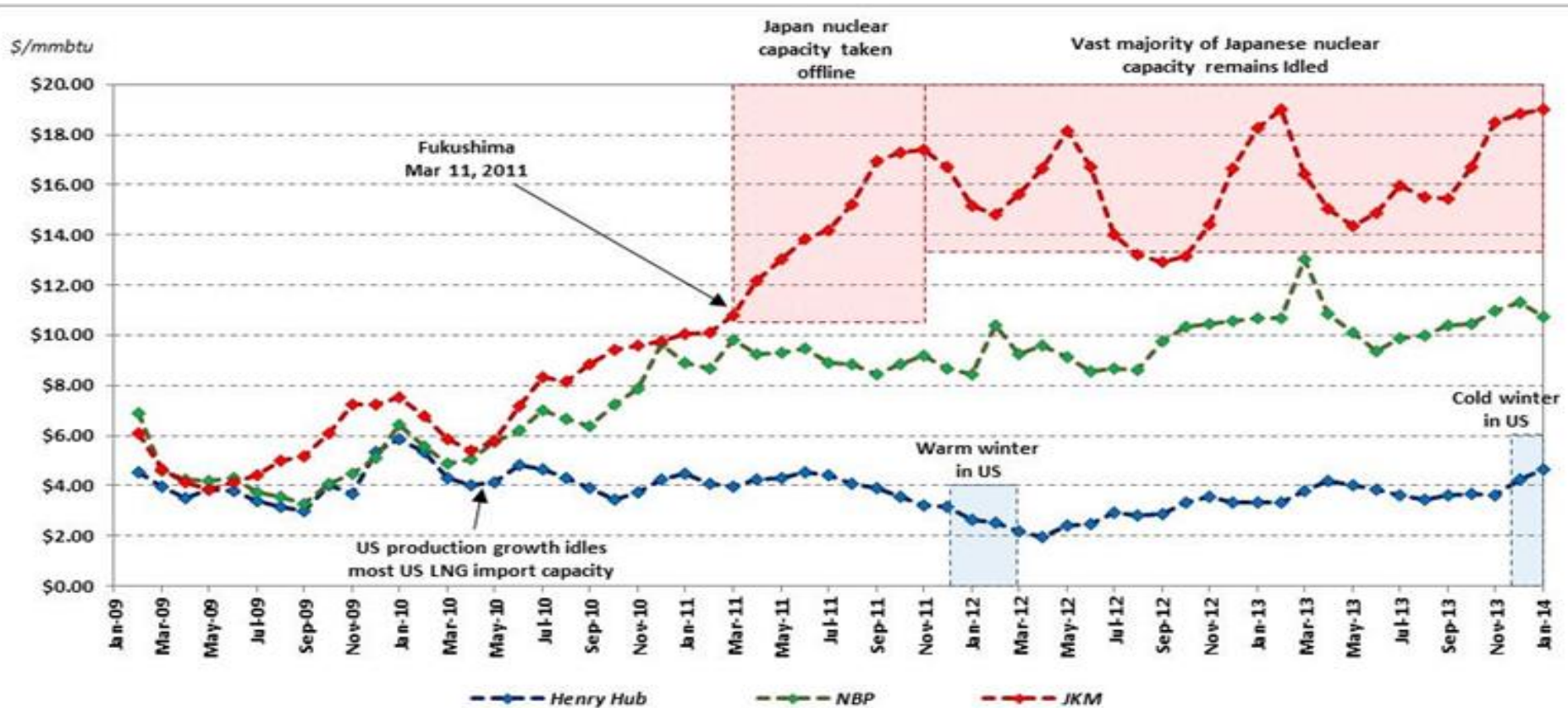
## Point 1

**You cannot separate the upstream from the midstream and downstream. Capital investments in the midstream are necessary to facilitate profitable investment in the upstream, and demand pull sets the stage for resource development. So, an integrated modeling approach is best, particularly when:**

- **demand is modeled by sector and by fuel**
- **supply is characterized as an investment**
- **infrastructure investments are modeled.**

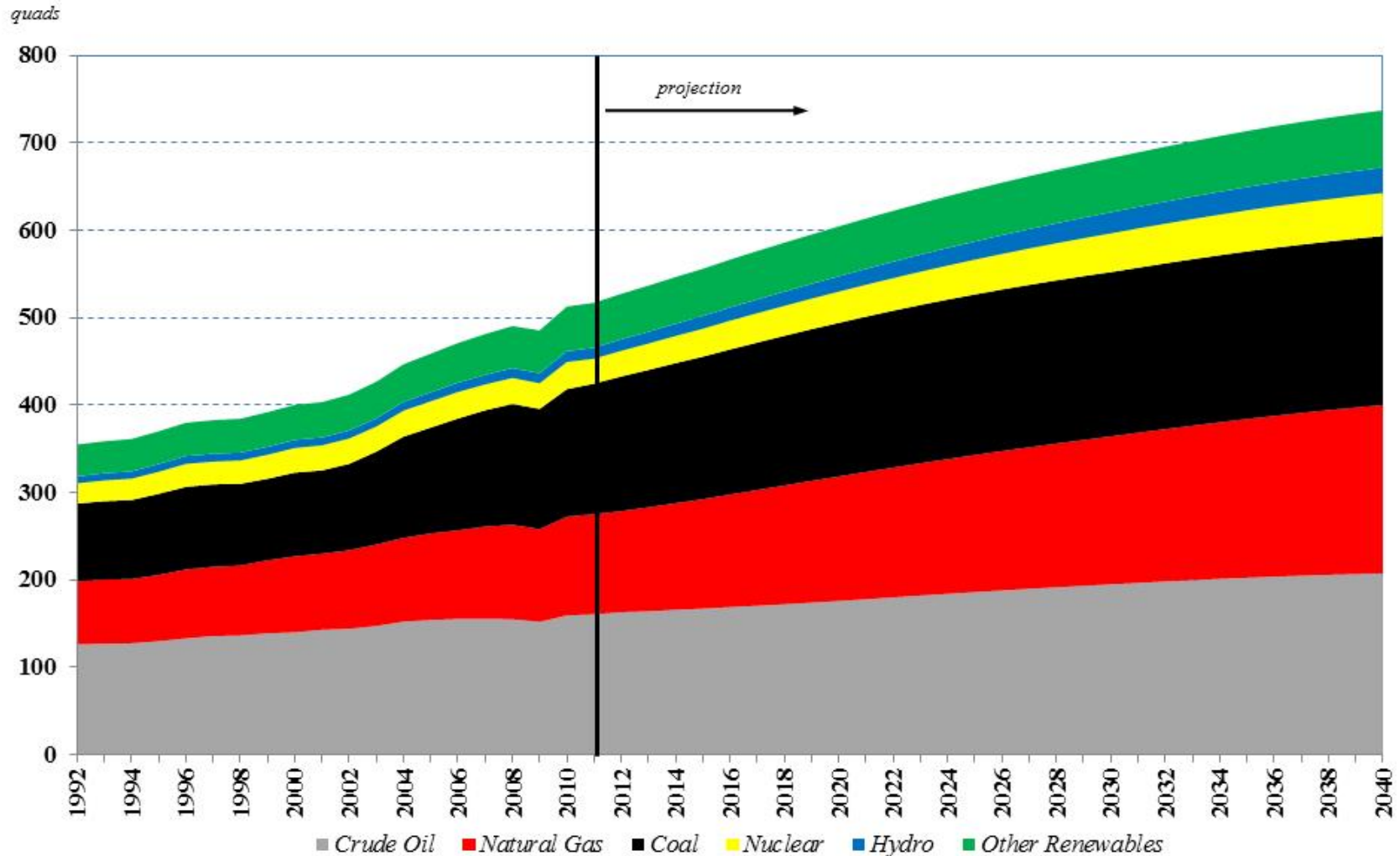
## Realized Constraints Distinguish the Short Run and Long Run: International Gas Prices

- Constraints drive short run pricing differentials, but infrastructure development that facilitates new supply can be equally transformative



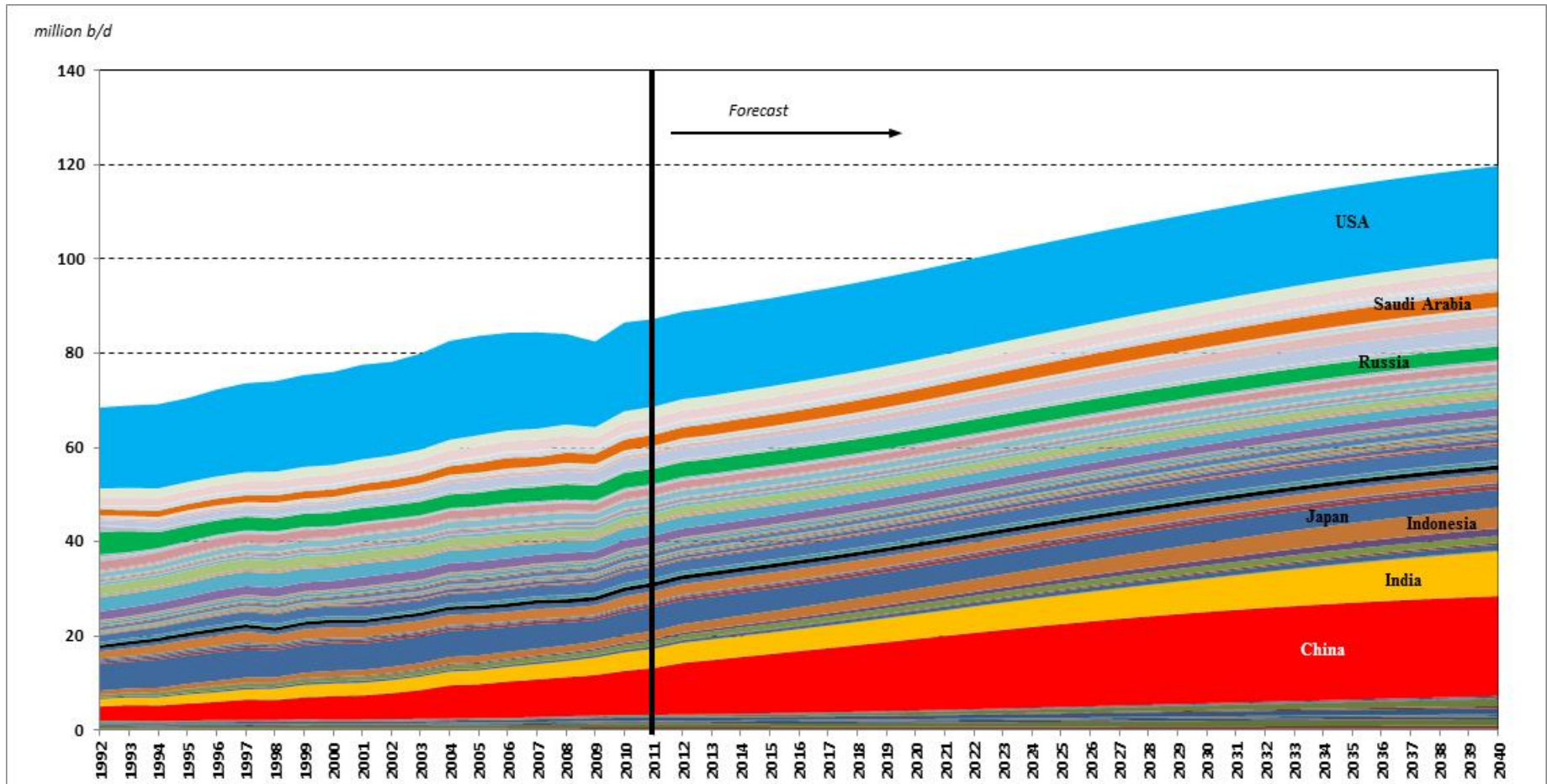
## Demand Pull: TPER

- Baker Institute CES forecast of TPER by fuel, 1992-2040



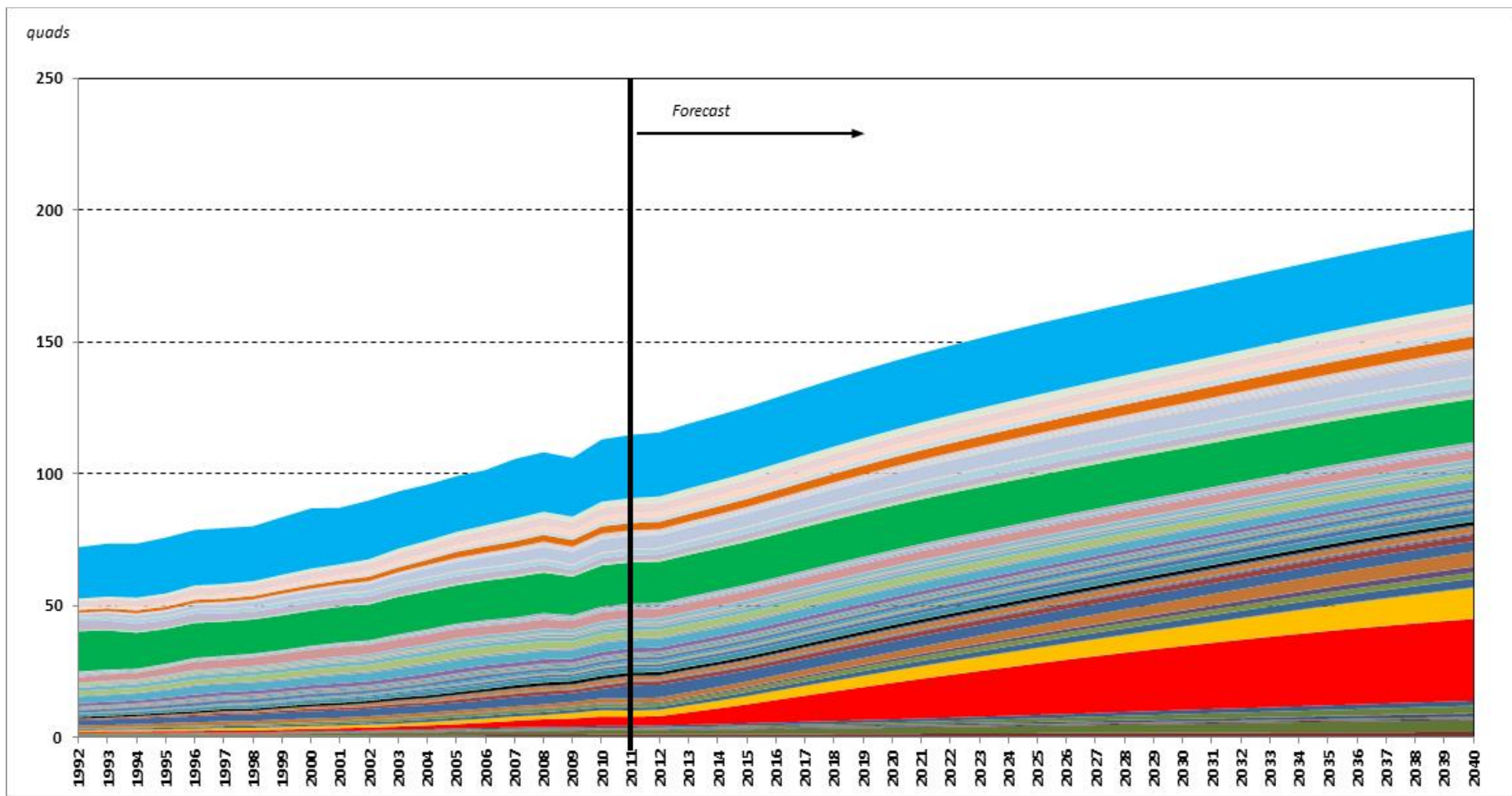
# Primary Oil Demand

- Baker Institute CES forecast of petroleum demand by country, 1992-2040
- Demand will continue to grow, driven largely by very populous developing economies such as China and India.



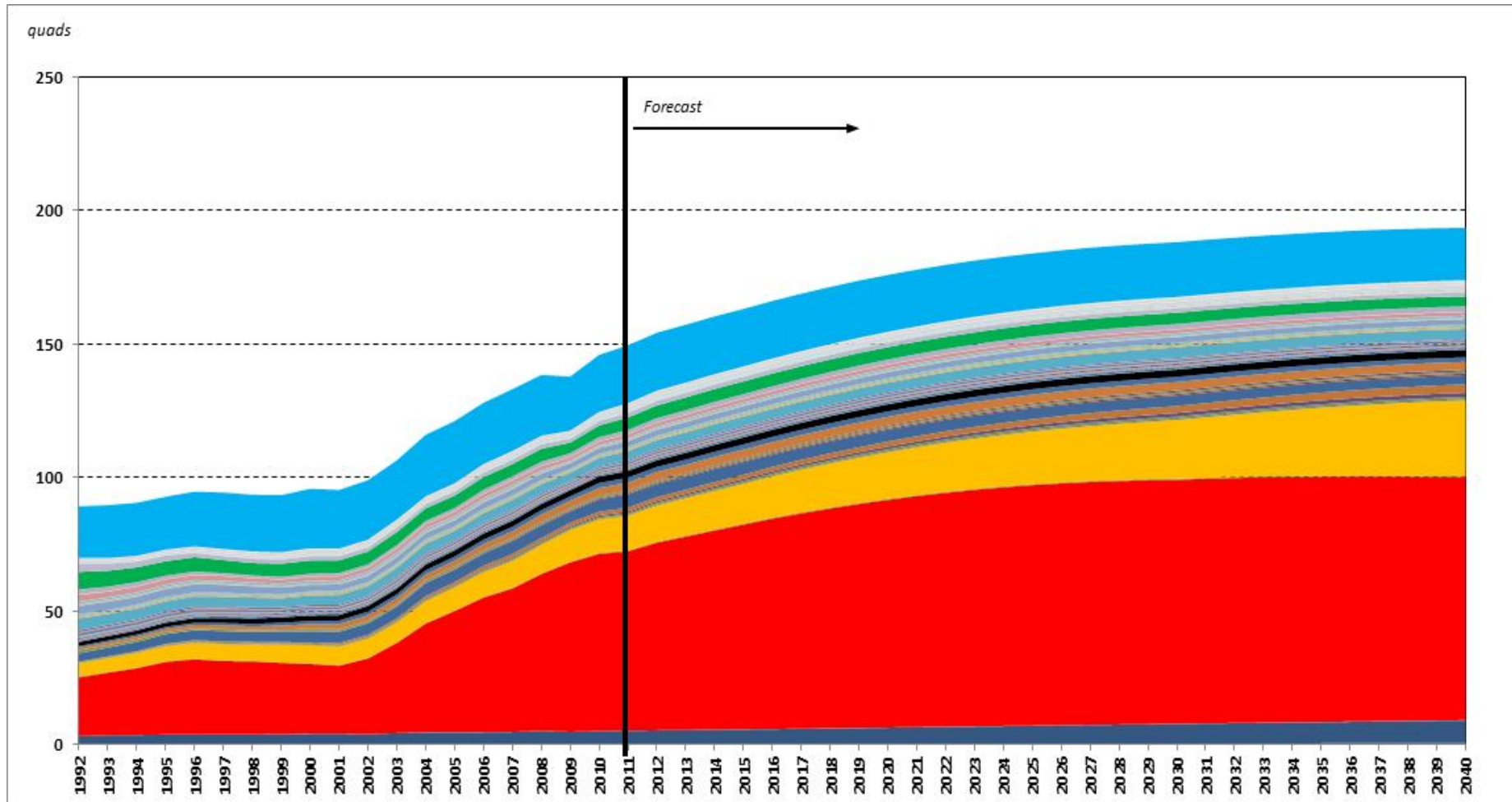
## Primary Natural Gas Demand

- Baker Institute CES forecast of natural gas demand by country, 1992-2040



## Primary Coal Demand

- Baker Institute CES forecast of coal demand by country, 1992-2040



## Point 2

**Resource assessments are a must, but resources are merely a *necessary* condition for resource development activity. Regulatory institutions, market structures, depth of service industries, well development costs, well performance, etc. dictate *sufficiency*.**

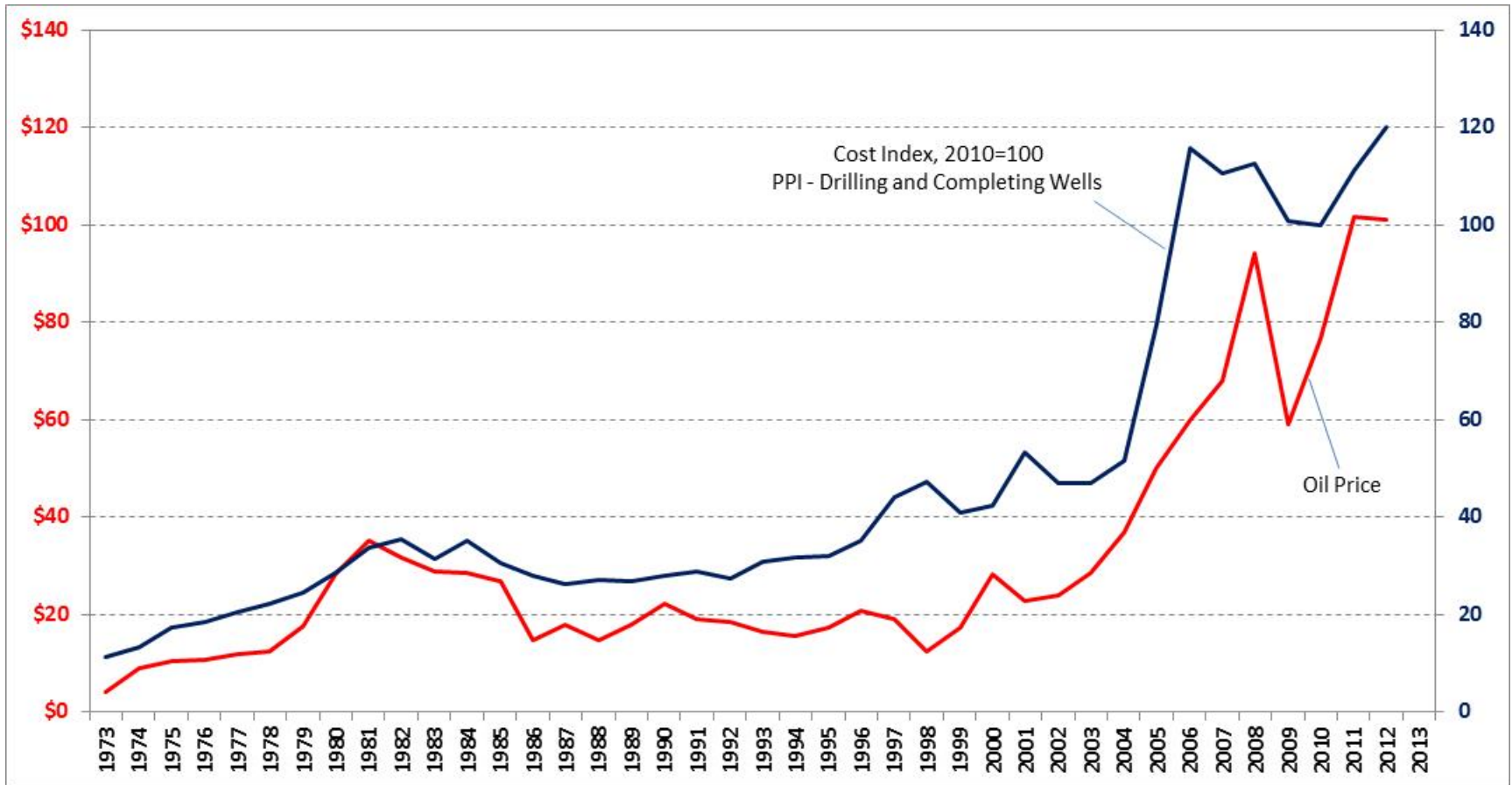


## Point 3

**The current cost environment must be reconciled with a long term view of costs**

## Price versus Cost

- The price of oil and the cost of development tend to move together.



Source: EIA, BEA

## Point 4

**Different market and regulatory institutions can convey different costs**

## Point 5

**Fiscal terms and local content requirements must be factored into any analysis of the local supply potential**

## Point 6

**The depth of support industries must be considered when distinguishing regional supply potentials**

## **Example: What are the foreign opportunities for shale? Is the US is Unique.**

- Key regulatory and institutional features
  - **Resource Access**
    - mineral rights ownership and acreage acquisition
    - resource assessments
    - environmental opposition
  - **Market Institutions**
    - transportation regulations (unbundled access vs. incumbent monopolies)
    - bilateral take-or-pay obligations vs. marketable rights
    - competitive upstream environment
    - existence of infrastructure
    - existence of a well-established service sector
    - transparent pricing paradigm

## Other relevant issues ...

- Many other issues confront resource development, and each affects different regions in different ways.
  - **Water**
    - use in production
    - water rights
    - flow-back options (recycling vs treatment)
    - concerns about watershed protection
  - **Other issues**
    - earthquakes related to injection of produced and treated water
    - methane emissions
    - ecological concerns over land use and reclamation

## Point 7

**Developing a long run view of supply amounts to first establishing a view of F&D costs, then using this to develop an assessment of the marginal cost of delivered supply (i.e. - a supply curve).**



## Point 8

**Supplies must be characterized with a relative degree of geographic, or play-level, specificity in order to stack competing supply opportunities against each other.**

## Point 9

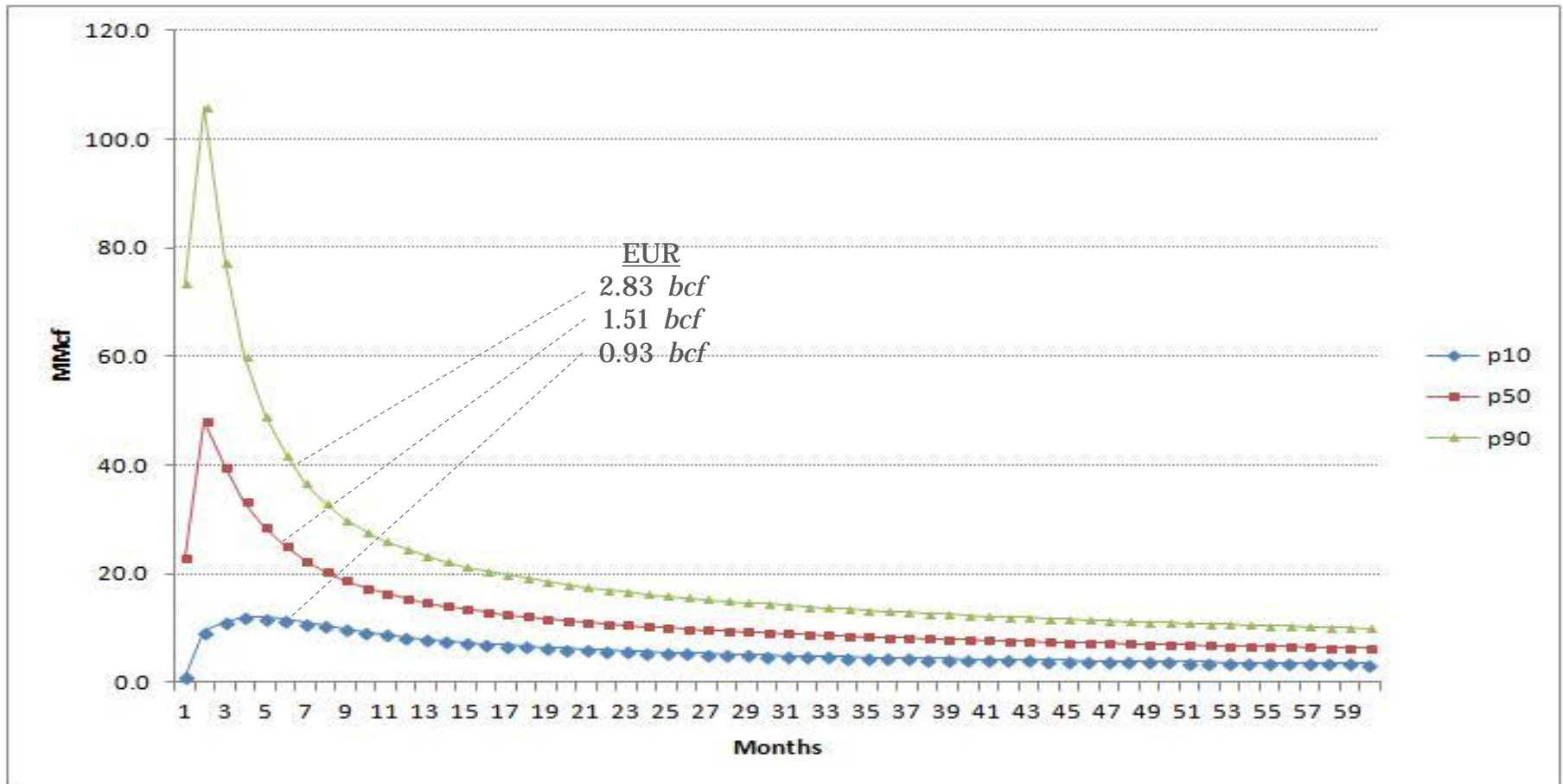
**Regional infrastructure detail must be sufficient to capture various constraints on the ability to move supplies to meet regionally distinct demands. Some resources may be transport-advantaged relative to others, even if they have a higher lifting cost.**

## Point 10

**Well characterization is important to establishing a distribution of possible EURs within a play. This, in turn, is important to determining the “breakeven” for wells drilled.**

## Example: Shale Well Performance

- Well-specific EURs can vary within a shale play substantially
  - Ultimately, profitability matters, as there is little debate about resource scale
  - Some wells are profitable at \$2.65/mcf, others need \$8.10... median is \$4.85.

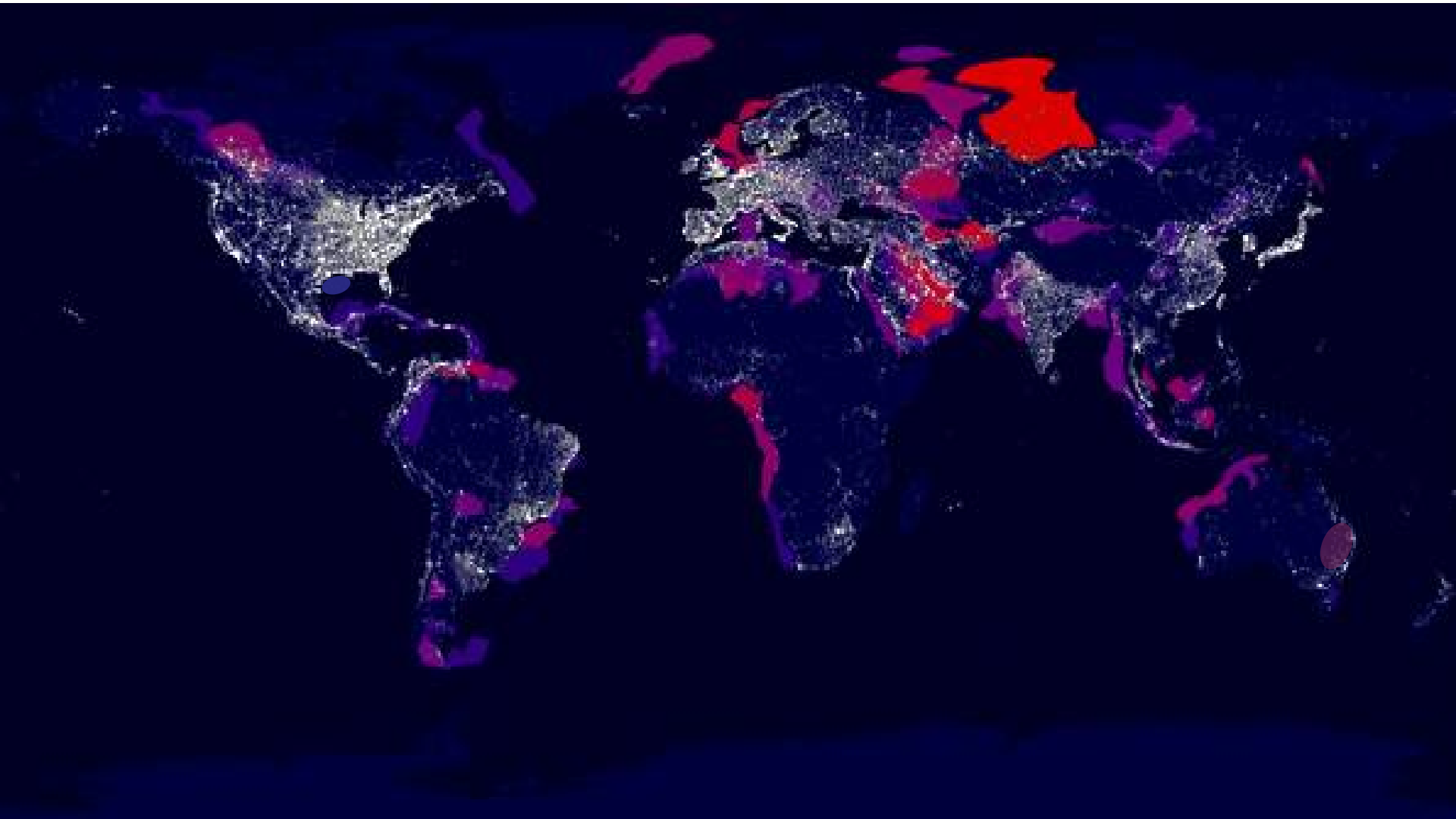


## Point 11

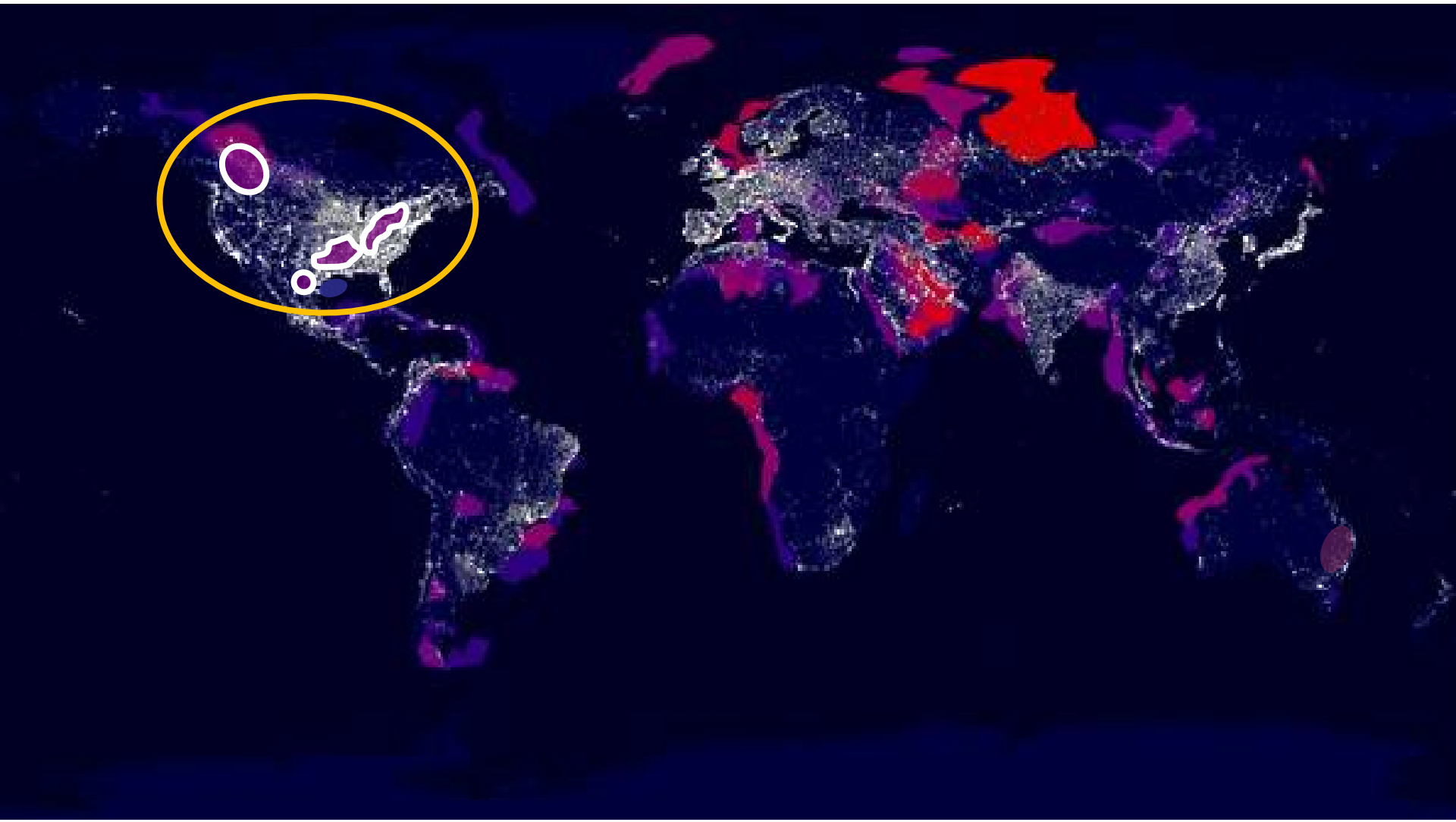
**Recognize any supply view is ALWAYS threatened by disruptive events and technologies. So, a view of technology and disruptive events is important to bracket any supply view.**

**Example: The natural gas market has been completely transformed over the past decade. At the center of the transition – shale gas in the US.**

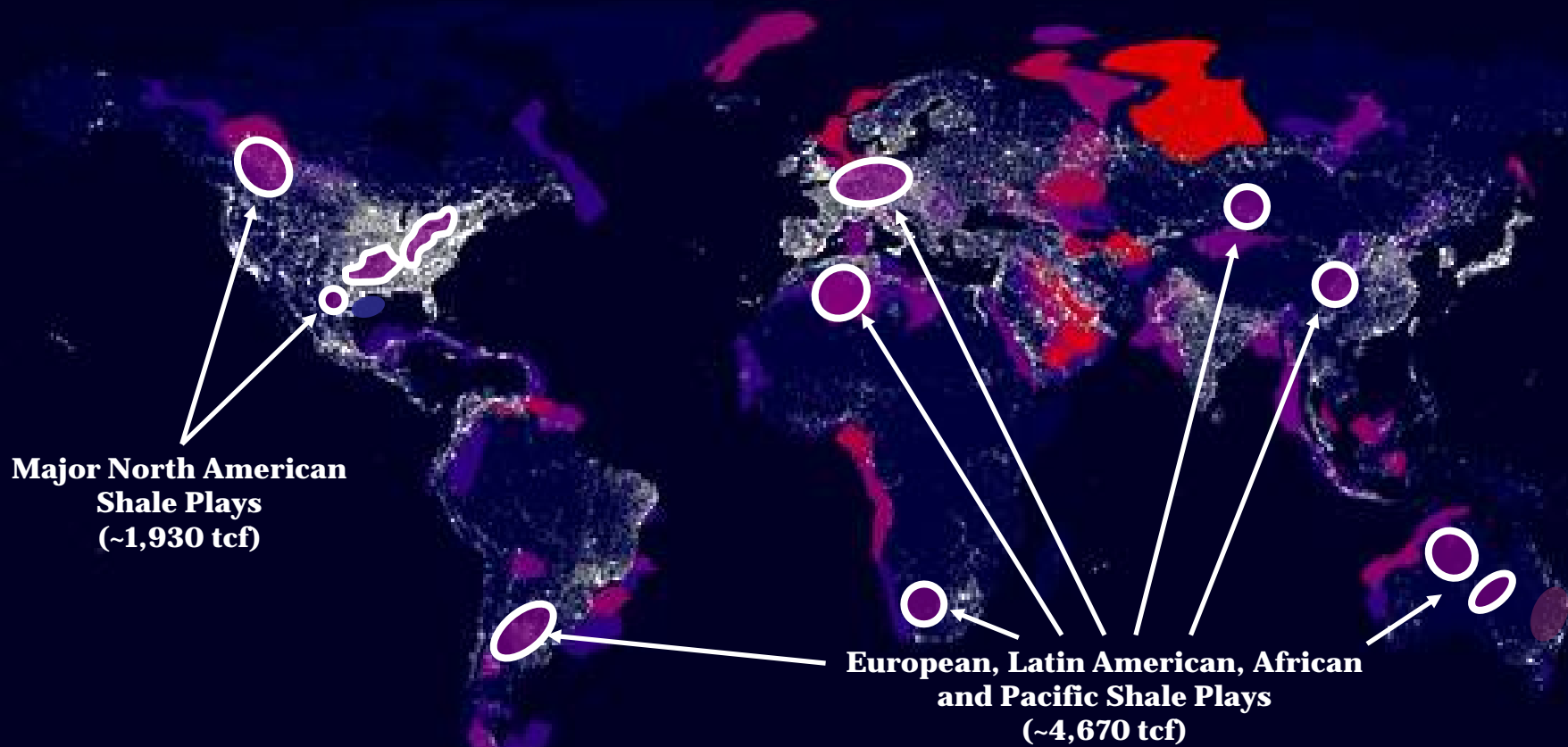
## **2003 – LNG is coming to North America**



## Then, shale happened in the US and Canada...



**... and we realized shale is everywhere\***



*\*Over 6,600 tcf of shale according to ARI report, 2011*



# Questions/Comments