

Update and Projections of North American Natural Gas Supply with NANGAS

Presented by

**U.S. Environmental Protection Agency
Clean Air Markets Division**

ICF Consulting

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Outline

- NANGAS Overview and Use by EPA
- Provisional Results
 - Supply Comparisons
 - Demand Comparisons
 - Price Comparisons
 - Summary of Differences
- Analytic Issue: Modeling LNG

NANGAS Overview

Resource Module

- 17,000 North American production reservoirs
- 23 Supply regions

Reservoir Performance Module

- Assesses individual reservoir performance and economics using type curve models and specific reservoir properties

Exploration and Production Module

- Decouples decisions on exploration/development/production

Demand/Transportation/Storage Module

- 4 end-use sectors
- Seasonal
- 17 demand regions
- Over 120 transportation links/corridors
- Includes over 500 storage sites

Production Accounting Module

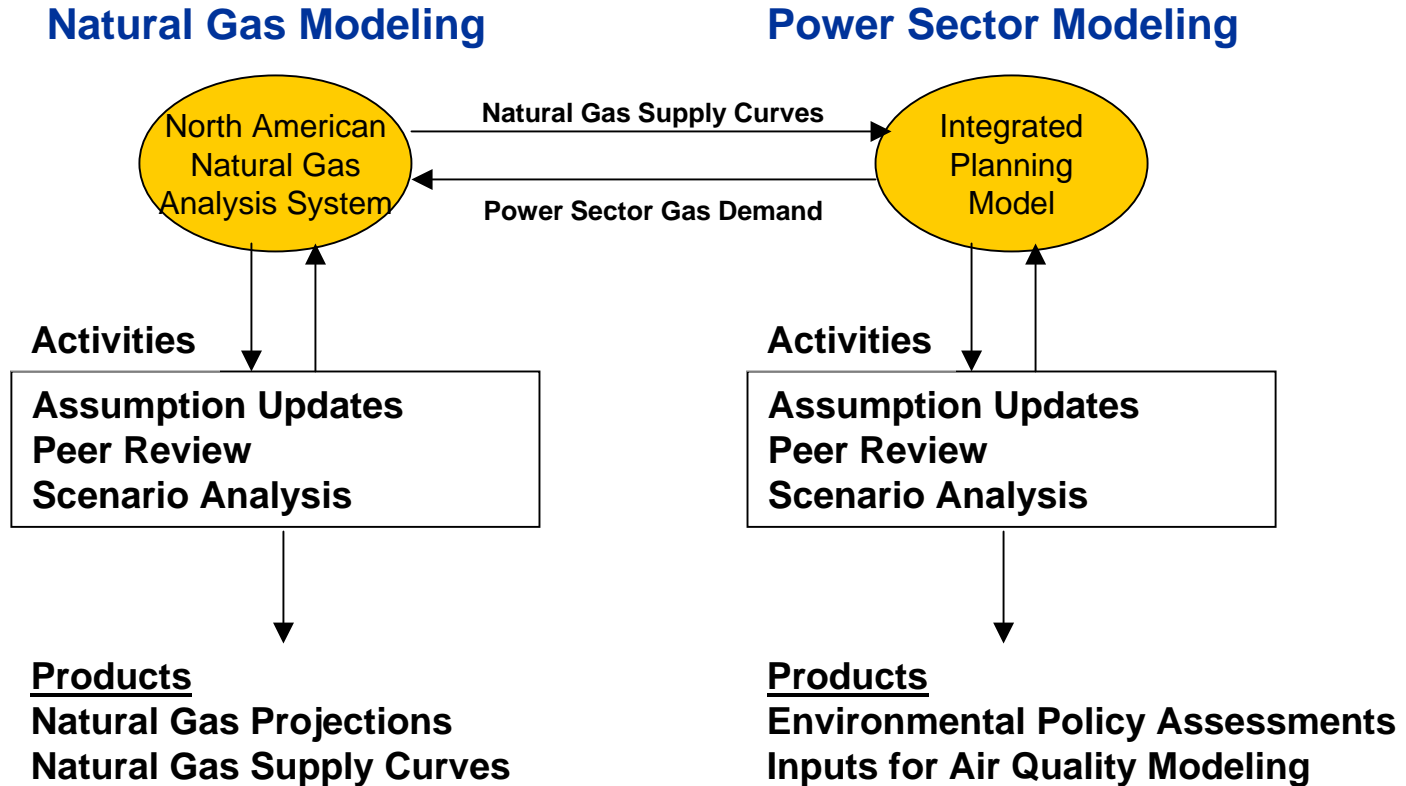
Final reporting by region, geologic play, state



North American Natural Gas Analysis System

- Developed and maintained by ICF Consulting, Inc. for use by private and public sector clients.
- Large-scale dynamic linear program to model economic decision making
- Minimizes total costs of meeting demand over 25 years
- Used to examine strategic issues relating to supply, pipeline infrastructure, pricing, adequacy, and demand characteristics.

How EPA Uses NANGAS



Updates in Response to Peer Review

- **Resources**

- Upgraded undiscovered resource data consistent with latest (2000-2003) studies conducted by USGS, AAPG and other publicly available data.
- Reclassified plays and resources: reducing tight resources and increasing coalbed resources.
- Re-grouped undiscovered reservoirs into smaller field size classes
- Reduced permeability values consistent with correlations (porosity/permeability correlation)
- Well spacing reduced
- Reduced thickness of some new plays
- Coal properties were changed to match different characteristics affecting coal bed methane production in different parts of the country

- **Cost of Capital**

- Separate rate of return for development drilling (12%) and exploration drilling (15%) to reflect exploration's higher risk

Updates in Response to Peer Review

- **E&P Technology**

- Updated E&P technology parameters (improved completion technologies; reduced length of horizontal well and fracturing length). Overall, E&P technology effects were reduced

- **LNG Assumptions**

- Updated LNG import assumptions given recent company announcements and other publicly available data

- **Arctic Supplies**

- Updated assumptions for Arctic gas – increased L-48 price threshold; revised availability date based on current expectations (Alaska North Slope in 2013 and Mackenzie Delta in 2008)

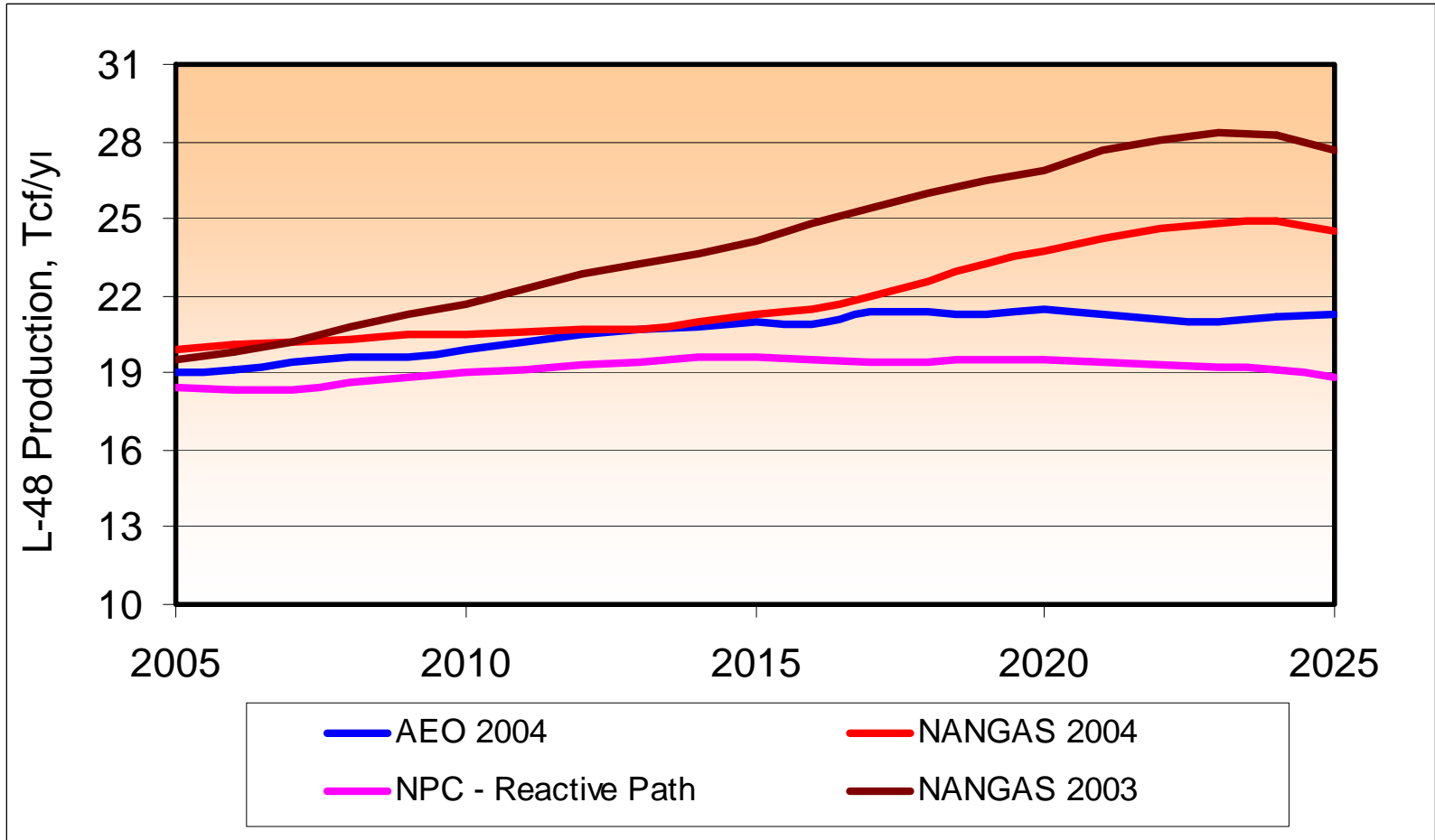
- **Industrial Demand**

- Price elasticity being incorporated in the model, Feedstock demand reduced

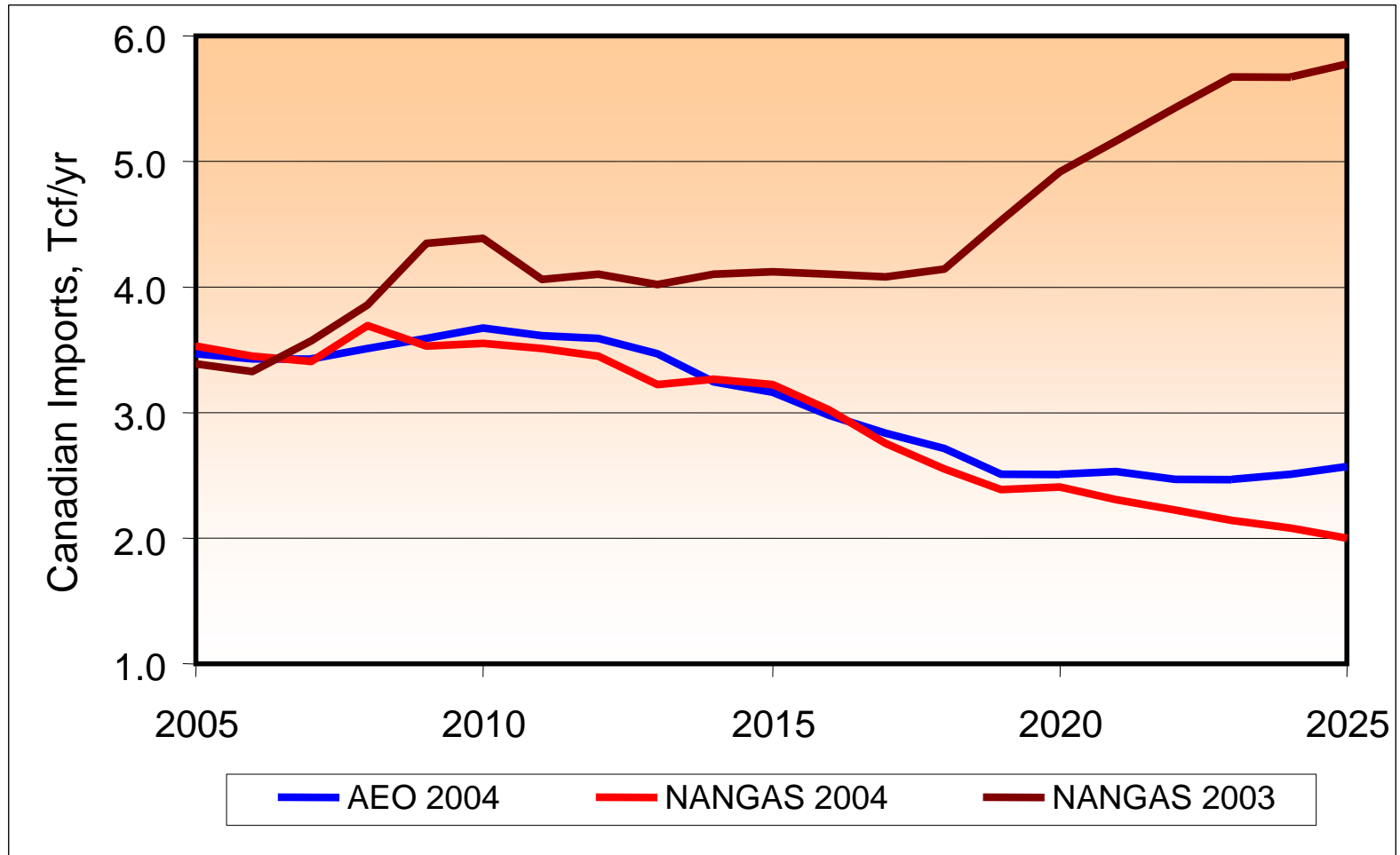
New Results and Comparisons

- Lower-48 supply
- Canadian imports
- LNG imports
- Alaska pipeline timing
- Demand
- Wellhead prices

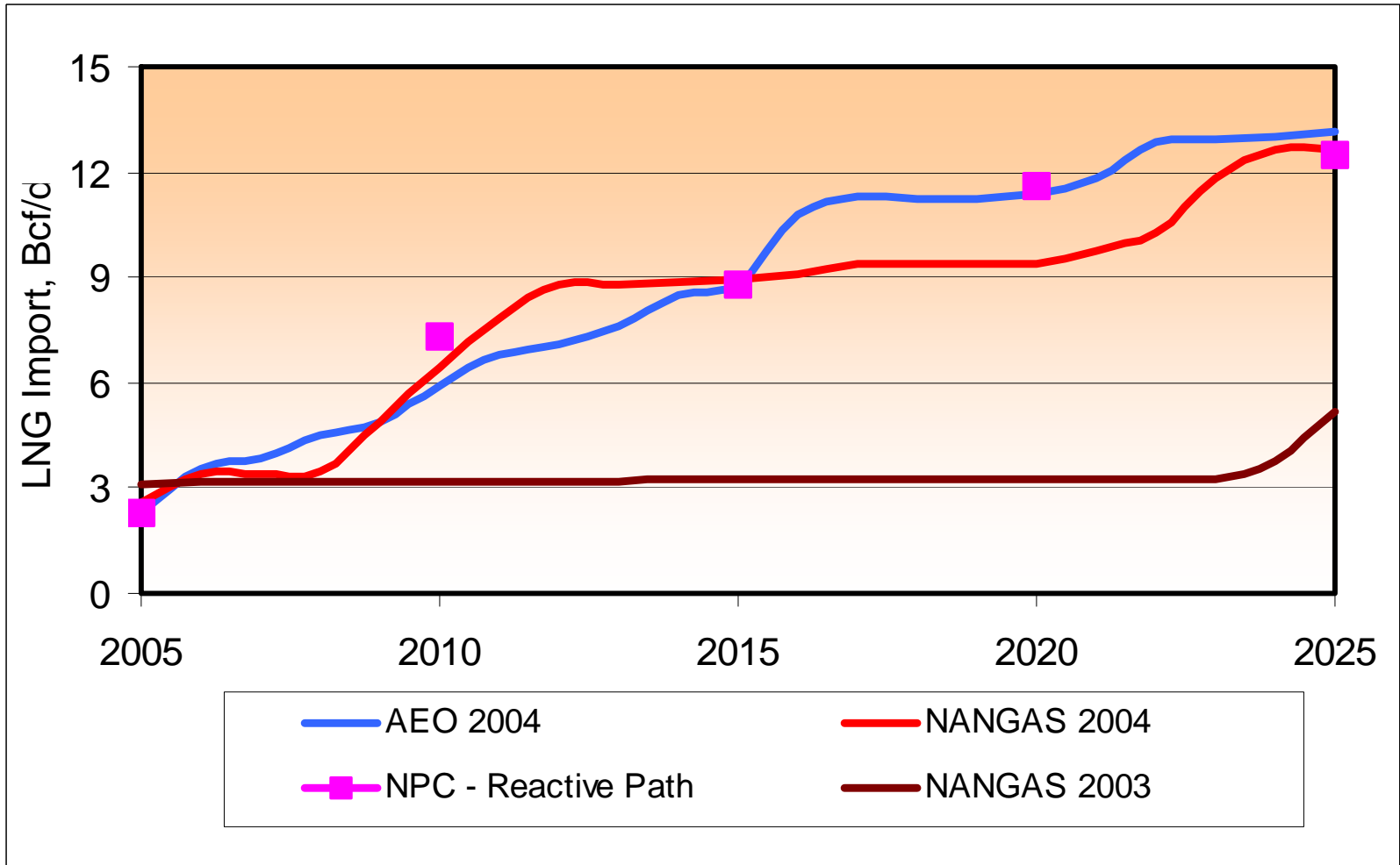
Lower-48 Supply



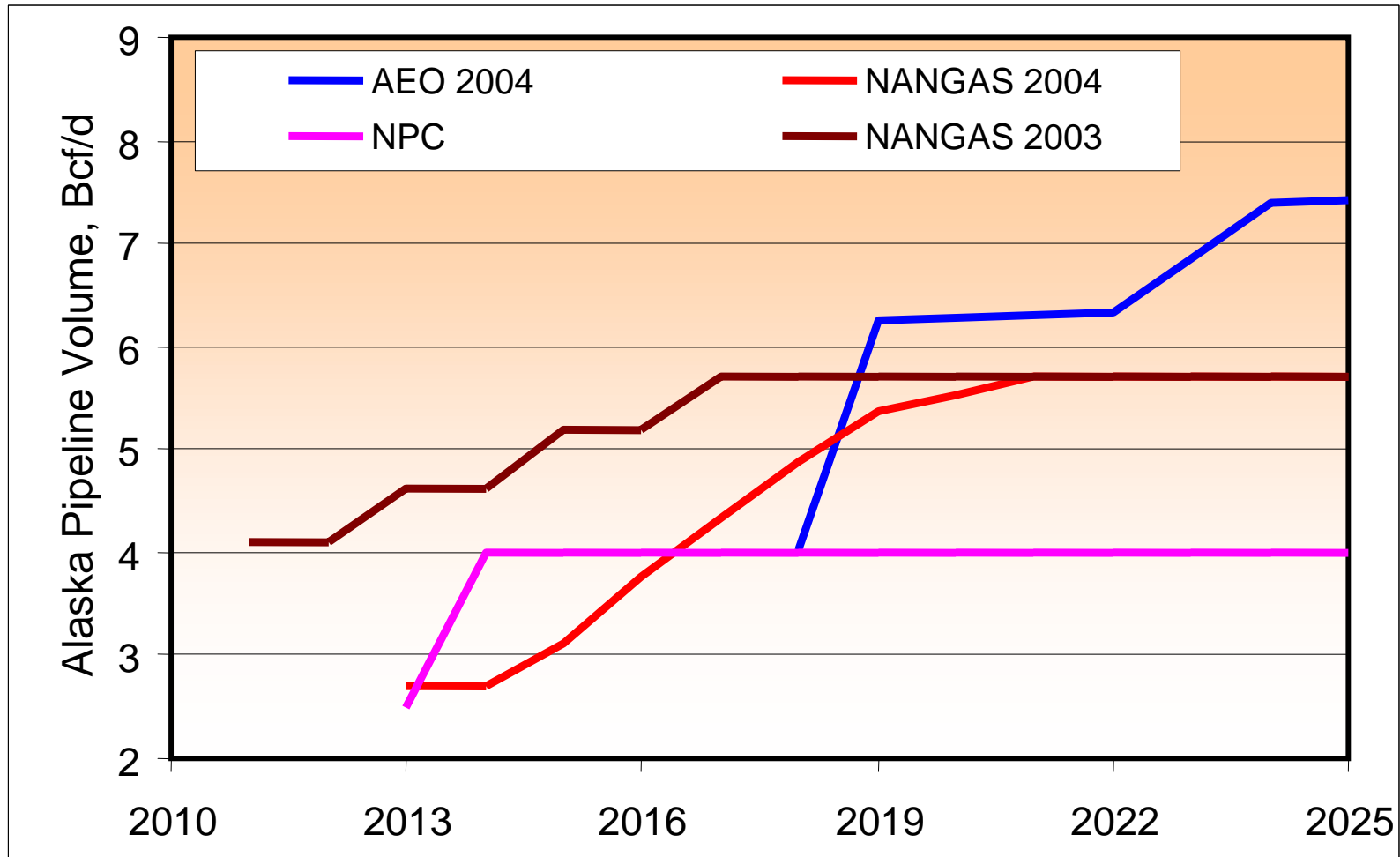
Net Canadian Imports



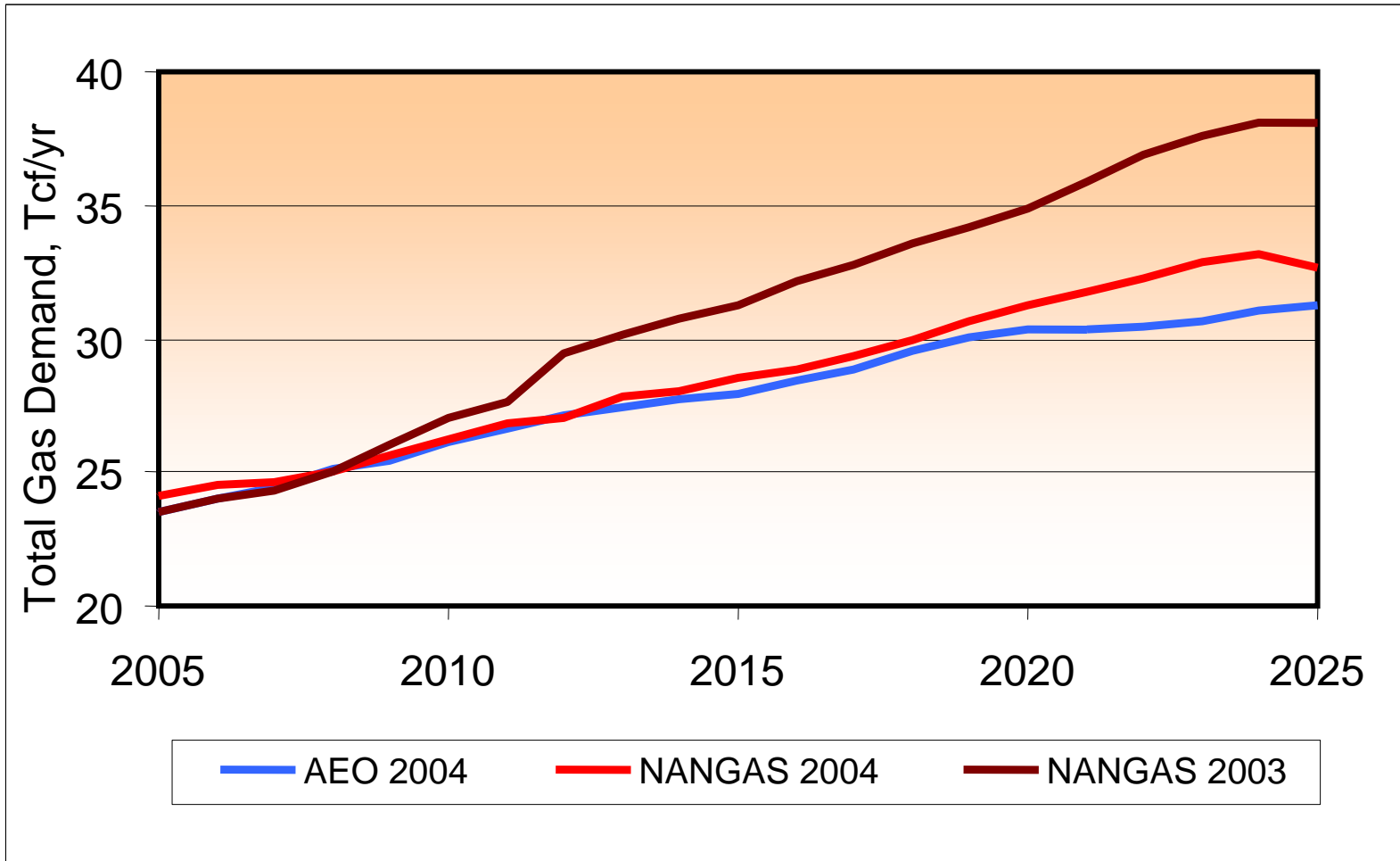
LNG Imports



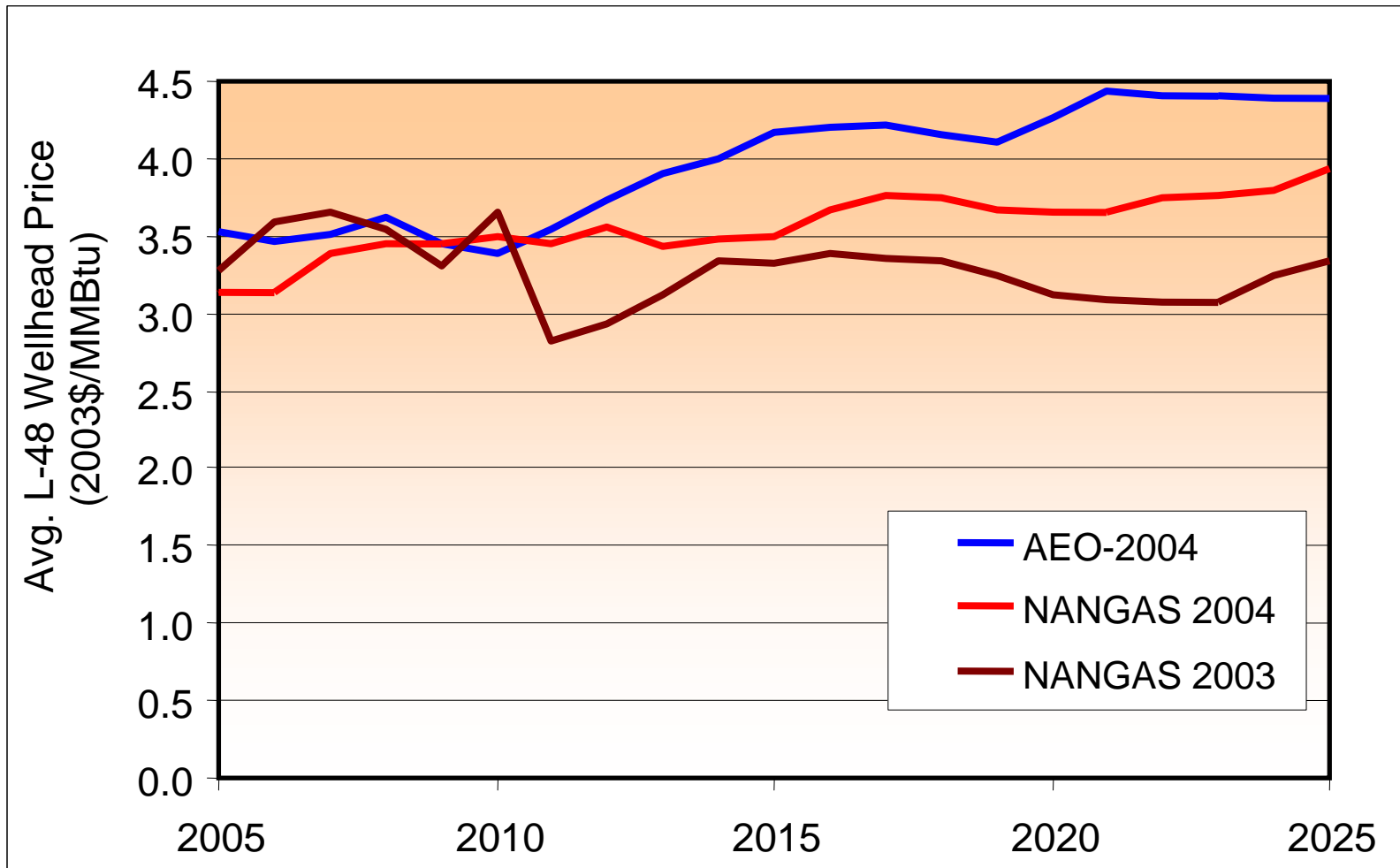
Alaska Pipeline Timing



Demand



Wellhead Prices



Modeling LNG

- LNG is project-specific not resource specific
 - Large lumpy investments
 - Timing LNG is an assumptions-based decision
- Two approaches to modeling LNG with NANGAS
 - Economic trigger price – LNG enters when trigger price reached (NANGAS 2004 approach)
 - LNG import project timetable – LNG imports are pre-specified in the model (LNG specified approach)

LNG Economic Input Assumptions

Node Name	Notes	Year	Expansion Price, 2003\$/Mcf	Maximum Sustained Capacity (Bcf/yr)	Maximum Sustained Capacity (MMcf/d)
Distrigas	Existing	2003		161	441
	Planned Expansion	2005	0.00	14	38
Cove Point	Existing	2003		278	762
	Planned Expansion	2005	0.00	91	249
Elba Island	Existing	2003		170	466
	Planned Expansion	2006	0.00	76	208
Lake Charles/Gulf Coast LNG	Existing	2003		230	630
	Planned Expansion	2006	0.00	208	570
	Future Expansion Potential	2009	3.25	500	1370
	Future Expansion Potential	2010	3.50	500	1370
	Future Expansion Potential	2011	3.50	500	1370
	Future Expansion Potential	2012	4.00	500	1370
	Future Expansion Potential	2016	4.00	500	1370
Bahamas LNG	Future Expansion Potential	2006	3.25	292	800
Bahamas LNG	Future Expansion Potential	2008	3.25	292	800
Baja LNG	Future Expansion Potential	2007	3.75	292	800

LNG Imports Specified

LNG Terminal Input Assumptions (Bcf/d)						
	2006	2007	2008	2009	2010	2011
East Coast						
Bearhead (N.S.)		0.75				
Providence, R.I.	0.5					
Florida						
FPL Project		1				
Gulf Coast LA						
Energy Bridge	0.4					
Cameron		0.75				
Pelican		0.8				
Liberty			2			
Main Pass			3			
Gulf Coast TX						
Freeport		1.5				
Sabine/Golden				1.5		
Corpus Christi/Vista				1.5		
West Coast						
Baja 1			0.75			
BHP Offshore					0.8	
Long Beach				0.75		
Capacity Totals	0.9	4.8	5.75	3.75	0.8	
Load Factor						
Year 1: 50% LF	0.45	2.4	2.875	1.875	0.4	
Year 2: 85% LF	0.765	4.08	4.888	3.188	0.68	
Cumulative	0.45	3.165	7.72	11.608	13.32	13.6

Price Effects of LNG Approaches

