California Energy Commission

National Cases:

High Gas Price, Low Gas Price, and Constrained Shale Gas

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National Cases: Road Map

- Purpose of the Cases
- Major Policy Issues
- What are the National Cases
- Case Descriptions
- General Impact of Price Changes
- Performance of Cases
  - Prices
  - Supply Portfolio Impacts
- Difference Results
- Conclusions

National Cases: Purpose of Cases

- To examine price and supply in the national natural gas market
  - Potential vulnerabilities to California
  - Potential opportunities for California
- To investigate natural gas price and supply uncertainty
  - Plausible range of conditions developed
- To evaluate the impact of relevant policy drivers
- To develop plausible outlooks of prices and supply

National Cases: Major Policy Issues

- Implementation of Renewables Portfolio Standard (RPS)
- Conversion of coal-fired generation
- Environmental mitigation of shale development
  - Water use and disposal
- Licensing of liquefied natural gas (LNG) export capability

National Cases:
What are the National Cases

- **Staff constructed the following national cases:**
  - **High Price case**
  - **Low Price case**
  - **Constrained Shale case**
- **Cases constructed to evaluate natural gas price movements and impacts**

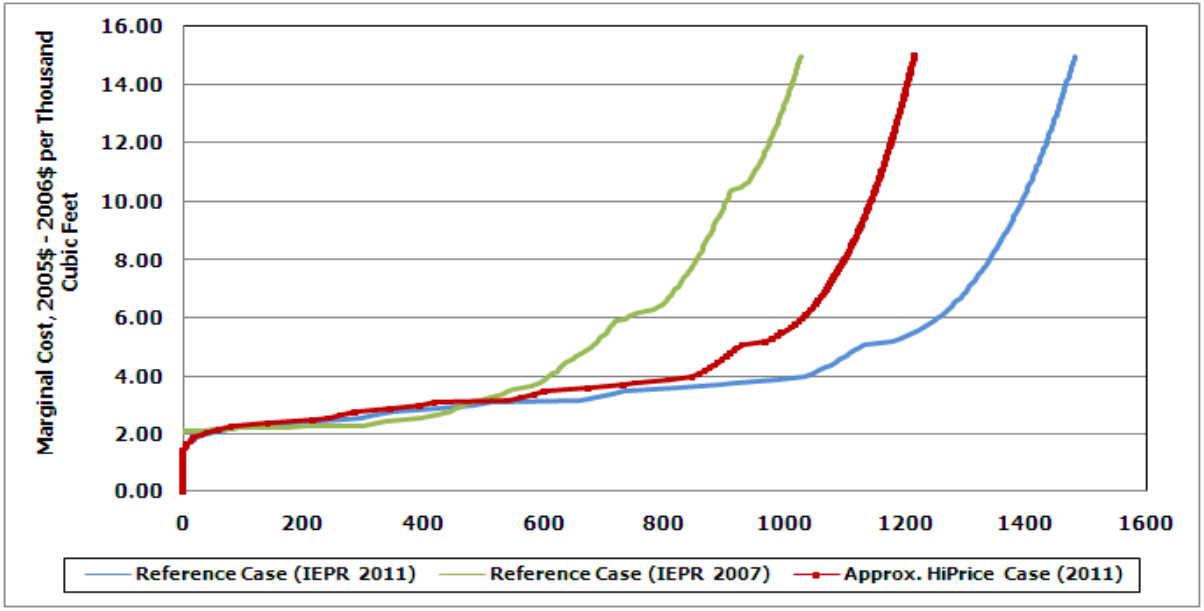
National Cases: High Price Case Description

- Removed 50 GW (280,000 GWh) of coal-fired generation distributed per Brattle Group analysis.
- Assumed robust economic performance, with long-term annual economic growth capped at about 3.5%.
- Delayed RPS implementation by additional 10 years as states grapple with budgetary concerns
- Starting in 2016, assumed robust LNG export capability developed and utilized at:
  - Kitimat (Canada, Apache)
  - Sabine Pass (Cheniere), Lake Charles (BG), and Freeport
  - Cove Point

National Cases: High Price Case Description (cont'd)

- Assumed added environmental compliance costs in Canada and the United States:
  - $0.40/Mcf to the O&M cost of developing shale formations
  - $0.20/Mcf to conventional resources
- Removed from development potential shale resources in particular regions, such as Pennsylvania, New York, Colorado, and Wyoming
  - Altered the available gas resource and shrank resource base by about 17.8%
  - Re-established merit order of resource selection
- Introduced constraints on development in Iraq, Iran, Venezuela, and Russia

National Cases: High Price Case Description (cont'd)



- **Resource base shrinks as a result of "turning off" potential reserves in sensitive areas**
- **Resource base shrinks by about 17.8%**

Sources: California Energy Commission; Altos Management Partners; Baker Institute; National Petroleum Council.

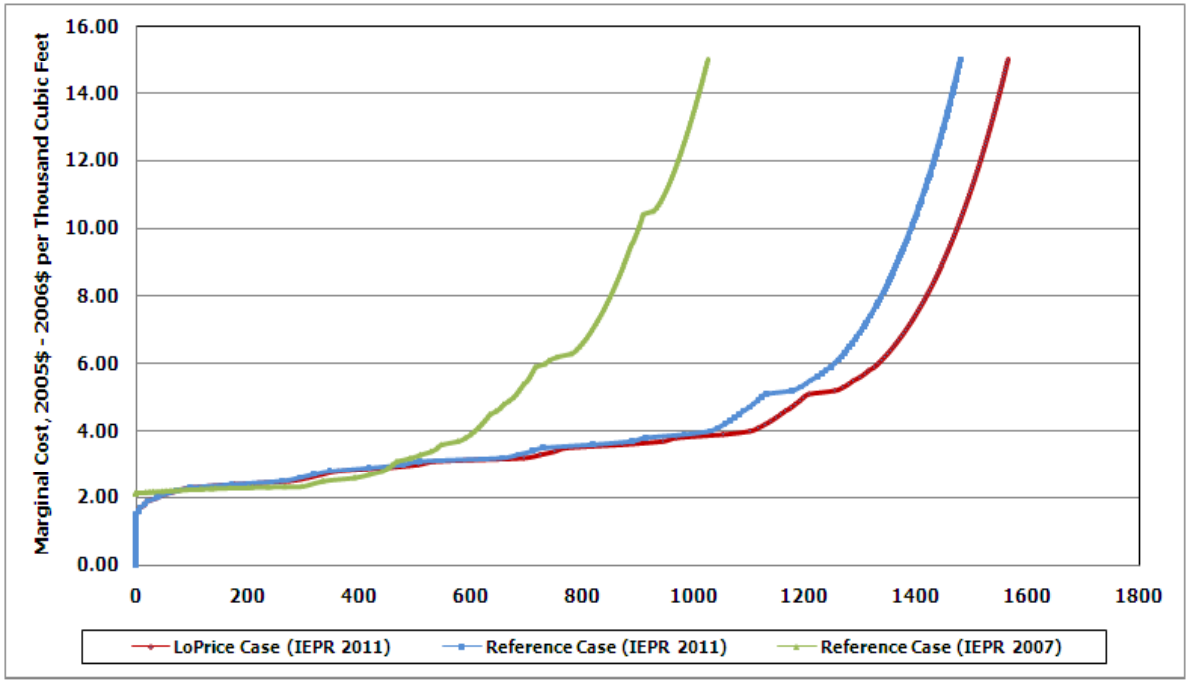
National Cases: Low Price Case Description

- Assumed all states meet RPS targets on time
- Capped long-term annual economic growth at about 2.1%, portending weak gross domestic product growth
- Disallowed LNG exports, thus keeping North America isolated
- Assumed technology develops at a rate of 2.5%

National Cases: Low Price Case Description (cont'd)

- **Assumed larger resource base**
  - **Increased assessment size in the Marcellus, Haynesville, and western Canadian shale formations**
  - **Used upper range of published data**
  - **Resulted in additional 5.76% rightward shift of overall supply cost curve**
- **Allowed Iran, Iraq, and Venezuela to enter the market unimpeded beyond pre-specified dates**

National Cases:
Low Price Case Description (cont'd)



- **Resource base expands as larger assessments of reserves become more likely**
- **Resource base expands by about 5.8%**

Sources: California Energy Commission; Altos Management Partners; Baker Institute; National Petroleum Council.

National Cases: Constrained Shale Case Description

- Assumed heightened environmental concerns related to development of shale formations
  - Implementation of additional regulatory requirements on further development, particularly related to fluids used in the hydraulic fracturing process
  - Acquisition, treatment, and disposal of water push state regulators to issue new policy directives.
  - Added requirements for protection of groundwater aquifers
- Regulatory compliance after 2013 in both Canada and the United States:
  - Adds another $0.40/Mcf to the cost of production of shale natural gas;
  - Adds $0.20/Mcf to conventional production.
- Resource base remains unchanged from reference case

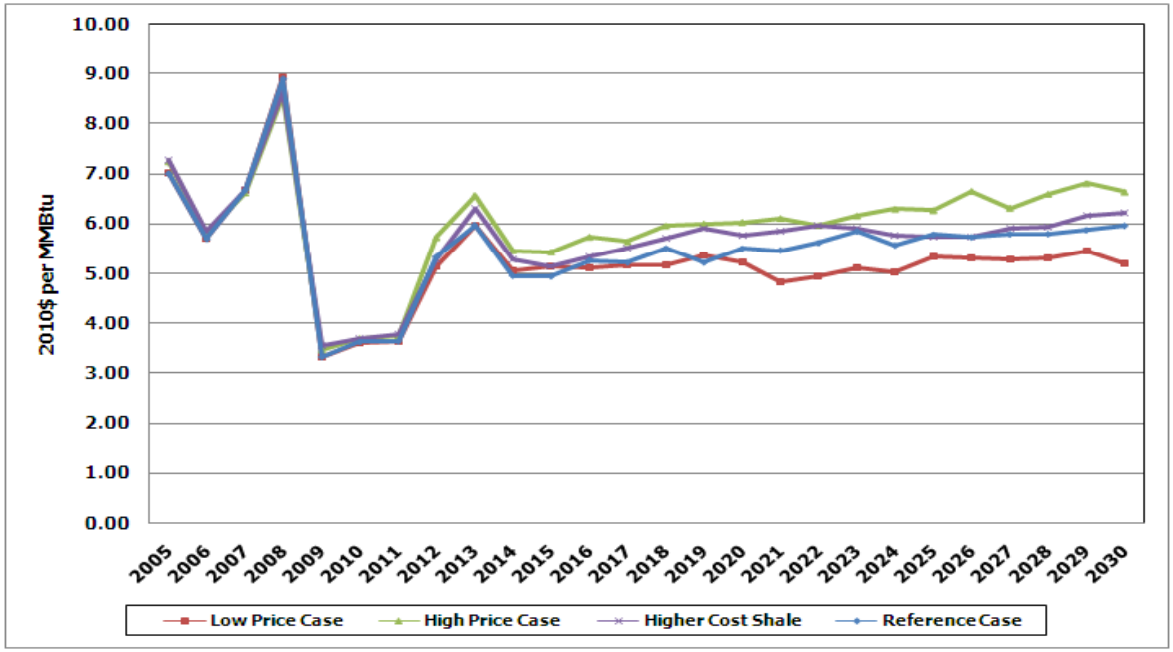
National Cases: General Impacts of Price Changes

- Price changes produce various responses:
  - Higher prices
    - Depress demand
    - Stimulate added supply
  - Lower prices
    - Stimulate demand
    - Suppress supply
- Usually, a combination of dual impact occurs
- Price *changes* also re-configure the order of economic selection and, thus, the supply portfolio
  - In a dynamic market, this can affect the attractiveness of particular supply resources
- Question: What is the dominant effect?

National Cases: Supply Balance

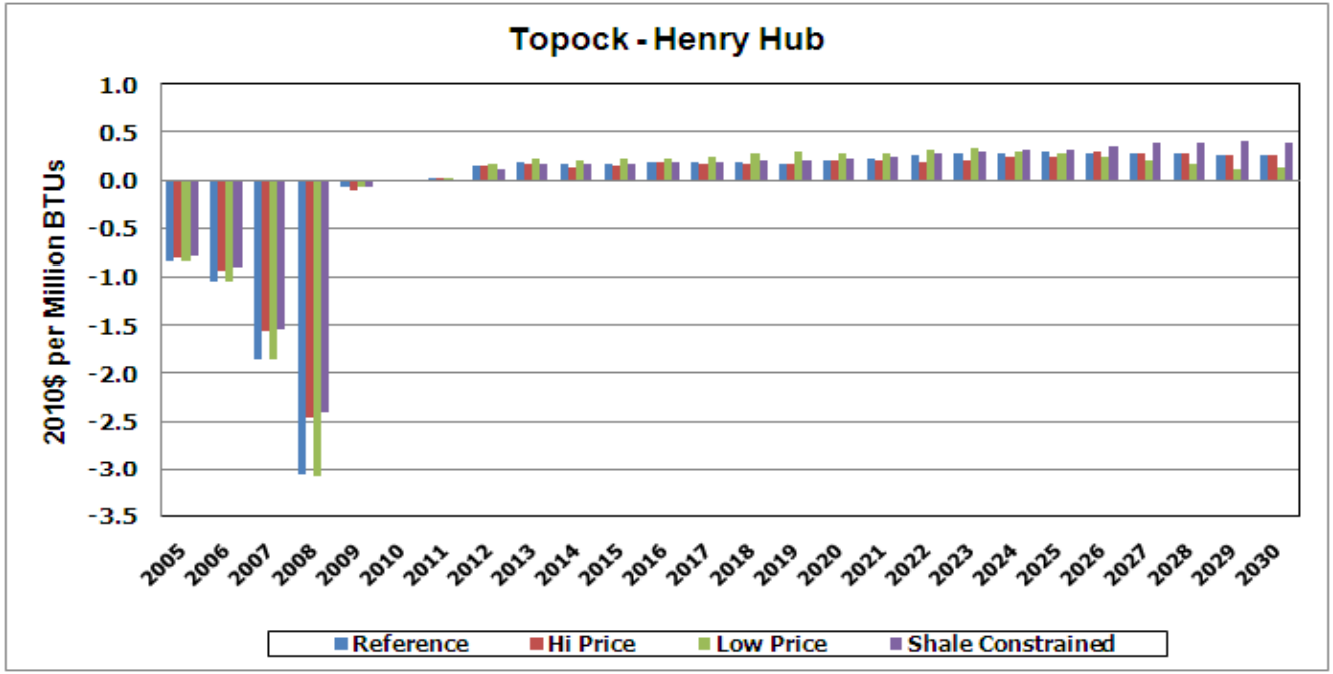
Performance of Cases: Lower 48

National Cases:
Price Performance of Cases (Henry Hub)



- **Prices behave as expected:**
  - **High Price case produced highest prices**
  - **Low price case produced lowest prices**
- **Together, four cases produced the "zone of uncertainty"**

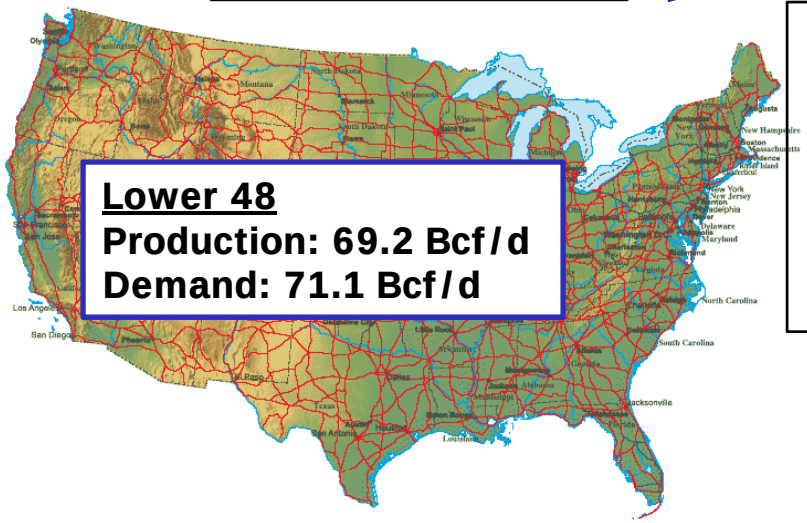
National Cases:
Price Performance of Cases (Differentials)



- **Differentials turn positive around 2013:**
  - **Access to shale and 'tight' gas resources is re-ordering the supply portfolio, impacting eastern prices more than western**

National Cases:
Supply Portfolio of Reference Case (2025)

Canadian Imports: 10.5 Bcf/d



Lower 48
Production: 69.2 Bcf/d
Demand: 71.1 Bcf/d

- **Two main demands: End-use and Exports**
- **Demand satisfied by:**
  - **Canadian Imports**
  - **L48 Production**
  - **LNG Imports**

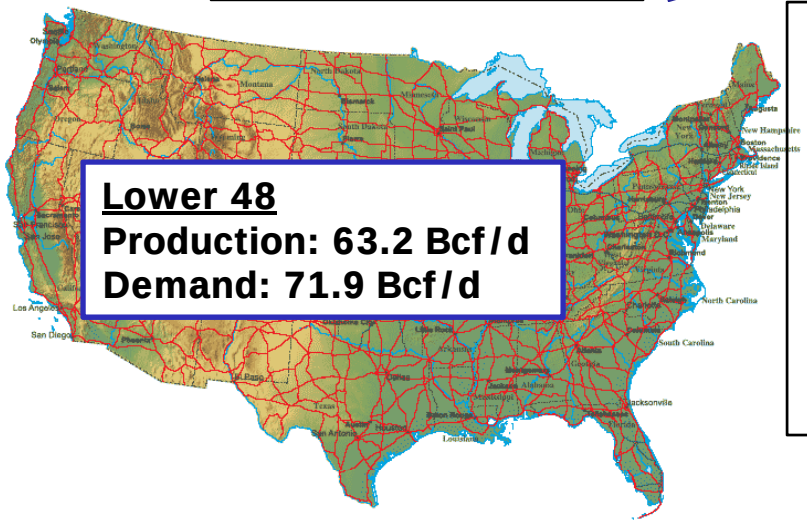
Exports: 7.2 Bcf/d

LNG Imports: 1.7 Bcf/d

National Cases: Reconfiguration of Supply Portfolio (2025)

High Price Case (+8.5%)

Canadian Imports: 13.2 Bcf/d



Lower 48
Production: 63.2 Bcf/d
Demand: 71.9 Bcf/d

- Two main demands: End-use (+1.1%) and Exports (+9.7%)
- Demand satisfied by:
  - Canadian Imports (+25.2%)
  - L48 Production (- 8.8%)
  - LNG Imports (+290.3%)
- Competing sources of natural gas reconfiguring the supply portfolio

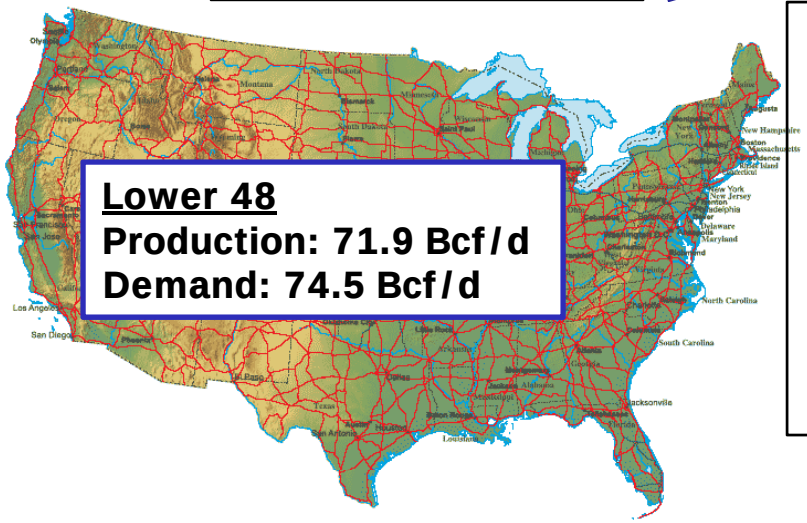
Exports: 7.9 Bcf/d

LNG Imports: 6.6 Bcf/d

( ) Percent change from reference case

National Cases: Reconfiguration of Supply Portfolio (2025)

Canadian Imports: 11.4 Bcf/d



Lower 48
Production: 71.9 Bcf/d
Demand: 74.5 Bcf/d

Exports: 7.2 Bcf/d

LNG Imports: 1.6 Bcf/d

Low Price Case (-7.6%)

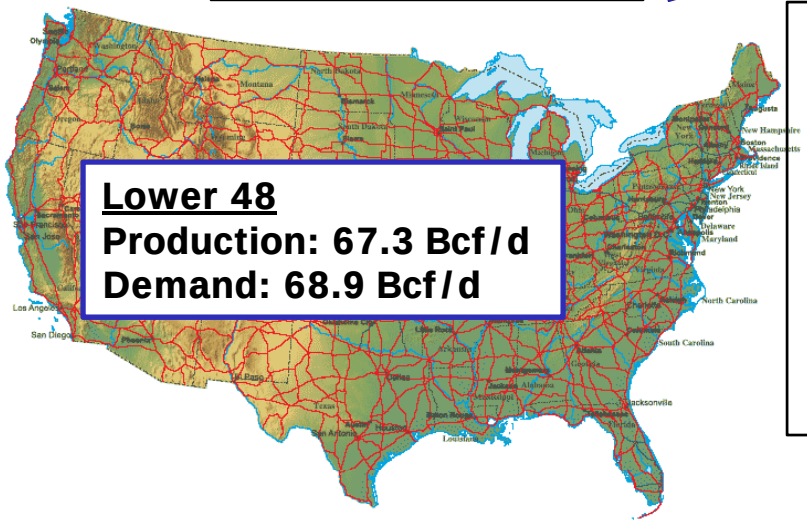
- Two main demands: End-use (+4.7%) and Exports (0%)
- Demand satisfied by:
  - Canadian Imports (+8.0%)
  - L48 Production (+3.9%)
  - LNG Imports (-14.7%)
- Competing sources of natural gas reconfiguring the supply portfolio

( ) Percent change from reference case

National Cases: Reconfiguration of Supply Portfolio (2025)

Canadian Imports: 9.0 Bcf/d

Constrained Shale Case (-1.0%)



Lower 48
Production: 67.3 Bcf/d
Demand: 68.9 Bcf/d

- Two main demands: End-use (-3.2%) and Exports (-16.7%)
- Demand satisfied by:
  - Canadian Imports (-14.8%)
  - L48 Production (-2.8%)
  - LNG Imports (+4.9%)
- Competing sources of natural gas reconfiguring the supply portfolio

Exports: 6.0 Bcf/d

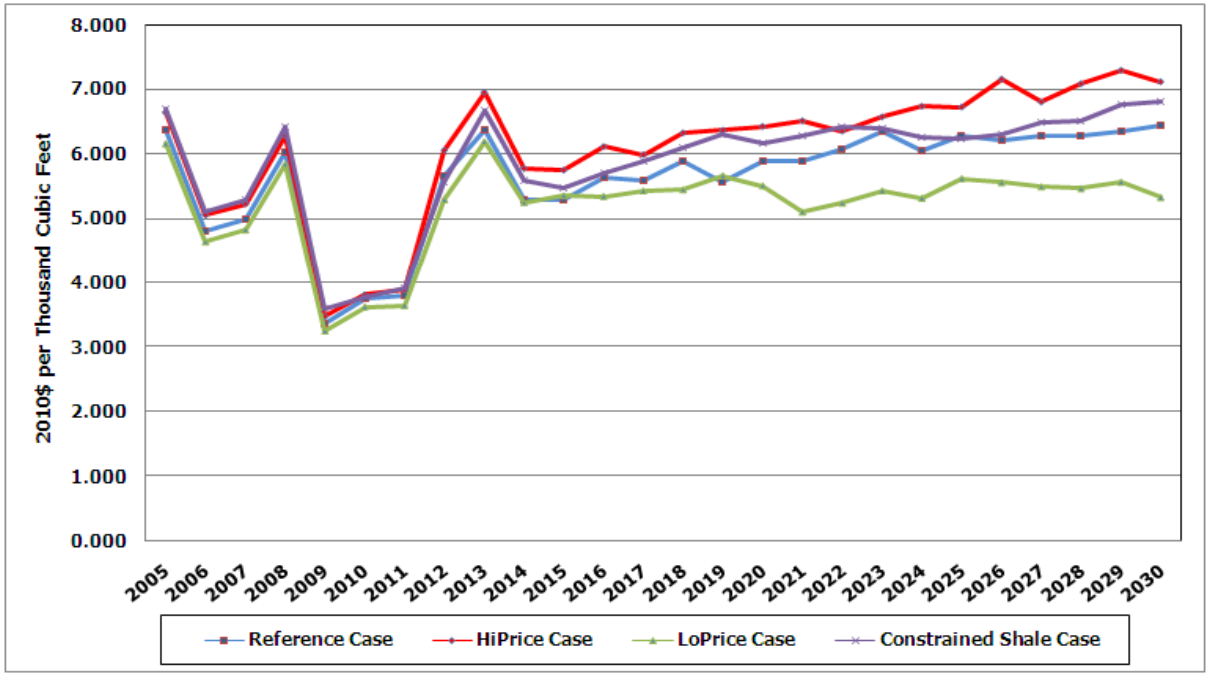
LNG Imports: 1.8 Bcf/d

( ) Percent change from reference case

National Cases: Supply Balance

Performance of Cases: California

National Cases:
Price Performance of Cases (Topock Hub)



- **Prices behave as expected:**
  - **High Price case produced highest prices**
  - **Low price case produced lowest prices**
- **Together, four cases produce "zone of uncertainty"**

National Cases: California Supply Portfolio (2025)

Canadian Imports: 2.41 Bcf/d

Rocky Mountain: 1.25 Bcf/d

Southwest: 2.24 Bcf/d

California
Production: 0.28 Bcf/d
Demand: 6.05 Bcf/d

Reference Case

- California Demand: End-use
- Demand satisfied by:
  - Canadian Imports
  - Rocky Mountain Supplies
  - Southwest Supplies
  - Local Production

( ) Percent change from reference case

National Cases:
California Supply Portfolio (2025)

Canadian Imports:
2.17 Bcf/d

Rocky Mountain:
1.16 Bcf/d

Southwest:
2.34 Bcf/d

California
Production: 0.35 Bcf/d
Demand: 5.93 Bcf/d

High Price Case (+7.3%)

- California Demand: End-use (-2.0%)
- Demand satisfied by:
  - Canadian Imports (-9.7%)
  - Rocky Mountain Supplies (-7.4%)
  - Southwest Supplies (+4.5%)
  - Local Production (+28.5%)
- Competing sources of natural gas reconfiguring the supply portfolio

( ) Percent change from reference case

National Cases: California Supply Portfolio (2025)

Canadian Imports: 2.63 Bcf/d

Rocky Mountain: 1.29 Bcf/d

Southwest: 2.15 Bcf/d

California
Production: 0.36 Bcf/d
Demand: 6.31 Bcf/d

Low Price Case (-10.1%)

- California Demand: End-use (+4.3%)
- Demand satisfied by:
  - Canadian Imports (+9.4%)
  - Rocky Mountain Supplies (+3.2%)
  - Southwest Supplies (-4.0%)
  - Local Production (+30.2%)
- Competing sources of natural gas reconfiguring the supply portfolio

( ) Percent change from reference case

National Cases: California Supply Portfolio (2025)

Canadian Imports: 2.25 Bcf/d

Rocky Mountain: 1.20 Bcf/d

Southwest: 2.25 Bcf/d

California
Production: 0.29 Bcf/d
Demand: 5.87 Bcf/d

Shale Constrained Case (-0.6%)

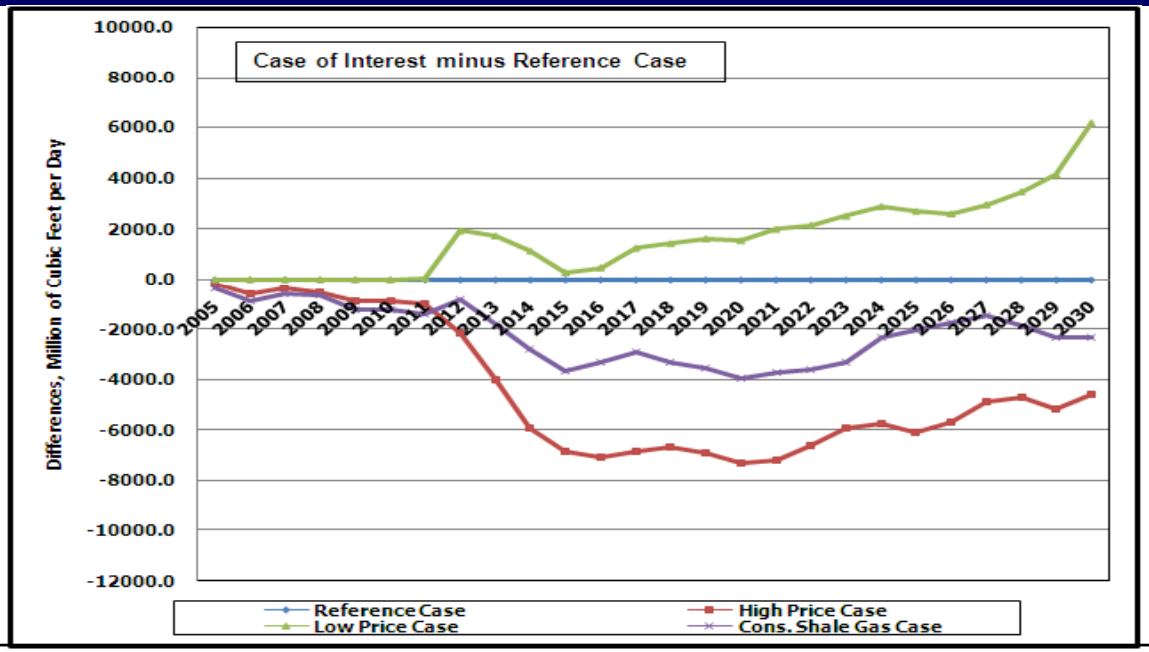
- California Demand: End-use (-3.0%)
- Demand satisfied by:
  - Canadian Imports (-6.4%)
  - Rocky Mountain Supplies (-4.1%)
  - Southwest Supplies (+0.6%)
  - Local Production (+4.8%)
- Competing sources of natural gas reconfiguring the supply portfolio

( ) Percent change from reference case

National Cases: Difference Results

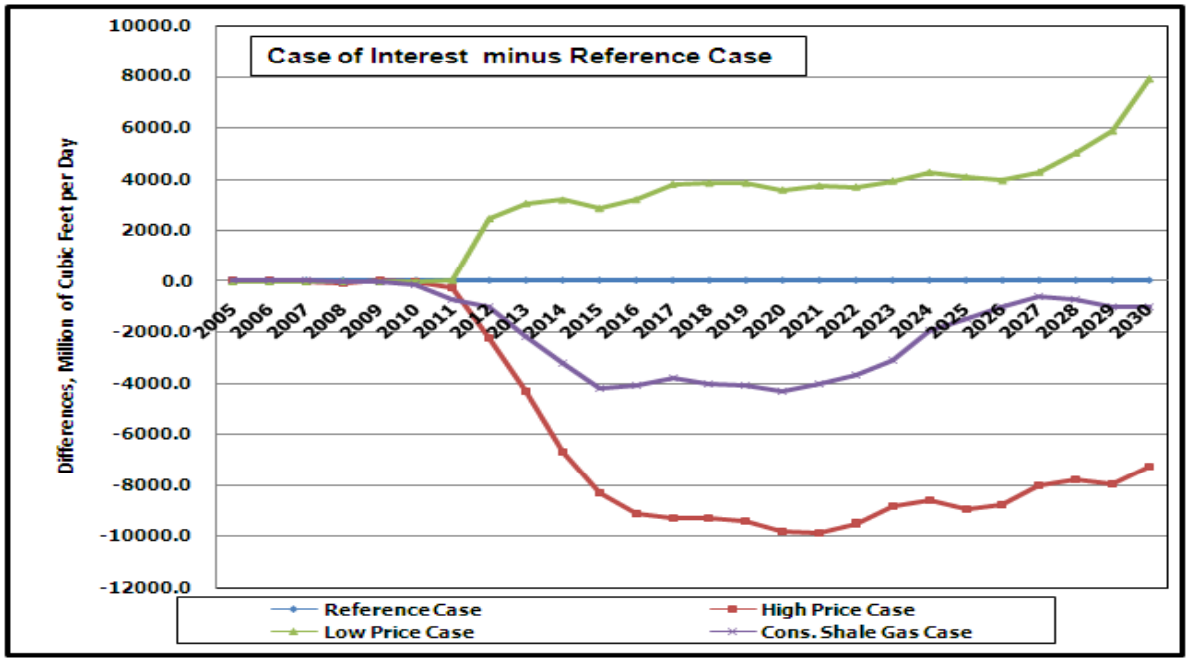
Difference Results

National Cases: Difference Results (All Supply Sources)



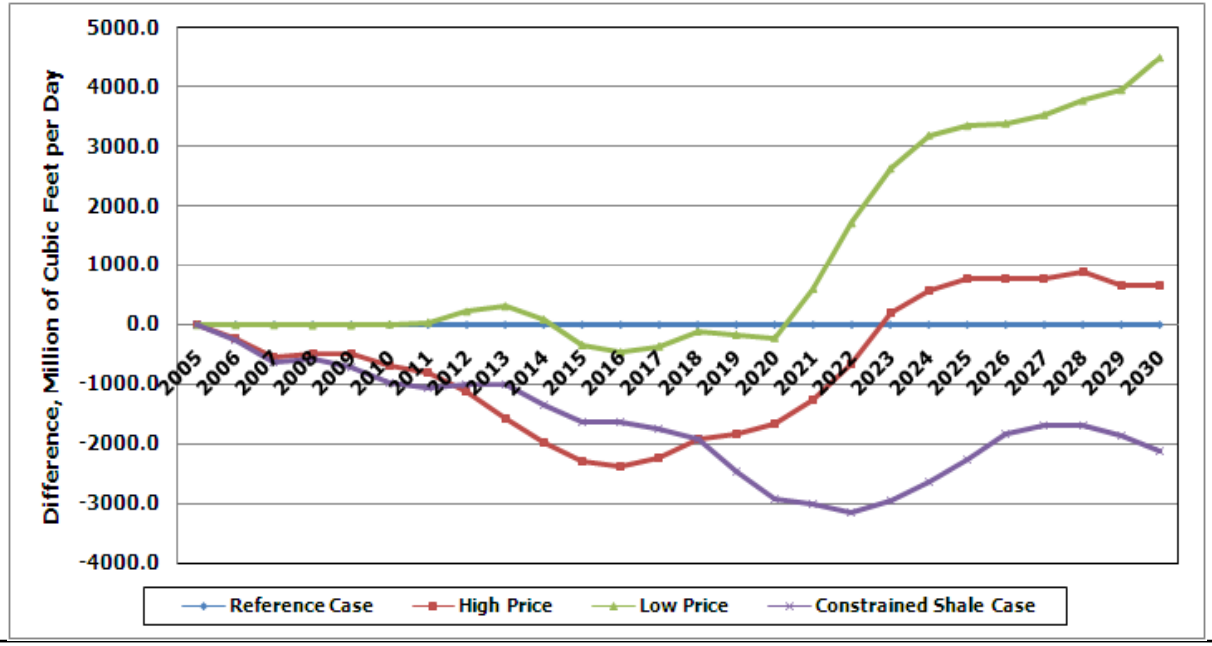
- **Higher environmental cost reconfigures the order of selection resources, pushing US production lower in the High Price case and the Constrained Shale case**
- **In the Low Price case, lower domestic prices pushes out LNG imports and increased domestic production fills the gap**

National Cases:
Difference Results (Shale Gas Production)



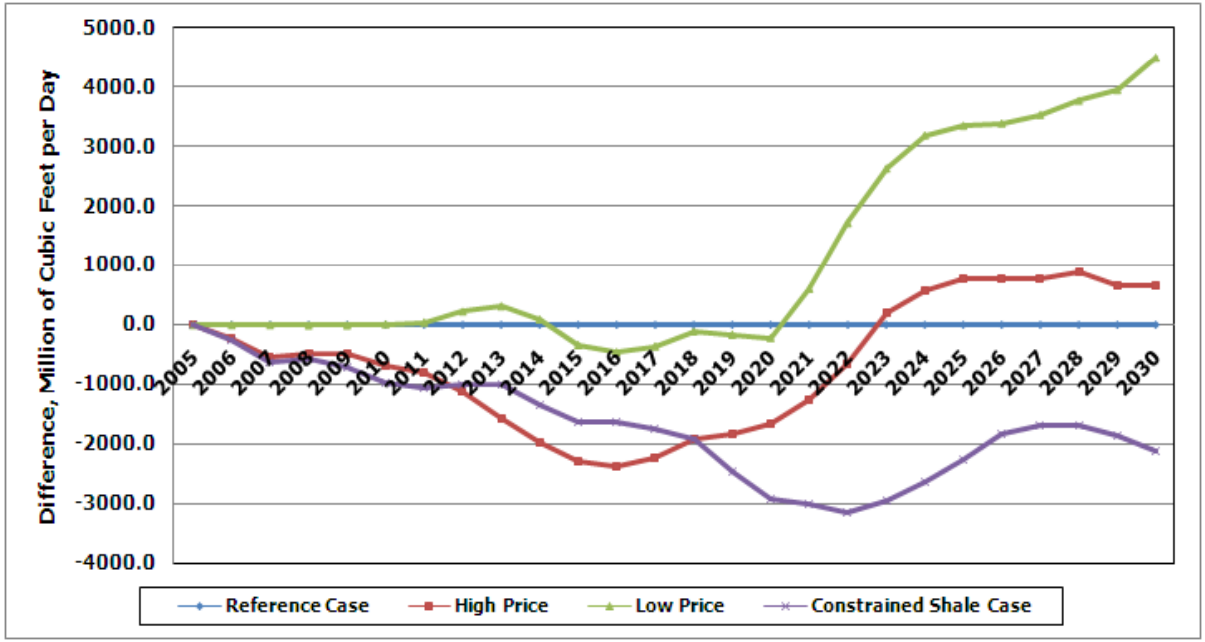
- **Higher environmental costs lower domestic shale production in both the High Price case and the Constrained Shale Gas case**
- **In the Low Price case, shale gas production increases as LNG imports lose out as a result of lower domestic prices**

National Cases: Difference Results (US Demand)



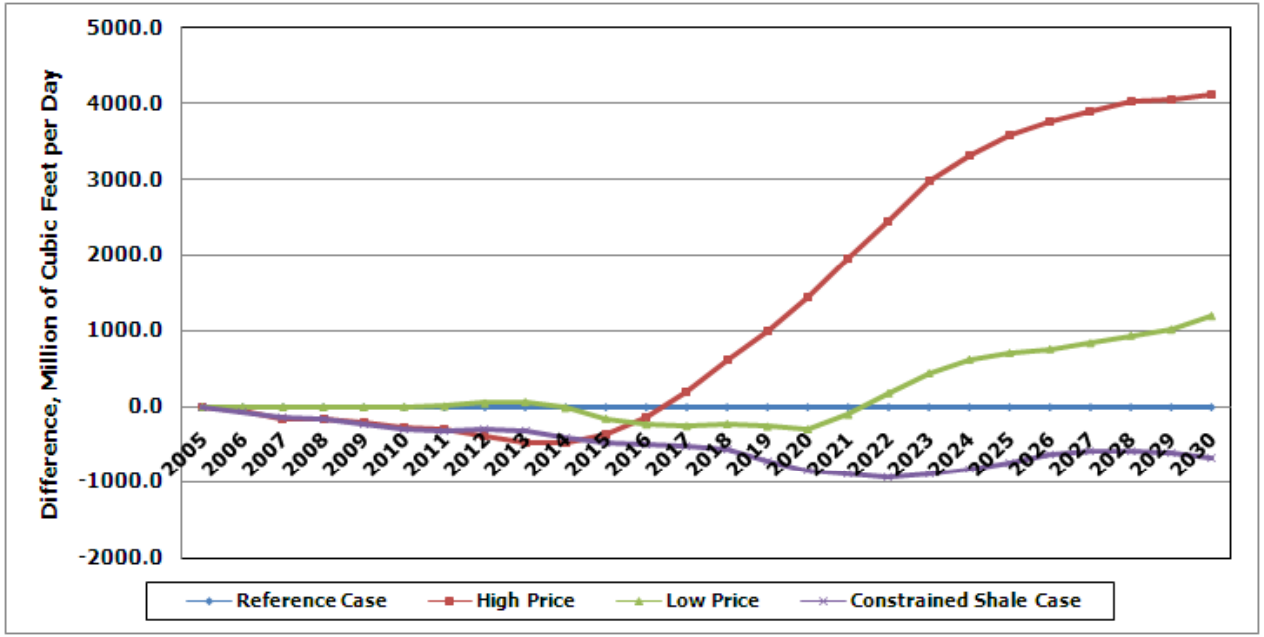
- **Higher prices push demand lower in the High Price case and the Constrained shale gas case**
- **Although demand starts out lower in the High Price case, robust economic performance and coal conversion push US demand higher after 2022**

National Cases: Difference Results (US Demand) (cont'd)



- **Low prices stimulate demand in the Low Price case, pushing demand higher**
- **All states meet RPS implementation on time**
  - **Dampen natural gas demand between 2012 and 2020**

National Cases: Difference Results (US Power Generation)



- **In the High Price case, power generation gas demand climbs higher as robust economic performance and coal conversion pull in more natural gas**

National Cases: Conclusions

- Added environmental mitigation costs may delay the development of shale formations
- Price changes can reconfigure the supply portfolio
- Plausible national cases produce a range of price and supply outcomes

National Cases: Epilogue

Questions & Comments