



California Energy Commission

Shale Production Uncertainty Cases: A Scenario Examination

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Shale Production Uncertainty Scenario Cases: Brief Background

- In the last ten years, the development of natural gas resources from shale formations has generated much controversy
 - The potential for groundwater contamination
 - The possibility of increased seismic activity
 - The diversion of freshwater used in hydraulic fracturing
 - The possibility of added methane emissions.



Shale Production Uncertainty Scenario Cases: Brief Background (cont'd)

- **Decision-makers are re-examining policies related to the development of these resources**
 - **Some jurisdictions such as New York have delayed the development of its shale resources**
 - **Others have instituted environmental impact fees**
 - **Others are tightening regulation of hydraulic fracturing**
- **Technological innovation has accelerated in the natural gas industry.**



Shale Production Uncertainty Scenario Cases: What are the Shale Production Uncertainty Cases?

- **Shale Abundance**
- **Shale Reconsidered**
- **Shale Expensive**
- **Shale Deferred**



Shale Production Uncertainty Scenario Cases: Key Variables

- Variations in four key variables:
 - Changes in the supply cost curves
 - Changes in the time of availability of some resources
 - Changes in environmental impact fees
 - Changes in the rate of growth of technological innovation
- Changes relative to the reference case.



Shale Production Uncertainty Scenario Cases: Shale Abundance

- **Shale Abundance:**
 - Begins with the Reference Case
 - Supply Cost Curves ~
 - Expanded resource base
 - All known shale formations developed
 - Current estimates 15% low; lead to upward adjustment of curves
 - Availability ~ No delay in production hook-ups
 - Environmental Impact Fees/O &M ~ Impact fees and water handling cost at low end of range: \$0.30/Mcf
 - Technology & Innovation ~ Technology grows at 2.5%.



Shale Production Uncertainty Scenario Cases: Shale Reconsidered

- **Shale Reconsidered:**
 - Begins with the Reference Case
 - Supply Cost Curves ~
 - Concerns about hydraulic fracturing delay further development of shale formations
 - Targeted moratorium on new drilling into shale formations
 - Resource base shrinks by 15%
 - Availability ~ Hookup of new production faces significant environmental challenges; delays run about 3 years
 - Environmental Impact Fees/O &M ~ Impact fees and water handling cost at high end of range: \$0.55/Mcf
 - Technology & Innovation ~ Technology grows at 1.0%.



Shale Production Uncertainty Scenario Cases: Shale Expensive

- **Shale Expensive:**
 - Begins with the Reference Case
 - Supply Cost Curves
 - Resource base unchanged from the reference case
 - Availability ~ Hookup of new production faces significant environmental challenges; delays run about 3 years
 - Environmental Impact Fees/O &M ~ Environmental impact fees in many jurisdictions are 20% higher than high end cost, reaching \$0.67/Mcf
 - Technology & Innovation ~ Technology grows at 0.5%.



Shale Production Uncertainty Scenario Cases: Shale Deferred

- **Shale Deferred:**
 - Begins with the Reference Case
 - Supply Cost Curves ~
 - Resource base unchanged from the reference case
 - Availability ~ Hookup of new production faces significant environmental challenges; delays run 3 - 5 years
 - Environmental Impact Fees/O &M ~ Impact fees and water handling cost at high end of range at \$0.55/Mcf
 - Technology & Innovation ~ Technology grows at 1.0%.



Shale Production Uncertainty Scenario Cases: Final

Questions & Comments