Technology Modeling In EIA’s New Oil & Gas Model

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Tulsa, Oklahoma

Presented by:
Michael Schaal, EIA
Hitesh Mohan, INTEK
AGENDA

- Scope of EIA’s NEMS Model
- Overview of Onshore Lower 48 Oil & Gas Model
- Technology Modeling in OLOGSS
- Effects of R & D Improvements
- Summary
EIA NEMS Model

Integrating Module

- Oil and Gas Supply Module
- Natural Gas Transmission and Distribution Module
- Coal Market Module
- Renewable Fuels Module
- Macroeconomic Activity Module
- International Energy Module
- Residential Demand Module
- Commercial Demand Module
- Transportation Demand Module
- Industrial Demand Module

Supply Conversion Demand
Analytical Capabilities of NEMS

• Impacts On The Production And Price Of Crude Oil And Natural Gas Resulting From Improvements In Explorations And Production Technologies.

• Responses Of The Energy And Economic Systems To Changes In World Market Conditions As A Result Of Changing Levels Of Foreign Production And Demand In The Developing Countries.

• Impacts Of New Technologies On Consumption And Production Patterns And Emissions.

• Impacts Of Existing And Proposed Energy Tax Policies On The U.S Economy And Energy Systems.

• Effects Of Specific Policies, Such As Standards Or Renewable Tax Credits, On Energy Consumption.

New Onshore Lower 48 Oil & Gas Model (OLOGSS)

- Oil and Gas Supply Module
- Natural Gas Transmission and Distribution Module
- Coal Market Module
- Renewable Fuels Module
- Macroeconomic Activity Module
- International Energy Module
- Residential Demand Module
- OGSM
- Domestic
- Foreign
- Onshore
- Offshore
- Alaska
- Oil
- Gas
- Known Fields - Conventional - Unconventional
- Undiscovered - Conventional - Unconventional
- Known Fields - Conventional - Unconventional
- Undiscovered - Conventional - Unconventional

The new “OLOGSS”
Capabilities of OLOGSS

- Model Entire Oil & Gas Resource in Lower 48 States
  - Conventional
  - Unconventional
    - Tight Sand
    - Oil Shale
    - Continuous Formations, etc

- Ability to Model
  - Technology Change / Improvements
  - Land Access Issues
  - Legislative Policy Issues (Royalty Relief, Tax Credits, etc)
Overview Of System Logic

Resource Database

Process Models

Economic & Timing

Technology Modeling
Effect of Technology Advances

- Three Major Effects:
  - Effect on Overall Production Profile of the Resource
  - Effect on Economics of the Resource
  - Combination of Both
Three Phases of Technology Development:

- **R&D Phase**
- **Demonstration**
- **Market Acceptance**
- **Market Saturation**
Possibilities of Phase Outcomes

- **RD & D Phase (Outcome)**
  - Technology May be a Success
  - Technology May be Unsuccessful
  - Performance May be a fraction of Targeted Goals

- **Implementation Phase**
  - Effective or Not Effective
  - Lack of Understanding
  - Lack of Access to Technology

Chances of Success

Market Acceptance
Impacts of Multiple Technologies

Measuring Technology Impacts

- Mutually Exclusive (M): $\text{Tech A} \text{ Or } \text{Tech B}$
- Additive (A): $\text{Tech A} + \text{Tech B} = \text{Tech A&B}$
- Synergetic (S): $\text{Tech A} \text{ Tech B}$

Example:

- Reservoir Characteristics Help Improve Production by 15%
- Drilling Bit Improvements Help Reduce Drilling Cost by 10%

These Technologies are Mutually Exclusive, Additive, and/or Synergetic
Why We Are Here

- To Identify Technologies/ Technology Groups
- Discuss Possible Outcomes of Such Technologies
- Suggest Target Improvement
- Market Acceptance & Possibility of Success
Technology Development Path

Increased Production

R & D

Increased Production Due to Technology Improvement

Cost Reductions

Invested

Policy & Economic Decisions

Uncertainties

INTEK
Technology Groups

A. Reservoir Characterization/Management

B. Drilling/Completion

C. Stimulation/ Fracturing

D. Specific Processes
A: Reservoir Characterization / Management

APPLICABLE RESOURCES

<table>
<thead>
<tr>
<th>R &amp; D FOCUS</th>
<th>CONVENTIONAL</th>
<th>UNCONVENTIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seismic 4D</td>
<td>OIL</td>
<td>OIL</td>
</tr>
<tr>
<td>Geological Modeling</td>
<td>GAS</td>
<td>GAS</td>
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<tr>
<td>Logging Tools</td>
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<tr>
<td>Downhole Sensors</td>
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<tr>
<td>Reservoir Simulators</td>
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<td>Project Management</td>
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</tbody>
</table>

POSSIBLE OUTCOMES

- Decrease Dry Hole rate
- Increase Resource Recovery
- Optimize Productivity
- Define Reservoir Heterogeneity
- Increase Resource Accessibility
- Optimize Well Planning & Construction
- Reduce Operating Cost
## A: Reservoir Characterization / Management Targets

<table>
<thead>
<tr>
<th>R &amp; D Focus</th>
<th>Possible Outcomes</th>
<th>Target (%)</th>
<th>Market Acceptance</th>
<th>Probability Of Success %</th>
<th>Cost to Apply Technology (%) **</th>
</tr>
</thead>
</table>
| • Seismic 4D                | - Reduce Dry Hole Rate  
- Increase Resource Recovery                                                        | - 20  
+ 5-10           | 50-70             | 60-80                  | 10
| • Geological Modeling       | - Define Reservoir Heterogeneity  
- Optimize Productivity                                                            | Qualitative  
+ 4-6            | 60-80             | 80-90                  | 2-4
| • Logging Tools             | - Define Reservoir Heterogeneity  
- Increase Resource Accessibility                                                   | Qualitative  
+ 4-6            | 80-90             | 60-80                  | 4-6
| • Downhole Sensors          | - Reduce Real Time and Cost  
- Optimize Productivity                                                             | - 6-8  
+ 4-7            | 50-60             | 50-70                  | 6-8
| • Reservoir Simulators      | - Increases Resource Accessibility  
- Reduces Real-Time and Cost                                                         | + 4-6  
- 2-5            | 75-80             | 80-90                  | 3-4
| • Project Management        | - Optimize Well Planning  
& Constructions                                                                         | Qualitative     | 80-90             | 80-90                  | 2-4

** % of Total Operating Cost
## B: Drilling/Completion

### APPLICABLE RESOURCES

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<tr>
<td>• Down Hole Seismic</td>
<td>OIL</td>
<td>OIL</td>
</tr>
<tr>
<td>• Drilling Cutters</td>
<td>GAS</td>
<td>GAS</td>
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<tr>
<td>• Drilling Fluids</td>
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<tr>
<td>• Down hole Logging While Drilling</td>
<td></td>
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<tr>
<td>• Advance Completion Techniques</td>
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</tbody>
</table>

### POSSIBLE OUTCOMES

- Reduce Near Well bore Damage
- Increase Drilling Efficiency
- Increase Rate Of Penetration
- Improves Hole Quality and Reduce Rig Time
- Increase Multiple Zone Completion
- Reduce Economic & Technical Risk
## B: Drilling/Completion Targets

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</thead>
<tbody>
<tr>
<td>• Down Hole Seismic</td>
<td>- Increase Accuracy of Formation Evaluation</td>
<td>Qualitative</td>
<td>50-70</td>
<td>65</td>
<td>7-9</td>
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<tr>
<td></td>
<td>- Increase Resource Development</td>
<td></td>
<td></td>
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<tr>
<td>• Drilling Cutters</td>
<td>- Increase Rate Of Penetration</td>
<td>+ 4-6</td>
<td>50-60</td>
<td>70</td>
<td>2-4</td>
</tr>
<tr>
<td></td>
<td>- Decrease Rig Time</td>
<td>- 5-7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Drilling Fluids</td>
<td>- Increase Drilling Efficiency</td>
<td>+ 4-7</td>
<td>50-70</td>
<td>55</td>
<td>2-4</td>
</tr>
<tr>
<td></td>
<td>- Reduce Drilling Cost</td>
<td>- 6-8</td>
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<tr>
<td>• Down hole Logging While Drilling</td>
<td>- Stability in Pay Zone</td>
<td>Qualitative</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>- Increase Drilling Efficiency</td>
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<tr>
<td>• Advanced Completion Techniques</td>
<td>- Multiply Zone Completions</td>
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<td></td>
<td>- Reduce Near WellBore Damage</td>
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C: Stimulation/Fracturing

APPLICABLE RESOURCES

R & D FOCUS
• Remote Sensors
• Natural Fracture Detection
• Advanced Stimulation Techniques
• Hydraulic Fracturing Techniques
• Well Bore Flow Modeling

POSSIBLE OUTCOMES

CONVENTIONAL UNCONVENTIONAL
OIL GAS OIL GAS

• Increase Resource Recovery
• Increase Target Efficiency
• Optimize Field Development
• Reduce Stimulation Cost
• Reduce Overall Cost
• Increase Production Rates, and Reduce Well Cleanup Times.
# C: Stimulation / Fracturing Targets

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<tr>
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<th>Cost to Apply Technology (%) **</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Micro Hole Fracture Techniques</td>
<td>- Increase Resource Recovery                                                     + 4-7</td>
<td>60</td>
<td>65</td>
<td>5-8</td>
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<tr>
<td></td>
<td>- Increase Production Rates                                                      + 5-7</td>
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<tr>
<td>• Borehole Imaging</td>
<td>- Increase Target Efficiency                                                     + 2-3</td>
<td>55</td>
<td>60</td>
<td>5-6</td>
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<td>- Reduce Stimulation Time                                                        - 5-8</td>
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<tr>
<td>• Advanced Stimulation Techniques</td>
<td>- Increase Target Efficiency                                                     + 6-9</td>
<td>60</td>
<td>68</td>
<td>4-5</td>
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<tr>
<td></td>
<td>- Increase Production Rates                                                      + 6-8</td>
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<td>&amp; Reduce Well Cleanup Times                                                      - 10</td>
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<tr>
<td>• Hydraulic Fracturing Monitors</td>
<td>- Increase Production Rates                                                      + 5-6</td>
<td>65</td>
<td>65</td>
<td>3-6</td>
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<tr>
<td></td>
<td>&amp; Reduce Well Cleanup Times</td>
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<tr>
<td>• Well Bore Flow Modeling</td>
<td>- Define Types Of Stimulation Required                                          Qualitative</td>
<td>62</td>
<td>60</td>
<td>2-4</td>
<td></td>
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</tbody>
</table>

** % of Total Operating Cost
Specific Processes

• CO2 EOR
  – Increase Injection Rate ---> By How Much?
  – Volume of CO2 Injected
    • 0.4 HCPV – Normally Used
    • Is 1.0 HCPV or Higher – A new industry practice?
  – Use of Industrial CO2
    • How soon do you think capture technologies can be commercialized
      – EIA assumes 4-8 years depending on source of emission.
    • How much is the operator willing to pay for CO2 delivered at well head?
Summary

• All target improvements will be calculated in the process and timing models.
• Variables will be defined to address such target improvements.
• EIA expects to complete this model by June/July 2008
  – Testing and final results by September 2008
• EIA will present preliminary results to this committee in August 2008 for comments and suggestions.
Other Technologies Not Considered
## Targets for Other Technologies

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