Devon’s Energy Water Conservation

2011 Oklahoma Governor’s Water Conference
Richard Luedecke

Oct. 18, 2011 Norman, Oklahoma
Devon Today

Proved reserves: ≈ 2.9 billion BOE  
(12/31/10)

Current production: ≈ 660 MBOED  
(Q2 2011)

Sales revenue mix: 59% liquids  
41% gas  
(Q2 2011)

Significant midstream business

2011 operating profit: ≈ $530 million projected

Enterprise value: ≈ $30 billion
Larger than you might think...

Enterprise value

US $, billions

#1 Innovation

Fortune’s Most Admired

FedEx
Allstate
Marriott
General Motors
Best Buy
Southwest Airlines

Source: Enterprise value as stated on Yahoo! Finance on Oct. 3, 2011.
Hydraulic Fracturing
3-7 day process

- Typical horizontal gas or oil well can require approximately 6 million gallons of water
  - This represents the equivalent amount of water used for nine Olympic size swimming pools
- Flowback: A portion of the injected water recovered in the first few weeks
- Produced water: Water that is naturally present in the formation; it is recovered over the life of the well
Projected Water Demand
State of Oklahoma - 2010

- Irrigation: 40.0%
- Oil & Gas Activities: 2.3%
- Livestock: 5.1%
- Thermoelectric Power: 14%
- Municipal & Industrial: 32%
- Self-Supplied Industrial: 4.8%
- Self-Supplied Rural: 1.6%

SOURCE: Oklahoma Water Resources Board
Characteristics of Flowback/Produced Water - Highly variable

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cana (OCC Presentation)</th>
<th>Cana - Devon Devon sample</th>
<th>Marcellus (OCC Present)</th>
<th>Marcellus (OCC Present)</th>
<th>Barnett Shale - Devon sample</th>
<th>Barnett Shale - Devon sample</th>
<th>PB - St. COM 5 - Devon sample</th>
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NYSE: DVN www.devonenergy.com page 6
Barnett Shale Flowback Analysis

Barnett flowback analysis

Cumulative flowback (Bbls)

TDS (PPM)

Denton County South
Denton County North
Johnson County

Denton County South
Denton County North
Johnson County
Water Sustainability Principles

• Devon is committed to the principles of conservation and re-use of water where feasible through the following:
  
  – Educating and working closely with governmental authorities and members of the public concerning water usage needs and the necessity of water management
  – Identifying usage needs, determining resource availability and monitoring water use
  – Applying conservation practices and identifying opportunities to improve water use efficiency
  – Employing economically and operationally feasible alternatives to fresh water usage
  – Advocating for appropriate regulations on water use and re-use
  – Continuing to employ prudent operating practices to ensure the protection of surface and groundwater
  – Planning for operations to continue if water availability becomes constrained
Planning Considerations for Water Management

• Acquisition and quantity/quality of source water

• Compatibility of the water with the formation rock and frac fluid engineering design

• Logistics of transporting the water

• Produced water quantity/quality

• Storage requirements of the frac water

• Cost of the required level of treatment

• Reuse or dispose of water
Treatment Required for Recycling
Multiple levels

• Water recycling is reusing treated wastewater for beneficial purposes

• Recycling can satisfy the demand as long as it is adequately treated to ensure the correct water quality
  – Primary treatment to settle and coagulate off the solids may only be necessary
  – Advanced treatment may be needed to eliminate chlorides and other undesirable constituents
    • Distillation is an advanced form and is very energy intensive
  – Some amount of “make-up” water will be needed
Produced Water Reuse Evaluation
Process Flow Diagram
Jim Myers, Chevron presentation to 11/19/10 SPE luncheon

Water Reuse Option

Information Gathering Phase
- PW Quantity & Quality
- Water Reuse Standards
- Local Water Needs

Design Phase
- Treatment Technology Selection
- Cost - CAPEX OPEX

Evaluation Phase
- Other Alternatives
- NEBA +’s and –’s

Decision?
- NO Injection
- YES Reuse the Water

Using Net Environmental Benefit Analysis (NEBA), Environmental Social Impact Assessment (ESIA), and other important factors to make the decision.
Regulatory Hurdles
Considerations for recycling

- This opportunity relies on the approval of permits for centralized commercial recycling impoundments
  - Enhanced construction and design requirements
    - Impoundments are larger than those historically permitted
    - Remain in place thereby exceeding “temporary” thresholds
    - Equipped with redundant leak detection systems
    - Public Comments

- However, some states are equipped with a risk-based permitting structure to encourage recycling - Oklahoma Corporation Commission (OAC 165:10-7)
Mobile Heated Distillation System
Devon and Fountain Quail Water Management

- Approved by the Railroad Commission of Texas in 2005
- Implemented in 2005
- Vaporizes frack flow-back water and condenses it into clean, distilled water
- Remaining concentrated water removed for disposal or utilized for controlling pressures in another well completion as a “kill fluid”
Water Recycling Results
Fountain Quail

- 22,500 bbls/day at peak
- 13.9 million barrels processed (584 million gallons)
- 10.8 million barrels of distilled water generated (454 million gallons)
- 100+ wells fracked with recycled water
Opportunities for Water Recycling
Cana Woodford Shale

• Exceptional flowback and produced water quality in the Cana Woodford Shale
  – Very low total dissolved solids (TDS)
  – Flowback water quality is approximately 12,000 TDS
  – Produced water quality is approximately 20,000 TDS
  – Potential exists to reuse these fluids, thus reducing the demand for fresh water

• Current quantities available for reuse:
  – 26,000 barrels per day of produced fluid from 196 wells
Cana-Woodford Water Recycling Facility

- Water will be moved into concrete-lined settling basin

- Solids will settle to the bottom of the basin before the water is separated for removal of remaining oil/natural gas liquids

- The water will go into a 500,000-barrel pond for storage before being sent by pipeline to be reused

- A disposal well is being drilled next to the recycling facility to handle excess water
Ongoing R&D Promoting Additional Reuse Opportunities

• Devon working with industry peers to partner with the Shale Gas Water Research Center

• Center will perform testing, chemistry research and analysis, and complete water management in shale and unconventional oil/gas production

• Center will perform rigorous testing with respect to a variety of water related issues to establish the best protocols for treatment, reuse, and recovery
Thank You.