SLIDES: Energy Development Water Needs Assessment and Water Supply Alternatives and Analysis

Benjamin Harding

Follow this and additional works at: https://scholar.law.colorado.edu/promise-and-peril-of-oil-shale-development

Part of the Administrative Law Commons, Climate Commons, Energy and Utilities Law Commons, Energy Policy Commons, Environmental Health and Protection Commons, Environmental Law Commons, Environmental Policy Commons, Geotechnical Engineering Commons, Land Use Law Commons, Natural Resource Economics Commons, Natural Resources Law Commons, Natural Resources Management and Policy Commons, Oil, Gas, and Energy Commons, Oil, Gas, and Mineral Law Commons, President/Executive Department Commons, Public Policy Commons, Science and Technology Law Commons, State and Local Government Law Commons, Water Law Commons, and the Water Resource Management Commons

Citation Information

Reproduced with permission of the Getches-Wilkinson Center for Natural Resources, Energy, and the Environment (formerly the Natural Resources Law Center) at the University of Colorado Law School.
Energy development water needs assessment and water supply alternatives analysis

Benjamin Harding, AMEC Earth & Environmental
The Promise and Peril of Oil Shale
February 5, 2010
Colorado Water for the 21st Century Act (HB 05-1177)

- Statewide Water Planning Process
- Nine Basin Roundtables
  - Formulate a water needs assessment
  - Conducting analysis of un-appropriated water
  - Propose projects or methods for meeting needs
- Interbasin Compact Committee
- Funding for special studies
Energy Water Needs Assessment

- Funded under the HB-1177 Process by the Colorado Water Conservation Board
- Project of Colorado River basin and Yampa/White River basin Roundtables
- Two phases:
  - Estimating energy development water needs
  - Evaluating water supply alternatives to satisfy those needs
## Phase 1 Industry Production Scenarios

<table>
<thead>
<tr>
<th>Scale</th>
<th>Capacity</th>
<th>Water Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>None (R&amp;D)</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>550,000 bbl/day</td>
<td>135,000 af/year</td>
</tr>
<tr>
<td>High</td>
<td>1,550,000 bbl/day</td>
<td>380,000 af/year</td>
</tr>
</tbody>
</table>
Phase 2 Approach

- **Refine Water Use Estimates**
  - Review and refine Phase I unit water use
  - Localize water use estimates
  - Develop water use scenarios

- **Evaluate use of Piceance Basin groundwater**
  - Ground water quality
  - Potential tributary connection
  - Overall feasibility of groundwater use

- **Develop water supply project alternatives**

- **Develop model and analyze alternatives**
Uncertainty: Industry Scale/Timing

- **Review history of Athabasca Oil Sands**
  - Surface-mined – (less overburden)
  - Separation process 1926
  - First commercial extraction 1967 30,000 bbl/day
  - 2005 production 760,000 bbl/day
  - 2006 production 1,100,000 bbl/day
  - Long-term growth rate c. 12%

- **Extrapolation to Piceance Basin**
  - Field demonstration of feasibility c. 2015
  - First commercial production c. 2035 (50,000 bbl/day)
  - 1.55 mm bbl/day by about 2060
Uncertainty: Electrical Energy

- **What in-situ technology will prevail?**
  - Electrically heated
  - Combustion or other heating method

- **Electrically Heated In-situ**
  - 120,000 GWh/year for 1.5 million bbl/day
  - Colorado total generation (2008): 53,000 GWh/year

- **What will be source of electrical energy?**
  - On-site Combined-cycle Gas Turbines (CCGT)
  - Yampa coal-fired thermal (Craig station approximately 10,000 GWh/year)
  - “Somewhere else”

- **Water requirements**
  - CCGT in-basin
  - Thermal in ????
  - Grid supplied

- ** Likely winner: CCGT?**
## Phase 2 Water Needs Estimates

<table>
<thead>
<tr>
<th>Industry Case</th>
<th>1,550,000 bbl/day</th>
<th>550,000 bbl/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct uses</td>
<td>110,000 af/year</td>
<td>42,000 af/year</td>
</tr>
<tr>
<td>Water for CCGT</td>
<td>55,000 af/year</td>
<td>19,000 af/year</td>
</tr>
<tr>
<td>Water for Thermal</td>
<td>181,000 af/year</td>
<td>61,000 af/year</td>
</tr>
</tbody>
</table>

### Colorado Total

| “Somewhere Else”       | 110,000 af/year   | 42,000 af/year |
| Using CCGT             | 165,000 af/year   | 61,000 af/year |
| Using Thermal          | 291,000 af/year   | 103,000 af/year |
Water Supply: Groundwater

- Quality—
  - Ranges from moderately poor to very poor (1,000- > 10,000 mg/l TDS)
  - Hard and scale forming
  - Will require treatment

- Quantity
  - Most feasible aquifers are probably tributary
  - Feasibility of development in other aquifers will depend on site specific investigations

- Overall—Not likely to be a regional resource

Modified from Tweto, 1983
Water Supply: Surface Water
Water Supply: Develop Conceptual Projects

- White River Basin
  - Identified Reservoirs
  - No feasible groundwater
- Imports from Colorado River
  - Exxon change case
  - Other projects?
- Imports from Yampa River
  - Shell proposal
Proposed Diversion Points & Reservoirs by Exxon Mobil
(Case NO. 08CW/199)
White River Reservoirs
Water Supply: Evaluating Projects

- Develop water rights “portfolio” from identified “energy” rights
- Associate Water Rights with Facilities
- Disaggregate demands to nodes
- Disaggregate annual demands to model time step
- Evaluate performance of project/water rights
Water Supply Uncertainties

- Will there be any oil shale industry?
- If there is an industry, can its scale be managed?
- What in-situ technology will be used?
- Where will the electricity come from?
- Where will upgrading and refining be done?
- Development approach?
  - Coordinated
  - “Scramble”
- How much water will be available?