Update on Upstream Oil & Gas CEP Plan Implementation

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Scope included water used for:

- Oil sands mining production
- Oil sands in situ production
- Conventional oil production
- Well drilling and completions
- Gas plants

Excluded:

- Shale gas production (due to lack of available data)
- Midstream or downstream oil & gas activities

Provided actual production and water use statistics from 2000 to 2009, and projections to 2015

CEP performance measure:

- Non-saline water use productivity; i.e., the volume of non-saline water used per volume of hydrocarbon produced
- Projected improvements compared to baseline (average of 2002 to 2004)
## CEP Plan Projected Improvements

<table>
<thead>
<tr>
<th>Activity</th>
<th>Non-saline water use productivity (m³ non-saline water/m³ oil or bitumen)</th>
<th>Baseline (2002-04)</th>
<th>Projected (2015)</th>
<th>Improvement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil sands mining (Athabasca only)</td>
<td></td>
<td>3.18</td>
<td>2.30</td>
<td>28%</td>
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<td>Oil sands mining (total fresh)</td>
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<td>4.04</td>
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<td><strong>Total</strong></td>
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<td><strong>24%</strong></td>
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Sector Non-Saline Water Use

- Production increased by 82% between the baseline period and 2014
  - Baseline: 92.5 Mm3 OE
  - 2014: 168.2 Mm3 OE
- Total non-saline water use increased 10%
  - Baseline: 183.1 Mm3
  - 2014: 200.7 Mm3
Sector Non-Saline Water Use Productivity

- Improved 40% between the baseline period and 2014
  - Baseline: 1.98:1
  - 2014: 1.19:1

Note: Dotted line is original projection from 2011 CEP Plan (CAPP, 2011)
Oil Sands Mining Non-saline Water Use

- **Between the baseline period and 2014**
  - 68% increase in bitumen production
  - 16% increase in non-saline water use
- **Mined bitumen production**
  - Baseline: 35.9 Mm3
  - 2014: 60.2 Mm3
- **Non-saline water use**
  - Baseline: 144.9 Mm3
  - 2014: 168.3 Mm3
  - Use from Athabasca decreased over decade
    - 114.2 -> 99.7 Mm3
Oil Sands Mining Non-Saline Water Use Productivity

- Improved 31% between the baseline period and 2014
  - Baseline: 4.04:1
  - 2014: 2.79:1
- Athabasca River water use productivity improved 48%
  - Baseline: 3.18:1
  - 2014: 1.66:1
  - Proportion sourced from Athabasca decreased 79% -> 59%
  - Increased proportion from runoff and mine depressurization water
Oil Sands In Situ Non-saline Water Use

- Between the baseline period and 2014
  - 269% increase in bitumen production
  - 56% increase in non-saline water use

- In situ bitumen production
  - Baseline: 20 Mm3 OE
  - 2014: 73.8 Mm3

- Non-saline water use
  - Baseline: 12.5 Mm3
  - 2014: 19.5 Mm3
Oil Sands In Situ Non-Saline Water Use Productivity

- Improved 58% between the baseline period and 2014
  - Baseline: 0.63:1
  - 2014: 0.26:1
- Primarily due to:
  - Saline groundwater use for steam generation
  - Reuse of mining wastewater streams for in situ makeup water
Conventional Oil Non-saline Water Use

- **Between the baseline period and 2014**
  - 7% decrease in production
  - 50% decrease in non-saline water use

- **Conventional oil production**
  - Baseline: 36.6 Mm3
  - 2014: 34.2 Mm3

- **Non-saline water use**
  - Baseline: 25.7 Mm3
  - 2014: 12.9 Mm3
  - Proportion of non-saline water decreased from 75% to 62%
Conventional Oil Non-Saline Water Use Productivity

- Improved 46% between the baseline period and 2014
  - Baseline: 0.70:1
  - 2014: 0.38:1
- Primarily due to
  - Increased reuse
  - Use of alternative water sources
  - Saline groundwater volumes remained relatively constant
### Performance Relative to Baseline

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Adoption of New Best Practices and Technologies

- **21 CEP opportunities were identified in the 2011 CEP plan that**
  - Reduce the volume of non-saline water required to produce bitumen, oil or gas; or
  - Reduce the environmental impact of water use

- **CAPP members were surveyed to evaluate the 21 opportunities for**
  - Level of adoption
  - Challenges
  - Successes

- **Opportunities were assessed for impact on water use**
CEP Opportunities with Moderate to High Impact

- Reuse mining wastewater streams for in situ makeup water; e.g., blowdown from upgraders, tailings pond water
- Use saline groundwater for in situ steam generation
- Recycle produced water from oil and gas wells instead of disposal or release
- Updates to equipment and operating procedures for improved water efficiency
- Alternative, less water-intensive oil sands tailings technologies and management techniques
- Alternatives to non-saline water for drilling or fracturing fluids
CEP Opportunities with Low to Moderate Impact

- Treat waste/produced/saline water for reuse rather than disposal
- Reuse municipal wastewater instead of diverting new water
- Use saline groundwater for pressure maintenance
- Use evaporator technology to treat blowdown at in situ operations
- Add polymers to waterfloods for improved productivity
- Treat water to increase recycling rate from tailings ponds
CEP Opportunities Not Adopted

● **Regulatory uncertainty**
  - Redefine water regs to prioritize use of lower quality non-saline water
    - Water Conservation Policy will identify alternative water sources - not released yet

● **In pilot or evaluation stages**
  - CO2 injection to enhance recovery instead of water injection
  - Solvent injection to enhance recovery for in situ
  - Combustion to enhance recovery for in situ

● **Cost and technical challenges**
  - Non-water-based mining extraction methods
  - Storage of water in aquifers for future use
  - Reduce evaporation from ponds
Concurrent Environmental or Social Benefits of CEP Efforts

- **Surface water storage options for oil sands mining**
  - Does not reduce water use, but can change timing of withdrawals to reduce impacts to aquatic ecosystems.

- **Less water-intensive tailings technologies**
  - Lower dependence on water from tailings ponds -> smaller ponds
  - Lower energy and GHG emissions since less water needs to be reheated for use in bitumen extraction

- **Updated equipment & operating procedures**
  - Water security
  - Reduced trucking (noise, dust, air emissions, costs)
  - Competitive advantage
  - Improved social licence to operate

- **Recycle produced water from oil and gas wells**
  - Reduced trucking
  - Reduced fresh water use
Concurrent Benefits cont’d

- Evaporator technology
  - Smaller physical footprint
- Polymer waterfloods
  - Lower GHG emissions
Environmental Tradeoffs of CEP Efforts

- **Reduction of river flows**
  - Where wastewater would have been released

- **Increased land disturbance/surface footprint**
  - Pipelines used to move water, rather than source wells on-site or trucking
  - New infrastructure

- **Increased GHG emissions**
  - Pumping alternative water sources over distances requires energy
  - Trucking water in
  - Water treatment processes
  - Evaporator technology

- **Risk of spills/pipeline failures**
  - Transmission of saline/produced/waste water

- **Additional waste generation**
  - Water treatment processes
Adjustments Needed to Sector Plan

- **Inclusion of shale gas, tight gas and tight oil water use**
  - Once water use statistics are available

- **Address overlap between existing CEP opportunities**
  - Combine if a plan update is undertaken
Summary

- **Upstream oil and gas sector has made significant improvements in non-saline water use productivity**
- **Improvements were equal to or higher than originally projected across all sub-sectors**
  - Oil sands mining - Athabasca River only: 48% (projected: 28%)
  - Oil sands mining - total: 31% (projected: 28%)
  - Oil sands in situ: 58% (projected: 47%)
  - Conventional oil: 46% (projected: 15%)
- **Overall, the sector had a productivity increase of 40%**
  - 2011 CEP plan projection: 24%
  - Exceeded the Alberta target of 30% improvement relative to baseline
- **Improvements were made due to many changes, especially:**
  - Operational and equipment improvements allowing the switching from non-saline water to other quality-impaired sources (e.g., saline groundwater, produced water, and municipal/industrial wastewater)