Pipelines and Power Plants: The Energy Needs of the West’s Future Water Supplies

Stacy Tellinghuisen
Energy/Water Analyst

WESTERN RESOURCE ADVOCATES
Energy and water are inextricably linked. As growing western cities seek to expand water supplies, they often must tap deeper groundwater aquifers, pump water over greater distances, and treat degraded water supplies. Water utilities’ proposed development projects will, in most cases, use more energy than existing water supplies – further increasing greenhouse gas emissions and the potential impacts of climate change.

The following slides present a sustainable approach to meeting the West’s new water demands.
Outline

- Overview of proposed water projects
- Energy use of projects
- Energy savings of water conservation measures
- Framework for “smart” projects
Energy is used for collecting, treating, and distributing potable supplies; heating, pressurizing, or cooling water at the end-user; and treating and discharging wastewater.
Proposed Projects
Proposed Water Projects

1. Southern Nevada Water Authority (SNWA)★
2. Lake Powell Pipeline ★
3. Southern Delivery System (SDS) ★
4. Northern Integrated Supply Project (NISP) ★
5. Yampa Pumpback Project (Maybell Pipeline) ★
6. Million Pipeline ★

Western Resource Advocates
Proposed Water Projects

1. Southern Nevada Water Authority (SNWA)
2. Lake Powell Pipeline
3. Southern Delivery System (SDS)
4. Northern Integrated Supply Project (NISP)
5. Yampa Pumpback Project (Maybell Pipeline)
6. Million Pipeline

Western Resource Advocates
Southern Nevada Water Authority

Proposed Project:

- Pump up to 200,000 acre-feet per year (AF/yr) 300 miles, from Clark, Lincoln, and White Pine Counties.
- Deliver 167,000 AF/yr to SNWA and 33,000 AF/yr to Lincoln County.

1 AF = 325,851 gallons, enough water to support two households for one year.

Southern Nevada Water Authority

**Cost**: $2 billion+

**Development Timeline**: Draft EIS expected, summer 2009

**Power Demands**: 79 MW (gross), 40 MW (net)

**Annual GHG Emissions**: 204,000 short tons CO₂

(the equivalent of burning 21,000,000 gallons of gasoline)

** Calculation by WRA. Assumes the average ghg intensity of electricity generated in Nevada in 2004, 0.79 tons CO2/MWh

Proposed Water Projects

1. Southern Nevada Water Authority (SNWA)
2. Lake Powell Pipeline
3. Southern Delivery System (SDS)
4. Northern Integrated Supply Project (NISP)
5. Yampa Pumpback Project (Maybell Pipeline)
6. Million Pipeline

Western Resource Advocates
Lake Powell Pipeline

Proposed Project:
- Pump 100,000 AF/yr almost 160 miles, from Lake Powell to Washington, Kane, and Iron Counties (southwestern Utah)
Lake Powell Pipeline

**Projected Cost**: $1.1 Billion (Capital; est. in 2008)

**Development Timeline**: Scoping completed in 2008; Draft EIS expected in 2010

**Power Demands**: 500 – 550 MW *gross*, 150 – 200 MW *net*

**Annual GHG Emissions****: 326,000 short tons CO₂

*(the equivalent of burning 33,600,000 gallons of gasoline)*

** Calculation does not include the energy used and greenhouse gas emissions for the pumped storage reservoir - an additional 173,000 tons CO₂. Calculation by WRA. Assumes the average ghg intensity of electricity generated in Utah in 2004, 1.06 tons CO₂/MWh.*
Proposed Water Projects

1. Southern Nevada Water Authority (SNWA)
2. Lake Powell Pipeline
3. Southern Delivery System (SDS)
4. Northern Integrated Supply Project (NISP)
5. Yampa Pumpback Project (Maybell Pipeline)
6. Million Pipeline

Western Resource Advocates
Southern Delivery System

Proposed Project:

- Pump 52,900 AF/yr from Pueblo Reservoir to Colorado Springs, Fountain, and Security
- Construct 62 miles of pipelines and 3 pumping stations.
- Store water in a new reservoir near Colorado Springs.
Southern Delivery System

**Cost**: $1.09 Billion (Capital); $651 Million (O&M from 2012 to 2046)

**Development Timeline**:
- Final EIS issued December 12, 2008
- Record of Decision expected in winter, 2009
- Construction in phases from 2012 to 2025

**Power Demands**: 58 MW (coal equivalent, based on expected patterns of pumping – 7 months/year)

**Annual GHG Emissions**: 243,285 short tons CO₂
  (the equivalent of burning 25,100,000 gallons of gasoline)

http://www.sdseis.com/FEIS.html
Proposed Water Projects

1. Southern Nevada Water Authority (SNWA)
2. Lake Powell Pipeline
3. Southern Delivery System (SDS)
4. Northern Integrated Supply Project (NISP)
5. Yampa Pumpback Project (Maybell Pipeline)
6. Million Pipeline
Northern Integrated Supply Project

Proposed Project:

- Divert 40,000 AF/yr of peak flows from the Cache la Poudre River
- Store water in Glade and Galeton Reservoirs
Northern Integrated Supply Project

**Cost**: $426 Million (Capital); $651 Million (O&M from 2012 to 2046)*

**Development Timeline**: Draft EIS issued April 2008

**Power Demands**: 5 - 8 MW

**Annual GHG Emissions**: 33,700 – 57,600 short tons CO₂
  (the equivalent of burning 3,500,000 – 5,900,000 gallons of gasoline)

* Other estimates suggest much higher costs of construction and operation
** Based on average ghg intensity of electricity in Colorado

Western Resource Advocates
Proposed Water Projects

1. Southern Nevada Water Authority (SNWA)
2. Lake Powell Pipeline
3. Southern Delivery System (SDS)
4. Northern Integrated Supply Project (NISP)
5. Yampa Pumpback Project (Maybell Pipeline)
6. Million Pipeline

Western Resource Advocates
Yampa Pumpback Project (Maybell Pipeline)

Proposed Project:

• Convey 300,000 AF/yr from the Yampa River to the Front Range of Colorado

• Water will be pumped up and over the Rocky Mountains - 250 miles

Yampa Pumpback Project
(Maybell Pipeline)

**Cost Estimates**: $3.97 billion (capital), 43 million annual O&M (North Alignment)

**Development Timeline**: Initial investigation completed, 2006

**Power Demands**: 230 MW *gross*, 112 MW *net*

**Annual GHG Emissions**: 649,500 short tons CO$_2$/yr*
  (the equivalent of burning 66,900,000 gallons of gasoline)

* Based on *net* electricity consumption and average ghg intensity of electricity in Colorado

Proposed Water Projects

1. Southern Nevada Water Authority (SNWA)
2. Lake Powell Pipeline
3. Southern Delivery System (SDS)
4. Northern Integrated Supply Project (NISP)
5. Yampa Pumpback Project (Maybell Pipeline)
6. Million Pipeline

Western Resource Advocates
Regional Watershed Supply Project (Million Pipeline)

Proposed Project:
• Convey up to 200,000 AF/yr from the Green River (Wyoming) to the Front Range of Colorado

Information from various newspaper articles
Regional Watershed Supply Project (Million Pipeline)

Cost: unknown

Development Timeline: Notice of Intent to begin scoping process expected in winter/spring, 2009

Power Demands: unknown

Annual GHG Emissions: unknown
Energy Use
Energy Use

1. Projects’ energy use
2. Energy intensity of water
3. Energy capacity for pipelines
## Net Energy Use of Proposed Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>SNWA</th>
<th>Powell</th>
<th>SDS</th>
<th>NISP</th>
<th>Maybell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of Water</td>
<td>167,000 AF</td>
<td>100,000 AF</td>
<td>52,900 AF</td>
<td>40,000 AF</td>
<td>300,000 AF</td>
</tr>
</tbody>
</table>

* The average Westerner uses between 7 and 24 MWh of electricity per year (including residential, commercial, and industrial energy use). Source: Northwest Power Council, 5th Power Plan, Appendix A.

* Preliminary Estimates
* The Powell estimate includes the pipeline and the pumped storage reservoir.
* The Million Project is not included, because no data was available.
The energy used by each pipeline could support thousands of residents.

<table>
<thead>
<tr>
<th>Project</th>
<th>Equivalent Energy Use (# of People)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Nevada Water Authority</td>
<td>15,100 Nevadans</td>
</tr>
<tr>
<td>Lake Powell Pipeline</td>
<td>32,500 Utahns</td>
</tr>
<tr>
<td>Southern Delivery System</td>
<td>24,000 Coloradans</td>
</tr>
<tr>
<td>Northern Integrated Supply Project</td>
<td>3,300 – 5,600 Coloradans</td>
</tr>
<tr>
<td>Yampa Pumpback (Maybell)</td>
<td>63,100 Coloradans</td>
</tr>
</tbody>
</table>
* Preliminary Estimates
* Powell estimate includes *only* the pipeline, not the pumped storage reservoir.
Electric Generating Capacity Needed for Proposed Projects

Gross capacity = total capacity needed to power the project’s pumping stations.

Net capacity = Gross capacity minus hydroelectric generating capacity.

*Preliminary Estimates

** The Lake Powell Pipeline Project includes the pumped hydro storage reservoir.
The energy used for the proposed projects falls into the “Collection, Extraction & Conveyance” step. Additional energy is used in treatment and distribution, by the end user, and for wastewater processing. The following slides present energy use estimates for the other steps.
Energy Intensity of Water:
A Case Study of St. George, Utah

- Lake Powell Pipeline
- Groundwater Wells
- Quail Creek WTP
- Distribution
- Wastewater Treatment (secondary only)
- Recycled Water: Treatment and Distribution

**Raw Water: Pumping**

**Wastewater Treatment**

**Treatment**

KWh/AF
A substantial amount of energy is used by the end-user, to heat, cool, and pressurize water.
“In-home heating” reflects the energy used to heat water to 106ºF, a typical water temperature for a shower.
Water Conservation: Water and Energy Savings
Water, Energy and GHG Savings

- Savings will vary, depending on the water supply and system configuration.
- Sample savings for St. George, UT:

<table>
<thead>
<tr>
<th></th>
<th>Potential Water Savings (gallons/capita/yr)</th>
<th>Potential Electricity Savings (kWh/capita/yr)</th>
<th>Electricity Bill Savings, per capita, at 6.8 c/kWh</th>
<th>GHG Savings (metric tons CO₂/capita/yr)</th>
<th>GHG Savings (Gallons of gasoline equivalent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Showerheads</td>
<td>1,129</td>
<td>151</td>
<td>$10.00</td>
<td>0.15</td>
<td>16.2</td>
</tr>
<tr>
<td>Faucets</td>
<td>2,711</td>
<td>165</td>
<td>$10.52</td>
<td>0.16</td>
<td>17.6</td>
</tr>
<tr>
<td>Clothes Washers</td>
<td>1,880</td>
<td>220</td>
<td>$14.47</td>
<td>0.21</td>
<td>23.5</td>
</tr>
</tbody>
</table>

All calculations incorporate numerous assumptions; please see WRA’s website for details, or contact Stacy Tellinghuisen.
## Cost/Benefit of Water and Energy Conservation Measures

### Sample savings for St. George:

<table>
<thead>
<tr>
<th></th>
<th>Typical, Basic Unit Cost</th>
<th>Annual Electricity Bill Savings, per capita, at 6.8 c/kWh</th>
<th>Payback Period: 1 Person</th>
<th>Payback Period: Household (2.85 Residents)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Showerheads</td>
<td>$10 – 12</td>
<td>$10.00</td>
<td>~1 year</td>
<td>4.2 months</td>
</tr>
<tr>
<td>Faucets</td>
<td>$25 – 30</td>
<td>$10.52</td>
<td>2.4 – 2.9 years</td>
<td>10.1 – 12.2 months</td>
</tr>
<tr>
<td>Clothes Washers:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Cost for</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front Loading Machine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(vs. basic, top-loading</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>machine)</td>
<td>$150</td>
<td>$14.47</td>
<td>10.3 years</td>
<td>3.6 years</td>
</tr>
</tbody>
</table>

*The average St. George household has 2.85 residents; this calculation assumes all residents share the same showerhead/faucet/clothes washer. The actual payback period will depend on behavioral patterns – including how many residents share the same appliance. For clothes washers, for example, the payback period is likely to be 3.8 years for a household; for showerheads, the payback period will likely fall between 4.2 months and 1 year.*
Framework for New Pipelines
Making New Pipelines “Smart”

1. Reduce water demands *first*
   - Conservation and water use efficiency
     - Indoor water use efficiency
     - Water-efficient landscaping
     - Effective water rate structures
   - Rainwater harvesting
Making New Pipelines “Smart”

2. Be carbon neutral
   - Power pumping stations with renewables
   - Offset additional loads with renewable energy credits
   - Use in-conduit hydropower to generate electricity, if possible
3. Avoid environmentally sensitive areas
   • Use existing reservoirs, pipelines, and infrastructure
Making it Smart: Examples

Southern Delivery System:
• Implement additional water conservation
• Power pumps with renewable energy

NISP:
• Implement additional conservation
• Pursue alternative supplies
• Power pumps with renewable energy
Conclusions

• Water – and energy – demands continue to grow in the arid Southwest
• New water supplies will be more energy intensive than existing water supplies
• The proposed water projects will – as planned – increase the water sector’s energy use and greenhouse gas emissions, further contributing to climate change.
• By increasing water conservation, many water utilities could delay or eliminate the need to develop new water supplies. This strategy would save both water and energy.
Key Recommendations

1. Water conservation can help us *mitigate* and *adapt* to climate change. Both energy and water utilities should aggressively pursue water conservation.

2. Meeting new demands will require an integrated approach between energy and water utilities. New water projects should rely on renewable sources of energy; likewise, new energy projects should reduce, or eliminate, their impacts on freshwater resources.

3. Decentralized solutions may offer both energy and water savings. Where possible, utilities and planning authorities should pursue and encourage decentralized solutions like rainwater harvesting.
For more information on water conservation, please see the following reports, available on our website:

**Nevada:**
- *A Sustainable Path: Meeting Nevada’s Water and Energy Demands* ([link](http://www.westernresourceadvocates.org/water/NV%20energy-water%20report.pdf))

**Las Vegas, Albuquerque, and Tucson:**

**Colorado:**
- *Front Range Water Meter* ([link](http://www.westernresourceadvocates.org/watermeter/index.php))

**Southwest Region:**
- *Smart Water: A Comparative Study of Urban Water Use Efficiency Across the Southwest* ([link](http://www.westernresourceadvocates.org/water.smartwater.php))
- *Smart Savings: Water Conservation Measures that Make Cents* ([link](http://www.westernresourceadvocates.org/media/pdf/Smart%20Savings%20Water%20Conservation.pdf))
Stacy Tellinghuisen
Energy/Water Analyst

stacy@westernresources.org
www.westernresourceadvocates.org