North American Energy – Water Nexus Roundtable
University of Nevada Las Vegas
April 1, 2011

U.S. – Mexico Transboundary Perspectives

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Acknowledgements

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Arizona Water Institute
Principal Question

What are the implications of the energy/water nexus at the US/Mexico border?
1. Water Supply and Demand
Arizona Border Aquifers Stressed

Hightower, Mike. 2007. At the crossroad: energy demands for water versus energy availability. *Southwest hydrology*, May/June 2007: 24-25, 37.
Sonora Border Aquifers
Stressed
2. Water Costs of Electricity
Average Gals/MWhr for Arizona-Based Facilities*

*Note logarithmic scale. First-sale only. Revised 11/28/2008
Dirty detail: Solar panels need water

How much is the question, as developers downplay frequency of cleanings
Parabolic Trough Concentrators
However,

- Air-cooled solar is feasible, although more expensive
- Several solar options use little water
3. Virtual Water Transfers
Arizona Electrical Sources, including imports

Average Annual Electricity Consumed in Arizona, 2002-2006: 88,747,753 MWhr

Revised March 2009
Electricity Exports

To Nevada: 2.8%
2,918,689 MWhr

To California: 13.2%
13,880,066 MWhr

In-State: 70.7%
74,205,960 MWhr

To Colorado: .94%
931,488 MWhr

To New Mexico: 2.7%
2,616,287 MWhr

To WAPA: 3,153,283 MWhr
To Northwest Market: 2,657,094 MWhr

Average Annual Electricity Generated in Arizona (2002-2006): 104,956,560 MWhr

To Texas: 4.1%
4,343,805 MWhr

Revised March 2009
Net Water Consumption - 29,813 AF

Arizona:
Export: 51,613 AF
Import: 21,800 AF

NV:
Export 3,042 AF
-3,042 AF

CA:
Export 24,501 AF

Kingman
Flagstaff
Prescott
Phoenix
Casa Grande
Tucson
Yuma

CO:
Export 900 AF
Import 4,277 AF
+3,377 AF

NM:
Export 6,771 AF
Import 17,572 AF
+10,801 AF

TX:
Export 10,469 AF
-10,469 AF

To Northwest power grid:
Export 5,930 AF

Revised 11/28/2008
4. Renewable Energy Resources
Border Renewables

Wind

Geothermal

Solar
United States - Annual Average Wind Speed at 80 m

Source: NREL
The annual wind power estimates for this map were produced by TrueWind Solutions using their Mesomap system and historical weather data. It has been validated with available surface data by NREL and wind energy meteorological consultants.

Wind Power Classification

<table>
<thead>
<tr>
<th>Wind Power Class</th>
<th>Resource Potential</th>
<th>Wind Power Density at 50 m W/m²</th>
<th>Wind Speed at 50 m m/s</th>
<th>Wind Speed at 50 m mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Poor</td>
<td>0 - 200</td>
<td>0.0 - 6.6</td>
<td>0.0 - 12.5</td>
<td></td>
</tr>
<tr>
<td>2 Marginal</td>
<td>200 - 300</td>
<td>6.8 - 14.3</td>
<td>12.5 - 14.3</td>
<td></td>
</tr>
<tr>
<td>3 Fair</td>
<td>300 - 400</td>
<td>14.3 - 15.7</td>
<td>24.1 - 25.7</td>
<td></td>
</tr>
<tr>
<td>4 Good</td>
<td>400 - 500</td>
<td>15.7 - 16.8</td>
<td>30.1 - 31.7</td>
<td></td>
</tr>
<tr>
<td>5 Excellent</td>
<td>500 - 600</td>
<td>16.8 - 17.9</td>
<td>33.9 - 35.2</td>
<td></td>
</tr>
<tr>
<td>6 Outstanding</td>
<td>600 - 800</td>
<td>17.9 - 19.7</td>
<td>36.8 - 39.1</td>
<td></td>
</tr>
<tr>
<td>7 Superb</td>
<td>&gt; 800</td>
<td>&gt; 8.8</td>
<td>&gt; 19.7</td>
<td></td>
</tr>
</tbody>
</table>

* Wind speeds are based on a Weibull k of 2.0 at sea level.

Transmission Line

<table>
<thead>
<tr>
<th>Voltage (KV)</th>
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</thead>
<tbody>
<tr>
<td>66</td>
</tr>
<tr>
<td>115 - 161</td>
</tr>
<tr>
<td>230</td>
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<tr>
<td>345</td>
</tr>
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</table>

* Source: POWERmap, ©2003 Platt, a Division of the McGraw-Hill Companies

U.S. Department of Energy
National Renewable Energy Laboratory
Geothermal Energy - US

Source: AZ Geological Society
Geothermal Energy

Mexico is 3rd Largest Geothermal Country (over 300 sites identified)

Solar Potential in the US
Solar Potential in Mexico

Solar radiation in Mexico is one of the highest in the world, allowing for an average solar power generation of 5 KW /m² per day.

Source: Renewable energies for sustainable development in Mexico 2006, Sener.
Solar Energy is the Most Abundant Renewable Resource in the Border Region
5. Solar/Water nexus at the US/Mexico Border
Solar/Water Potential

- Water Purification
- Water Pumping
- Desalination
Continuing Reduction in Energy Consumption

What is the relationship between energy and water for renewable energy at the border?

Open space, isolated areas of demand, rapid growth, water scarcity, dropping costs, and world-class resources favor the development of solar energy for power and for water.
Next Steps

- Costs
- Scale
- Locations
- Barriers

Insufficient Interconnections