Innovative Low Cost, Low Head Hydropower for Irrigation Canals

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Location of EBID
Features of EBID
Elevations of Features

Total drop of 430 ft
Conventional Hydropower

- Largest renewable energy source in the United States
- In 2011: 6% total US energy production, 63% of renewable generation

Source: www.eia.gov “Energy Explained - Hydropower Explained”

### Net Generation from Hydroelectric Power

<table>
<thead>
<tr>
<th>State</th>
<th>2010</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Mexico</td>
<td>253</td>
<td>271</td>
</tr>
<tr>
<td>Texas</td>
<td>1,032</td>
<td>1,029</td>
</tr>
<tr>
<td>Arizona</td>
<td>6,626</td>
<td>6,427</td>
</tr>
<tr>
<td>Colorado</td>
<td>1,746</td>
<td>1,886</td>
</tr>
<tr>
<td>US Total</td>
<td>257,053</td>
<td>273,445</td>
</tr>
</tbody>
</table>

(Thousand Megawatthours)

Hydroelectric Application Opportunity For Irrigation Conveyance

Diversion/Conveyance

Rio Grande

Canal

5.0’-10.0’ Available Head

10.0’-12.0’ Available Head

Drain

Canal to Drain

Hydropower Application
## Turbine Cost per 50kW

<table>
<thead>
<tr>
<th>Hydraulic Device</th>
<th>Minimum Cost</th>
<th>Maximum Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufactured turbine</td>
<td>$120,000</td>
<td>$450,000</td>
</tr>
<tr>
<td>Manufactured high flow Pump As Turbine</td>
<td>$50,500</td>
<td>$200,000</td>
</tr>
<tr>
<td>EBID fabrication and design</td>
<td>$15,000</td>
<td>$55,000</td>
</tr>
</tbody>
</table>
Projections

Potential Power in District

Total Power (kW)

Power per unit (kW)

- 20 Sites
- 50 Sites
- 100 Sites
**Grants for R&D of Turbine**

**Drop 8**
- New Mexico Energy, Minerals and Natural Resources Department, EMNDRD
- Cost share with EBID
- R&D by EBID, NMSU College of Engineering
- $265,000 total, cut short
- Produce and commission 50kW at Drop 8 site

**Wasteway 5**
- USDA NRCS Conservation Innovation Grant
- 50% cost share with EBID
- Design and Fabrication by EBID
- $150,000 total funding
- Produce electricity to provide pressurized water to Porter Farms drip system
Drop 8
EBID’s First Low Cost Hydropower
Site Location Drop 8

- Hydropower and replacement check structure built upstream of historical drum structure
- Elevation drop of 8 feet
- Consistent average flow rate of 300 cfs
- Ample room for dry well
- Historical structure preserved
Site Location Drop 8
Arial view of site 7/2009
Site Location Drop 8

Site Requirements

- Head of at least 7 feet
- Significant flow rate
- Area for dry well
- Proximity to electric grid or use for power

Drop 8 on the Westside Canal

- Elevation drop of 8 feet
- Flow rate of 300 cfs
- Ample room for dry well
- Grid and pole within 150 ft
Construction of Drop 8

Upstream Drain

Downstream Drain

Start water level

8 ft

End water level

12/2008 12/2008
Construction of Drop 8

Finished structures
Construction of Drop 8

Grating of dry well

Spiral staircase
Construction of Drop 8

Finished structures 3/2009
## Construction Costs of Drop 8

<table>
<thead>
<tr>
<th>Component</th>
<th>Material Cost</th>
<th>Labor/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check Structure</td>
<td>$50,000</td>
<td>In-kind</td>
</tr>
<tr>
<td>Dry Well</td>
<td>$15,000</td>
<td>In-kind</td>
</tr>
<tr>
<td>Drain Pipe</td>
<td>$5,000</td>
<td>In-kind</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$70,000</strong></td>
<td><strong>In-kind</strong></td>
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</table>
Drop 8 Prototypes, Transformations, and Progress
Turbine 1

- 36” paddle wheel encased
- 8 blades
- 2” shaft
- Teardrop inlet

Installed with 24” Manifold 3/2009
Turbine 2

Layout 5/2009

Turbine 1 and 2 5/2009
Turbine 3

- Axial flow
- 15” three blade impeller
- 1.5” shaft

24” to 16” 8/2009
Turbine 4

- Axial flow
- 24” throughout system
- 23” five blade fixed pitch Kaplan style impellor
- All fabricated at EBID
- Chain and sprocket drive
Turbine 4

Below: Complete 24” system

Right: Chain and sprocket drive