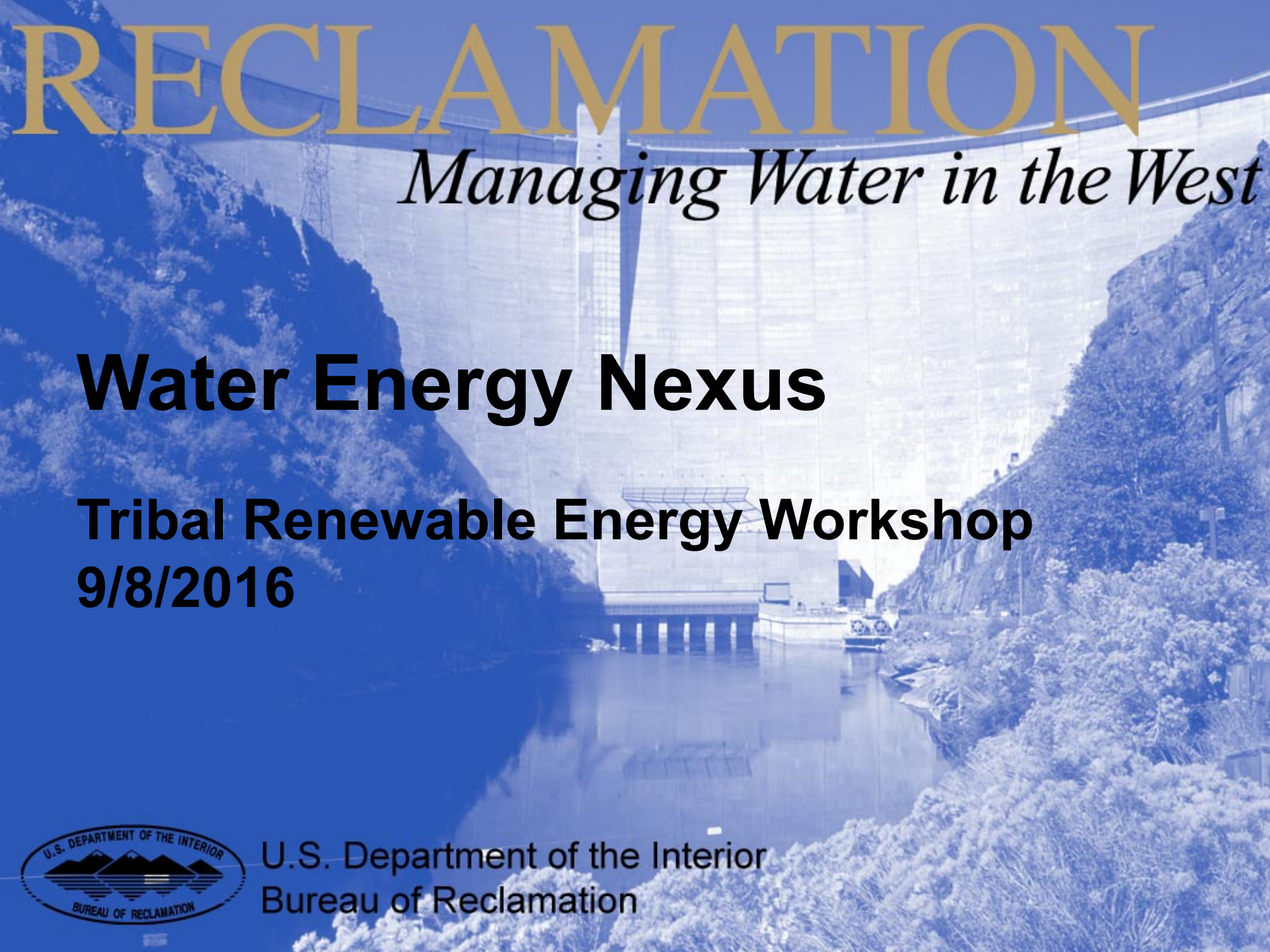


Water Energy Nexus

Tribal Renewable Energy Workshop
9/8/2016

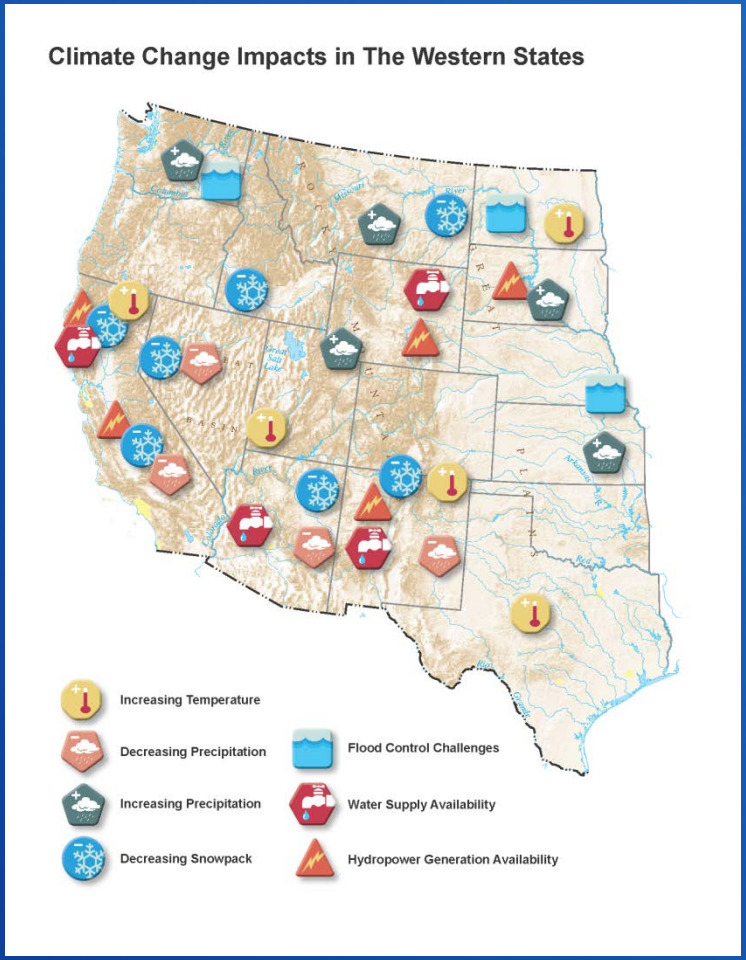
U.S. Department of the Interior
Bureau of Reclamation

Water Energy Nexus

Climate Change and Hydropower

Climate Change Challenges:

- Drought and other Extreme Weather Events
- Changes in seasonal precipitation patterns
- Increase in air temperatures and energy demand
- These changes will exacerbate existing pressures on water and power resources that are inexorably linked



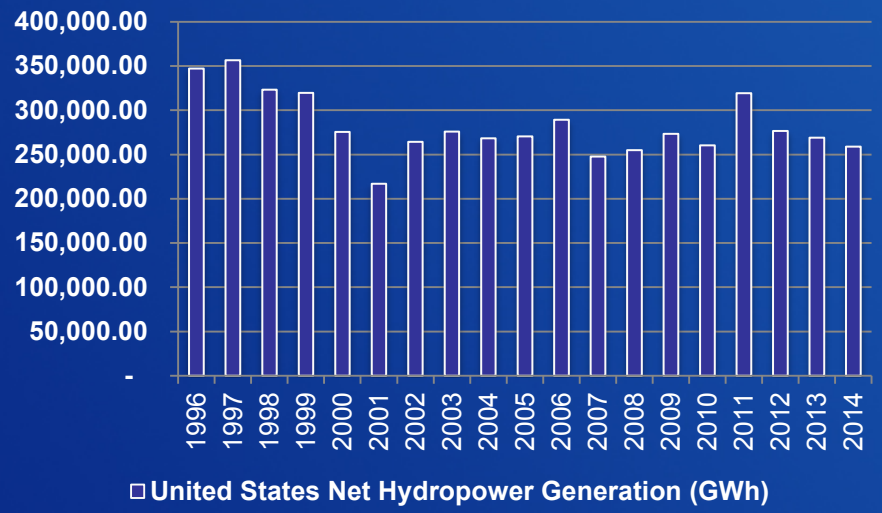
RECLAMATION

Water Energy Nexus

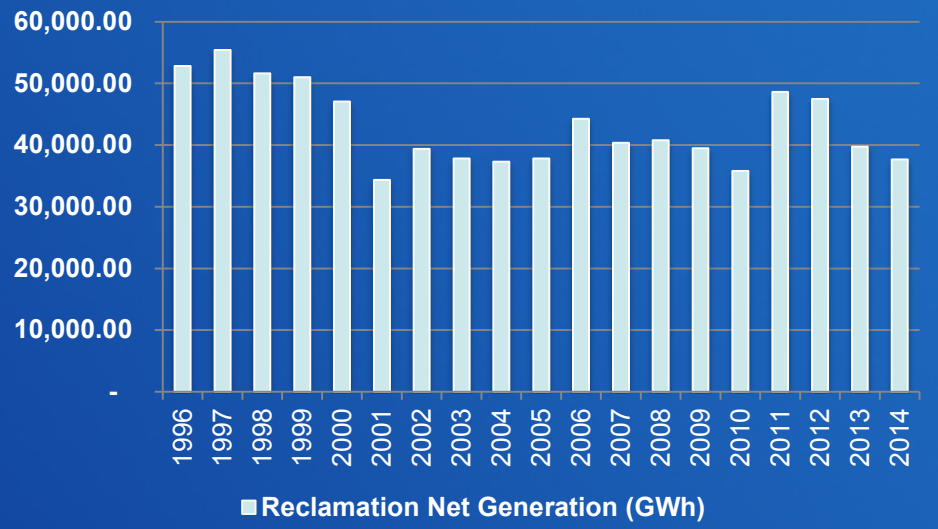
Climate Change and Hydropower

- **Hydropower can be part of the Climate Change solution**
  - Low GHG Emitting Resource
  - Can be used to help integrate other renewables into the grid
  - Flexible and on demand resource
- **But there are challenges from changes to hydrology**
  - Loss of total generation
  - Loss of regulation capacity
  - Increased rough zones
  - Increased maintenance

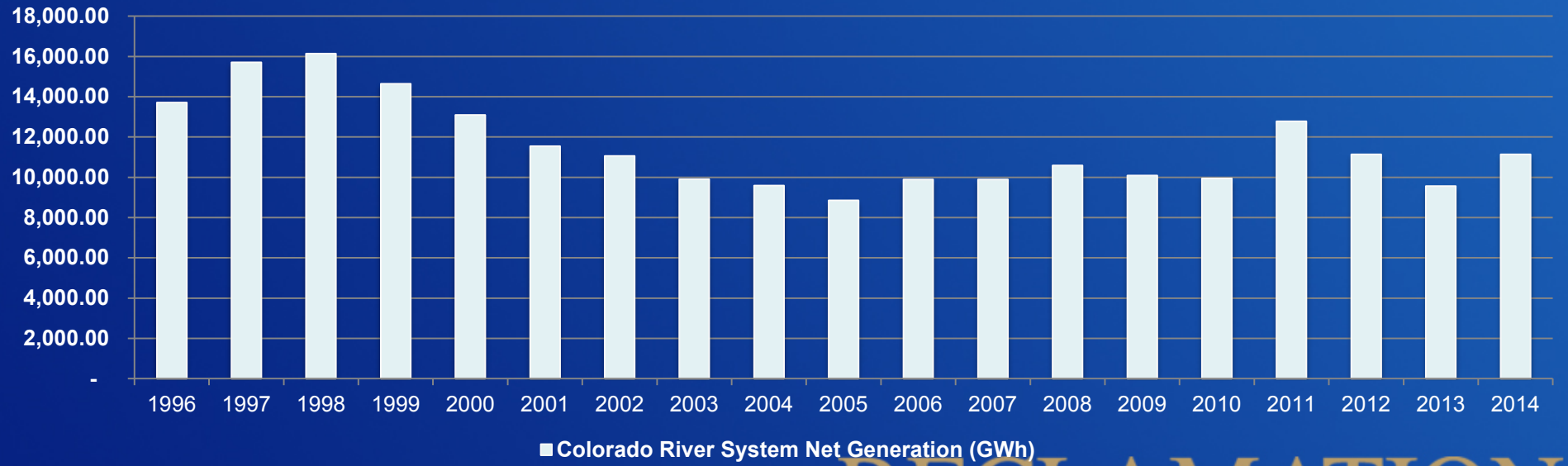
United States Hydropower Generation (GWh)



Reclamation Hydropower Generation (GWh)



Colorado River System Generation (GWh)



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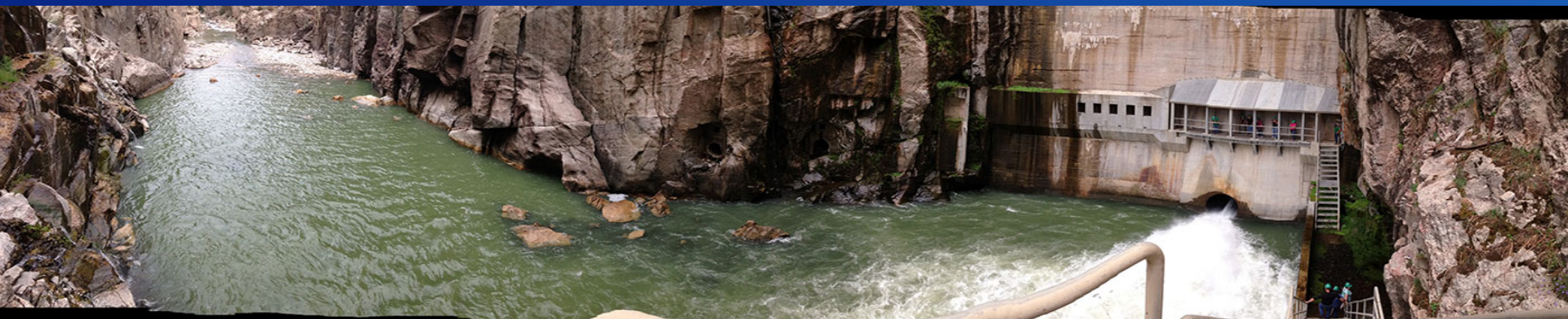
What is Reclamation Doing?

- Capital and Operational Improvements
  - Gaining Efficiencies
- Policy Development and Research
  - Identifying new opportunities

Desired outcome: more flexible, resilient, and effective water resource projects



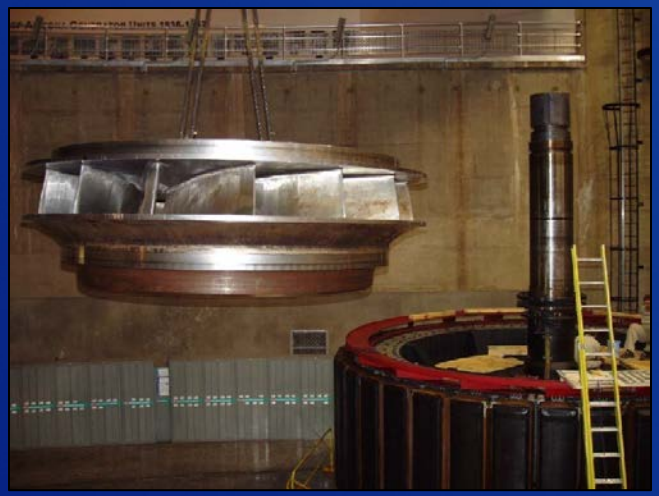
Reclamation Wide Turbine Replacements and Rewinds

- Generator Uprates/Rewinds
  - 3 rewinds completed in 2013
  - 2 rewinds completed in 2015
  - 3 rewinds ongoing
  - Many more in the out years
- Turbine Replacements
  - 31 turbine replacements since 2009
  - 3 - 7% efficiency gain
  - Wider head range
  - 319,122 MWh/year
  - 4 ongoing replacement projects
  - 5 scheduled replacement projects

Hoover Wide Head Turbines

- Increase available operation ranges (flexibility)
- Minimize rough zones
- Increase unit efficiency and capacity
- Increase power output at lower lake elevations
- Less water – More Power

- Five wide head turbines installed by FY17
- ~ 3% efficiency gains



Optimization at Reclamation

- **What is Optimization?**
  - **Continuous computer modeling to determined the best way to operate a hydroelectric powerplant to achieve desired power production using the least amount of water.**
- **Increases Efficiency**
  - **Uses Less Water at Same Power Output Level**
  - **Or Increase Generation Levels – Use Same Amount of Water**
- **When All Reclamation Plants are Optimized**
  - **1% - 3% Efficiency Gains**
  - **410,000 MWh – 1,230,000 MWh**
  - **$10.3M - $30.8M Annually (at $25 per MWh)**

- **New Opportunities: Resource Assessments and other Research**

USBR Conventional Hydropower Potential – Resource Assessments

	Reclamation Potential		
	Count	MW	MWh/CY
2011 Assessment	191	268	1,168,248
2012 Assessment	373	104	365,219
Total	564	372	1,533,467

Resource assessments available at: http://www.usbr.gov/power/

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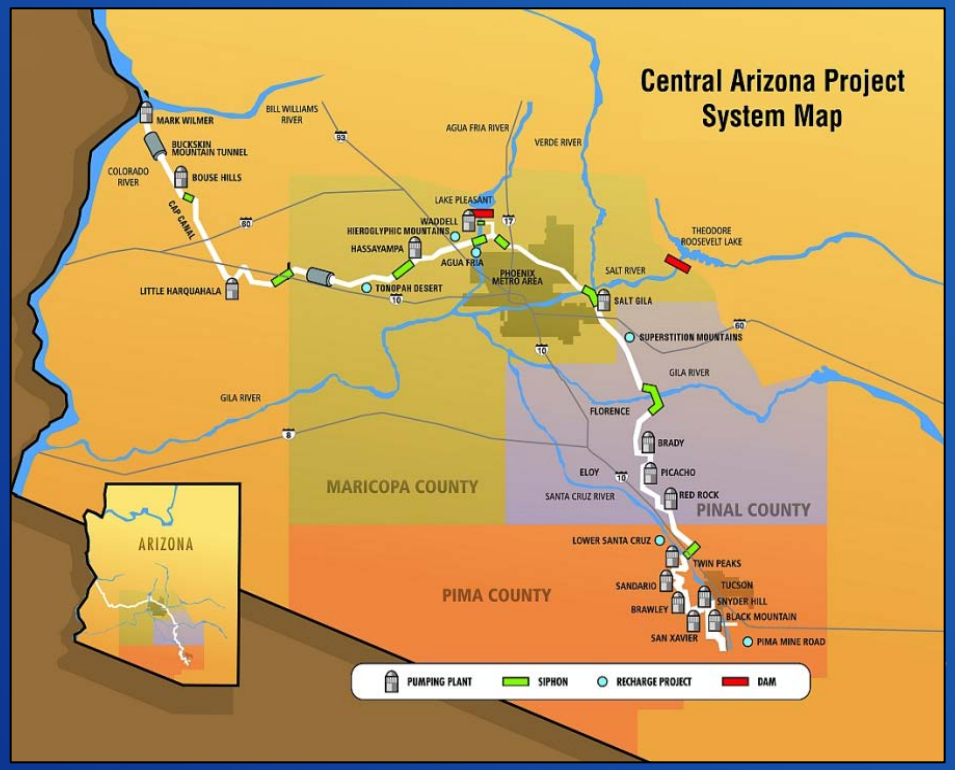
Reclamation-Wide Pumped Storage Screening Study (2014)

- Screening-level analysis evaluated adding PS facilities to Reclamation's 348 existing reservoirs

- 15 sites located at 7 reservoirs showed a preliminary cost estimate of less than $1.5 million per MW Installed

Demand Management Opportunities

- **Reclamation is currently conducting a study in the Central Arizona Project to understand what opportunities may exist to:**
  - **Reduce pumping load or increase flexibility through equipment upgrades; and**
  - **Shift pumping loads or employ demand response to support renewable energy integration and/or grid stability**
  - **Target Completion 01-2017**



Lease of Power Privilege

RECLAMATION

Lease of Power Privilege (LOPP)

Reclamation Conduits

Reclamation Dams - authorized for federal power development

All other Reclamation facilities – i.e. dams not authorized for federal power development – would proceed through FERC

Reclamation and Non-Federal Hydropower Development

All non-federal development must be consistent with Reclamation project purposes

Power Delivery

Water Delivery

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Reclamation Small Conduit Hydropower Act PL 113-24

- Enacted August 9, 2013
- Amends the Reclamation Project Act of 1939 to:

1. Authorize LOPP at all Reclamation conduits
2. Reaffirms that LOPP projects cannot negatively impact the Reclamation Project
3. Requires that LOPP be offered *first* to an irrigation district or water users association operating or receiving water from the applicable transferred or reserved conduit.
4. Requires Reclamation to apply its categorical exclusion (CE) process to conduit development

Conventional Non-Federal Snapshot

Lease of Power Privilege

Operating:	12 sites (43 MW)
In Development (C):	17 sites (51 MW)

Federal Energy Regulatory Commission

Operating:	52 sites (465 MW)
In Development (C):	21 sites (59 MW)

64 non-federal facilities, comprising approximately 508 MW currently operating on Reclamation infrastructure

RECLAMATION

Thank You!

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Helpful Links:

http://www.usbr.gov/power

http://www.usbr.gov/power/LOPP/

http://www.usbr.gov/power/data/data.html