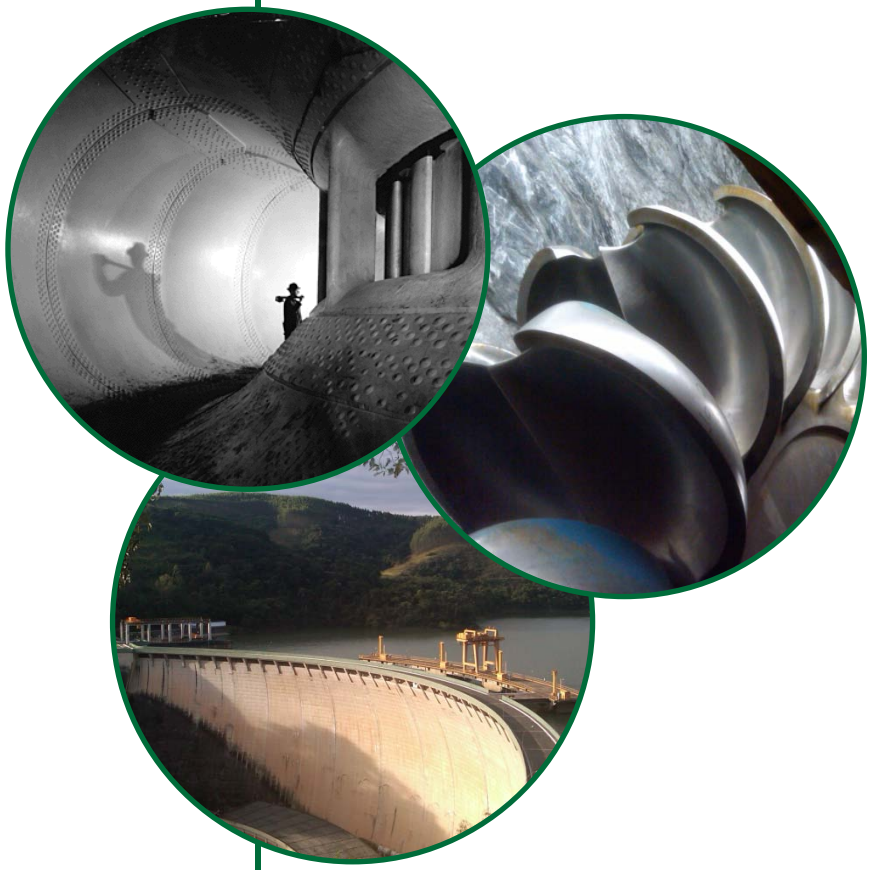
U.S. Hydropower

Fleet and Resource Assessments

National Hydropower Association
Annual Conference

April 5, 2011
Capital Hilton
Washington, D.C.



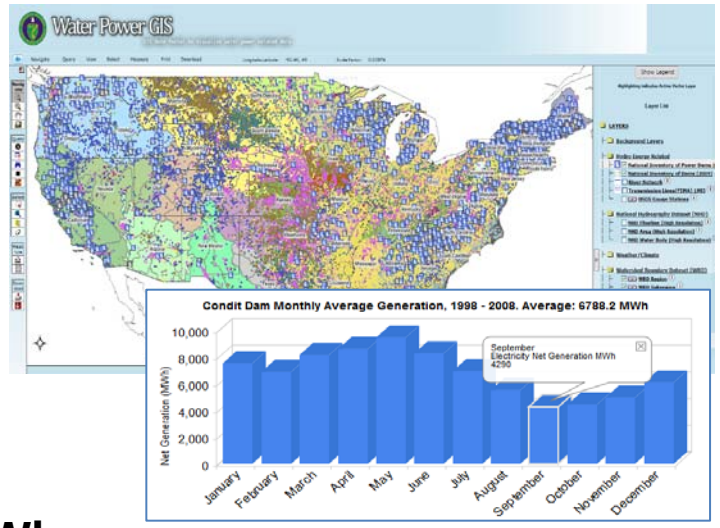
presented by

Brennan T. Smith, Ph.D., P.E.

U.S. DEPARTMENT OF ENERGY

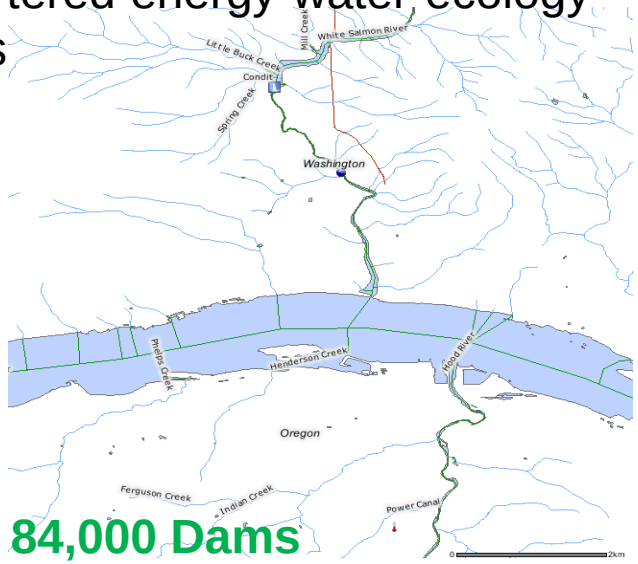
OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

National Hydropower Asset Assessment Program (NHAAP)



What:

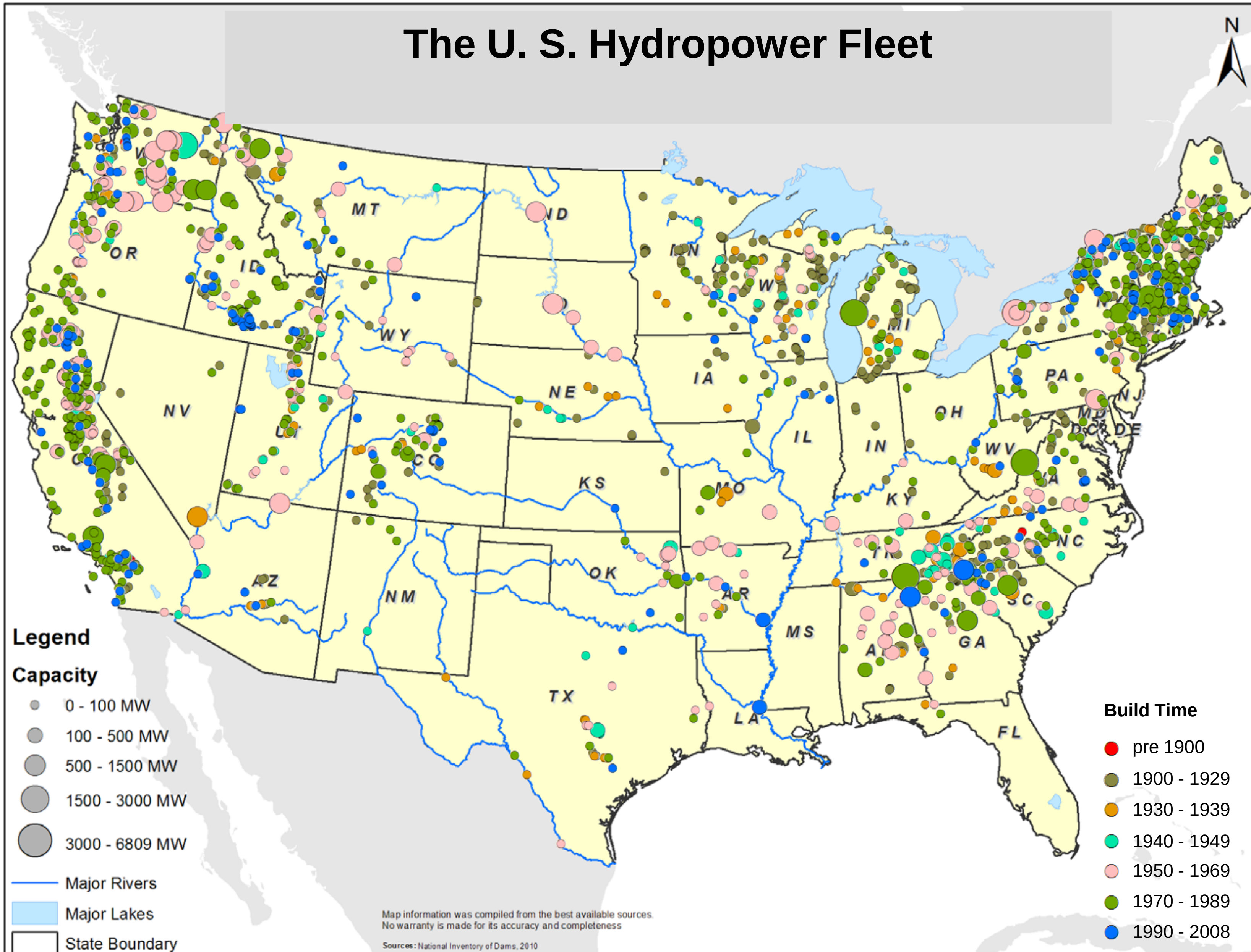
- A core geospatial energy-water database
- A core hydropower project configuration and production database
- Dynamic linkages to multiple agencies and federally-chartered energy-water-ecology data products



84,000 Dams
17,000 Stream gages
5,116 Hydroelectric Units
1,200 Climatology Stations

Who

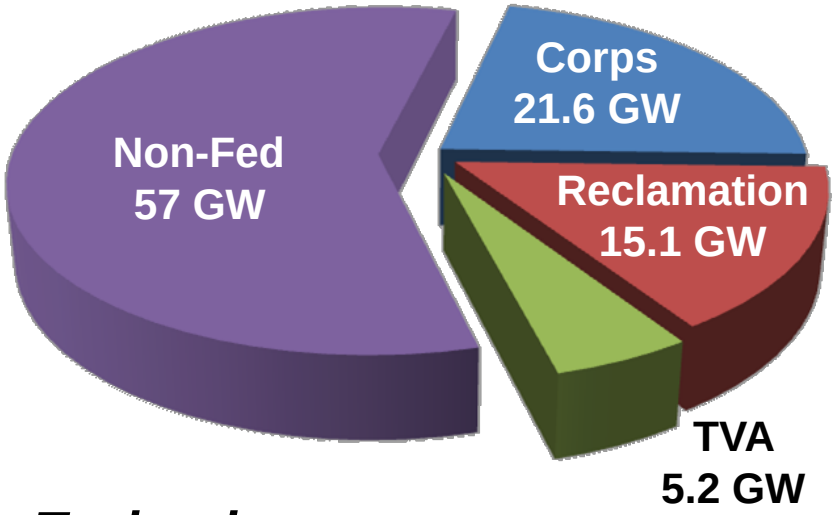
- Authorization, funding, and guidance from DOE
- NHAAP team of hydropower engineers, aquatic ecologists, environmental assessment professionals, and geospatial analysts to validate, integrate, maintain, and disseminate information
- Federal agency partners whenever possible, including Reclamation, Corps, and USGS



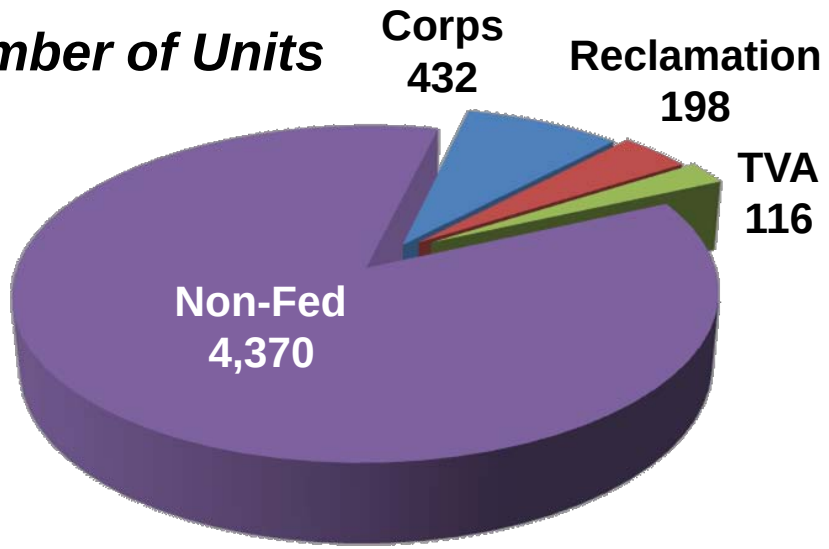
The U. S. Hydropower Fleet
N
WA
OR
ID
MT
ND
SD
MN
WI
MI
NY
VT
NH
ME
MA
CA
NV
UT
WY
NE
IA
IL
IN
OH
PA
NJ
MD
DC
DE
WV
VA
KY
CO
KS
MO
AZ
NM
OK
AR
TN
NC
SC
MS
AL
GA
TX
LA
FL
Legend
Capacity
0 - 100 MW
100 - 500 MW
500 - 1500 MW
1500 - 3000 MW
3000 - 6809 MW
Major Rivers
Major Lakes
State Boundary
Build Time
pre 1900
1900 - 1929
1930 - 1939
1940 - 1949
1950 - 1969
1970 - 1989
1990 - 2008
Map information was compiled from the best available sources.
No warranty is made for its accuracy and completeness
Sources: National Inventory of Dams, 2010

U.S. Hydropower – 2011 Status

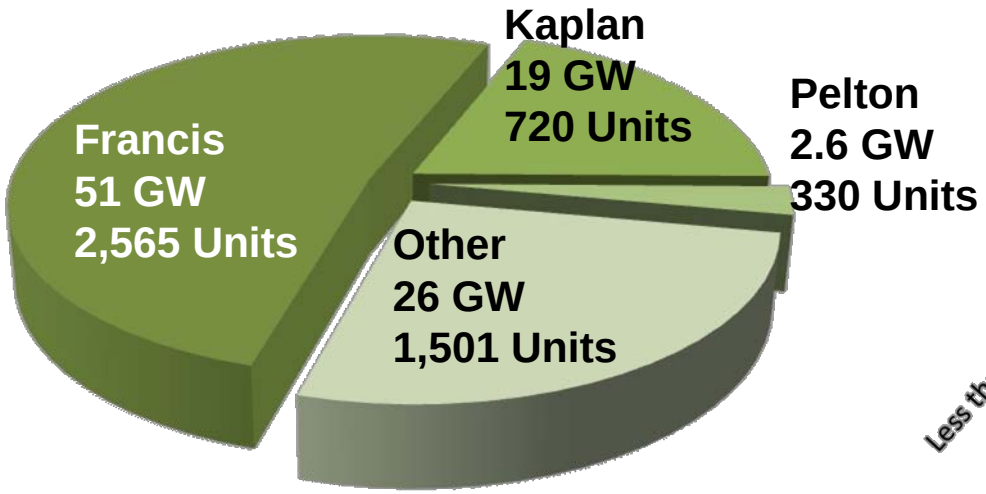
Rated Capacity



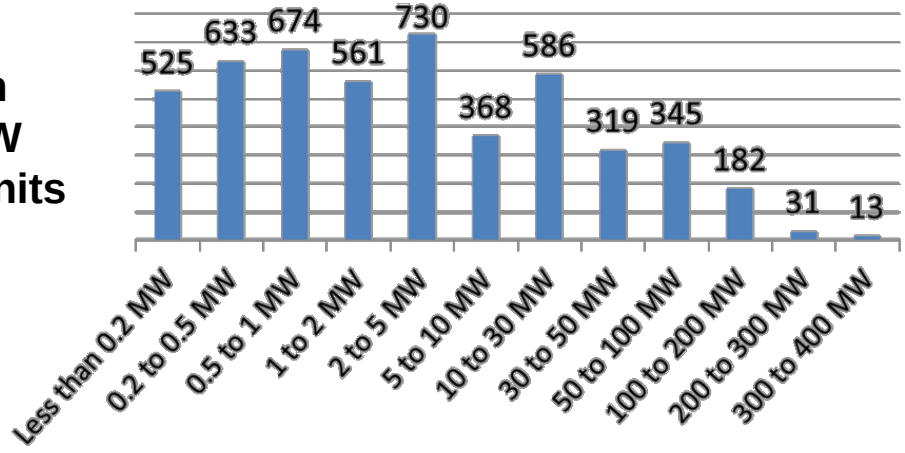
Number of Units



Technology



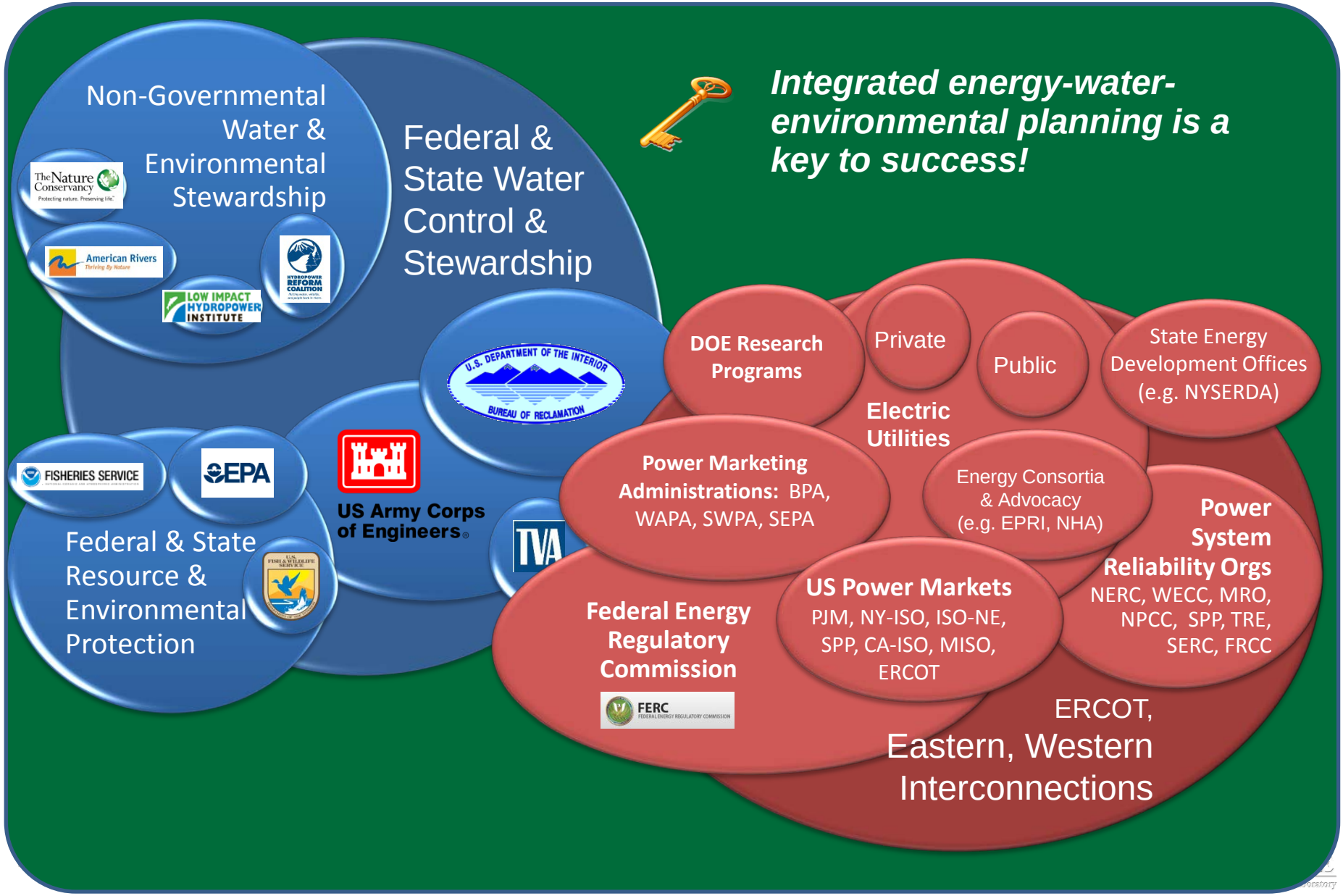
Size (Capacity) Distribution



Not Shown: Bath County (VA) 6@477 MW
Grand Coulee (WA) 3@600 MW, 3@805 MW

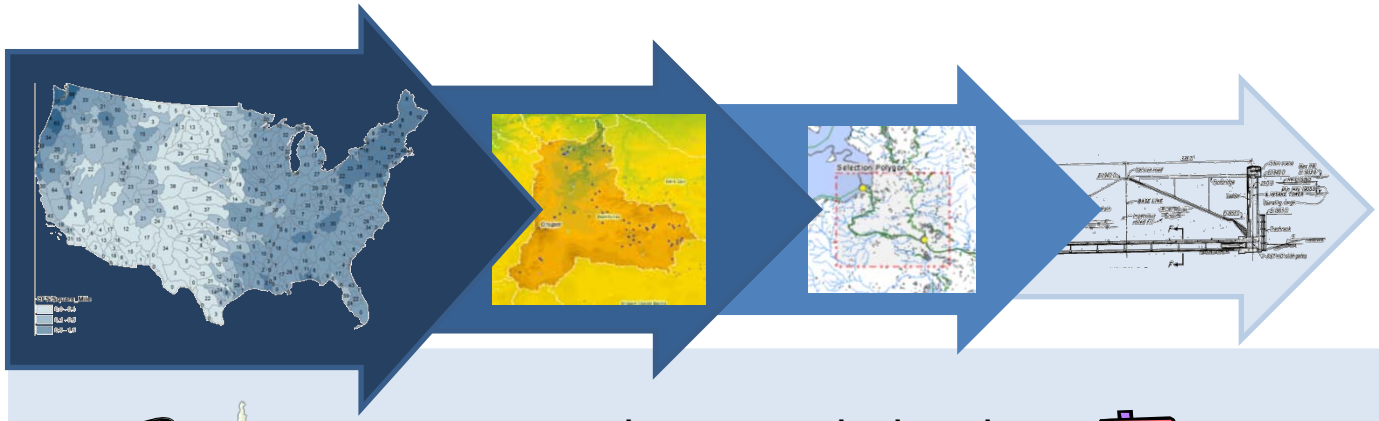
The Energy-Water-Environment

Context *for National Hydropower Assessments*

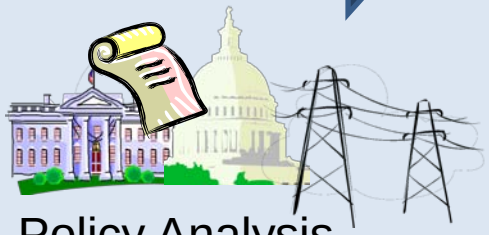


Hydropower Assessment & Development

Scale

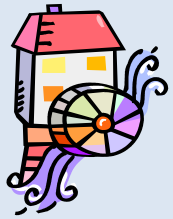


Users & Uses



Policy Analysis
Research Programming
Transmission Planning

Environmental Planning
Generation Planning
Project Developers



Site-Specific Feasibility
Technology Deployment
Project Developers

Clarity

Modeling & Remote Sensing → **Increasing Detail, Decreasing Uncertainty** → ***Site-Specific Assessment***

Roles

Government → **Industry**

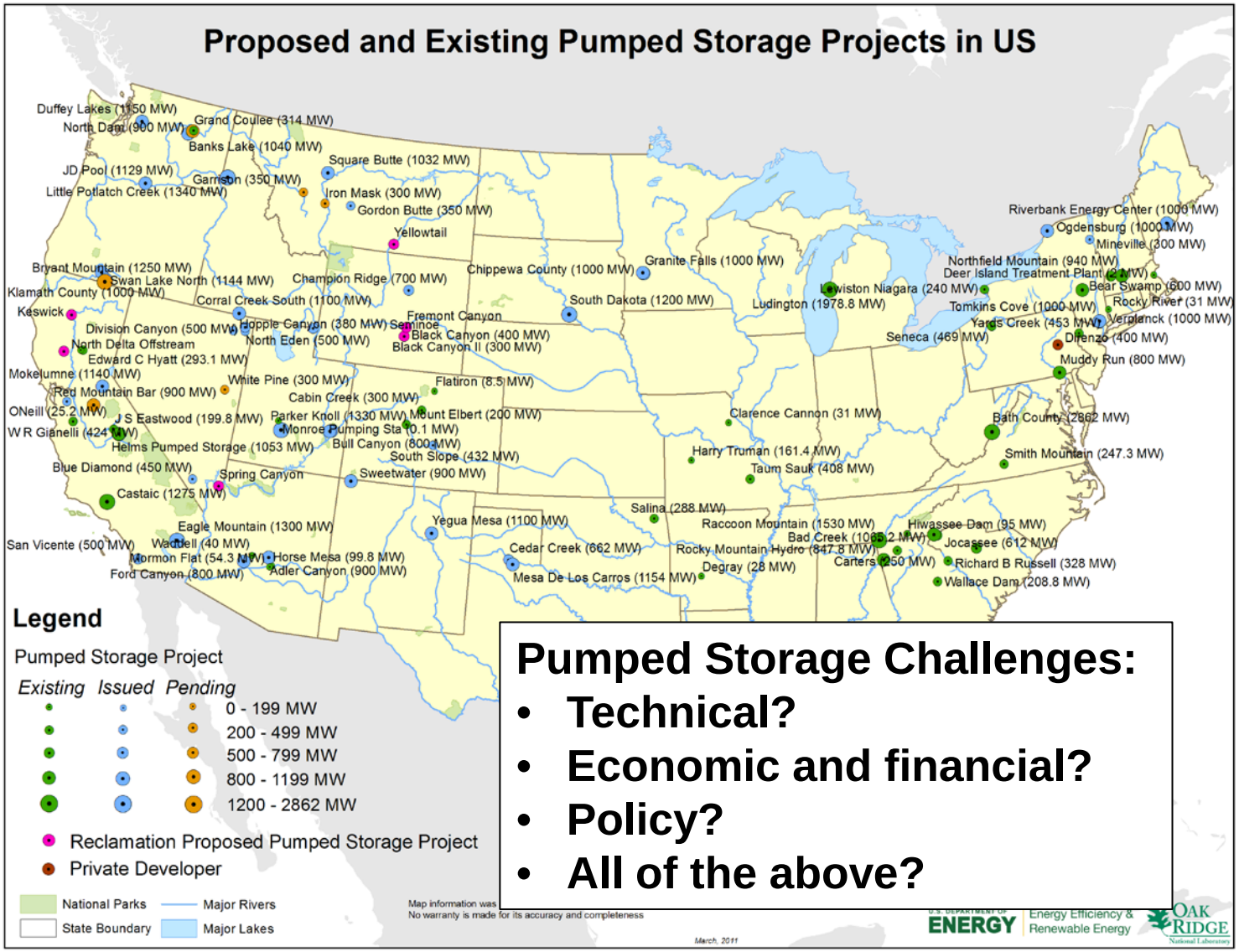
Classification of Hydropower Assets & Opportunities

Hydropower Resource Class	DOE Water Power Effort	Products
Existing Assets	**National Hydropower Asset Assessment Project (NHAAP)** includes all FERC-licensed, Corps, Reclamation, and TVA hydropower facilities.	• Asset configuration, monthly production, water availability, and power system context database assembled in 2010. • Environmental, cost, and economic modules integrated in 2011 • Public data portal mid-2011
Upgrades & Expansions	• **Hydropower Advancement Project (HAP)** will assess potential for increased generation through efficiency improvements and uprates at 50 projects nationwide • Expansion study criteria TBD	• Interim 2009 assessment • Best Practices Catalog • Assessment Manual • Nationwide Opportunity Summary 2012
Non-Powered Dams	Assess the amounts of new hydropower energy resources potential in existing non-powered dams (H>10 feet).	• March FY11 – Generation & Capacity Summary for US Non-Powered Dams • Mid FY11 – NPD Database available via NHAAP • Late FY11 – Cost and Supply Curve Report for US Non-Powered Dams

Classification of Hydropower Assets & Opportunities

Hydropower Resource Class	DOE Water Power Effort	Products
Pumped Storage	Identify the readily developable potential for new large scale (>100MW) pumped storage hydropower facilities .	• FY11 - Baseline Assessment of existing and proposed PSH • New Engineered cost study for existing pumped-storage facility
Constructed Waterways	Assess technically feasible energy generation related to different classes of constructed waterways	• FY11 Demo of Irrigation System Opportunities Assessment (INL)
New Sites	Assess energy resource potential from new, low-impact hydropower facilities.	• FY12 activity TBD

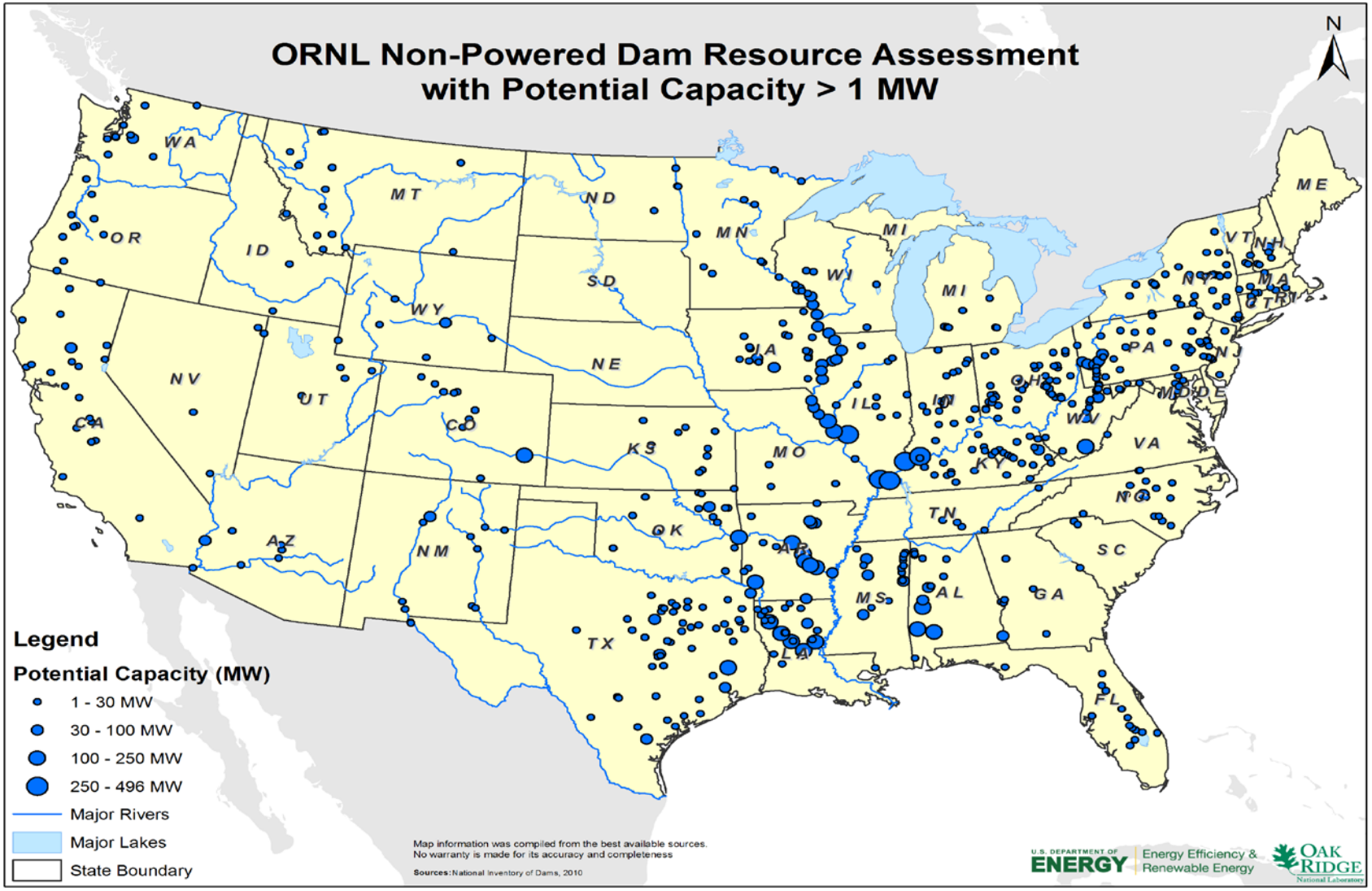
Pumped-Storage Hydropower



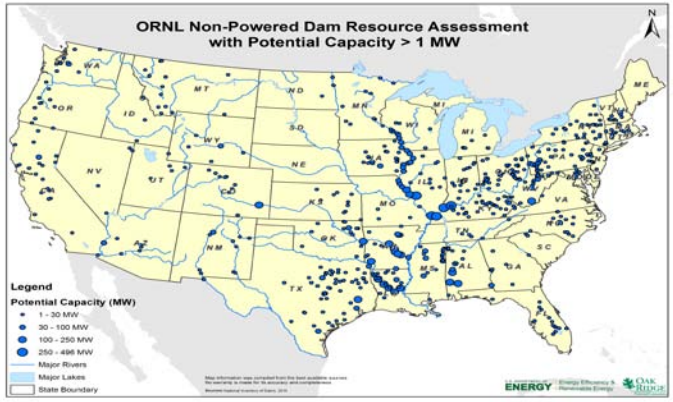
Pumped Storage Challenges:

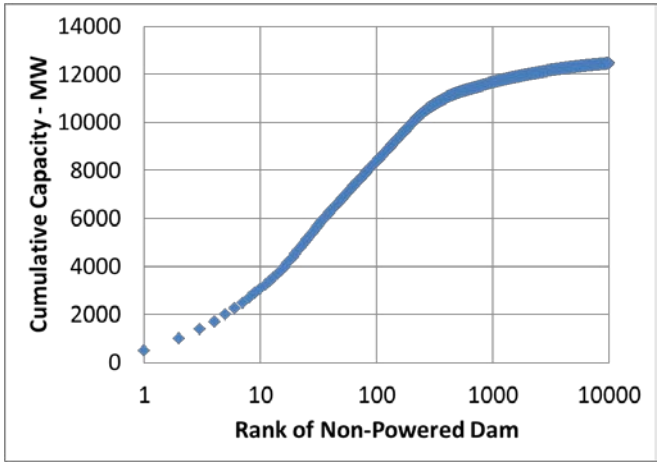
- **Technical?**
- **Economic and financial?**
- **Policy?**
- **All of the above?**

Non-Powered Dam Potential: 12.6 GW at 54,000 Dams



Non-Powered Dam (NPD) potential is concentrated:





The NPD Top 10:

- 3 GW at Corps of Engineers Facilities
  - 4 Ohio River Dams
  - 1 Mississippi River Facility
  - 1 Alabama River Facility
  - 2 Tombigbee River Facilities
  - 2 Arkansas-Red River Facilities

The NPD Top 100 includes 8 GW

- Including 81 Federal (Corps) facilities

260 MW at Reclamation facilties

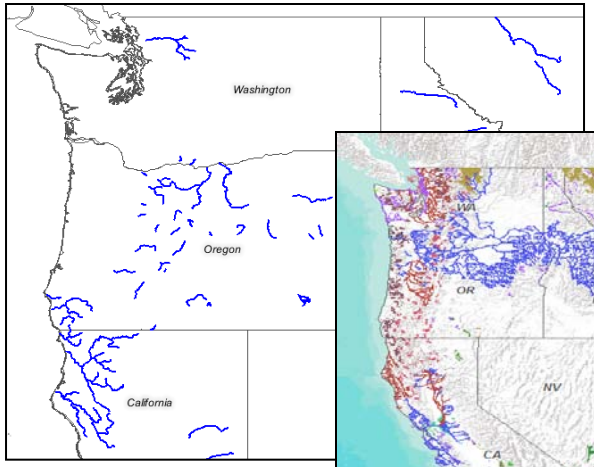
In Construction:

- Cannelton: 2-unit (44 MW)
- Smithland: 2-unit (48 MW)
- Meldahl: 3-unit (111 MW)

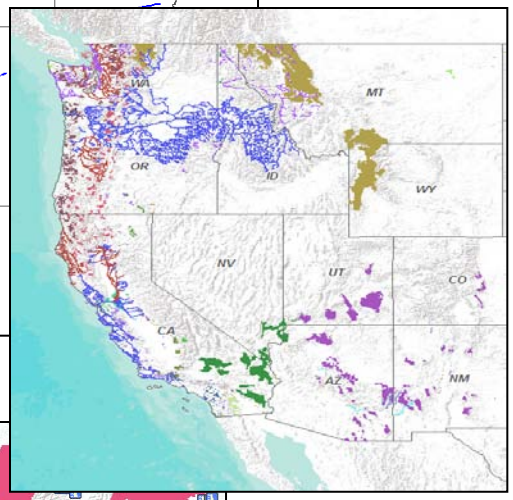
In Planning or Design:

- **Willow Island: 3-unit (84 MW):**
- **RC Byrd: 3-unit (76 MW):**

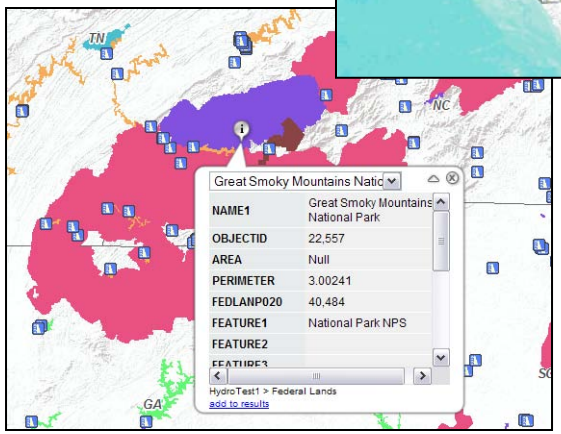
NHAAP Preliminary Environmental Assessment of Non-Power Dam Potential



Wild & Scenic Rivers

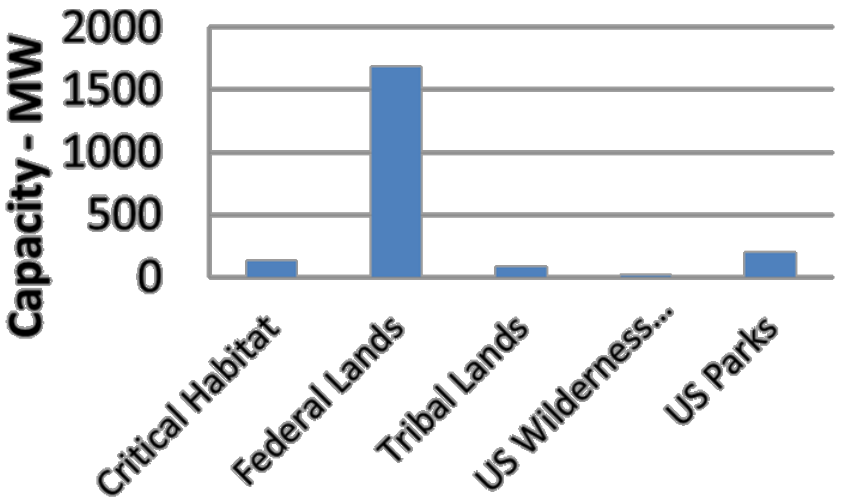


Critical Habitats



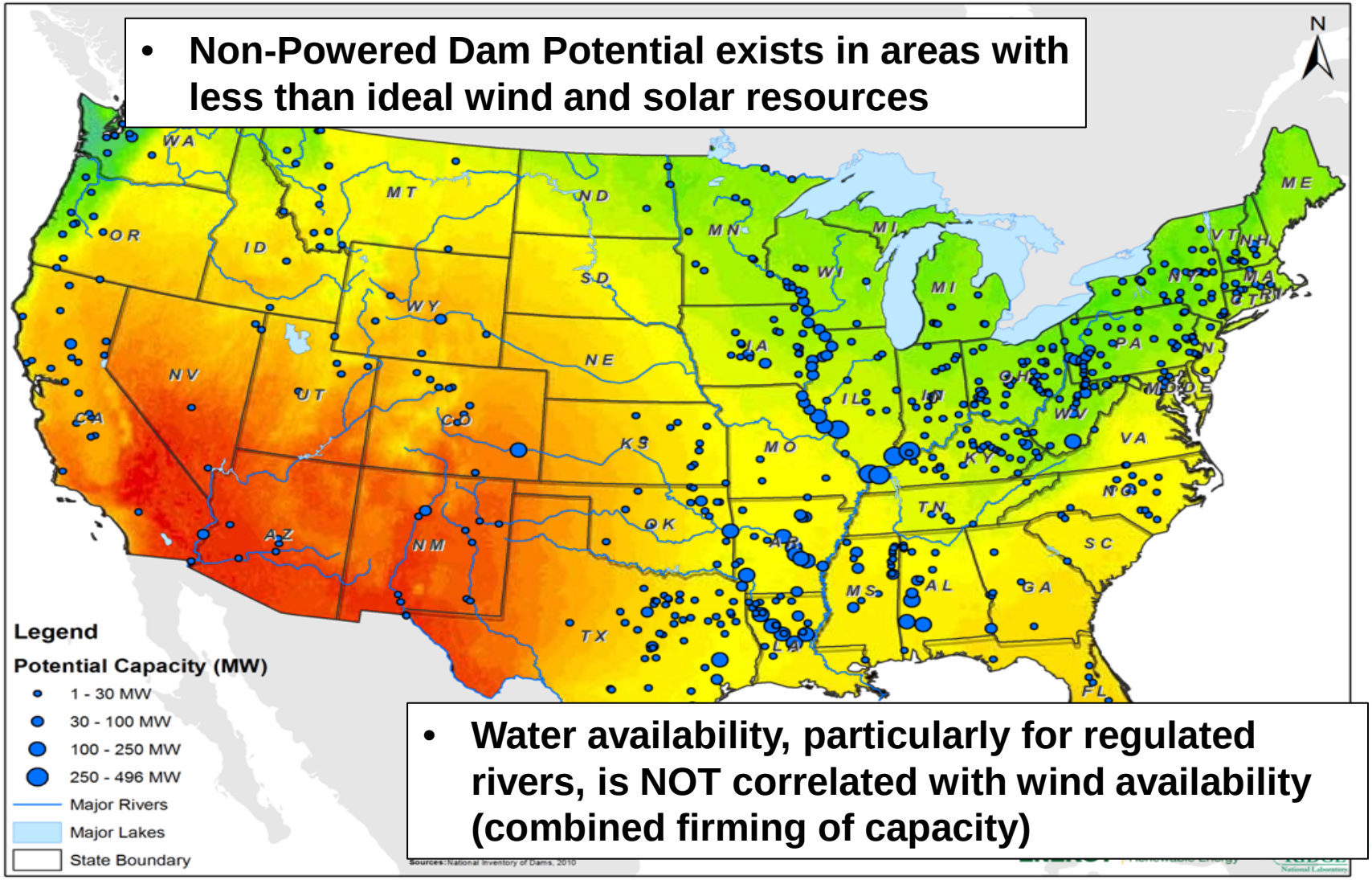
Federal & Tribal Lands

Most non-powered dams and potential capacity can be developed outside of critical habitat, parks, and wilderness areas.



Non-Powered Dam Potential With Other Renewables

Wind & Solar Maps: NREL



Next Steps and Summary of Non-Powered Dam Efforts

- Improvements in Methodology (FY11)
  - Refined seasonal/monthly flow statistics, flow-duration analysis
  - Refine gross and net head computations for Top 100
  - Intelligent penstock diversion model for mountainous regions
- Feasibility Assessment (FY11)
  - Fact-based environmental data overlays and statistics (Critical species, Impaired streams, …)
  - Updated cost estimators for powerhouse construction
- 3 GW at the Top 10; 8 GW at the Top 100
  - What are the policy and process barriers to development of these concentrated resources?

Acknowledgments and Credits

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