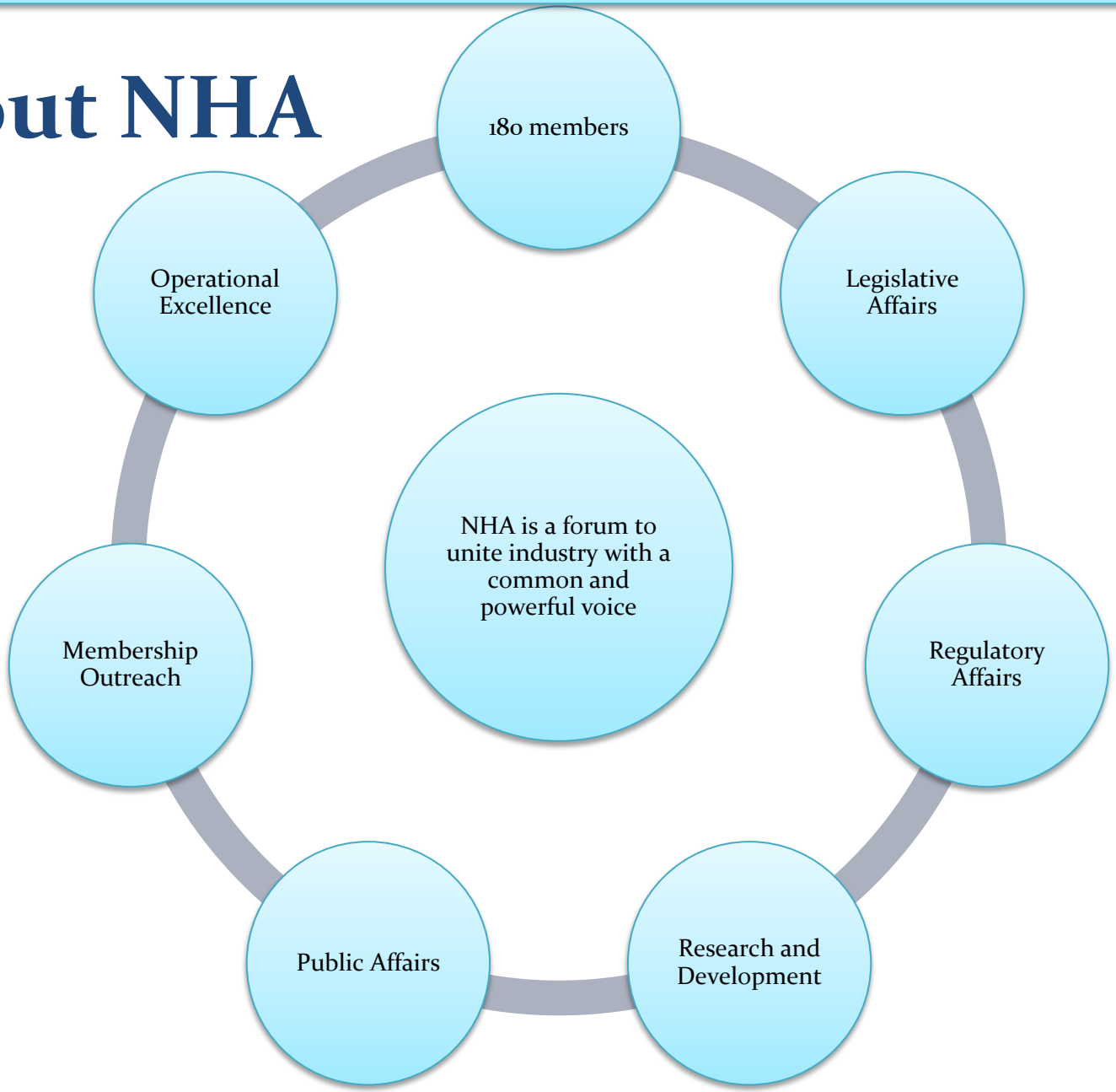
AN OVERVIEW OF U.S. HYDROPOWER AND PUMPED STORAGE POTENTIAL

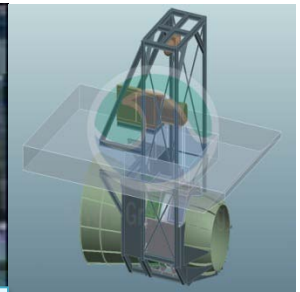
National Hydropower Association
BLM Pumped Storage Conference
November 2012

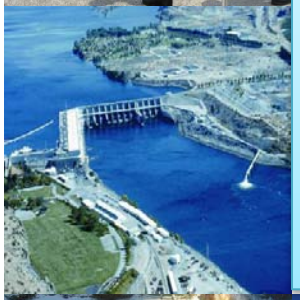
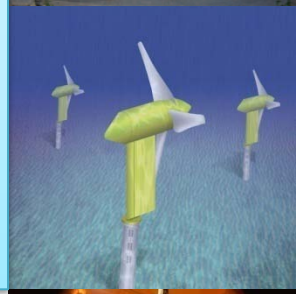
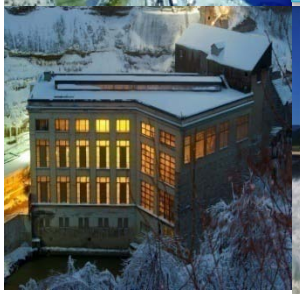
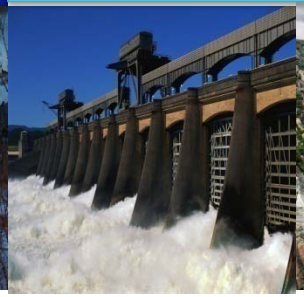
About NHA

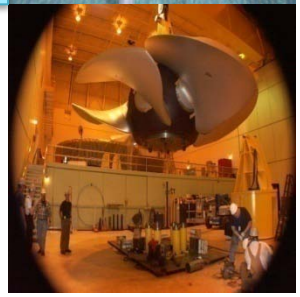

180 members
Legislative Affairs
Regulatory Affairs
Research and Development
Public Affairs
Membership Outreach
Operational Excellence
NHA is a forum to unite industry with a common and powerful voice







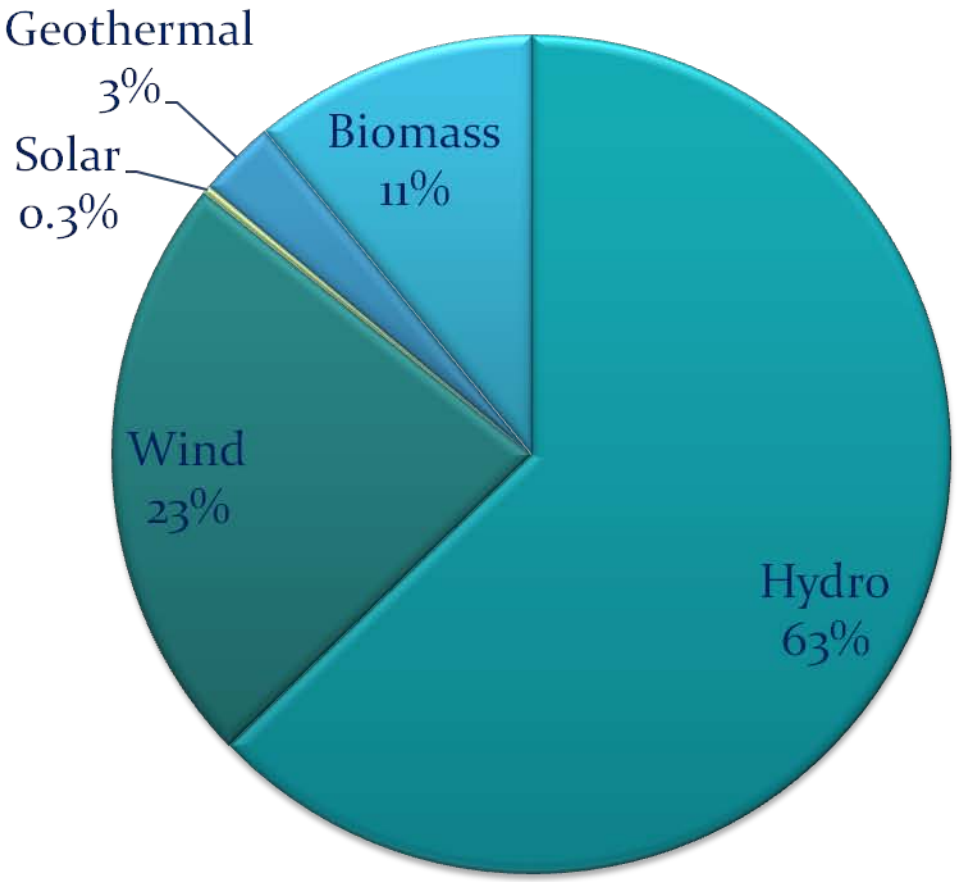






Vision

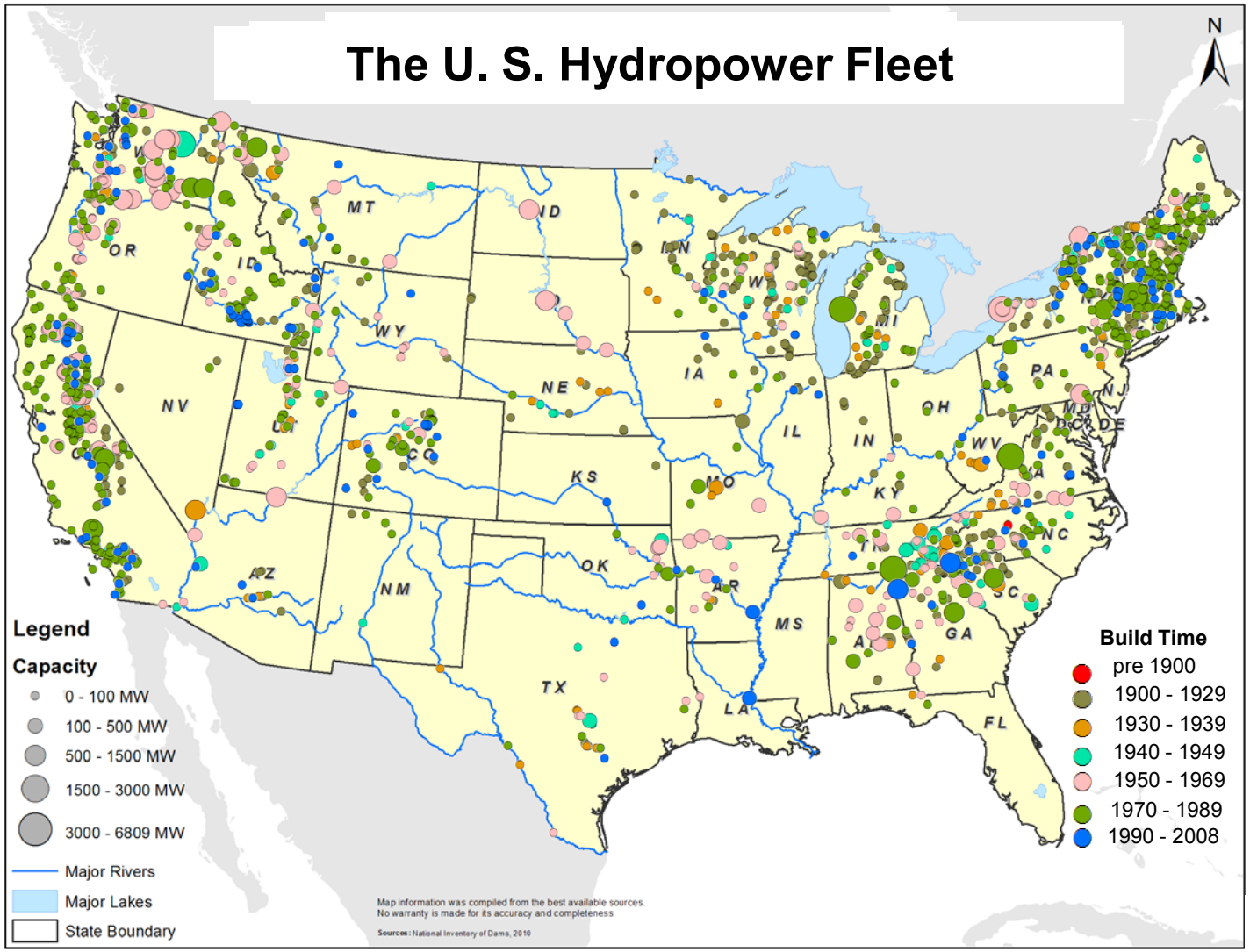
Double America's largest renewable energy resource – hydropower – in support of a sustainable and secure energy future.

U.S. Renewable Electricity Generation
2011



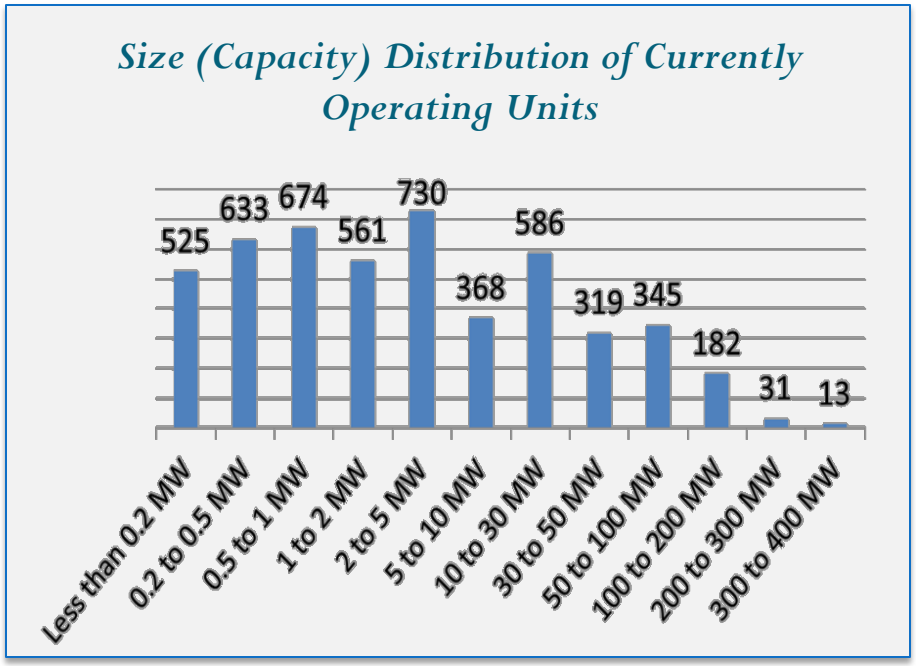
Hydropower is available .

It is the largest source of renewable electricity in the U.S., and made up 7% of overall electricity generation and close to two thirds of renewable electricity in 2009.



Sources: ORNL, NID

Key Characteristics of the Hydro Fleet



Only 3% of the 80,000 U.S. dams generate electricity – there is significant room for growth.

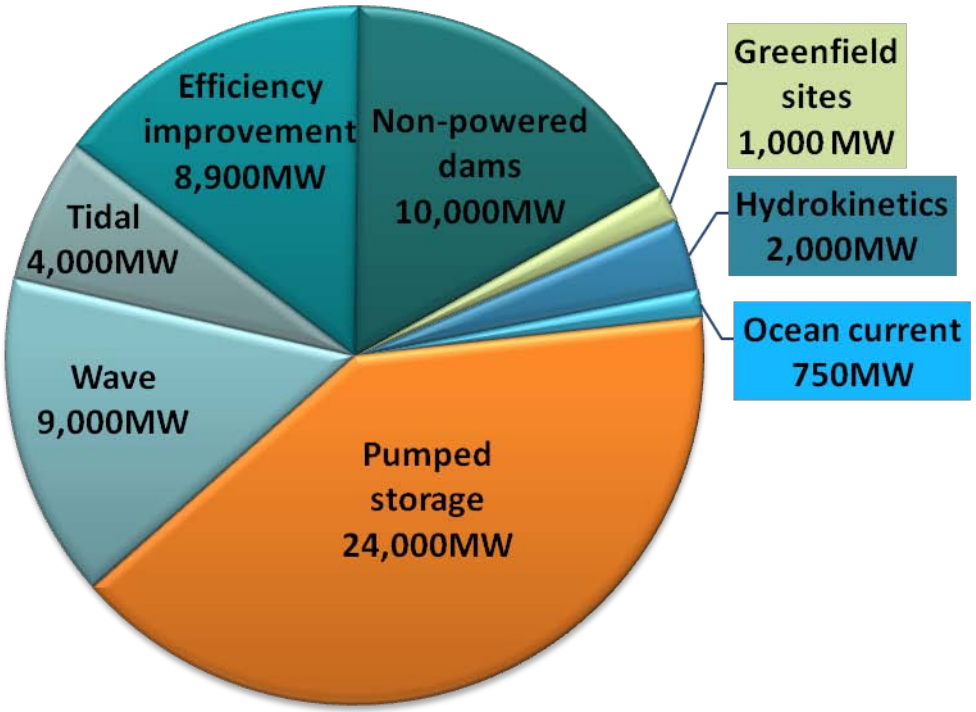
Hydropower is generated in every region and benefits every state, employing up to 300,000 workers around the U.S.

Future availability

With the right policies in place, **the U.S. could add 60,000 MW** of new hydro capacity by 2025, much of which can be created by maximizing existing infrastructure or with low-impact projects.

There are also some greenfield project opportunities.

Hydro Capacity Growth by Technology

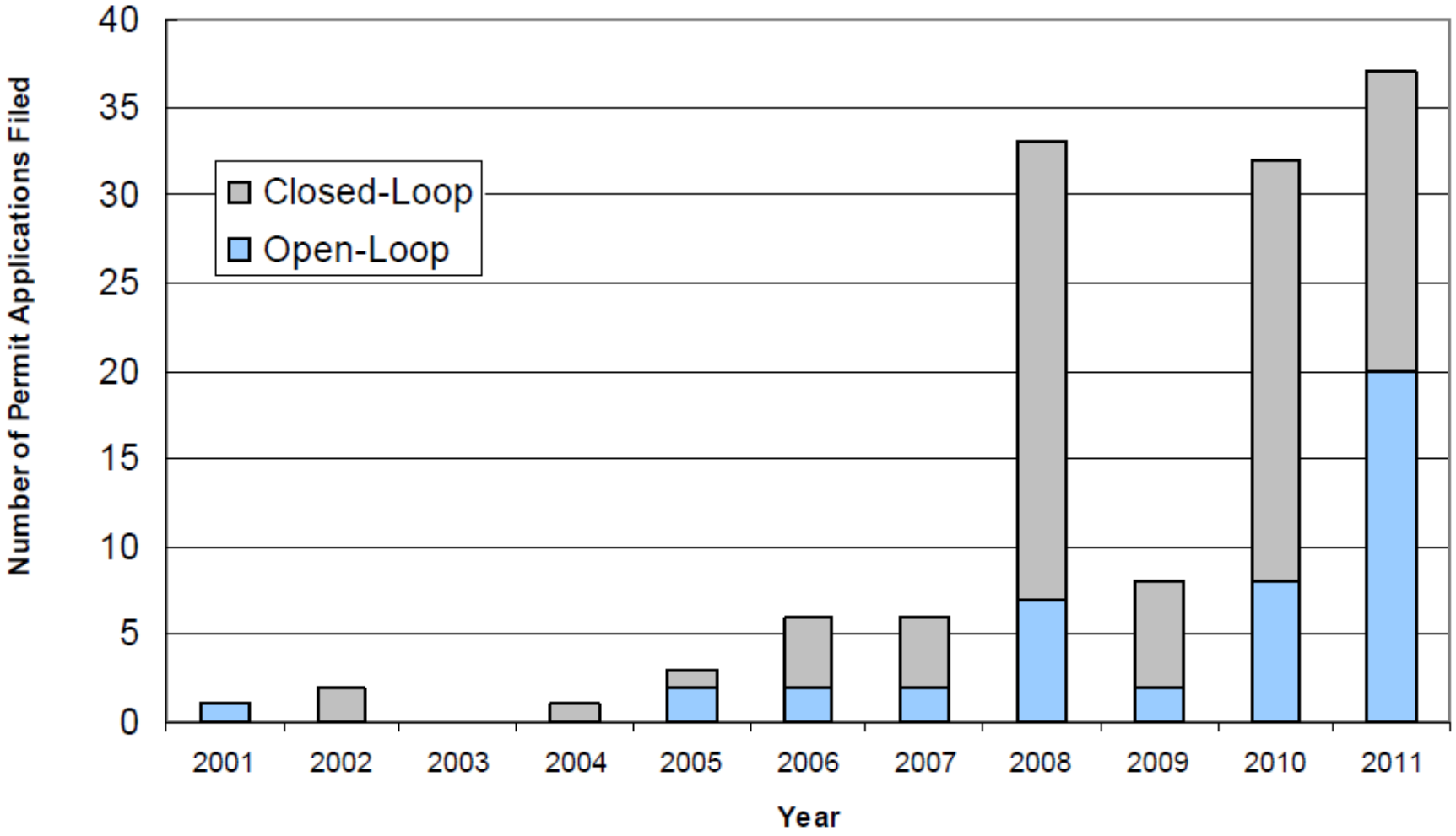


Navigant Consulting Study, 2009

Hydro Projects In Line

The FERC pipeline tops 87,500 MW across 593 projects

- **Pending Licenses/Relicenses / Exemptions: 113 projects, 14,500+ MW, 42 states**
- **Preliminary Permits Issued: 413 projects, 62,200+ MW, 44 states**
- **Preliminary Permits Pending: 67 projects, 10,700+ MW, 17 states**


Preliminary Permit Application Trends for Open- and Closed-Loop Pumped Storage Projects
Number of Permit Applications Filed
40
35
30
25
20
15
10
5
0
Closed-Loop
Open-Loop
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year

Contact

Jeff Leahey
Director of Government Affairs
202.682.1700 x. 15
jeff@hydro.org

Visit us on the Web

www.hydro.org

NatlHydroAssoc

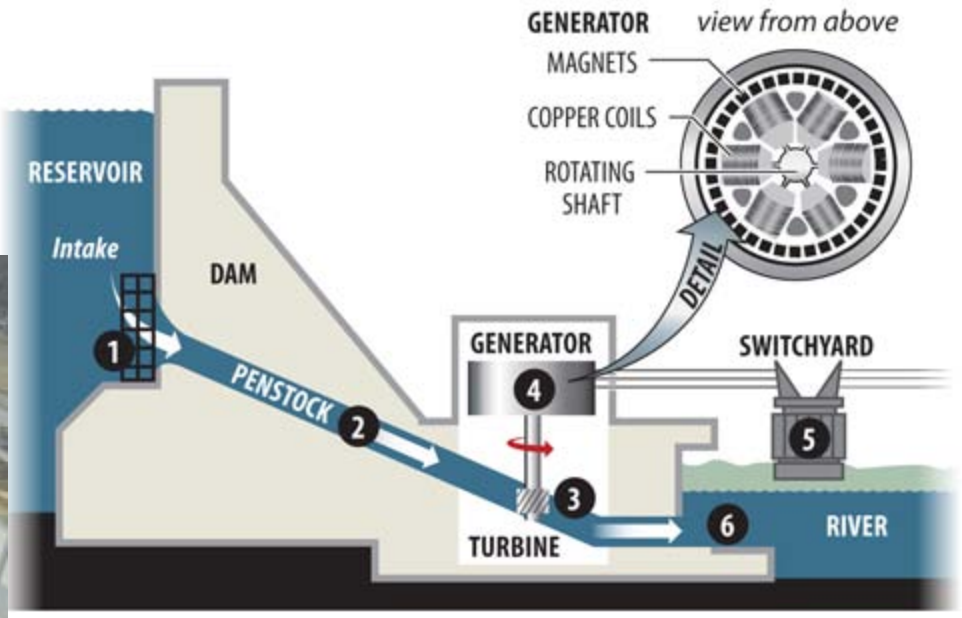
@NatlHydroAssoc

Questions?

U.S. AND WORLDWIDE PUMPED STORAGE DATA

National Hydropower Association
BLM Pumped Storage Conference
November 2012

Other hydropower technologies



Conventional hydro

Ocean wave and tidal

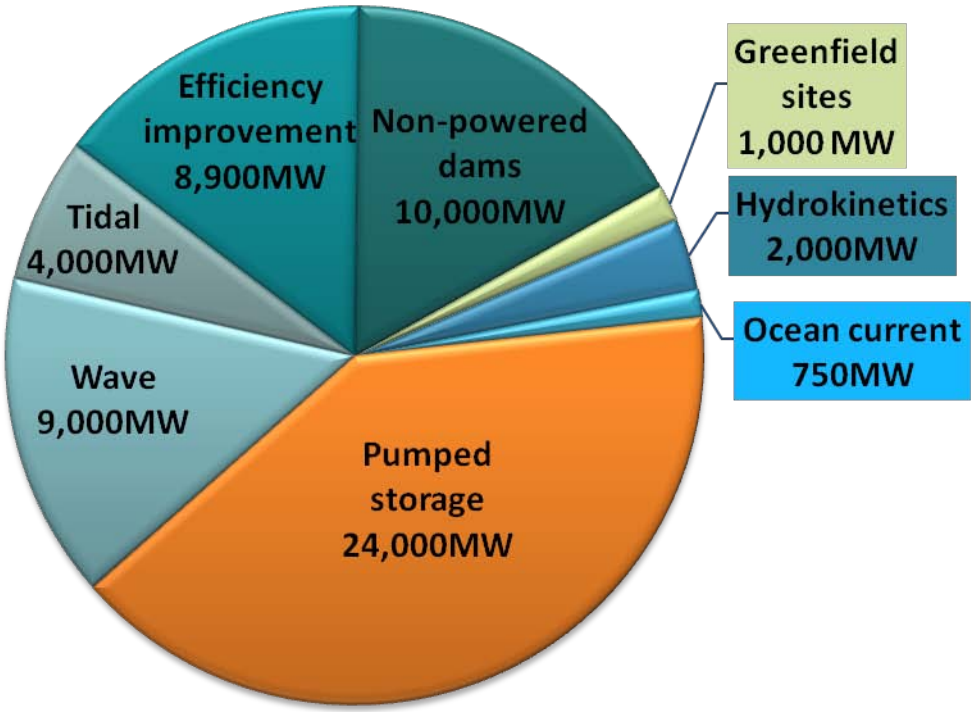
Conduit power

Future availability

With the right policies in place, **the U.S. could add 60,000 MW** of new hydro capacity by 2025, much of which can be created by maximizing existing infrastructure or with low-impact projects.

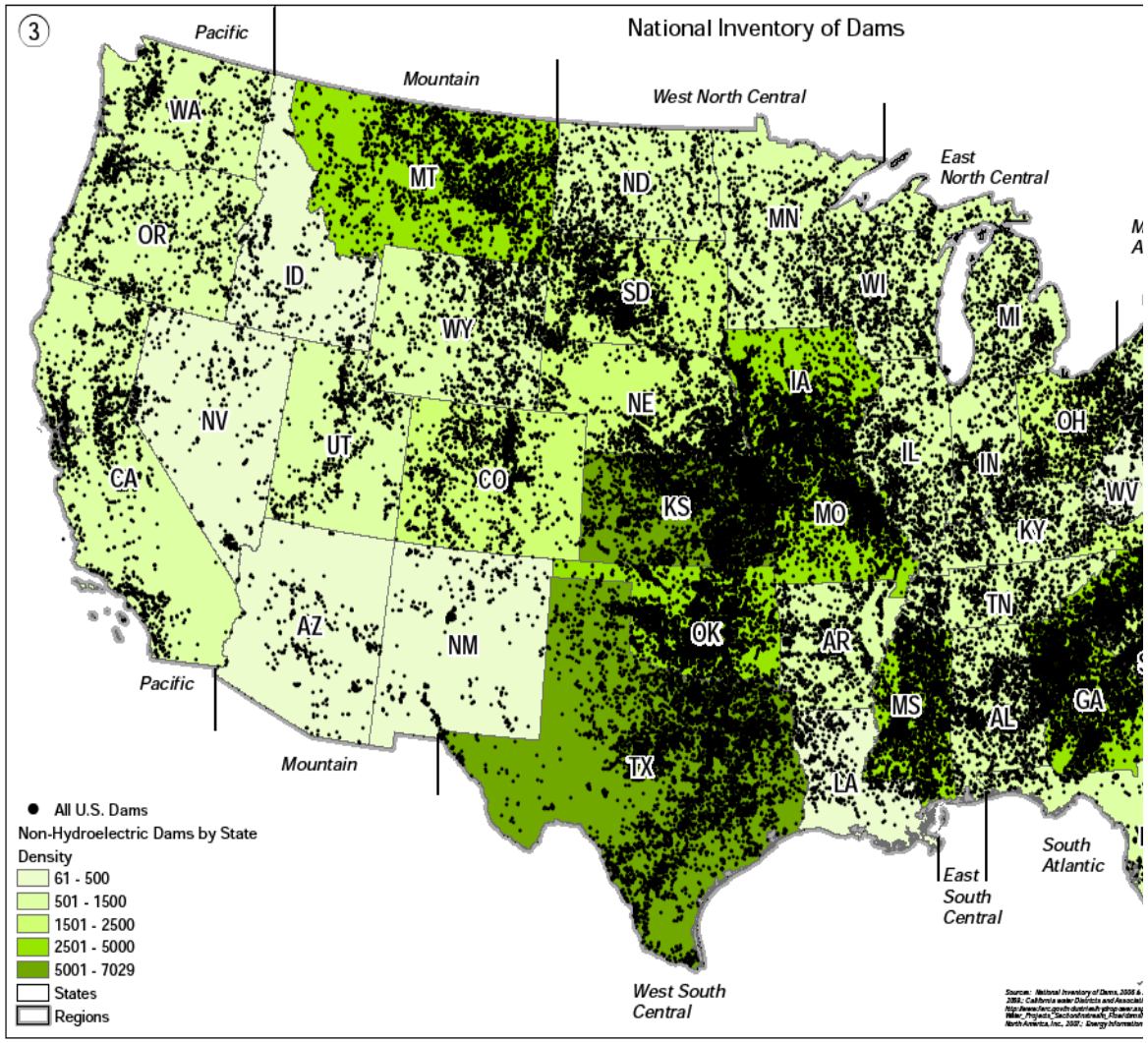
There are also some greenfield project opportunities.

Hydro Capacity Growth by Technology



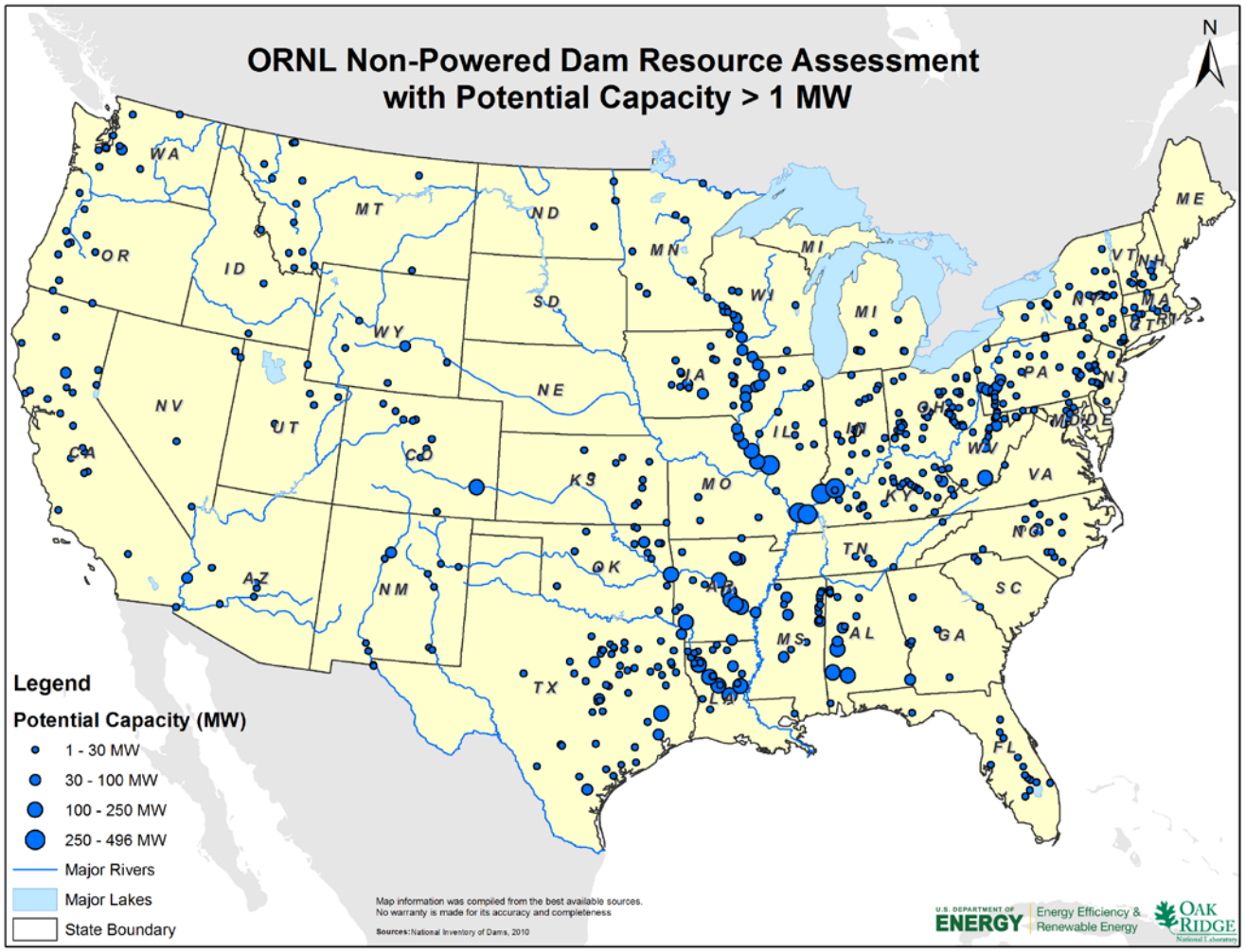
Navigant Consulting Study, 2009

80,000 Dams Across the U.S.



Source: USACE, ORNL

DOE/ORNL: 12+ GW at over 54,000 sites



Source: ORNL

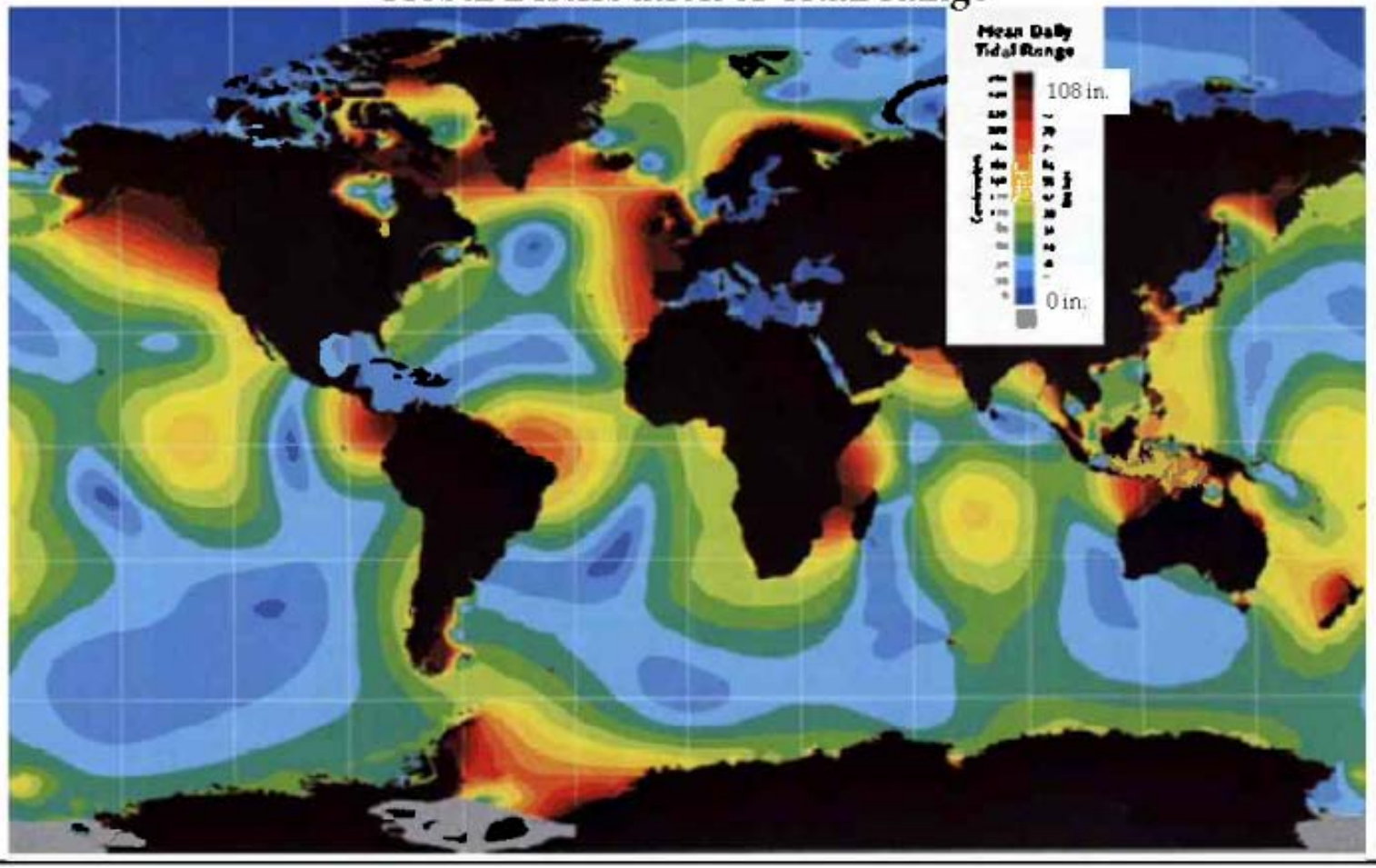
BuRec: Conduit Opportunities

Region	Canal Sites	Potential Installed Capacity (kW)	Potential Annual Energy (kWh)
GP	175	38,525	122,204,196
LC	28	5,239	29,283,867
MP	39	4,392	17,550,289
PN	74	22,755	85,385,703
UC	57	32,717	110,794,792
Total	**373**	**103,628**	**365,218,846**

U.S. Technical Potential for Tidal (Tidal Barrage and TISEC)

An assessment of technical potential has not been undertaken. EPRI has conducted a TISEC study of 5 states, finding 300 MW of feasible technical potential, and an estimated 3,800 MW of theoretical potential in Alaska. [1]

Global Distribution of Tidal Range



Back to Pumped Storage

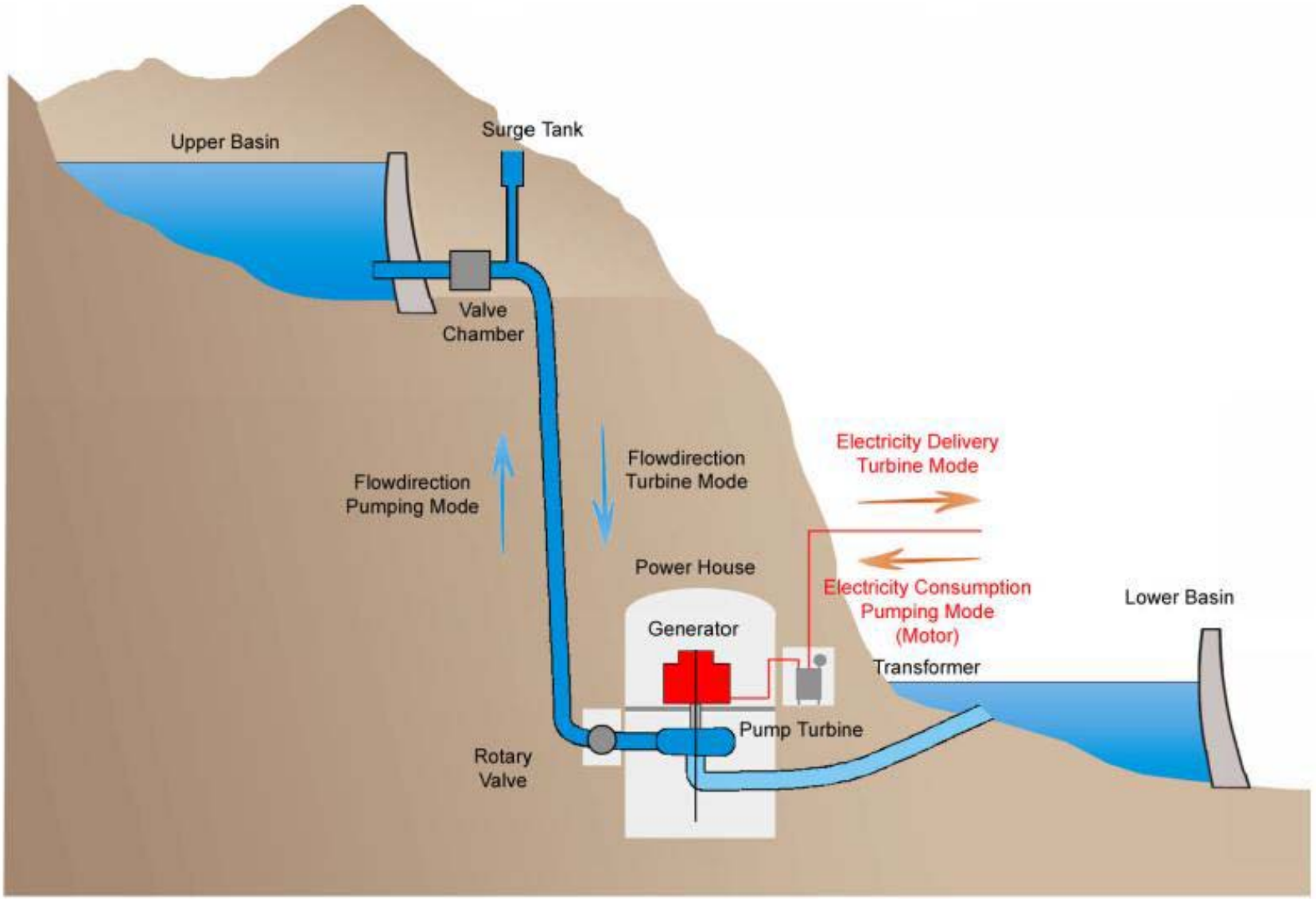
Pumped storage projects move water between two reservoirs located at different elevations (i.e., an upper and lower reservoir) to store energy and generate electricity.

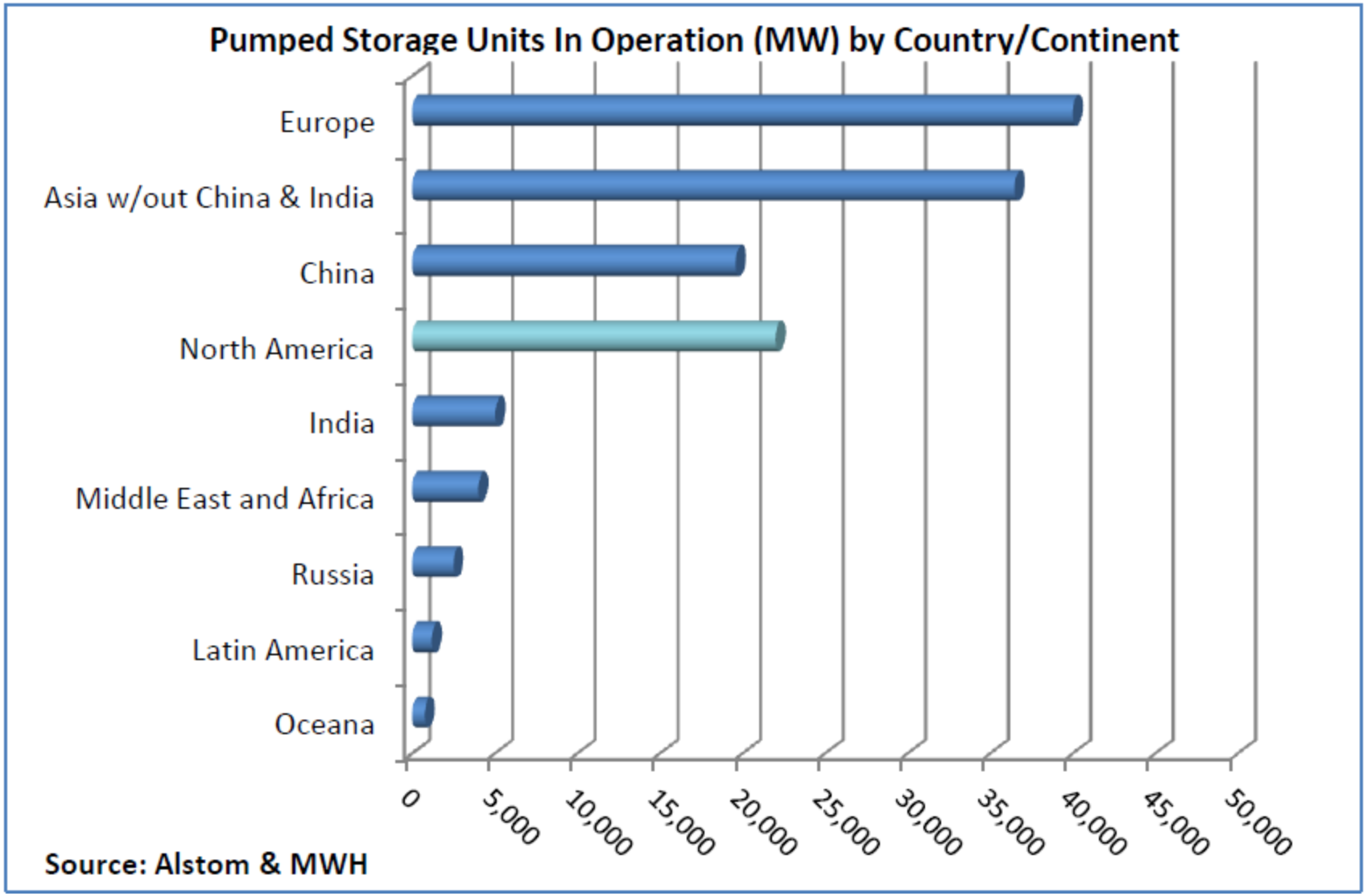
Generally, when electricity demand is low (e.g., at night), excess electric generation capacity is used to pump water from the lower reservoir to the upper reservoir.

When electricity demand is high, the stored water is released from the upper reservoir to the lower reservoir through a turbine to generate electricity.

Pumped storage projects are also capable of providing a range of ancillary services to support the integration of renewable resources and the reliable and efficient functioning of the electric grid.

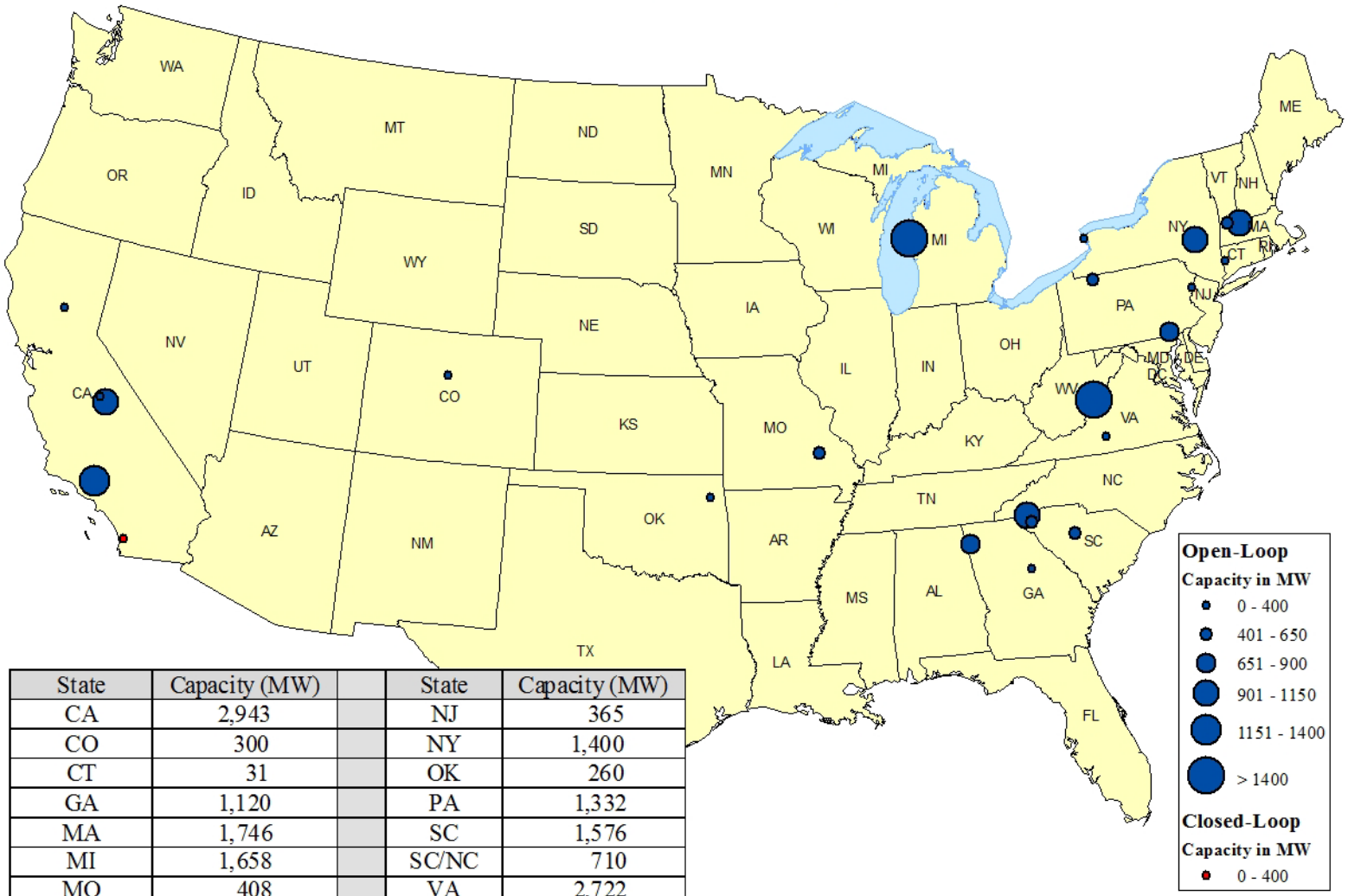
Typical Pumped Storage Plant Arrangement (Source: Alstom Power)





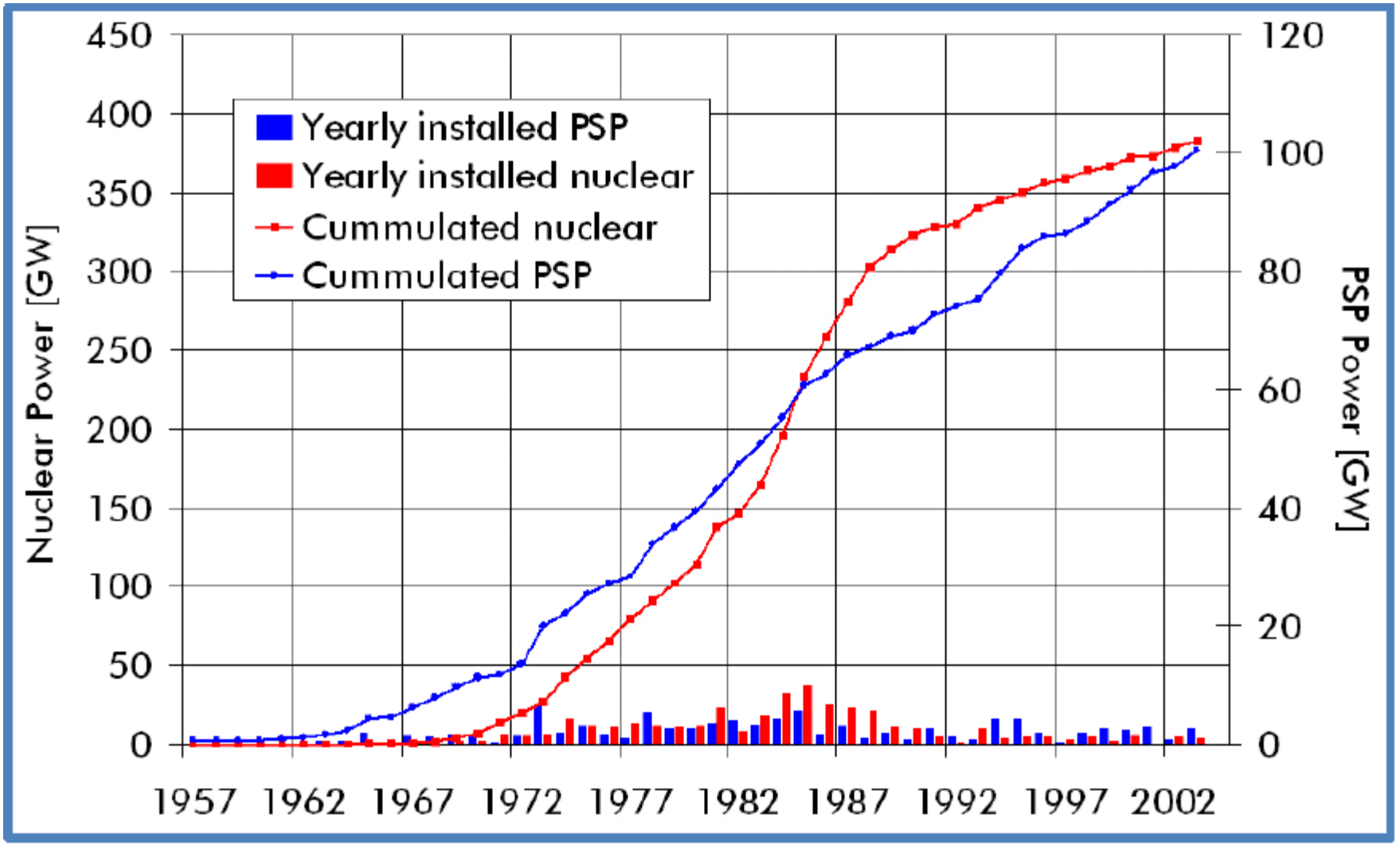
International Distribution of Pumped Storage by Country/Continent

Licensed Pumped Storage Projects



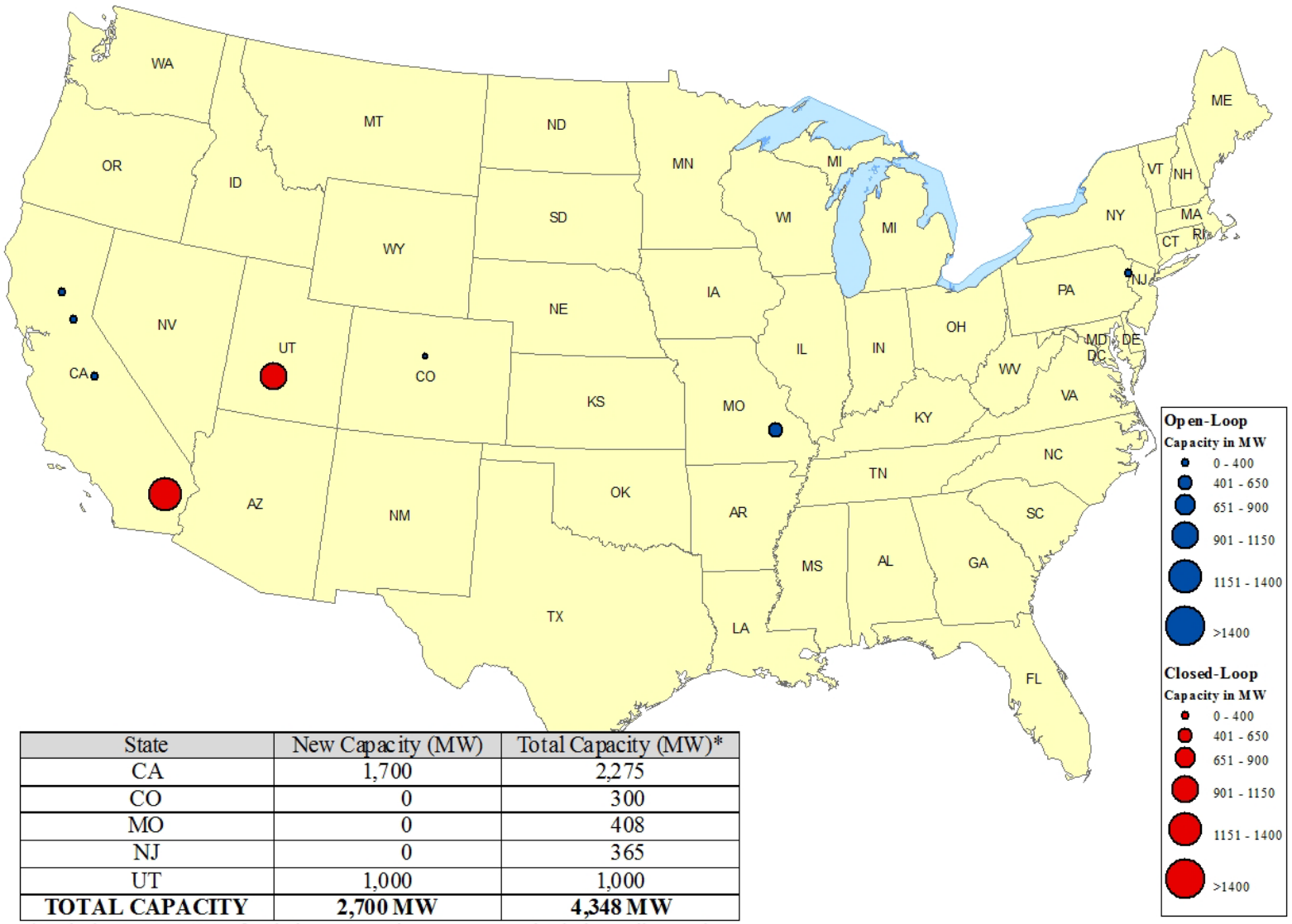
State	Capacity (MW)		State	Capacity (MW)
CA	2,943		NJ	365
CO	300		NY	1,400
CT	31		OK	260
GA	1,120		PA	1,332
MA	1,746		SC	1,576
MI	1,658		SC/NC	710
MO	408		VA	2,722
TOTAL CAPACITY				**16,571 MW**

Source: FERC Staff, July 1, 2012



Worldwide Installed Nuclear and Pumped Storage Project Development History (Source: Alstom Power and UDI database).

Pending Licenses and Relicenses for Pumped Storage Projects

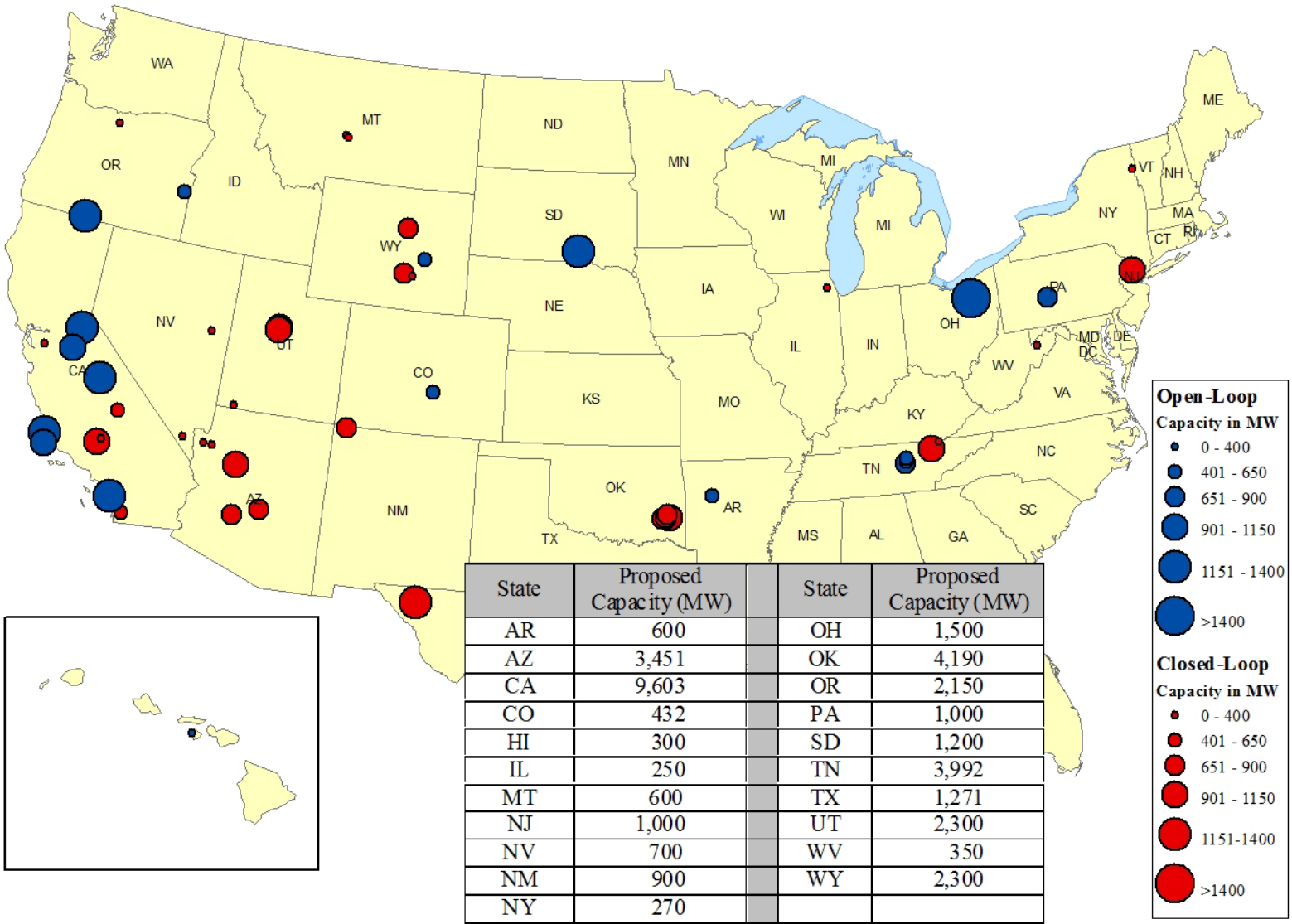


State	New Capacity (MW)	Total Capacity (MW)*
CA	1,700	2,275
CO	0	300
MO	0	408
NJ	0	365
UT	1,000	1,000
TOTAL CAPACITY	**2,700 MW**	**4,348 MW**

*Includes 1,648 MW of existing pumped storage capacity being relicensed.

Source: FERC Staff, July 1, 2012

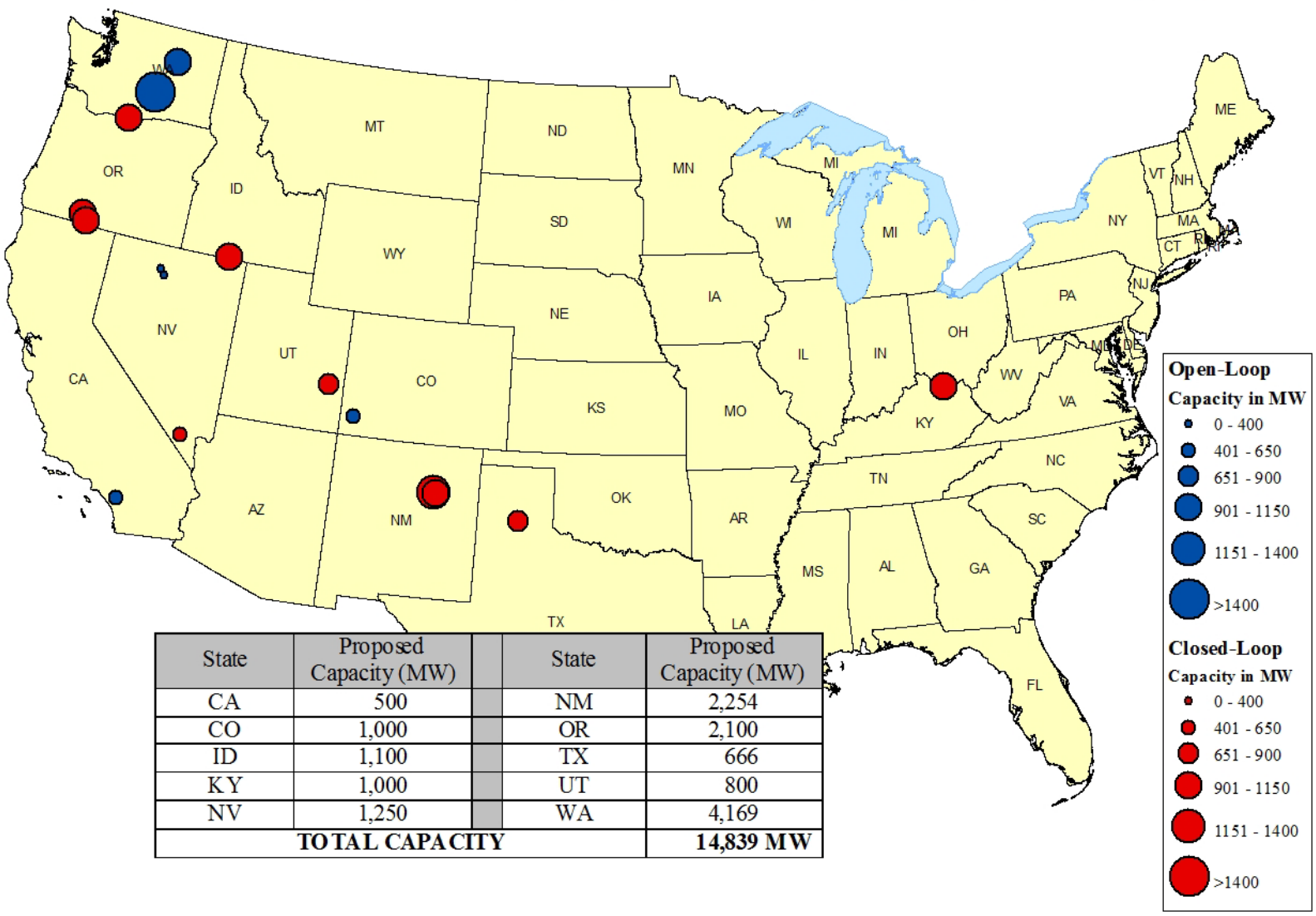
Issued Preliminary Permits for Pumped Storage Projects



State	Proposed Capacity (MW)	State	Proposed Capacity (MW)
AR	600	OH	1,500
AZ	3,451	OK	4,190
CA	9,603	OR	2,150
CO	432	PA	1,000
HI	300	SD	1,200
IL	250	TN	3,992
MT	600	TX	1,271
NJ	1,000	UT	2,300
NV	700	WV	350
NM	900	WY	2,300
NY	270		
TOTAL CAPACITY			**38,359 MW**

Source: FERC Staff, July 1, 2012

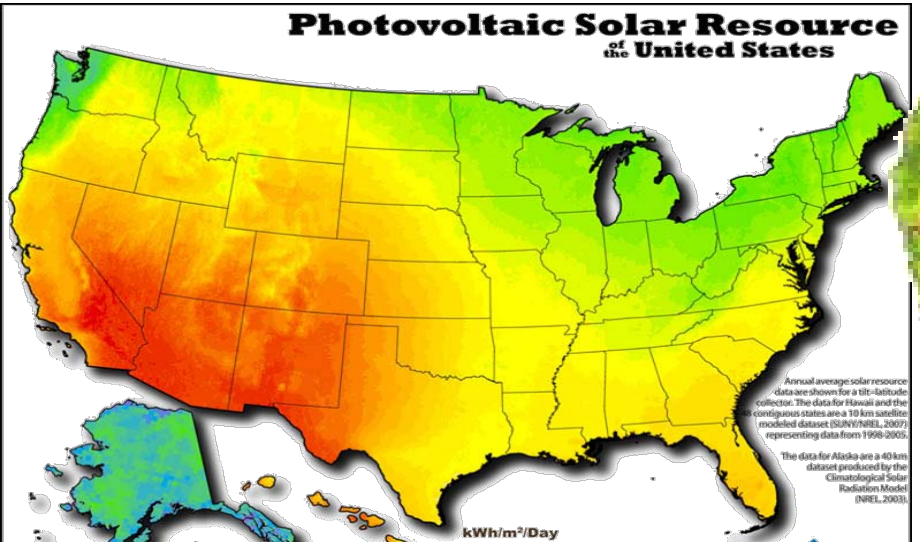
Pending Preliminary Permits for Pumped Storage Projects

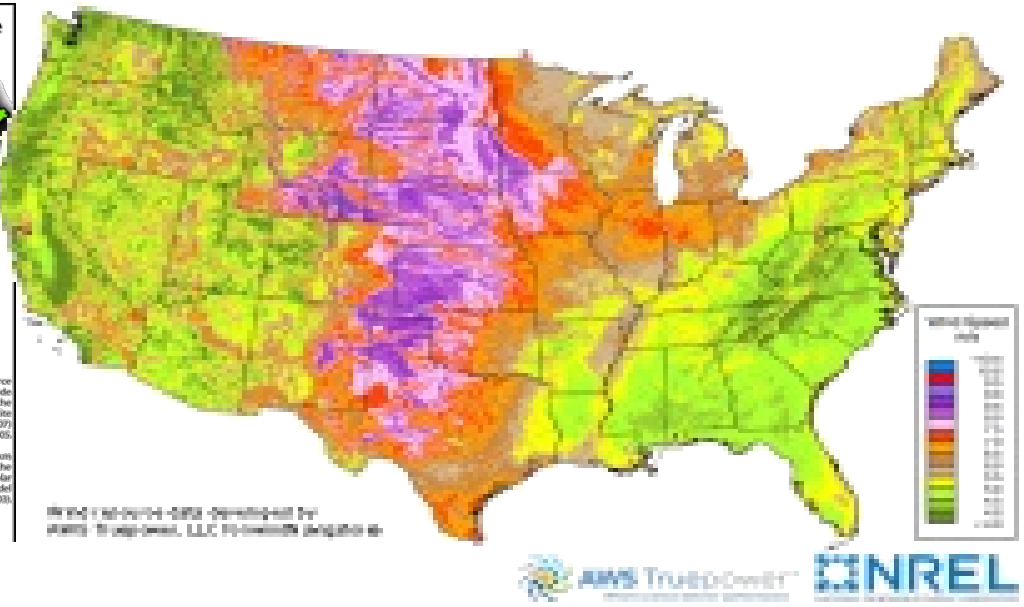


State	Proposed Capacity (MW)		State	Proposed Capacity (MW)
CA	500		NM	2,254
CO	1,000		OR	2,100
ID	1,100		TX	666
KY	1,000		UT	800
NV	1,250		WA	4,169
TOTAL CAPACITY				**14,839 MW**

Source: FERC Staff, July 1, 2012

Question: Why pumped storage and why now?





Answer: Integration of variable renewable resource potential and grid reliability

Contact

Jeff Leahey
Director of Government Affairs
202.682.1700 x. 15
jeff@hydro.org

Visit us on the Web

www.hydro.org

NatlHydroAssoc

@NatlHydroAssoc

Questions?