

An illustration of three people in a small wooden boat navigating through blue rapids. The water is depicted with white and blue swirling lines, suggesting turbulent flow. The background is a solid dark blue. The boat is positioned in the lower-left quadrant of the illustration area.

# Job Creation Opportunities in Hydropower

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Annual Conference

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NAVIGANT  
CONSULTING

## Project Scope

**For the National Hydropower Association, Navigant Consulting estimated the job potential for the U.S. Hydropower Industry.**

### U.S. Hydropower Market Job Creation Potential Study

1

**Develop US hydropower market characteristics and technical resource potential for two RES scenarios through 2025**

2

**Estimate direct, indirect and induced jobs created for each growth scenario regionally and by state**

## Conclusions

**Development of hydropower resources in the U.S. can result in a significant number of jobs.**

### Conclusions

- Expanded hydropower deployment will likely result from a Strong national Renewable Electricity Standard (RES).
- A Strong RES are estimated to support 1,400,000 cumulative jobs across the country by 2025.
  - Direct Jobs ~ 420,000
  - Indirect Jobs ~ 280,000
  - Induced Jobs ~ 700,000
- States likely to see the most job growth include:
  - Western states with the greatest resource potential (e.g. WA, CA, OR, and AK),
  - Manufacturing states (e.g. PA, WI, TN and OH), and
  - States with advanced hydro potential (e.g. FL, ME, NY, TN).

**Below are some details about the existing hydropower landscape.**

### Key U.S. Industry Characteristics

- The U.S. hydropower industry currently accounts for ~200,000 – 300,000 jobs.
  - The jobs span four specific value chain elements: 1) Project Development, 2) Manufacturing, 3) Project Deployment and 4) O&M
- The U.S. has the 2<sup>nd</sup> largest installed capacity of hydropower in the world
  - ~100 GW (including pumped storage)
  - Accounts for ~7% of domestic electricity production in the U.S.
- Over 400+ GW of untapped hydropower resource potential (inland and ocean) exists within the U.S.
- Developing these untapped hydropower resources could contribute significantly to the emerging green jobs market in the U.S.

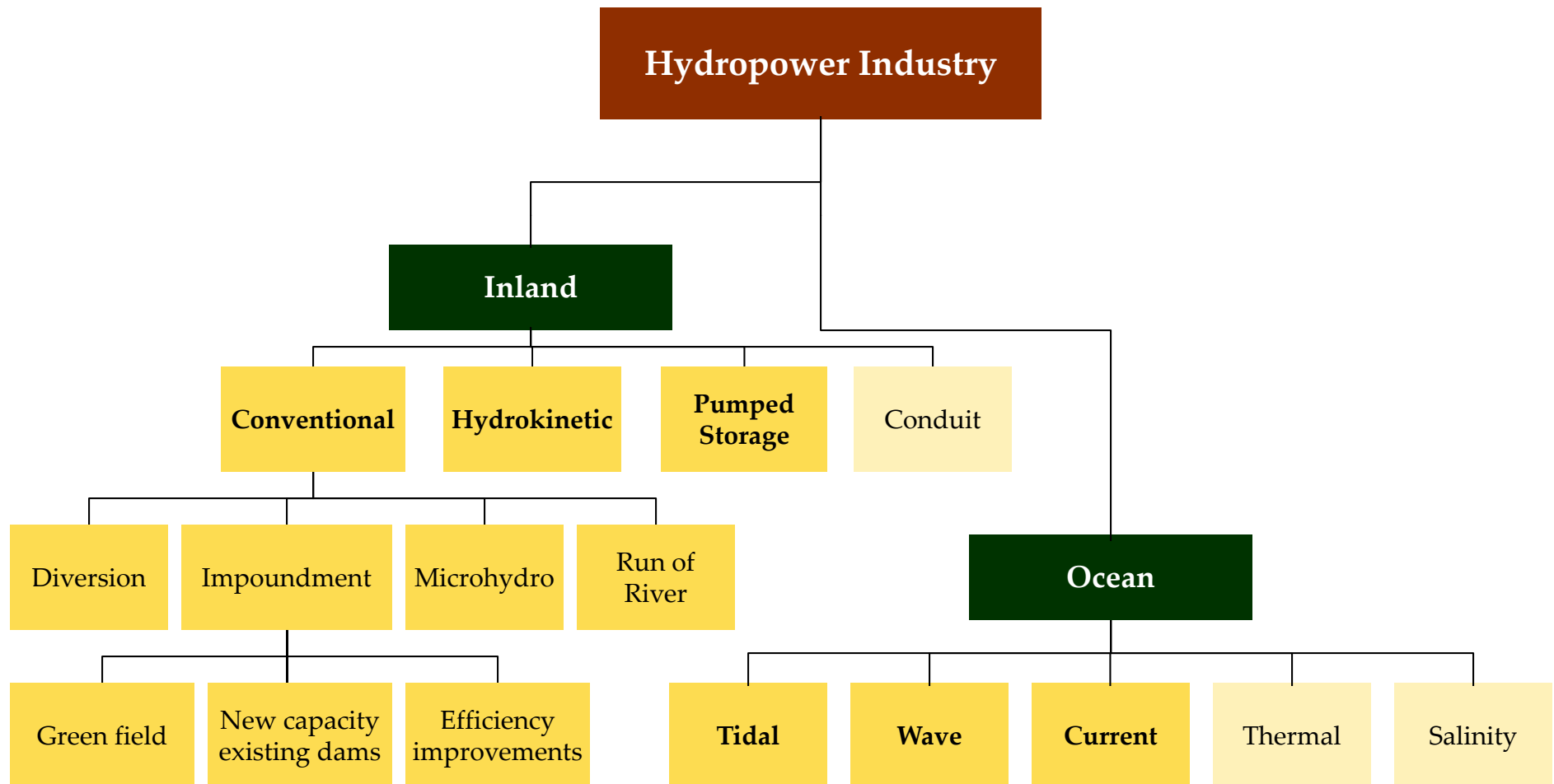
## Comparison of NCI Report to DOE Report

Navigant’s upper limit for the 2025 technical potential was based on DOE inland reports, supplemented with information from other sources.

Comparison of Findings		
	Navigant (NCI) Report	DOE Report
Theoretical Potential	<ul style="list-style-type: none"> <li>• Not assessed in this report</li> </ul>	<ul style="list-style-type: none"> <li>• 600 GW</li> </ul>
Reduced due to environmental and other placement constraints	<ul style="list-style-type: none"> <li>• Not assessed in this report</li> </ul>	<ul style="list-style-type: none"> <li>• 300 GW (after removal of already developed potential and protected areas)</li> </ul>
Additional constraints	<ul style="list-style-type: none"> <li>• Not assessed in this report</li> </ul>	<ul style="list-style-type: none"> <li>• 200 GW (after site feasibility taken into account)</li> </ul>
Technical Potential	<ul style="list-style-type: none"> <li>• 60 GW (plants&lt;30MW at existing dams without hydro and green field)</li> <li>• 15 GW (plants&gt;30MW at existing dams without hydro and green field)</li> <li>• ~9 GW (capacity+efficiency upgrades)</li> <li>• No estimate of technical potential for Pumped storage</li> <li>• 95 GW (Ocean – largely theoretical potential)</li> </ul>	<ul style="list-style-type: none"> <li>• 60 GW (plants&lt;30MW)</li> <li>• Additional hydro potential examined by NCI was not assessed in the DOE report.</li> </ul>

## Hydropower Classifications

Navigant Consulting has classified the hydropower industry into two categories and several subcategories shown below.



Note : Lighter colors indicate less mature technology not considered in this study

## U.S. Hydropower Market Growth: Inland

NCI reviewed two scenarios: a *Weak RES* (10% by 2025) and a *Strong RES* (25% by 2025).

U.S. Hydropower Market Growth Scenarios – Cumulative Capacity by 2025					
Category	Technology	Realizable by 2025 (Weak RES)	Realizable By 2025 (Strong RES)	Projected Level of Development	
Inland	Efficiency Improvements + New Capacity	5,750 MW	8,900 MW	4,400 MW is current industry consensus for commercial. Add 3% improvement to 45 GW at federal facilities for Weak RES; 10% improvement for Strong RES.	
	New facilities in existing dams without hydropower	5,000 MW	10,000 MW	Weak RES consistent with EPRI projections for 2025; >60% of resource potential deployed for Strong RES	
	Greenfield Sites	500 MW	1,000 MW	Strong RES twice that for Weak RES	
	Inland Hydrokinetic	500 MW	2,000 MW	Projecting 2/3rds of full resource potential achieved in Strong RES	
	Pumped Storage	10,000 MW	24,000 MW	Project 1/3 <sup>rd</sup> of current queue deployed for Weak RES; Strong RES has >80% of all in queue projects (31 GW being approved).	
	<b>Total by 2025</b>		<b>21,750 MW (7%)</b>	<b>45,900 MW (15%)</b>	
	<b>% of Total Resource Available</b>		<b>7%</b>	<b>15%</b>	300,000 MW total available inland

Sources: INL, EPRI and industry interviews.

## U.S. Hydropower Market Growth: Ocean

Below are ocean *Weak RES* and *Strong RES* potentials by 2025.

U.S. Hydropower Market Growth Scenarios – Cumulative Capacity by 2025				
Category	Technology	Realizable By 2025 (Weak RES)	Realizable By 2025 (Strong RES)	Projected Level of Development
Ocean	Wave	900 MW	9,000 MW	Project 1% of achievable capacity deployed after 2015 (Weak RES);10% of capacity for Strong RES
	Ocean Current	250 MW	750 MW	Assumed FL potential with 1/3 of full potential realized for Weak RES; full capacity realized for Strong RES
	Tidal In-Stream Energy Conversion (TISEC)	400 MW	4,000 MW	Project 10% of achievable capacity deployed after 2015 (Weak RES ); full capacity achieved (Strong RES)
	<b>Total</b>	<b>1,550 MW</b>	<b>13,750 MW</b>	Assumed after 2015 by 2025
Total Hydro	<b>Inland + Ocean</b>	<b>23,300 MW</b>	<b>59,650 MW</b>	
	<b>% of Total Resource</b>	<b>6%</b>	<b>15%</b>	300,000 MW Inland + 95,000 MW Ocean

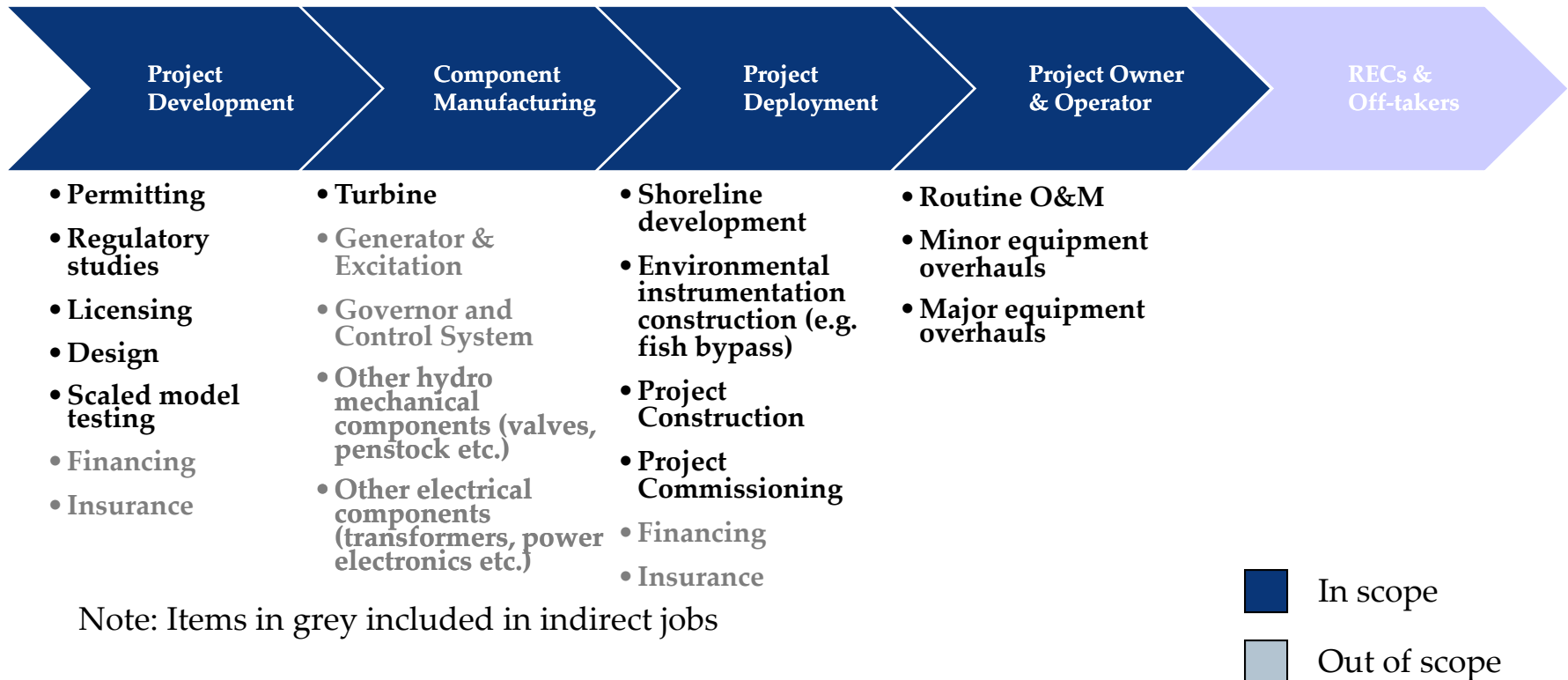
Sources: INL and industry interviews.



## Value Chain

This analysis covered key parts of the value chain impacting jobs. Over 20+ interviews were conducted with companies representing several different parts of this value chain to estimate job numbers.

### Hydropower Value Chain



## Methodology for Employment Estimates by State

Job allocations were either based on the state of project installations or the physical location of staff, depending on the value chain piece.

### Hydropower Value Chain

	Methodology for State Job Allocation
Project Development	<ul style="list-style-type: none"><li>Based on a percentage of development companies in each state (based on NHA membership lists and 2008 Hydro Review company data)</li></ul>
Component Manufacturing	<ul style="list-style-type: none"><li>Based on turbine manufacturing capabilities - heavily allocated to PA, followed by WI and TN (allocations in other states where future manufacturing is expected e.g. OH, were based on discussions with NHA)</li></ul>
Project Deployment	<ul style="list-style-type: none"><li>Inland: based on resource potential associated with the state</li><li>Ocean: wave potential mostly across the west coast and some off the coast of ME and NY</li></ul>
Project Owner & Operator	<ul style="list-style-type: none"><li>Based on the technical potential allocation applicable to each state, for each technology.</li></ul>

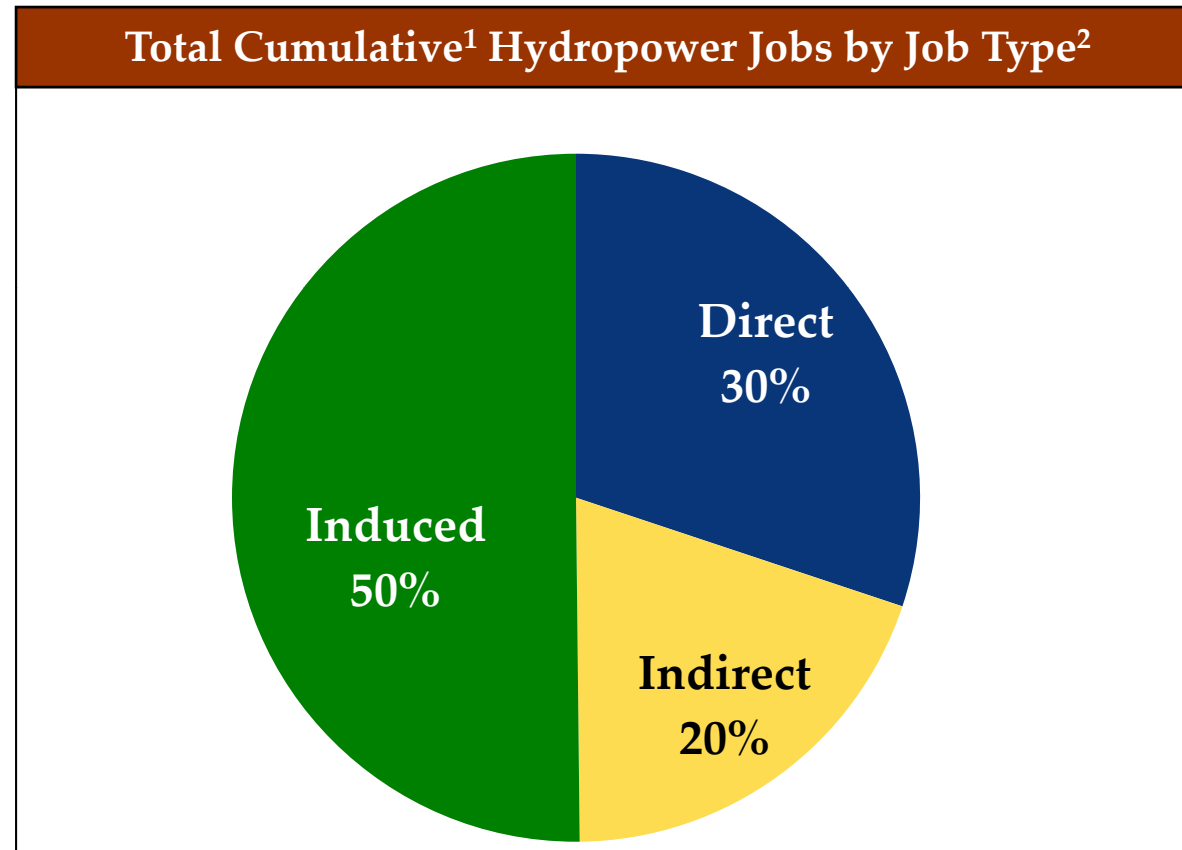
## Job Rule of Thumbs

**Navigant cross-checked cost basis job estimates with industry interviews. Below are typical full time equivalents (FTEs) per MW.**

<b>U.S. Hydropower Market Direct Jobs in FTE (Full Time Equivalents) – 2009</b>		
<b>Technology</b>	<b>Average Project Size</b>	<b>Total FTE/MW (Average)</b>
<b>Inland Hydrokinetic, Micro Hydro (&lt;1 MW)</b>	10 MW	6.00
<b>Efficiency Improvements, New Capacity in existing facilities, modifications</b>	10 MW	6.50
<b>New Facilities in low head/low flow Existing Dams without Hydropower</b>	10 MW	5.30
<b>Green Field Small</b>	50 MW	6.00
<b>New Facilities in higher head / higher flow Existing Dams without Hydropower</b>	50 MW	5.30
<b>Green Field Large</b>	100 MW	6.00
<b>Pumped Storage</b>	500 MW (interviews) 1,000 MW (cost basis)	5.10
<b>Ocean – Wave, Tidal</b>	15 – 200 MW (literature) 50 MW (cost basis)	14.0

## Types of Jobs

**Induced jobs comprise half of the total cumulative jobs created.**



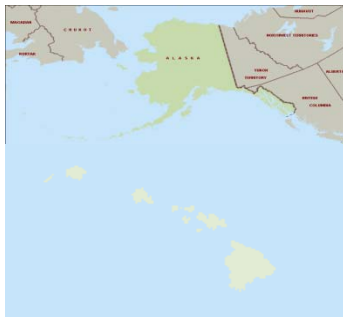
Notes:

1. "A cumulative job is a job-year, which is defined as 1 person working full-time for 12 months
2. Percentages estimated based on direct jobs from MWs installed and indirect and induced jobs based on multipliers described in previous slide

## Total Jobs by State for Weak RES

Under the *Weak RES* scenario, total cumulative jobs (~480,000) are concentrated in the West and TN (due to project deployment) and PA (due to manufacturing).

### Weak RES Scenario - Total Jobs Allocation by State (2009 - 2025)



Total Cumulative Jobs

	0-4999
	5000-19999
	20000-59999
	60000-99999
	100000-139999
	140000-179999
	180000-220000



## Total Jobs by State for Strong RES

Under the *Strong RES* scenario, significantly more total cumulative jobs (~1.4 million) are concentrated in the West and PA (driven by manufacturing).

### Strong RES Scenario – Jobs Allocation by State (2009 - 2025)



Total Cumulative Jobs

	0-4999
	5000-19999
	20000-59999
	60000-99999
	100000-139999
	140000-179999
	180000-220000



## Contact Information

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