

## 2017 HRF Topics and Areas of Interest for Research Awards Program

In 2016, the hydropower industry released the Hydro Vision Report outlining advances in the industry to support hydropower's role in our clean energy future. Five areas of advancement were identified as well as actions within each area.

The 2017 topics are categorized within this framework, and applicants are asked to reference topic numbers in their applications.

To view the full report, please visit: [www.energy.gov/eere/water/water-power-technologies-office](http://www.energy.gov/eere/water/water-power-technologies-office)

### Five Areas for advancement of the hydropower industry

#### Actions within the five areas of advancement

Topic

Number

Action

Technology Advancement-Developing Next Generation Hydropower Technologies	
1	Advances in instrumentation and controls [protection, automation, governors, Supervisory Control and Data Acquisition (SCADA)]
2	Generator design for quick start, frequent cycling, and load following
3	Advances in generator insulation systems or stator core materials
4	Advanced high-efficiency generator designs (superconducting technology, etc.)
5	Innovative methods to reduce the cost of underground excavation in project construction
6	Improvement in materials such as cavitation and erosion-resistant materials, environmentally friendly oils & lubricants and coatings for water conveyance structures
7	Cavitation detection methods- identifying damaging cavitation using non-damaging technology
8	Hydraulic performance testing and improved flow measurement
9	Standardized equipment components that can be mass produced and assembled in a variety of packaged designs.
10	Scalable modular civil structure designs, manufacturing and implementation plans, or a database describing performance characteristics of modular designs.
11	Application of additive manufacturing for the production of hydropower machinery that are more corrosion resistant and are quicker to build and install
12	Advanced turbines for energy efficiency and environmental performance
13	Design of standardized low-head and inline turbines (e.g. drop-in turbines)having minimal environmental impact
14	Demonstration of potential and feasibility of innovative closed-loop PSH design concepts
15	Modular pumped storage designs (<100MW size range)
16	New technology to enhance downstream water quality such as advanced weirs
17	Database of new and emerging technologies and associated studies
Enhance Environmental Performance of New and Existing Hydropower Technologies	
18	Develop metrics, monitoring, and measurement methodologies for environmental stressors
19	Biologically-based design and evaluation techniques for hydropower components and associated water control facilities
20	Methods and evaluation of the use of adaptive management to prompt environmental performance improvements to given hydropower technology
21	Metrics, monitoring, and measurement methodologies for environmental stressors associated with hydropower operations
22	Compare environmental performance before and after upgrades, new environmental requirements, or deployment at select example facilities to validate and communicate the success of environmental mitigation measures
23	Sedimentation and erosion control
24	Endangered species, habitat protection, and restoration program design
25	Identify improvements do downstream fish passage for new and existing hydropower facilities
Validate Performance and Reliability of New Hydropower and Pumped Storage Hydropower Technologies	
26	Advances in Pump-Turbines, and Related Technologies for use in pumped-storage hydropower and renewable energy storage such as improvements in pumps or pump-turbines, and advances in generators
27	Optimization tools for realizing the full potential of pumped storage projects for provision of grid services
28	Enhanced methodologies for benchmarking and performance assessment across the industry
29	Develop test and performance certification mechanisms such as technology testbeds, standards and methods to certify new designs, accepted certification protocols for emerging technologies, validated models and information on performance and reliability of new technologies
Ensure Hydropower Technology Can Support Increased Use of Variable Renewable & Generation Resources	
30	Predictive Maintenance/Repair and Condition Monitoring
31	Tools for turbine/generator equipment failure forensics and root-cause analysis
32	Innovative integration and control mechanisms for power systems with various types of renewable energy
33	Innovations in planning and strategies for rehabilitation for increases in efficiency and capacity
34	Develop new criteria and tools for assessing hydropower equipment performance related to grid support and response
35	New technology to increase energy efficiencies of turbines or generators under a wide range of operating conditions, particularly related to support of intermittent energy sources

36	New technologies and materials that can better withstand stresses arising from variable and extreme operating conditions
37	Simulation and optimization models for machine and operational improvements in mixed renewable power systems

#### **Sustainable Development and Operation-Increasing Hydropower's Resilience to Climate Change**

38	Hydropower-focused climate change assessment framework
39	Climate data repository for hydropower operational studies
40	Long-term forecasting for precipitation, runoff, and storage, particularly Probable Maximum Precipitation/Probable Maximum Flood
41	Develop scientific information on the influence of climate change on water demands
42	New technology to increase water-use efficiency in hydropower design and operation
43	Modelling operational and storage scenarios to help offset climate change impacts
44	Atmospheric emissions from Reservoirs, including GHG's and evaporation

#### **Improve Integration of Water Use within Basins and Watersheds**

44	Evaluation of options beyond the bounds of individual hydropower projects to mitigate any adverse project effects
45	Tools for less costly, more effective environmental optimization including improving understanding of barriers to applying existing tools
46	Improving environmental flow requirements, especially at peaking projects

#### **Evaluate Environmental Sustainability of New Hydropower Facilities**

47	Technology to reduce the cost of effective fish passage compliance requirements.
48	Management strategies for invasive species
49	Metrics for evaluating environmental sustainability for new hydropower development.
50	Methodologies to design and operate new hydropower in ways that are compatible with the environment
51	Comparison of benefits, drawbacks and models in order to develop or expand upon existing certification programs

#### **Enhanced Revenue and Market Structures**

52	Cost reduction strategies for maintenance of facilities
53	Tools to improve valuation and compensation of hydropower in Electricity Markets including costs of supporting intermittent renewables
54	Quantify operational flexibility of hydropower and its value to the electricity system
55	Identification of operational improvements to maximize and monetize ancillary benefits
56	Explore innovative market structures that recognize hydropower's ancillary benefits
57	Toolkits to assist developers (particularly smaller developers) in understanding what types of renewable and clean energy markets are available, how their projects can qualify and how to overcome specific barriers

#### **Improve Valuation and Compensation of PSH in Electricity Markets**

58	Renewable energy integration strategies using pumped storage and conventional hydro
59	Improve the valuation and market recognition of PSH services, contributions including system-wide benefits

#### **Regulatory Process Optimization**

60	Review and report on existing regulatory processes and propose potential improvements
61	Resolution of conflicts with tribal/indigenous peoples perspectives

#### **Enhanced Collaboration, Education, and Outreach**

62	Explore human factors considerations for safe operation of hydropower facilities- including noise reduction and arc flash detection
63	Compillation of best practices and benchmarking in operations and Research and Development (R&D)
64	Compare and make recommendations for improved methods for knowledge capture and transfer in hydropower workforce transitions

#### **Beyond the Vision Areas of Interest-Critical Infrastructure Protection & Other**

65	Development of risk assessment and management tools for critical hydropower infrastructure
66	Development of critical hydropower infrastructure protection strategies including physical security and cyber security for hydropower
67	Improvements in the assessment of effectiveness of critical hydropower infrastructure protection methods and technology
68	Reliable surveillance and monitoring of hydropower dams (even during power outages) including rapid notification of developing emergencies such as floods, structural problems, leaks, security breaches, etc.
69	Structural and geotechnical aspects of hydropower dam safety
70	Other research topics that will directly contribute and be of value to the hydro industry