Major milestones and achievements 2014/2015

Industry Overall

Technology evolution and deployment

1. **Hydropower development market**: new development mainly in non-OECD countries, such as China, Brazil, India, Turkey and other Asian countries.
2. **Modernization:** significant activity in the modernization of ageing hydroplants, particularly in Europe and North America. Increased output of up to 10% often achievable at modest cost of energy.
3. **Small-scale hydro:** continued development of small scale hydropower particularly for local development. OECD countries are looking for modular technologies
4. **Equipment manufacturers:** Continuous but limited improvements in equipment performance. New turbines with very fast response time, which are more efficient for load following, are being developed for pump storage devices.
5. **Pumped storage:** Increased development curtailed in many electrical networks by limited economic feasibility. New technologies include variable speed turbine/generator sets
6. **Tidal lagoon:** Hydropower technology transfer to potentially large scale tidal lagoon developments and could be associated with other RE technologies (wind for instance)

Policies

1. Hydropower is increasingly valued as an integrator of variable renewables and a source of peaking power. However, in some jurisdictions, the services rendered by hydropower are not well recognized nor monetized and market compensation is not considered adequate. Overall, hydropower support mechanisms are losing ground to wind and solar
2. Policies for upgrades and refurbishment of ageing hydroplants, considered environmentally and socially attractive, are generally inadequate in terms of economics and have many limitations.
3. Small-scale hydropower development is increasingly considered for distributed generation and isolated grids.

IA's work and impact

Technology evolution and deployment

1. Most technology development is undertaken by major equipment manufacturers, with limited contributions from research laboratories.
2. Hydropower development is usually undertaken by governments, other public entities or private investors. The hydropower IA is not involved with development or deployment of technology.
3. There is a potential risk of high GHG emissions from a select few reservoirs that could affect their carbon footprint under certain circumstances (climate conditions, biomass present, residential time, etc.). Annex work is considering guidelines to cover best practice for the measurement, monitoring, modelling and management of these potential emissions in these instances.
4. Reservoirs developed for hydropower often have multipurpose benefits. Developers are looking to value and allocate the costs of these benefits to the respective consumers (i.e. idea to share costs and benefits)

Policy relevance

1. The genesis of the work on managing the carbon balance in freshwater reservoirs was the recognition that the present state of the art on reservoir GHG emissions has numerous uncertainties and diverging positions and can perversely preclude their consideration in energy policies, legislation and regulations. The hydropower IA will produce three Annex reports on the subject
   - Guidelines Volume 1 with a focus on Measurement Programs and Data Analysis was launched in 2012
   - Guideline Volume 2, with a focus on Modelling will be launched in October 2015
   - Guideline Volume 3 with a focus on best practices of reservoir carbon balance management will start in 2016
2. The small-scale hydro report on government policies and experiences, provided by six countries/organizations is being updated based on recent input including comments received from presentations and panel discussions at international conferences.
3. The task reporting on Sustainable Small-Scale Hydropower in Local Communities is drawing to a close, with analysis and reporting planned for early 2016. The report will include a collection of survey material and case histories highlighting small-hydro projects that are successful financially and socially accepted

Forward looking: opportunities & challenges

for the next three years

<table>
<tr><th colspan="2">Industry Overall</th></tr>
<tr><th>Technology evolution and deployment</th><th>Policies</th></tr>
<tr><td>1. There is a growing expectation for hydropower as a future key player in a low-carbon society as it represents a domestic, mature, affordable and sustainable source of energy.
2. In addition to providing renewable base load, hydropower is gaining renewed recognition for its load-balancing system capabilities coupled to the increased penetration of intermittent wind energy and solar power.
3. In particular, storage hydropower provides a wide range of energy and non-energy services, with the latter including flood protection, irrigation flows and navigation.
4. While hydropower is an accepted and mature technology, the electricity sector is changing continuously and a program of hydropower research is essential to ensure its place in the energy supply mix as a sustainable user of water resources.
5. No major breakthroughs in hydropower technology is anticipated, rather a gradual increase in performance improvements, particularly in electronic controls.
6. Deployment of new hydropower will continue strongly in non-OECD countries. Slowly increased development is expected in some African countries</td><td>IEA Hydro countries believe that there are emerging issues surrounding the status and the future role of hydropower in some mature energy markets. These include:
• The transformation of energy markets that hydropower generators sells into now and in the future
• Changing demand patterns - changes to industry composition and emerging industries (e.g. data centres, electrification), responding to the decline in residential grid connected demand
• Increased generation from other renewable sources, e.g. wind, solar
• Interconnection - ability of hydropower to provide renewable energy to other regions and/or act as battery for increased renewable generation
• Economics of hydropower life extension
• Policy and regulatory frameworks to provide right incentives for investment (re-investment) and continued value realisation
In addition, the IEA Hydro
• Broadening our outreach to developing countries
• Follow-up on outcomes of the Hydropower Technology Roadmap
• Consider an Annex on Climate Change/Energy Challenges</td></tr>
<tr><th colspan="2">IA's work</th></tr>
<tr><th>Technology evolution and deployment</th><th>Policy relevance</th></tr>
<tr><td>1. The work of the Annex on valuing hydropower services investigates the services provided by storage hydro projects and establishes the economic values of energy management, water management and other socio-economic services enhancing understanding of:
• the type of energy and non-energy services hydropower can provide to energy security, water security and sustainable development
• the potential consequences of providing such services for the hydropower sector in terms of required adjustments in operation, maintenance and development practices;
• appropriate economic assessment methods to quantify the value of these services;
• how the costs of providing multiple services are apportioned between stakeholders;
• how regulatory frameworks, market mechanisms and business models can sustain or hamper the optimal deployment or development of multipurpose hydropower services</td><td>1. Completion of the guidelines for measurement, monitoring, modelling, allocation and management of potential GHG emissions from multipurpose reservoirs, which will be an important step in understanding the science and developing energy policies, legislations and regulations
2. Completing the final report on renewals and upgrades of hydropower plants in October 2015. Case histories gathered from around the world cover good practice and will be an excellent reference and guide for utilities modernizing their assets.
3. The work hydropower and fish will increase knowledge and provide a better understand of the effects of hydropower on fish. This will enable the identification of best practices for management and mitigation and the provision of sound advice on ways for industry, investors and government to make good decisions for sustainable hydropower. The scope of investigations and research will cover impacts for new hydropower developments, operation of existing hydropower and the modernization of hydroplants and their equipment.</td></tr>
</table>

Outreach & collaboration (key messages)

	Past period	Planned for 2015/16
Dissemination & publications	• **HYDRO 2014 –** Lake Como, Italy. October 2014. The hydropower IA organized three sessions as part of the conference and held two days of Annex workshops and meetings directly afterwards • **HydroVision 2015.** Portland, Ore. USA. The Hydropower IA organized a panel session on the work of the IA as part of the conference.	• **HYDRO 2015** – Bordeaux, France. October 2015**.** The hydropower IA is organizing three sessions as part of the conference and held two days of Annex workshops and meetings directly afterwards . • **ASIA 2016** – Vientiane, Lao PDR. March 2016. The hydropower IA may organize an exhibition booth as part of the conference. • **Regular Website updates**
Collaboration & cooperation (with IEA Secretariat, IAs network, other organizations…)	**IEA/IAs** • Chairman and Secretary attended **67th REWP meeting** and participated in the associated workshops • **Reviewed IEA publications**: Medium-Term Renewable Energy Market Report 2015 • Vice Chair attended September 18th 2015 **Consultation meeting on the forward agenda for the IEA.** "Preparing the next 40 years of multilateral energy technology collaboration". A presentation was made in the form of an information circular. **Other Organizations** **Aqua Media.** Publishers of *Hydropower and Dams* and organizers of HYDRO conferences **International Hydropower Association (IHA)** MoU for collaboration on Annex XII	**IEA/IAs** • Attend at least 1 **REWP meeting** per year. • Review **IEA publications** as requested. • **Proposed Joint Task**, Hydropower IA is considering a joint task with Ocean Energy Systems IA on tidal lagoon hydro. **Other Organizations** **Liaison with REWP.** Following the September 2015 workshop the Hydropower IA will follow up with REWP to discuss ways to raise awareness of IA's and to empower a bigger role of IAs in IEA's strategic direction. This includes broadening outreach and communication and inclusion of hydropower through broader IEA avenues?

Changes in Membership

Contracting Countries 2014/15	Participating organizations 2014/15
New China	**Members** Australia, China, Brazil, Finland, France, Norway, Japan, USA

Management / process information and issues to come

ExCo meetings & workshops	RfE / AOB
30th ExCo. June 2014. Rovaniemi, Finland **31st ExCo.** March 2015. Rio de Janeiro, Brazil **32nd ExCo:** February, 2016. Hobart, Australia **Workshops.** Annex XI, Annex XII, Annex XIII and Annex XIV **Expert Meetings:** Annex II, Annex XI, Annex XII, Annex XIII and Annex XIV	IA extension approved by CERT to 2020.

Annexes: specific remarks

Annexes to begin in 2015/16

1. Annex XIV: Management Models for Hydropower Cascade Reservoirs

Annexes: activities and milestones

Annex	Start/ End	Annex Tasks/Activities	Comments
Annex II: Small-Scale Hydro	1995-ongoing	▪ World-wide Small Hydro Information and Technology Exchange Website ▪ Government policies and experience – what works and what doesn't? ▪ Sustainable Small-Scale Hydropower in Local Communities	The Small Hydro International Gateway website (www.small-hydro.com) has over 1700 registered users and includes 350 listings in the on-line directory of experienced small hydro individuals available to provide advice. With an extensive small-hydro library, it includes a database of potential sites with RETScreen evaluation files for USA non-powered dams and Ontario small dam sites.
Annex IX: Valuing Hydropower Services	2011-ongoing	▪ Value of grid services, such as ancillary services to stabilize the electric grid ▪ Analyzing, valuing and allocating non energy services such as flood / drought protection, irrigation, water supply, navigation and recreation.	Case studies will be used to validate economic assessment methods, quantifying the added value created by a specific hydropower scheme, in a given river basin, through its various multipurpose enabling functions.
Annex XI: Upgrading and Renewal of Hydroplants	2011-2015	Case histories cover two main categories: ▪ Public policies, decision indicators, facilitation measures, asset management criteria and life cycle cost evaluation. ▪ Modern technologies and good practices in terms of systems and materials.	▪ Case histories gathered from around the world cover good practice in the renewal and upgrading of existing hydropower plants ▪ The final report will be launched in October 2015
Annex XII: Managing the Carbon Balance in Freshwater Reservoirs	2009-ongoing	The Annex manages a comprehensive program with the objective to: ▪ Increase knowledge on processes linked to reservoir GHG emissions ▪ Standardize GHG flux evaluation methods ▪ Develop an acceptable methodology to measure, model and manage the carbon balance in reservoirs	▪ Guidelines Volume 1 with a focus on Measurement Programs and Data Analysis was launched in 2012 ▪ Guideline Volume 2, with a focus on Modelling will be launched in October 2015 ▪ Guideline Volume 3 with a focus on best practices of reservoir carbon balance management will start in 2016
Annex XIII: Hydropower & Fish	2013-ongoing	This Annex has the objective to provide a better understand of the effects of hydropower on fish. This will enable the identification of best practices for management and mitigation and the provision of sound advice on ways for industry, investors and government to make good decisions for sustainable hydropower. The scope of investigations and research will cover impacts for new hydropower developments, operation of existing hydropower and the modernization of hydroplants and their equipment.	The Annex scope covers the development of a roadmap/guideline for sustainable fish populations and management in rivers with hydropower production. Case histories will focus on best practice, covering: ▪ Introduction to hydropower and fish ▪ Estimation of impacted populations ▪ Regulatory requirements ▪ Design of upstream passages ▪ Design of downstream passages ▪ Monitoring techniques ▪ Environmental flow requirements ▪ Pest fish management ▪ Reservoir management ▪ Management models
Annex XIV: Management Models for Hydropower Cascade Reservoirs	2016-for approval	The purpose of this Annex is to examine key issues that need to be addressed in the design of new hydropower cascade reservoir schemes and the operation and management of existing ones. Examples will be presented of both successful management models as well as lessons learned. The Annex will conclude with documentation and dissemination of the findings including case histories from the participating member countries.	Key issues to be covered include: ▪ Safety compliance, specifically the routing of large floods ▪ Consistent management of environmental and social risk issues ▪ Meteorological and hydrological monitoring, modelling and forecasting, flow routing, specifically the interdependencies along the cascade ▪ Flow dispatch approaches for power generation optimization including coordination with other sources of generating (thermal, nuclear etc.). ▪ Dispatch rules for providing other energy and water services, ▪ Operational constraints and their cumulative impacts ▪ Communication models between cascade reservoir operators and managers, ▪ Governance models, specifically for multiple owners and cross boundary issues