WORLD DECLARATION ON THE ROLE OF DAMS FOR ENERGY TRANSITION AND CLIMATE CHANGE ADAPTATION

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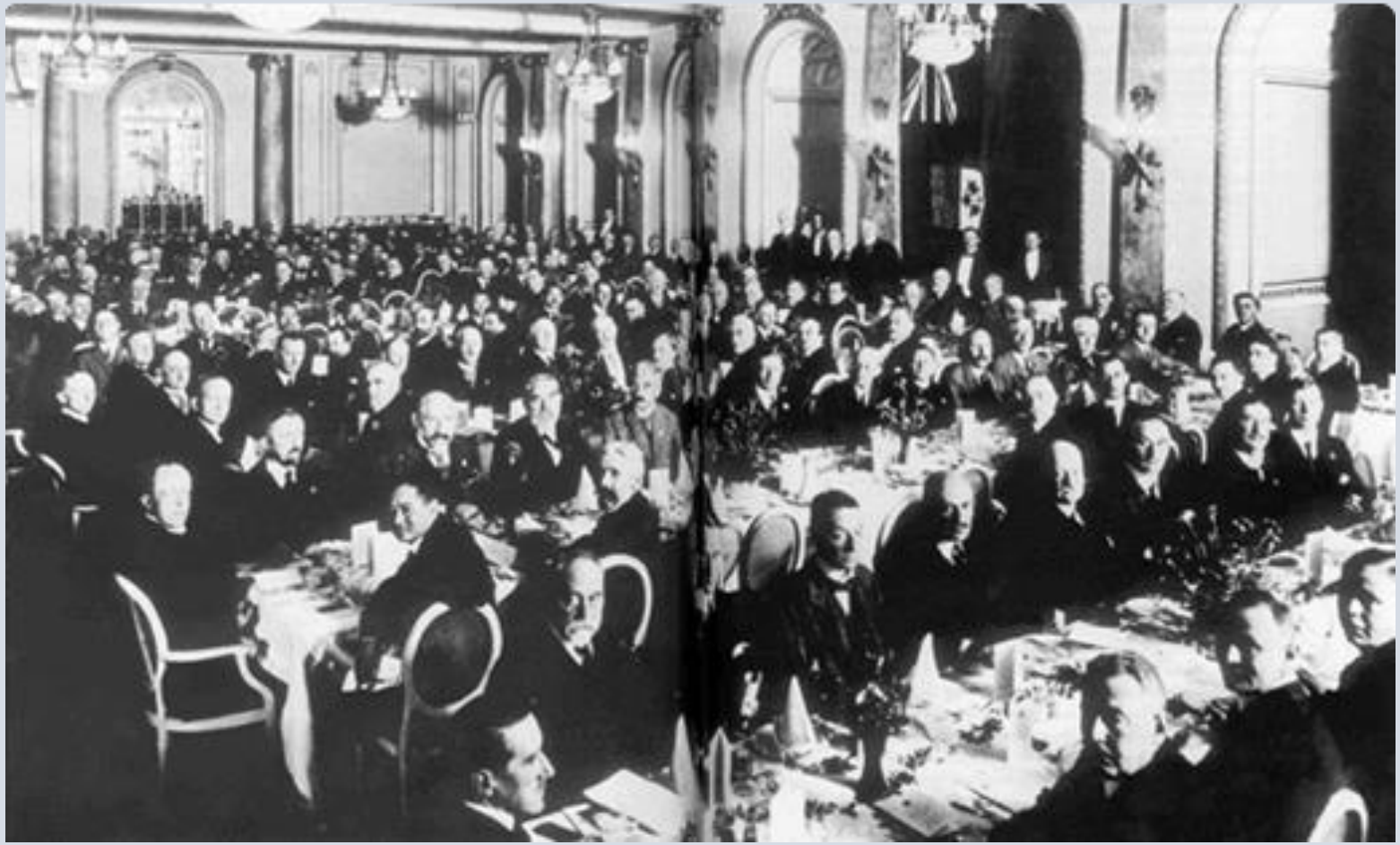
President of ICOLD

INTERNATIONAL COMMISSION ON LARGE DAMS

- Non-governmental International Organization founded in 1928
- 106 Member Countries

- 20 000 Members

  Engineers, geologists and scientists form governmental or private organizations, consulting firms, universities, laboratories, construction companies, financial institution…



The role of dams in the energy transition and climate change adaptation

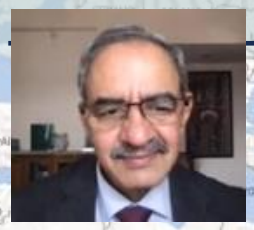
- **ICOLD** leads the profession in **setting standards and guidelines** to ensure that dams are built and operated safely, efficiently, economically, and are environmentally sustainable and socially equitable.
- **ICOLD** is assisting nations to prepare to **meet the challenges of the 21st century** in the development and management of the world's water and hydropower resources.

The role of dams in the energy transition and climate change adaptation

AQUA WATT
HYDROPOWER in the energy transition
CONFERENCE WITH EXHIBITION
OCTOBER 29th-30th, 2024
PIACENZA - ITALY

ICOLD BOARD launched the initiative in Gothenburg June 2023

Chairs



World declaration on
the Role of Dams for Energy Transition and Adaptation to Climate Change

- A changing world impacted by Climate Change
- The Role of Dams and Reservoirs in Climate Change Adaptation
- The Role of Dams in Climate Change Mitigation
  - ✓ Role of Dams in Clean Energy Transition
- 11 Key Recommendations

rising standards of living. At the same time ... Maintaining the present trend of a decreasing ... measures for strengthening the structure's

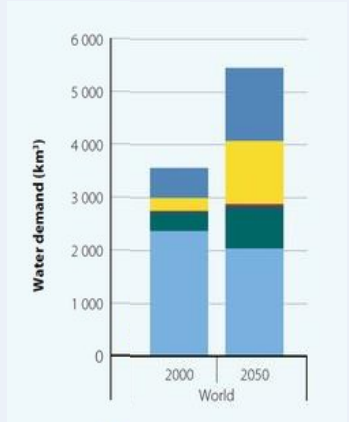
A CHANGING WORLD

- **Population Growth**

The global population has risen from 1.5 billion in the early 20th century to nearly 8 billion today, with projections of 10.4 billion by 2100. This growth increases water demand, which could rise by 20-30% by 2050.

- **Water Demand and Food Security**

Current global water demand is 4,600 km³ per year, with 70% used for irrigation. Feeding a population of 9.7 billion by 2050 will require more freshwater storage to avoid water stress for up to 4.6 billion people.

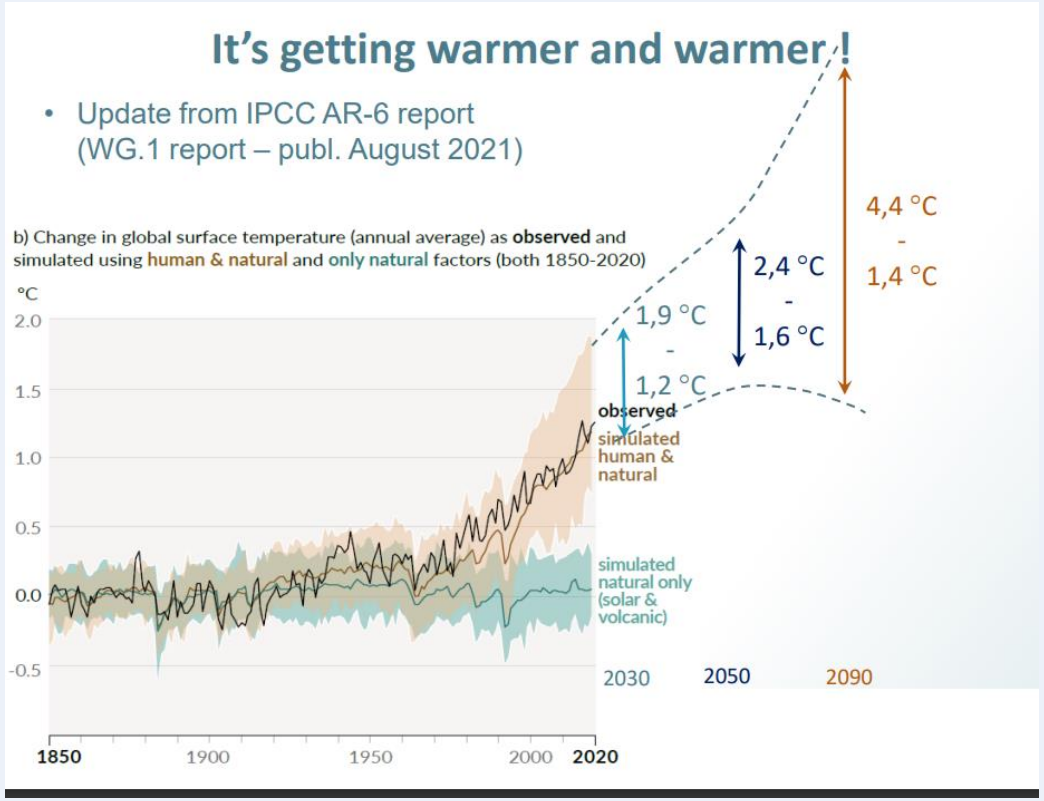


Irrigation Domestic Livestock Manufacturing Electricity

A CHANGING WORLD

Climate Change Impact

- Human activities, mainly through greenhouse gas emissions, have unequivocally caused global warming, with global surface temperature reaching an increase of 1.1°C above 1850-1900 levels in the past decade (2011-2020).
- The IPCC AR6 report has issued alarming forecasts on global climate change, warning of increasing temperatures, extreme weather events and rising sea levels.
- Changes in precipitation patterns, increased evaporation rates and melting glaciers are expected to exacerbate water scarcity in many regions.



ICOLD Q107 – General Report – 2022

❑ *Increasing water storage is the solution to secure water and food supply in a more populated and warmer world*

DAMS AND RESERVOIRS FOR CLIMATE CHANGE ADAPTATION

Flood and Drought Management

- Storage reservoirs help mitigate **flood risks** and reduce the frequency of inundations. Enhanced dam safety standards are required due to the uncertainty of climate-induced flood events.
- Dams also address **droughts**, providing resilience through annual and interannual water storage, supporting human uses, and maintaining ecosystems.

DAMS AND RESERVOIRS FOR CLIMATE CHANGE ADAPTATION

Water Supply and Irrigation

- Dams with reservoirs assure water supply and food safety under climate induced conditions

Multipurpose dam projects and Integrated River Basin Management

- Increased storage volume in reservoirs, and effective water and sediment management are necessary to ensure a climate-resilient supply for drinking water, agriculture, energy generation, and environmental needs, with stakeholders' consideration.

❑ ***Increased freshwater storage and integrated river basin management enhances resilience to Climate Change.***

CLEAN ENERGY TRANSITION

- **Renewable Energy Goals**: Achieving net zero emission by 2050 requires a huge increase in renewable energy, particularly solar and wind. Total global electricity generation is expected to rise 2.5 times by 2050.
- **Hydropower's Role**: Hydropower provides low-carbon, flexible energy storage, supporting intermittent renewables like solar and wind. The current pace of new hydropower contribution has to double from 2030 to 2050
- **Challenges**: Financial uncertainties, regulatory ambiguities, and administrative delays hinder new hydropower and storage projects. Clear frameworks and streamlined permitting processes are needed for faster hydropower development.

❑ ***Hydropower is the backbone for clean energy transition***

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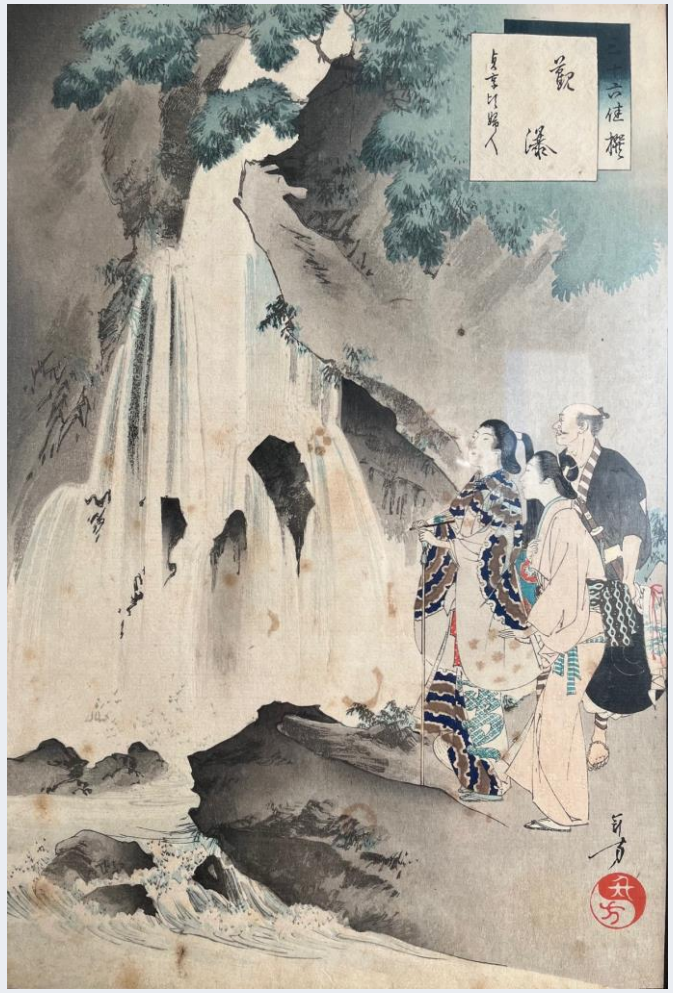
DAMS AND ENVIRONMENT

- **Understanding the potential effects of dam construction** is crucial for mitigating the impact of dams and reservoirs which must be evaluated and properly addressed in **Environmental Impact Assessment and Environmental Management Plans**

- **The positive and negative impacts of the reservoir** need to be carefully studied and weighed against each other.



❑ ***Better understanding dams' impacts and effect of preventive and mitigation measures enhance sustainability throughout their life cycle.***

RECOMMENDATIONS

1. Develop storage capacity worldwide

Per capita storage capacity has been steadily declining since the 1980s due to population growth, sedimentation in reservoirs, and a decline in dam construction pace.

New storage is needed for energy transition and to maintain the traditional benefits of dams under the new challenging conditions shaped by climate change.

RECOMMENDATIONS

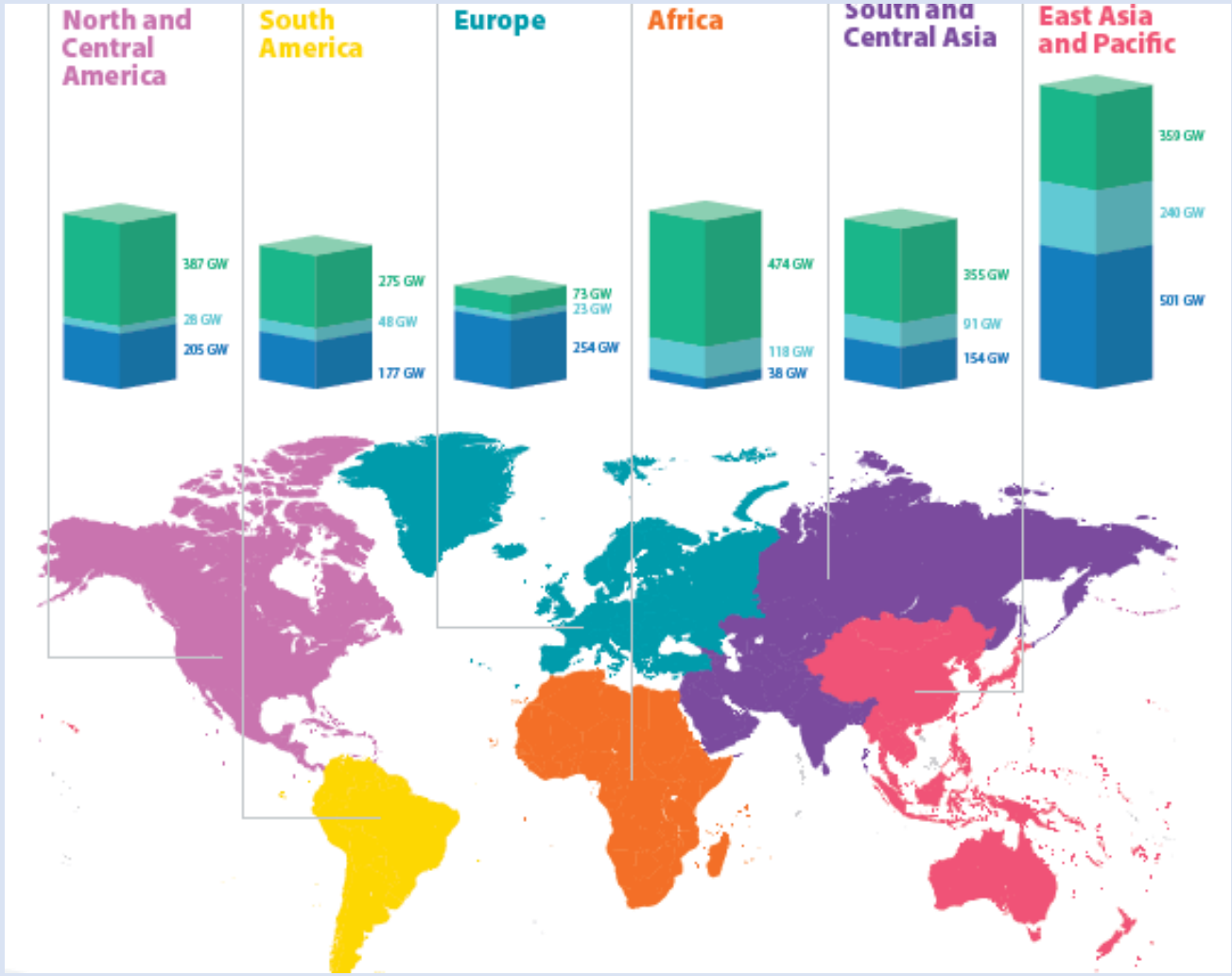
2. Speed up hydroelectric development

Policy makers and civil society need to focus **on sustainable storage-based hydro-schemes**, to balance growth and energy transition towards the net zero goal.

RECOMMENDATIONS

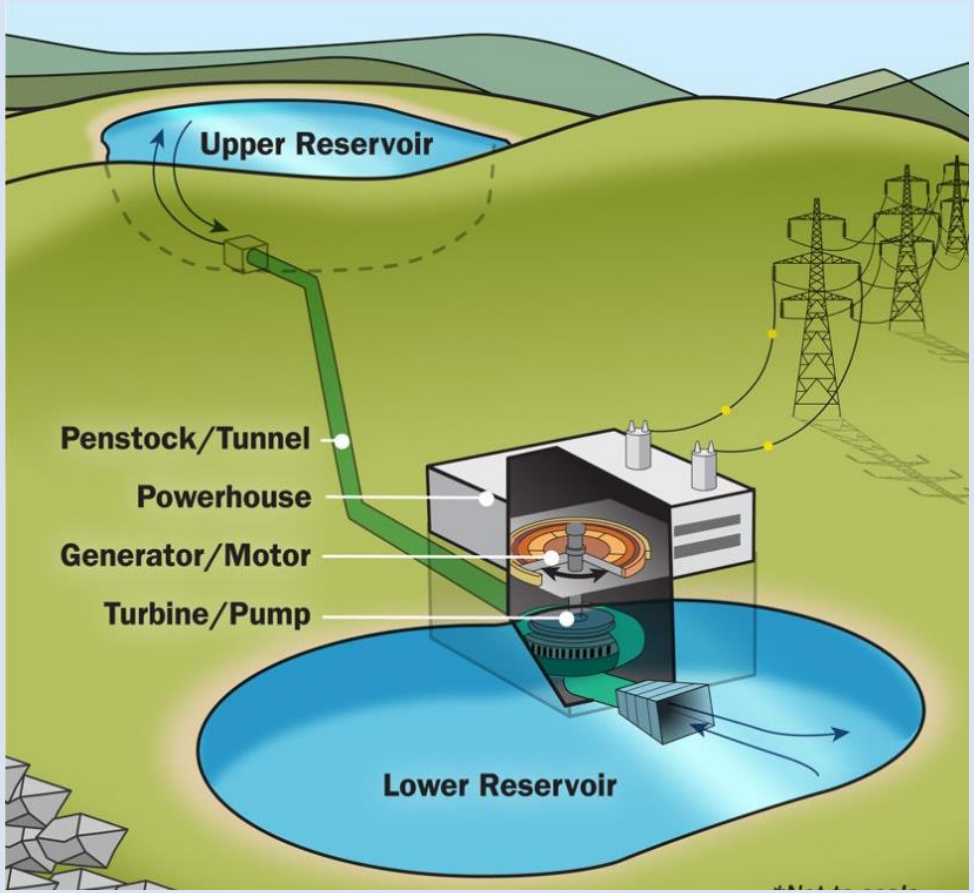
3. Develop hydroelectric potential in developing world

Where only 10 to 30 percent of hydroelectric potential has been harnessed, it demands significant efforts, commitment and cooperation amongst main stakeholders such as international organizations, governments, relevant institutions, NGOs, and civil society.



RECOMMENDATIONS

4. Include **energy storage** in water laws and licensing regulations **as a new official use of reservoirs**.



RECOMMENDATIONS

5. Establish a clear and stable **regulatory framework for energy storage**

RECOMMENDATIONS

6. Implement Administrative reforms

to **simplify** and expedite procedures for granting concessions for new hydroelectric and pump storage projects, especially concerning environmental permitting and grid access.

RECOMMENDATIONS

7. Encourage Concessional financing

needed to boost long duration energy storage in reservoirs.

RECOMMENDATIONS

8. Highlight the positive environmental impacts of dams and reservoirs

Contributing to water needs and energy transition, recognizing that in many cases, the positive impacts can outweigh other negative impacts.

RECOMMENDATIONS

9. Strengthen dam safety management in face of extreme events exacerbated by climate change.

through surveillance, rehabilitation and upgrading,

real time flow forecast and early warning systems,

optimized reservoir management operation,

and capacity building.

World declaration on
Dam Safety

The construction, operation and maintenance of dams and their storage reservoirs have provided significant benefits to humankind throughout history. Storage of water behind dams regulates natural streamflow, provides benefits resulting from increased water availability, renewable energy production and reduction of adverse impacts caused by nature's extremes of flooding and drought. This document addresses the importance of the dam safety, which encompasses water dams, mining tailings dams and levees.

Growing population in our fragile world is causing steady increases in demand for water, food, energy, minerals and flood control. **Dams are critical infrastructure to meet these basic human needs as well as rising standards of living.** At the same time, however, dams create new hazards involving potential risks to downstream communities, including potential adverse impacts on life, property and the environment. The potential for dam safety incidents, possibly resulting in an uncontrolled or catastrophic release of stored water is of the highest concern.

The profession of dam engineering has a profound ethical responsibility to carry out its professional duties so that dams and reservoirs are designed, constructed and operated in the most effective and sustainable way, while also ensuring that both new and existing dams are safe during their entire lifespan, from construction to decommissioning.

ICOLD and Dam Safety

For almost a century, the International Commission on Large Dams (ICOLD) has made dam safety one of its highest organizational commitments, as stated in the ICOLD Mission statement:

«ICOLD leads the profession in setting standards and establishing guidelines to ensure that dams are built and operated safely, efficiently, economically, and are environmentally sustainable and socially equitable.»

Before the creation of ICOLD in 1928, knowledge on dam safety was disparate, while the need for building water storage infrastructure was very high and growing. It therefore became a priority of ICOLD to disseminate the understanding of the design and operation of dams based on experience within the global dam engineering community. And along with this dissemination came a strong focus on dam safety that has permeated up to the modern era.

ICOLD has played a key role in improving dam safety through its work in collecting and analyzing information on the lessons learned from past successes and failures. Since the very beginning, ICOLD and its thousands of professionals within the member countries have continuously contributed to the improvement of dam safety through publication of technical papers and exchange of experience during Annual Meetings and Congresses. ICOLD's Technical Committees develop Bulletins for publication that summarize the current state of the practice.

Since the creation of ICOLD, the number of failures compared to the total number of dams in operation has been reduced significantly, which is a positive achievement that reflects the worldwide influence of ICOLD in raising dam design and management standards. Nonetheless, constant vigilance and commitment to dam safety is still required in order to continue the global trend towards safer dams. Any dam incident is a matter of the gravest concern for dam professionals. **It is our ICOLD Declaration that Dam Safety is our highest priority.**

Changing Conditions of Dam Safety

Due to the vital need for water, food, energy, minerals and flood control, the total number of dams worldwide continues to grow. Maintaining the present trend of a decreasing incidence of dam failure is a never-ending challenge for the profession. ICOLD's role in knowledge transfer and capacity building through the dissemination of the best practices is as pertinent as ever. The science, technology and human roles in dam safety are in constant evolution with many changing conditions:

- **Ageing of existing infrastructure,** creating new concerns related to the longevity of construction materials and equipment, including infilling of reservoirs with sedimentation.
- **Lack of experience in dam safety management and operations** in some countries engaged in building dams, requiring the need for capacity building.
- **Retirement of experienced personnel** in all countries, leading to a deficiency in qualified engineers trained in dam design.
- **Increasing participation of the private sector** in the development of dams as well as increasing cost and time pressure on developers, designers, contractors and operators, creating a need for new governance conditions for dam safety.
- **Climate change causes changes in extreme precipitation** and drought events, resulting in increased hydrological risks. It is critical to consider changes in climate during planning and management, including resilient design and adaptive reservoir operation of dams. In some regions, this results in a need to increase the height of dams, expand spillway capacity, modify reservoir operating procedures, and/or construct new dams. There may also be a need to assess and address other hazards created by climate change as part of the planning, design and operational phases.
- **The most suitable sites for dams have largely been utilized,** thus new dams must be built in more and more challenging locations, especially regarding geological conditions.
- **Changing local, regional and national governance** can have a significant impact in regulatory authority for dams.

As a recognized international organization of experts in dam engineering, ICOLD calls upon governmental authorities and financing institutions to promote an awareness of the subject of Dam Safety. **The goal of this ICOLD World declaration on Dam Safety is to restate the fundamentals of dam safety** that have been learned over time. Furthermore, all involved entities should be reminded to ensure, through the fulfillment of their responsibilities, that these fundamentals are respected in order to minimize risks associated with dams and reservoirs.

Pillars of Dam Safety

With almost a century of commitment to dam safety, and knowing that the zero risk does not exist, ICOLD recognizes several overarching pillars of dam safety:

- **Structural integrity of dams is the keystone to dam safety.** Best current practices of dam design and performance during the occurrence of hazardous events such as extreme floods and earthquakes have been largely documented by ICOLD bulletins in order to create a sound basis on which existing and future dam structures should be designed, built and operated in safe conditions.
- **A routine surveillance and maintenance programme is necessary for early detection.** Inspection and upkeep are of high importance to minimize the risk and to ensure dam safety in the long term. Periodic safety review by qualified engineers that are highly experienced in dam safety assessment is mandatory. Supervision of dams should be based on both the operator's self-supervision and periodic external safety reviews by an independent and competent authority or institution.
- **An instrumentation and monitoring programme is essential throughout the life of a dam.** A comprehensive dam monitoring programme is necessary to: a) determine behavior during construction; b) assess performance during first reservoir filling; c) compare actual performance with design; d) characterize long-term behavior; e) provide early warning of abnormal conditions; f) capture & analyze response to events, such as large floods, earthquakes, etc.; g) predict future performance of dam; and h) demonstrate safe management of the dam to regulatory authorities.
- **Design-Intrinsic risks need to be adequately addressed.** These risks are based on dam type, materials, ageing, foundations, hydraulic structures, etc., in which good practices and surveillance are the keys for safety.
- **Natural hazard risks change with time, thus should be regularly reviewed and updated.** These hazard risks like floods and earthquakes are external threats, for which risks are accepted based on known science and likelihood of occurrence.
- **Emergency planning is of utmost importance for all dams.** Emergency plans should be developed with the objective of avoiding loss of life and reducing damage to property, infrastructure and the environment resulting from a dam failure. The first filling of the reservoir being a critical period during which the emergency plan must be ready for implementation in a timely manner. Periodic review, updates and practice of the emergency plan is mandatory.
- **Adequate training of operators is part of a comprehensive dam safety programme.** Those placed in charge of dams bear an important responsibility to maintain their training and understanding of their dam. Mis-operation of a dam, especially of spillway gates, can lead to accidents, downstream flooding or potential overtopping of the dam.
- **Sharing lessons learned benefits the entire industry, making all dams safer.** The experience of ICOLD has shown that sharing lessons from dam incidents and failures is crucial to improve state-of-the-art practices. For all involved parties, it is thus imperative that any documentation on dam incidents, including independent expert reports on the root causes of such incidents, be made freely accessible to the international community.
- **A comprehensive dam safety approach will allow minimization of risks.** This is done through collaboration of national organizations to support dam safety: structural measures for strengthening

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Summary Decla

With the aspirational goal o
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ICOLD, as the leading inter
tion committed to dam safety, calls upon **all involved professionals and companies to make a firm commitment to safety improvements and risk reductions at all dams.**

Furthermore, **Governments, Financial Institutions and other Developers, in their contribution to the development and regulation of dam infrastructure, are called upon to make a similar political and financial commitment** so that the all-important safety recommendations for dams outlined in ICOLD Bulletins, will be disseminated to the relevant entities and followed to completion.

This common effort will contribute immeasurably to the overarching ICOLD vision:

"Better Dams for a Better World"

Approved on October 18th 2019, in Porto.
International Commission On Large Dams

RECOMMENDATIONS

10. Investing in **sustainable water and sediment management**

    Essential to preserve the functions of dams and reservoirs,

    considering techno-economical, environmental and regulatory constraints.

RECOMMENDATIONS

10. **Promoting research and development** into new technologies that facilitate climate change mitigation and adaptation efforts.
    - Implementation of hybrid hydro-battery systems,
    - Virtual power plants,
    - Automated data systems and comprehensive information system
    - Advanced materials for sustainable dam construction and rehabilitation.

The role of dams in the energy transition and climate change adaptation

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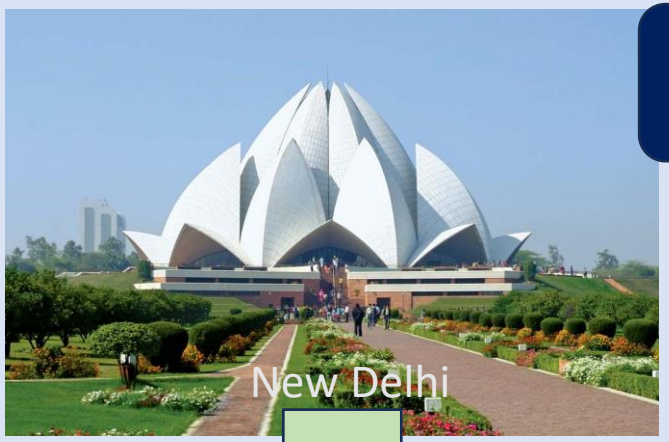
ROAD MAP

Draft

NATIONAL COMMITTEES

WORKSHOP



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COP 29 BAKU AZERBAIJAN

The role of dams in the energy transition and climate change adaptation

Storing Water, Securing the Future

Dams and Reservoirs for a Resilient and Sustainable World