New Frontiers in Sustainable Hydropower Development
Hydropower Sustainability Forum
Oslo, Norway 4-6 September 2017

IEA Hydropower TCP highlights
Torodd Jensen, NVE and IEA Hydro Chair
Status of Program: Annexes

Technology Cooperation Program on Hydropower

Annexes

ANNEX II
Small Scale Hydropower

ANNEX IX
Valuing Hydropower Energy and Water Services

ANNEX XII
GHG Emissions from Freshwater Reservoirs

ANNEX XIII
Hydropower and Fish

ANNEX XIV
Management Models for Hydropower Cascade Reservoirs

ANNEX XV
Maintenance Works and Decision-Making for Hydroplant Renewals
There is a solid future for hydropower as a key player in a low-carbon society as it represents a domestic, mature, affordable and sustainable source of energy.

Hydropower provides a renewable base load and important load-balancing system capabilities for the increased penetration of intermittent wind energy and solar power.

Flexible hydropower provides a wide range of non-energy services, including flood protection, irrigation flows, water supply, recreation and navigation.

With the electricity sector changing continuously, a program of hydropower research is essential to ensure its place in the future sustainable energy supply mix.

Hydropower technology advancements provides activities in OECD countries.

Deployment of new hydropower will continue strongly in non-OECD countries.
IEA Hydro Annex II (Hidden Hydro)

Elands irrigation dam

RSA

Potential: ~3.5 MW
~25 GWh annually
Annex IX: Valuing Hydropower Services

Annex IX Objectives:

- Identify the energy and water management services created by hydropower developments and their spatial and temporal distribution.

- Enhance the understanding of the economic values and costs related to the provision of energy and water management services as well as of other socio-economic contributions by multipurpose hydropower projects.

- Analyse and suggest appropriate methodologies to estimate the value of these services and generate policy recommendations for optimum development.
Annex IX: Appropriate Approaches to Estimate Fair Value for Allocation of Various Water Management Services

<table>
<thead>
<tr>
<th>Water Service</th>
<th>Proportional to water-use</th>
<th>Commercial benefits</th>
<th>Intrinsic value</th>
<th>Conflict resolution</th>
<th>Holistic approaches</th>
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<tbody>
<tr>
<td>Flood Reduction</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Navigation/Transport</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Irrigation</td>
<td></td>
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<td>Water Supply</td>
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<td>Socio-economic Contributions</td>
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<tr>
<td>Aquaculture</td>
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<tr>
<td>Water Quality</td>
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<td></td>
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</tbody>
</table>
Hydropower – Supporting other Renewables

Solar

Hydro

Wind
Annex XII: Hydropower & the Environment: Managing the Carbon Balance of Freshwater Reservoirs
Nam Leuk, Laos: 78 g CO₂/kWh

Nam Ngum, Laos: -60 g CO₂/kWh

Petit Saut, French Guyane: 970 g CO₂/kWh

Follsjø, Norway: 2 g CO₂/kWh

Copy from SINTEF
Embrettsfoss HPP in the Drammen River, Norway

<table>
<thead>
<tr>
<th>Environmental Indicator</th>
<th>Declared unit: 1 kWh, from raw material extraction to the distribution net</th>
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</thead>
<tbody>
<tr>
<td>Global warming:</td>
<td>2.19 g CO₂ equivalents/DU</td>
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<tr>
<td>Energy consumption:</td>
<td>1.19 kWh/DU</td>
</tr>
<tr>
<td>Renewable energy share:</td>
<td>99 %</td>
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<tr>
<td>Indoor climate</td>
<td>Not relevant</td>
</tr>
<tr>
<td>Chemicals</td>
<td>No chemicals from the candidate list</td>
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</table>
Annex XIII: Hydropower and Fish

The Mandal river in Southern Norway
Decades ago polluted by acid rain from coal fired thermal plants in European countries that almost killed all trout and salmon.

Today a living river with values for fish migration, recreation and clean electric energy generation.
Hydropower TCP countries will continue to identify and address emerging issues on status and future roles of hydropower in mature energy markets.

- The transformation of energy markets that include hydropower, covering changing demand patterns - industry composition, emerging industries and increase in residential grid-connections
- Increased generation from other renewable sources, e.g. wind, solar and ability of hydropower to provide storage
- Approaches and economics for life extension and modernization
- Policy and regulatory frameworks to remove barriers and provide incentives for investment
Thank you
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