Global Hydropower Development

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Our mission
advancing sustainable hydropower

Four strategic objectives:
• Advancing policies and strategies for the sector
• Building a vibrant community
• Creating a platform for knowledge
• Delivering value for members
Estimated Renewable Energy Share of Global Electricity Production, End-2014

Fossil fuels and nuclear
77.2%

Renewable electricity
22.8%

Hydropower
16.6%

Wind
3.1%

Bio-power
1.8%

Solar PV
0.9%

Geothermal, CSP, and ocean
0.4%

Based on renewable generating capacity in operation at year-end 2014.

REN21 Renewables 2015 Global Status Report
Figure 2 - Global total of pure installed hydropower capacity (GW) by country in 2014. Figures do not include pumped storage.

2014 total: 1,036 GW

Total = 1,036 (not including PSP)
Hydropower capacity added in 2014

Figure 1 - Distribution of new capacity added by region, including pure hydropower and pumped storage (PSP):

Total capacity added in 2014:
36 GW pure hydro
1.5 GW pumped storage (PSP)

21.3 GW

China

South America

Central and South Asia

North and Central America

East Asia and Pacific (excl. China)

Europe

Africa

0.1

0

5

10

15

20

25

G W

+0.6 PSP

+0.2 PSP

+0.7 PSP

+0.01 PSP

Source: IHA 2015 Hydropower Status Report
Growth in hydropower development

Source: IHA 2015 Hydropower Status Report
Hydropower, by major regions

Figure 4 - Global hydropower technical potential, generation and installed capacity by region. Pumped storage is shown in brackets.

Source: IHA 2015 Hydropower Status Report
Drivers for New Investment in Hydropower

Renewable systems; Regional development; Water-Energy Nexus
What can hydropower bring to the mix?

**Large range of capacity available**
- From kWs to GWs of low-carbon electricity in a single project
- Potential to supply electricity at the regional level

**Operational flexibility**
- Fast start-up and shut-down
- Adjustable output depending on needs

**Storage**
- Rapid availability, can be used as a back-up
- Option to absorb surplus (pumped storage)

**Multiple purposes**
- Water supply, irrigation, navigation, tourism
- Climate-change adaptation (flood and drought mitigation)
Types of hydropower

Run-of-river hydro

Storage hydro

Pump-storage hydro

Hydropower typology, covering all scales of development
Less established versions of hydropower:
1 = tidal range; 2 = osmotic; 3 = hydrokinetic;
4 = wave power; 5 = tidal current
Hydropower balancing renewables

Weekly cycle (three weeks shown)

Hydropower

Wind

Schematic illustration

Monday - Friday

Load

Hydro

Wind

supply / demand

Source: IHA 2012
Challenge of variable feed-in to the grid and over/under supply.

Hydropower’s ancillary services:

- **Fast power control** to meet load variations
- Electrical **frequency** and **voltage control**
- Efficient **storage** facilities
- Guaranteed **power availability** for defined time frames
- **Power reserves** to balance peak load
- **Blackstart** capacity on system interruption
Small scale  El Hierro, Canary Islands (2014)

- 11.5MW wind turbine, 11.32MW pumped storage (generation mode)
- System powers domestic and industrial system, as well as desalination plant

Source: IHA 2015 Hydropower Status Report
Solar and hydro

Large scale  Long Yang Xia, China (2013, 2015)

- Hydropower plant (1,280 MW) was built in 1992
- Solar PV plant (320 MW) commissioned in 2013. Phase 2 (+210 MW) in 2016
- PV station and hydro plant operate together to guarantee firm output
Solar output with full sun

Solar output with clouds

Solar output with rainfall

Demand for electricity

Counter-balanced hydro output

Variable solar output

Demand for electricity

Counter-balanced hydro output

Variable solar output

Source: IHA 2015 Hydropower Status Report
1. **Sector monitoring** (reporting on 2015 and monitoring new developments in 2016)

2. **Climate mitigation** (GHG status of freshwater reservoirs)

3. **Climate resilience/adaptation**

4. **Water consumption** (assessment of evaporative losses)

5. **Hydropower’s macroeconomic benefits**

6. **Hydropower finance and investment** (including risk management)

7. **Regional cooperation** (river-basin development and grid interconnection)

8. **Clean energy systems** (hydro’s role and energy storage/support for other renewables)
2016 Hydropower Status Report

- Overview of global trends
- New capacity added in 2015
- Detailed regional and country analysis
- Maps of generation, potentials and more
- Updates on key topics

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