European Commission

Leadership in renewables

Hydropower: the impact of EU R&D funding

Bioenergy | Biofuels | Geothermal | **Hydropower** | Ocean | Solar PV | Solar thermal | Wind

OBJECTIVES

A comprehensive study of hydropower research and development (R&D) support within the EU over the past 20 years

1. Identify the impact of EU R&D support of the hydropower sector
2. Understand how the hydropower sector has developed

METHODOLOGY

EFFECTIVE DATA COLLECTION ACTIVITIES USING A RANGE OF METHODS

- DATA FROM EXISTING DATABASES
- & STAKEHOLDER QUESTIONNAIRE
- & CASE STUDIES
- & EXPERT INTERVIEWS
- & LITERATURE REVIEW

KEY FIGURES: FUNDING OF R&D

EU Framework Programmes funding

- **21** hydropower projects funded through the Framework Programmes (FP5-Horizon 2020)
- **€24 m** EU funding through the Framework Programmes (FP5-Horizon 2020) for hydropower technologies
- **55 %** invested in the development of small hydropower technology, making it the most funded hydropower R&D topic

Member State funding

- **€10 m** R&D budget grew from less than €5 m per year before 2009 to €10 m+ after 2009
- **Top 5**
  1. Finland
  2. Poland
  3. Austria
  4. Sweden
  5. Italy
- **72 %** of hydropower funding is from the top 5 Member States

International funding

The EU region had an average funding in hydropower R&D of €8.9 m a year (1995–2015), which makes it the third highest globally. Over the same period, the USA and Canada spent an average per year of €10 m and €9.1 m respectively

IMPACT ON KNOWLEDGE GENERATION

Patents

EU share of global patents has been relatively stable at around 20%

The number of EU patents filed grew from approximately 250 per year in the early 2000s to approximately 540 per year between 2010 and 2014

Publications

EU-based authors were involved in 30 % of the global publications between 1995 and 2017, making it the global leader

Two of the top 5 recipients of EU funding (France and Switzerland) have some of the world's leading knowledge institutions

Additional impacts

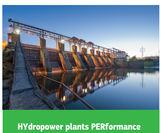
EU FP funding contributed to improved and optimised designs of existing technologies and developed tools for refurbishing old plant

EU FP funding helped to improve small hydropower technologies and designs, which enabled sites that were previously not technically or economically viable to be exploited

IMPACT ON SECTOR DEVELOPMENT

- **130 000 MW** installed capacity in 2017, growing from 106 000 MW in 1995 — *Installed capacity*
- **10 %** gross final electricity consumption from hydropower in 2016 — *EU electricity*
- **€560 million** average exports per year (2011-2015) to the rest of the world (versus €160 million/year imports) — *Exports*
- **€8 billion** EU hydropower sector turnover in 2016 — *Turnover*
- **107 000** people employed in the EU hydropower sector in 2016 (manufacturing, construction, installation and O&M) — *Jobs*
- Stable but competitive levelised cost of electricity (LCOE) — *Hydropower costs*

EXAMPLES OF IMPACT FROM R&D PROJECTS



HYdropower plants PERformance and flexible Operation towards Lean integration of new renewable Energies (HYPERBOLE)

- Enhanced the capability of hydropower stations to function over larger operating ranges and with a faster response time by using frequency converters in the form of double fed induction machines or full size frequency converters
- Developed a methodology to review the dynamic behaviour of hydropower stations operating outside their rated operating ranges – increasing the operating range from 60 % to 100 % of rated power to potentially below 30 % to about 110 % of rated power
- Demonstrated the benefits hydropower stations can provide for the safe integration of new renewable energy into the existing power network by drastically reducing the time required to change the operating modes of reversible pump turbines

Hydropower converters with very low head differences (HYLOW)

- Developed an innovative hydrostatic pressure turbine to exploit small hydropower with very low head or pressure differences below 2.5 m and hydraulic power ratings of between 50 kW and 1 000 kW
- Two field installations, of 5 kW and 10 kW power rating and 1.20 m head difference, were built and tested – a 5 kW grid-connected machine installed on the River Lohr, Germany, and a 10 kW standalone installation at a river weir on the River Iskar, Bulgaria
- The project has demonstrated that it is possible to generate electricity in these environments with reasonable efficiencies of 40 % for with typical flow velocities of 1.5 m/s to 1.8 m/s

Research and Innovation