

THE HYDROPOWER SECTOR'S CONTRIBUTION TO A SUSTAINABLE AND PROSPEROUS EUROPE

Executive Summary

Scope and Purpose of this Report

The climate and energy policy of the European Union (EU-28) and many European countries, including Norway and Switzerland, is based on three overarching objectives, i.e. to build an affordable, secure and sustainable energy system. Many European countries, including the EU-28, have committed themselves to substantially reducing greenhouse gas emissions progressively. For instance in their recent decision on the 2030 climate and energy policy framework¹, EU policy makers agreed on binding targets for reducing greenhouse gas emissions in 2030 by at least 40% compared to 1990, and increasing the share of renewable energy sources (RES) in the EU's total energy consumption to 27%. In addition, the EU-28 set itself an indicative target for improving energy efficiency in 2030 by at least 27% compared to current projections of future energy consumption. At the same time, European policy makers confirmed their goal to also provide an affordable and secure supply of electricity to European consumers.

In order to achieve these ambitious goals, it is generally expected that a particularly high share of decarbonisation will have to be delivered by the power sector. It is against this background that the unique role and importance of European hydropower becomes evident. Hydropower already delivers an important contribution in achieving Europe's targets in an ever-changing European energy system. As the share of variable RES in the power system grows, European hydropower will increasingly take a central role for facilitating the transition to a future power system based on a mix of low-carbon technologies, i.e. by providing flexibility and storage. This study has, therefore, been commissioned by a group of European hydropower companies and equipment manufacturers in order to analyse and highlight the economic and social value that hydropower brings to the European society.

Contribution of Hydropower to Europe's Economy²

The hydropower sector directly and indirectly contributes to the European economy in several ways:

- With an annual value creation of approx. EUR 38bn today, which may grow to some EUR 75bn to 90bn by 2030, the hydropower sector makes an important contribution to the European economy, which is similar to the gross domestic product (GDP) of Slovenia.
- At present, European hydropower generation and manufacturing companies invest an average of EUR 8bn to 12bn per annum. Projected investments in the European hydropower sector may reach up to EUR 180bn by 2030, but may be lower in the case of deteriorating framework conditions³. Due to the longevity of hydropower, which by far exceeds those of any other type of generation

¹ European Council, Conclusions on 2030 Climate and Energy Policy Framework. SN 79/14. Brussels, 23 October 2014

² Unless stated otherwise, the term „Europe“ refers to the 28 Member States of the European Union (excluding Malta and Cyprus) plus Norway, Switzerland and Turkey.

³ Apart from possible changes in economic conditions or an insufficient reward of flexibility in future power markets, there is a risk that the construction of new and utilisation of existing hydropower plants may be inhibited by a range of other issues, such as difficult authorisation procedures, lack of public acceptance or increasingly strict environmental constraints, for instance related to implementation of the Water Framework Directive (WFD).

technology in the electricity sector, several generations of European citizens will benefit from these investments⁴.

- Directly and indirectly, European hydropower ensures more than 100,000 jobs (FTE), which is comparable to employment in the European aluminium industry. In addition, each FTE in the hydropower generation sector produces an average annual value of approx. EUR 650,000, which is equivalent to eight times the average productivity in the European manufacturing sector.
- The European hydropower sector generates major revenues for governmental budgets at national, regional and local levels. Direct tax contributions are estimated at almost EUR 15bn annually, or more than one third of total value creation, which is several times more than the limited volume of subsidised payments to small hydropower⁵. A substantial share of this value goes directly to local and regional budgets and helps to foster regional development.
- In addition to these direct contributions, many hydropower plants deliver further benefits by serving several functions at the same time. Some of the most important multi-purpose benefits include flood mitigation, supplying drinking water as well as water for irrigation and industrial needs, or the promotion of tourism and navigation. Whilst it is difficult to estimate the associated benefits, the analysis carried out in this study indicates that the multipurpose functions of hydropower represent an additional annual economic value of EUR 10bn to 20bn, even when neglecting the potential value of avoided damages from flood events, which may be substantial. Due to climate change, these benefits can be expected to further increase in the future, for instance due to an increased need for water management and flood control.

Support to the Key Pillars of EU Energy and Climate Policies

As already mentioned above, the 2030 climate and energy policy framework of the EU-28 includes binding targets for reducing greenhouse gas emissions by at least 40% compared to 1990 and increasing the share of renewable energy in the EU's total energy consumption to 27%. This decision is part of a wider policy framework for building an affordable, secure and sustainable energy system. Hydropower is perfectly suited to supporting these targets as it delivers on all three key objectives for the European power system.

Sustainability

- Hydropower represents a cornerstone for a sustainable power sector. At present (2013), it supplies 13% and 18% of the total electricity generation in the EU-28 and Europe, respectively. Similarly, it accounted for 49% and 59% of electricity generation from RES in the EU-28 and Europe, respectively. Although the future growth of hydropower is expected to be substantially lower than that of other types of RES (e.g. wind and solar power), it is estimated that hydropower will represent about one third of total generation by RES by 2030.
- At present, hydropower helps to avoid approx. 180 Mt⁶ of CO₂ emissions in the EU-28, which is equivalent to about 15% of total CO₂ emissions in the EU-28 power sector. For Europe, savings are even bigger with 280 of CO₂, or about 21% of total power sector emissions.

⁴ Please that these investments and benefits will not be evenly distributed across Europe.

⁵ Estimated at EUR 2.6bn p.a.

⁶ This estimate is based on the assumption that hydropower generation is replaced by the current generation mix. When alternatively assuming that the loss of production was replaced by electricity from fossil fuels only, avoided emissions would amount to about 350 Mt of CO₂, or 32% of total CO₂ emissions in the EU-28.

Affordability & Competitiveness

- Hydropower helps to supply **affordable electricity** to European consumers. Besides the cost-efficient supply of electricity itself, the flexibility of hydropower plants helps to avoid price spikes in volatile wholesale electricity markets. Together, these effects help to mitigate the trend of increasing electricity prices, which final consumers have been faced with in many European countries in recent years.
- The price effects may trigger additional long-term benefits and contribute to the **competitiveness** of the European economy. Our analysis shows that hydropower has a positive effect on value creation and employment in other sectors. For instance a 10% increase of hydropower in the year 2030 would create up to 27,000 jobs in the EU-28, or almost 35,000 in Europe, mainly outside the hydropower sector itself. Indeed, the analysis in this study shows that the effects of employment in other sectors are significantly greater than in the hydropower industry itself, i.e. each additional job in the hydropower industry creates up to seven additional jobs in the overall economy.

Security of Supply

- Hydropower directly contributes to the reliability of the European power system, by providing flexible and reliable capacity that can be safely called upon when needed. Both aspects will become increasingly important in the future as the penetration of variable resources grows.
- Electricity generation from hydropower helps to avoid the combustion of fossil fuels. In 2010, fossil fuel consumption in the EU-28 would have had to increase by an estimated 2,700 to 4,300 PJ⁷ without hydropower, which is equivalent to approximately 7% to 11% of total imports of EU-28 fossil fuels imports in that year. Based on the range of coal and gas prices in the years 2010 to 2013, this corresponds to annual savings of between EUR 12bn to 24bn⁸ for the EU-28.
- European hydropower plants provide a combined storage capacity of more than 220 TWh, which is equivalent to nearly 25 days of average European consumption.
- Pump Storage plants are perfectly suited for providing flexibility during daily operations and allow for the temporary storage (excess) of electricity and use it when it provides the largest value to the system. Based on actual generation and market prices in the year 2013, European pump storage plants were able to save up to an estimated EUR 1bn in fuel consumption.


European Hydropower as the Enabler of RES Integration

In order to reach its ambitious decarbonisation goals, EU policy foresees that generation by other types of renewables energies will strongly increase by 2030. The variable nature of some of these resources will create major challenges for the future European power systems. In particular, volatile generation by wind and solar power will require increasing flexibility from other generation technologies, as well as the ability to sometimes efficiently deal with excess power supply and shortage situations at other times. Furthermore, the availability of variable RES cannot be guaranteed, such that they need to be backed up by other types of generation.

These developments will greatly increase the value of hydropower as it creates an ideal solution to cope with these challenges. Due to its flexibility, hydropower can efficiently contribute to the balancing of

⁷ Based on the carbon intensity of the fossil fuel mix (upper bound) and the average mix of nuclear energy and fossil fuels (lower bound) in the year 2010.

⁸ Based on the range of avoided consumption of fossil fuels (see footnote 7) and the commodity prices in 2010 (lower bound) and 2013 (upper bound), respectively.



variable generation from wind and solar power across different timescales, and mitigate the impact of sudden changes in residual load, which has to be supplied by conventional plants. Moreover, pump storage plants are the only form of electricity storage that is available on a large scale and at competitive prices today. This makes it possible to efficiently store electric energy for varying periods of time, i.e. from several minutes or hours to weeks, months or even on a seasonal scale. Similarly, other types of hydropower power storage may adjust their output to the variable generation by RES. The storage potential of hydropower plants thus increases reliability by providing power as required by the system.

Overall, the flexibility and storage capabilities of hydropower plants make them a perfect instrument for dealing with the challenges of integrating increasing volumes of variable RES into the European power system. Leading up to 2050, the role of European hydropower will thus further evolve from providing clean electricity at competitive rates to taking a central role for enabling the transition to a future power system based on a mix of low-carbon technologies.

Technology Leadership and Innovation


The success of the European hydropower sector is based on its technology leadership, as reflected by the fact that European equipment manufacturers account for an estimated two thirds of the world market. This includes three current global leaders, which account for more than 50% of the worldwide market, plus a large number of small and medium-sized companies. In order to maintain its leading position and to be prepared for dealing with the challenges of the transition to future power systems dominated by variable RES, the European hydropower industry is continuously investing in research and development and innovative technologies. European manufacturers spend more than 5% of annual turnover on R&D, which is more than twice the European industry average.

Increasing Role of Hydropower on the Road to a Low-Carbon Power Sector

Hydropower has been a cost-efficient source of clean electricity for more than a century. At present, it supplies about 380 TWh of electricity to the EU-28 and 600 TWh to Europe, which is equivalent to 13% and 18% of total electricity generation, respectively. Given a positive economic and regulatory framework, total electricity generation from hydropower in Europe may grow to some 700 TWh by 2030, and 750 to 800 TWh in 2050. Compared to today, this would represent an increase of approximately 31%, or 200 TWh, which represents an important contribution for the decarbonisation of the European power sector.

In addition to the supply of clean electricity, flexible hydropower has a long tradition of providing a range of ancillary services, which are essential for operating the power system in a safe and reliable manner. As outlined above, the flexibility and storage capabilities of hydropower plants have gained additional value as they represent an important instrument for dealing with the uncertain and variable generation of other types of renewable energies. Indeed, the role of hydropower has gradually evolved in line with an increasing penetration of wind and solar power over the past fifteen years. To date, hydropower has already been instrumental for enabling the successful integration of variable renewables in countries such as Denmark, Germany or Spain, and in some cases based on the contribution of hydropower in neighbouring countries (e.g. Norway, Austria and Switzerland).

In line with Europe's energy and climate goals, it is generally expected that the share of variable resources will continue to grow and that the future generation structure will be dominated by wind and



solar power in particular. This implies that the challenges of RES integration will become even more important in the future, especially as increasing substitution of fossil fuels by clean electricity may lead to additional electricity demand. In turn, this will require an even larger penetration of variable RES and further increase the future need for and value of flexibility. Some of the corresponding capabilities may be provided by more flexible generation, demand response or even new types of electricity storage. Nevertheless, this development will further reinforce the value and importance of hydropower, which is perfectly suited to deal with these challenges, and which provides the necessary capabilities on a large scale at competitive costs.

Leading up to 2050, the role of European hydropower will thus further evolve from providing clean electricity at competitive rates to taking a central role for enabling the transition to a future power system based on a mix of low-carbon technologies.