EGU24-10664, updated on 17 May 2024
https://doi.org/10.5194/egusphere-egu24-10664
EGU General Assembly 2024

Multi-Dimensional Feasibility Assessment of the Deployment of Vortex-induced vibration Energy Harvester to utilize hidden hydro potential in European water and energy infrastructure

Bjarnhéðinn Guðlaugsson[1], Matej Secnik[2], Ivana Stepanovic[1], Bethany Bronkema[1], Marko Hocevar[2], and David Finger[1]

[1]Reykjavik University, School of Science and Engineering, Menntavegi 1, 102 Reykjavik, Iceland (bjarnhedinng@ru.is)
[2]University of Ljubljana, Faculty of Mechanical Engineering, Aškerčeva cesta 6, 1000 Ljubljana, Slovenia

In recent years, there has been an increased interest in technologies such as Vortex-induced vibration energy harvesters (VIV-EH) concerning the potential to harvest and utilise the energy potential in oceans, rivers, channels and water pipelines. VIV-EH could be an ideal solution for energy generation through harvesting the kinetic energy from flow-induced vibration in open water systems such as rivers, lakes and lagoons, as well as closed water systems like water pipe systems in water and energy infrastructure. The energy generated could enable a self-powered sensor monitoring system and, therefore, replace the need for batteries or diesel generators to power the monitoring system, enhancing the water system's reliability. One of the applications explored for deploying VIV-EHs is installing into existing water pipelines to harness the flow vibration for energy generation. Assessing the feasibility of new energy technology such as VIV-EH is crucial to successfully implementing any technology into the pre-existing system. To fully determine feasibility requires information and inputs attained from assessing multiple cross-dimensional factors, which can provide information on the positive and negative economic, environmental and societal impacts and technological barriers or opportunities related to implementing this technology to any existing system infrastructure. To address this, an assessment framework is being developed, incorporating data and calculations from Life Cycle Assessment for calculating environmental impacts, MatLab for calculating the VIV-EHs key characteristics, and stakeholder engagement for assessing the selection of crucial evaluation metrics. The assessment tool will allow the user to carry out a multi-dimensional (Socio-Economic, Technical, Environmental) or single-dimension feasibility assessment concerning the integration of VIV-EHs into existing water infrastructure using a web-based tool. The application of the assessment framework provides critical informations such as VIV-EH's energy generation potential and role in the energy transition towards a cleaner and green energy system, which are relevant to designing a technology implementation strategy. The framework is applied, tested and used to evaluate the potential of VIV-EHs in various case studies: i) a geothermal district heating network in Reykjavik, Iceland; ii) a drinking water supply system in Ferlach, Austria, and iii) the MOSE flood protection in the Lagoon of Venice, Italy. Preliminary results suggest that the VIV-EH can reach capacities to supply sufficient energy – measured in watts – to power sensors for monitoring,

maintenance and operation of water infrastructure. This continuous supply for monitoring networks can increase the resilience of water infrastructure and improve water resource utilisation, which is becoming more critical during climate change. The findings will be used to develop the assessment tool further and provide information that can help build a strategy for deploying VIV-EHs into water and energy infrastructure across Europe. The framework is tested on representative case studies across Europe but can potentially be applied in any energy system worldwide.