2021-IP02: WPFE Workshop on Water-Energy Nexus

The IEA Working Party on Fossil Energy (WPFE), organised on the 8th December 2020 a workshop on the Water-Energy Nexus, inviting international experts to discuss this extensive area. This workshop will guide the WPFE's work on the broader environmental impacts of fossil energy production and use, with a focus on water impacts.

The Water-Energy Nexus represents the strong relationship between water and energy production. Energy production demands water, and similarly, water production requires energy. Under the current CO_2 emissions reduction goals, it is relevant to note that low carbon technologies do not mean low water consumption. Consequently, water availability and requirements should be considered in the early design stages of the low carbon energy system.

The session, chaired by **Mr. Jarad Daniels and Dr Saviz Mortazavi**, opened with the global perspectives presented by **Mr. Tomás de Oliveira Bredariol (IEA).** He showed the current water withdrawal and consumption by the different energy sectors and the predictions by 2030[1]. While the water withdrawal is currently led by coal and nuclear power generation[2], the predictions include biofuels and nuclear power generation as the main sectors on water withdrawal by 2030. The predictions also include biofuels as the leader on water consumption[3]. The IEA work emphasizes that plans for power generation must take current and future water availability into consideration. Additionally, based on the IEA work[4], the water sector can help strengthen energy transitions.

Dr. Andrew Minchener (IEACCC) presented the challenges and opportunities of the coal-water nexus, highlighting regions where coal power generation will still be significant in the coming years, such as China. He presented a typical water balance in a subcritical power plant and the wastewater streams generated. In addition, IEACCC analysed the alternative sources of water, several of which can offer synergies with other aspects of clean coal power generation. Dr. Andrew Minchener highlighted that, although water use in coal power plants is significant, the impact of this can be limited by the implementation of water saving schemes or the higher efficiency of modern new-build coal-fired power plants. Moreover, current policies, such as the zero liquid discharge regulation (ZLD), supports the scenarios where this issue is of concern.

Professor Amit Kumar (University of Alberta) presented the Energy-Water Nexus modelling work for energy pathways. The WEAP (Water Evaluation and Planning Model) is a water specific planning, forecasting, and modelling tool. It can be used for assessing alternative water development and management of strategies, assisting on the estimations of future water demand and supply. The projections on the electricity sector showed that, although the greenhouse gas emissions dramatically decrease towards 2050, approximately by 70%, the water consumption increases nearly 17%. Changes on the decarbonization scenario will influence the projections of water consumption.

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[1] To note that here withdrawal is referred to the volume of water removed from a source, always greater than or equal to consumption; and consumption is referred to the volume of withdrawn water that is not returned to the source and by definition is no longer available for other sources (IEA, Water Energy Nexus- Excerpt from the World Energy Outlook 2016)

[2] Data from 2016

[3] For water stressed regions, desalination and water reuse can offer a solution for limited freshwater resources. However, these techniques also increase the energy demand, and energy efficiency and energy recovery could present an opportunity if exploited economically.

[4] IEA, Water Energy Nexus- Excerpt from the World Energy Outlook 2016

Dr. Monica Garcia (IEAGHG) presented the implications of the Water-Energy nexus when CCS (Carbon Capture and Storage) is incorporated in a power plant or a fertilisers production facility. She divided her presentation in two sections, analysing the water demand of the carbon capture section, and the potential of the extracted water from the storage site. Adding a CO_2 capture system might increase the water consumption but there are mature techniques to reduce the water requirement to zero or close to zero. Therefore, the water requirement is not expected to be a constraint to adopt CO_2 capture technologies. The water extracted from the storage site might be beneficial to increase the space for CO_2 storage, and this can also be explored as an alternative water supply for the power plant. However, the reuse of extracted water requires further treatment to achieve the minimum water quality. The economic evaluation of this pathway must consider the water availability and the CO_2 emissions reduction potential as significant factors. Similar learnings can be transferred to the industrial sector, such as the fertilisers production facilities.

The WPFE contributes to the efforts of the IEA to ensure the future production and use of fossil fuels is compatible with the United Nations sustainable development goals related to energy and climate change. Attendees had the opportunity to discuss the implications of low carbon strategies on the water consumption and under water scarcity scenarios, and how the Water-Energy Nexus must address these.

This event was an opportunity to explore water needs and impacts for the production and use of fossil energy today and in the future, including water impacts of advanced technologies such as hydrogen and carbon capture, use and storage (CCUS) that will play a key role in energy transitions. IEAGHG will continue exploring this area, supported in recent work[5] and investigating additional approaches, such as water use in hydrogen production with CCS and in geothermal energy.

Monica Garcia
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[5] IEAGHG 2020/09 Understanding the cost of reducing water usage in coal and gas fired power plants, September 2020. See webinar at: https://www.youtube.com/watch?v=5Gm_i8ywe44