Summary for Overseas Travel
WENDI 2018-2019

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Grade	D1
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Travel period	March 8th – March 21st
UN agencies / International organization visited	International Energy Agency IHE Delft Institute for Water Education
Theme of overseas travel	Study on the Role of Water-Energy-Nexus in Deployment of Renewable Energy Resources in Iran

Outline of the activities

(1) Global leadership

Due to climate change, the number of countries in the world facing stress on their renewable water resources is increasing. On the other hand, energy systems are to decrease dependency on fossil fuels and transfer to green systems, which cause problems need to being dealt with, such as instability due to the inherent fluctuation of renewable energy resources. Redesigning water sector and energy sector in such countries is unavoidable which is both a potential and threat for the future systems. The following trends show the need for designing sustainable energy and water systems for future and global leadership:

- Population growth and changes in diets as a result of increasing incomes and improved living standards will lead to higher agricultural water demand. For example, the production of a meat based diet typically consumes twice the amount of water as compared to a vegetarian diet. Demand for biofuels and fiber drives the demand for agricultural products further and hence increases pressure on agricultural land & water.

- Accounting for 70% of all water extracted for human purposes, agriculture is by far the biggest water user worldwide. Increasingly, water for food is linked to environmental problems (such as fragmentation and drying up of rivers, salinization, eutrophication of water bodies, degradation of wetlands) and biodiversity loss.

- Agriculture is a major contributor to GHG emissions, directly and indirectly through land use change. At the same time food production will be heavily impacted by changes in climate and increases in climate variability in particular.

- Access to water and food is skewed: over 860 million people are food insecure, while over 1 billion are overweight.

- Water sector is both an energy user and supplier (through biofuels). The food sector accounts for 30% of global energy use and 22% of greenhouse gas (GHG) emissions. Improved agricultural water management can contribute to 'energy and climate' smart food production.

- While highly volatile, fossil fuel prices show a rising trend and many countries are striving to diversify energy sources. Energy generation from biofuels and hydropower has a direct effect on water and water resources and in many cases competes with food production.

- The energy sector accounts for roughly 10% of total water withdrawals (the amount of water removed from a source) and 3% of total water consumption (the volume of water withdrawn but not returned to the source) worldwide.

- Over the period to 2040, water withdrawals for the energy sector rise by less than 2% to reach over 400 billion cubic meters (bcm). The amount of water consumed increases by almost 60% to over 75 bcm, in part due to a switch to advanced cooling technologies in the power sector that withdraw less water, but consume more.

- Over the period to 2040, the amount of energy used in the water sector is projected to more than double. The largest increase comes from desalination, followed by large-scale water transfer and increasing demand for wastewater treatment (and higher levels of treatment).

According to World Energy Outlook-2016, in the Middle East, the water sector's share of total electricity consumption is expected to increase from 9% in 2015 to 16% by 2040, due to a rise in desalination capacity. Iran has several plans to transfer from the current energy system to a more green energy system, which are under question such as feed-in tariffs for renewable electricity production. With spending $45.1 billion on fossil energy consumption subsidies in 2017, Iran ranked first globally based on International Energy Agency report. Iran's economy is suffering from over-dependence on fossil fuel export and the high unemployment rate about 12.1 percent based on the World Bank report.

Although agriculture contributes just 10% to the gross national product, it has the largest share of non-oil exports of the country and employs a sixth of the labor force, in consequence of which, it is vital for the country to support the agriculture sector as the largest water consumer. Moreover, hydroelectric power generation, which is producing around 10 percent of Iran's electricity production and is the only renewable energy resource of the country, has suffered more as water reserves have declined, leading to an overall loss of 45% in power generation capacity. Deployment of renewable energy resources and desalination plants to transfer from current system to a more sustainable system (energy system with high share of renewable resources and water system with zero excess water extraction which refers to the difference between the amount of water extraction and outlet from the underground and surface water resources and the amount of water returns to these resources from the neighbor secondary basins and precipitation) is unavoidable in Iran.

(2) Scientific significance

This study aims to examine the performance of current and feasible support policies, economic and regulatory instruments to increase the share of the renewable resources and sustainable management of water supplies and understand the key stakeholders and factors, which are to shape the future water and energy sectors. Finding the role of water-energy-nexus to alter these policies and instruments to meet the targets is the key point of this study, in order to design a realistic roadmap to reach a sustainable energy and water system in the future. The chosen country as a case study, Iran, is facing severe stress on fresh-water resources and has an energy system, which mostly relies on fossil fuel.

(3) Originality/Universality

Almost all the weaknesses in the global energy system, whether related to energy access, energy security or the response to climate change, can be exacerbated by changes in water availability. Almost all of the fault lines in the global water supply can be widened by failures on the energy side.

For the energy sector, constraints on water can challenge the reliability of existing operations as well as the physical, economic and environmental viability of future projects. Equally important, the use of water for energy production can impact freshwater resources, affecting both their availability and quality. And the dependence of water services on the availability of energy can impact the ability to provide clean drinking water and sanitation services.

To develop energy & water resources in a sustainable and equitable way and in synergy with natural systems, a shift in thinking among policy-makers is needed. The outcomes of this study lead to answer the following questions:

- What are the consequences of not considering the nexus between the water and energy sectors? How better understanding the nexus between water and energy sectors can guide us to design a more sustainable system?

- Whether (or under what conditions) real-life policymakers would be willing and capable to pursue sustainability goals? How much is the rate of self-organization of the system and to what extent the authorities need to keep controlling system?

- How will the stakeholders change based on each policy and how it changes the future shape of the system? How can each stakeholder influence the scenario adaption in the future and how much can they influence each other?

(4) Reasons and motivations for visiting UN agencies / International organizations

IHE Delft Institute for Water Education is the largest international graduate water education facility in the world and is based in Delft, the Netherlands. IHE Delft has a research program on water management and governance ultimately investigates how water management decisions are made, determining where water flows, for what purpose, and at what cost (ecological, social, economic).

The research program on water management and governance centers on the conviction that in order to fully understand how decisions are made, where water flows and under what conditions it is necessary to study the intrinsic linkages between the social, biophysical and technological processes of water systems.

International Energy Agency has a research group which is focusing on shifting the emphasis towards an integrated approach focused on delivering three energy-related Sustainable Development Goals - energy for all, reducing the impacts of air pollution and tackling climate change, results in significantly lower water withdrawals. This makes this pathway the best option of those assessed by this research group for achieving the SDG 6 target on water use efficiency and for reducing the energy sector's vulnerability to potential water disruptions such as drought or the effects of climate change on water availability.

As my research is focused on water-energy-nexus, I have visited IHE Delft Institute for Water Education and International Energy Agency which are the world's leaders in water studies and energy studies during this trip. More precisely, I have met several professors and colleagues in the mentioned research groups to get feedback on my research and also find opportunities for future collaboration. As a result of these discussions and meeting, I have been offered to do an internship in the International Energy Agency and also collaborate on SIM4NEXUS project which funded by the Horizon2020 program in Europe.

Through these two weeks, I also visited Utrecht University and Norwegian University of Science and Technology to widen my perspective of the field of water-energy-nexus. These discussions have guided me to understand that it is vital to find a way to evaluate the model in the proposed study.