Researches for sustainability of Thailand from the perspective of water-energy nexus

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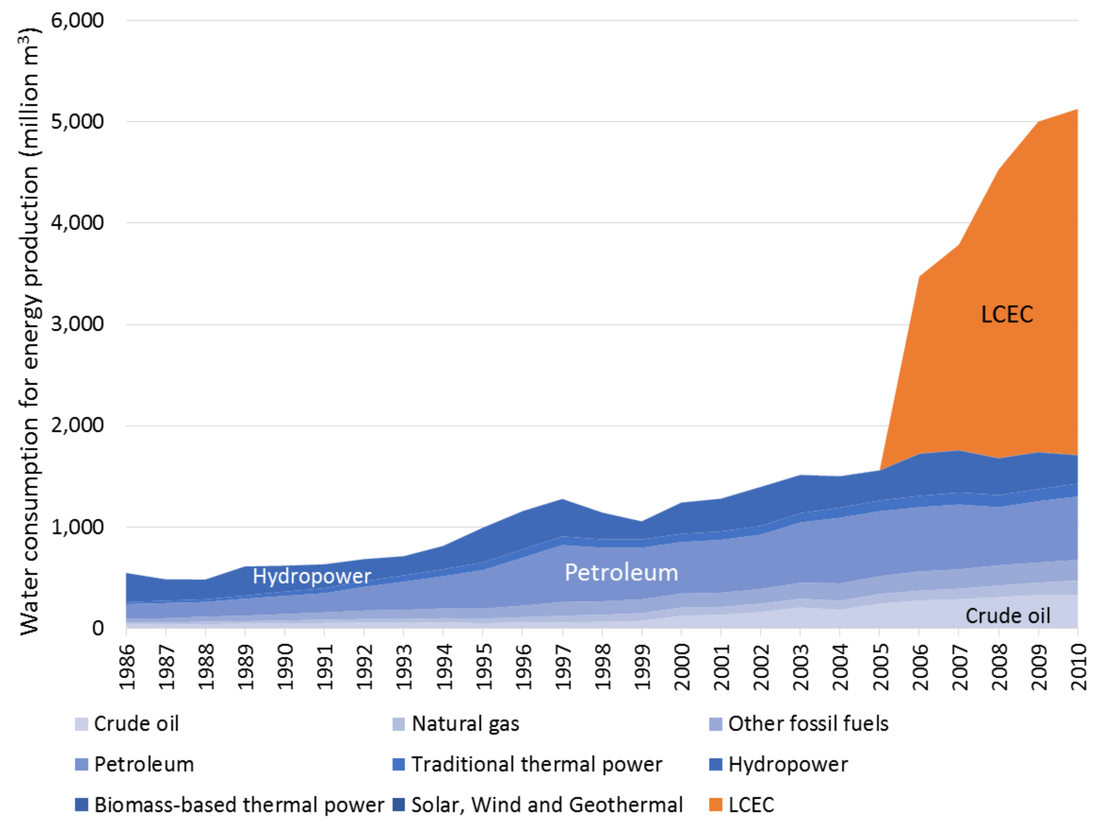
For Domestic Sustainability

Low carbon society, environmental monitoring, biodiversity and ecosystem services, and waste management and recycling are important and useful frameworks for sustainable future in Asia. Water and energy are not only essential resources for the sustainable development but also considerable fundamental factors to apply the frameworks to society, such as nations, regions and communities.

Thailand is one of the countries that has been promoted concrete countermeasures related to sustainable development. Low-carbon energy commodities (LCEC), for example, with biomass such as bioethanol and biodiesel, has been positively utilized since 2006 and contributed to decrease energy external dependency of Thailand (Energy Policy and Planning Office, 2011).

However, energy production requires much amount of water. Indeed it is reveals that water requirements for domestic energy production in Thailand has increased for the past 25 years and recently significantly risen up due to LCEC (Okadera et al., 2014; Figure 1).



Notes: The above sectors is aggregated by the author based on Okadera et al. (2014).

Figure 1 Water for energy production in Thailand

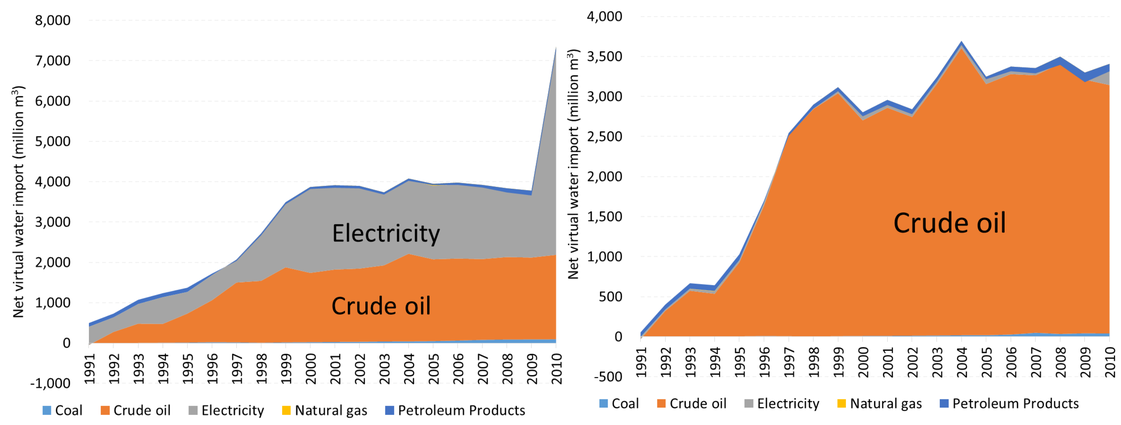
Furthermore, it is estimated that the LCEC production needs more water in the future (Gheewala et al., 2013), thus research and development (R&D) of water-saving bioenergy production systems are important. Especially most of the water requirements of LCEC is caused by feedstock cultivation and production, so these systems must be designed to save water.

In addition, the average amount of water stored in dams of Thailand at the end of year is 49 billion m^3 (HAII, 2013) while it is estimated that 57 billion m^3 of water is withdrawn for agriculture, industry and household for a year (Food and Agriculture Organization of the United Nations, 2015). It thus seems that Thailand is under the situation of no spare water storage capacity. Moreover, the water availability differs by region, such as flood in Bangkok (Villalovos, 2011) and drought in Suphanburi (Asfouri, 2015). Thus a new investigation on domestic water scarcity by energy production with taking account of regional water availability will be necessary.

Photos: Left: Big flood in Bangkok in 2011 (Villalovos, 2011). Right: The worst drought in Suphanburi in 2015 (Asfouri, 2015).

For Global Sustainability

Although the energy external dependency has been lower as above, it is found that international energy trade of Thailand has worsened global water scarcity, as results of virtual water flow analysis weighting water-scarcity index by nation (Okadera et al., 2015). Especially imported crude oil is the greatest contributor to global water scarcity, though water amount for imported electricity is significant (Figure 2). This is because most of the crude oil has been imported from water-scarce regions, such as the Middle East.



(a) Standard (b) Water scarcity-weighted

Notes: Virtual water , which is a useful term to analyze the water required for the international trade of various commodities, consists of two components: virtual water import (VWI) and virtual water export (VWE). VWI is water needed to produce goods and services related to importation, whereas VWE is that related to exportation. Net VWI = VWI – VWE. (Okadera et al., 2015)

Figure 2 Net virtual water of energy imported to Thailand

Crude oil is one of the most essential resources for main industries and economy in Thailand. For improvement of global water scarcity by the international energy trade, water-friendly energy trade systems so as to import crude oil from water-abundant regions instead of the current water-scarce regions, are necessary. Therefore it is important to update global water resource monitoring and simulation models (Hanasaki et al., 2013a: 2013b; Hanasaki et al., 2008), to identify water scarcity of trading countries, with an interface to integrate the models to international energy trade database (Thai Ministry of Commerce, 2014) as a future task.

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