The water-energy nexus in the context of climate change

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A new report from the Water Research Commission (WRC) highlights the importance, implications, and challenges of the water-energy nexus, particularly in light of South Africa's post-2015 development agenda.

Background

The water–energy nexus describes the inextricable linkages between water and energy. Energy production requires water, either directly (through, for example, hydropower) or indirectly. In conventional thermal power plants, the production chain of energy involves various stages, including fuel acquisition, processing and transportation. For instance, water is required in the mining, washing, beneficiation and transportation of coal, plant construction and power generation (cooling coal plants). The extraction, treatment (including recycling) and distribution of water also requires energy.

As such, efforts to develop and/or increase power generation should equally be matched by considerations of water use and/or the water footprint associated with power generation. Energy generation planning should therefore consider water resources and water. The opposite is true for water extraction, treatment and distribution.

In reality, however, water availability is often taken for granted due to the relative importance of energy to economic development. In addition, energy, water, and environmental sustainability are closely interrelated and are vital not only to the economy but to the health and welfare of all humans.

Projected population growth, climate change and variability and urbanisation increasingly call for an integrated approach. This reaffirms the assertion that the water–energy nexus would become more important in coming years. Climate change is expected to put additional strain on water provision due to projected changes in seasonal and regional temperature patterns of precipitation. This places increased stress on water and energy planning in that the impacts of climate change are uncertain and variable across the country. It is now expected that future policy will be influenced by their successor, the Sustainable Development Goals (SDGs). The SDGs 6, 7, 8 and 9 all allude to the need for an integrated water–energy nexus planning approach.

Therefore, this review seeks to highlight the importance and implications thereof of the water–energy nexus to the country and region's post–2015 development agenda.

Water requirements for energy generation

Water is the basic resource required to produce all forms of energy as it is used in power generation, extraction, transport and processing of fossil fuels and irrigation of biofuels feedstock crops. For power generation, for example, water provides cooling and other process related needs at thermal power plants, hydropower facilities harness its movement for electricity production (Figure 1).

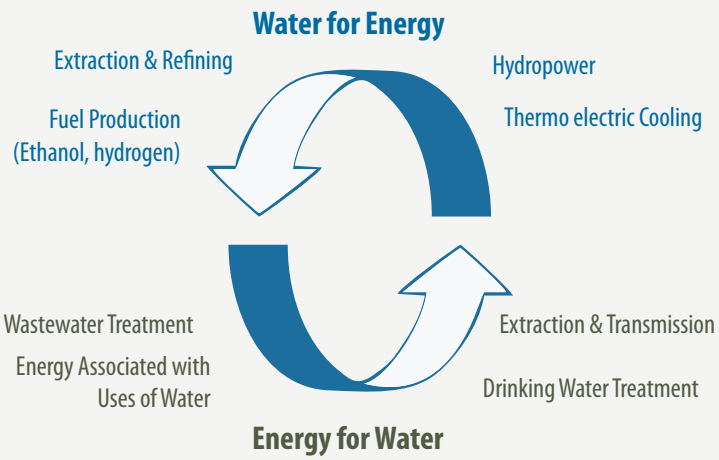

Figure : The Interlinking nature of water and energy.

Cooling water for energy generation is accounted for differently within the different member states. This makes it difficult to accurately account for this particular water use within the country. A recently completed WRC study forecast a more water constrained future due to climate change, population growth and global economic challenges.

These multi–stresses will impact the energy sector with regards to the reliability of energy generation and supply as well as associated energy costs. This, against the backdrop of already scarce water resources, suggests a more water constrained future with significant impacts on energy generation and costs. This will affect some of the development agenda within the country which relies to a large extent on availability of energy to support plans for industrialisation

as enunciated in the National Development Plan (NDP), Department of Energy (DoE) Strategic documents. Already, growth forecasts for the country have been cut down due, in part, to critical energy shortfalls. This again places a water–energy nexus approach as being pivotal to both national and regional economic development.

The WRC report stated that the water requirements for fossil fuel based and nuclear power plants – the largest users of water in the energy sector could be reduced significantly with advance cooling systems. However, most of the country's coal power plants are old and use old technology hence they use significant amounts of water. South Africa and other countries within the SADC region have also started to consider alternative sources of energy. For example, countries such as South Africa and Mozambique are currently exploring non–fresh water sources such as saline water, treated waste water, storm water and water from oil and gas operations.

Water–energy nexus challenges

Water scarcity already exists in some of South Africa's catchment areas, thus placing an economical or physical constraint to water resources. In addition, increasing population growth and proposed economic growth both place huge demands on the region's water resources. Currently, most of the country's water resources (>60%) are used in agriculture, with the remaining being used for domestic, industrial and power generation purposes.

The realities of climate change within the country serve as a multiplier effect for the drivers increasing demand on the country's water resources. Thus, the country is currently perplexed with how to ensure delivery of safe and clean water to its growing populace, especially in rural areas. As the country moves to adopt the SDGs, their attainment will depend, to a large extent on how the country's water–energy nexus is managed.

Economic development as envisaged in the NDP, based on industrialisation, will require availability of electricity to power current and new industries. In addition, foreign direct investment will also be stimulated if the country, as a whole, can provide evidence of water and energy security to encourage investor confidence. While the water–energy nexus presents many challenges to the country's development agenda, it also presents many opportunities for water and energy planning for development. These opportunities lie in integrated water resources management and use of renewable energy resources of which the country is well endowed with.

There is growing recognition by several organisations of this issue. For example, organisations such as the WRC, Shell, World Wildlife Fund (WWF), Department of Energy (DoE), Department of Water and Sanitation (DWS) and ESKOM, among others, are championing the slogan "saving water saves energy".

Energy efficiency initiatives offer opportunities for delivering significant water savings, and likewise, water efficiency initiatives offer opportunities for delivering significant energy savings. In addition, saving water also reduces carbon emissions by saving energy otherwise required to move and treat water. Energy use for water is a function of many variables, including water source (surface water pumping typically requires less energy than groundwater pumping), treatment (high ambient quality raw water requires less treatment than brackish or seawater), intended end – use, distribution (water pumped long distances requires more energy), and amount of water (stringency of water quality regulations to meet discharge standards). However, attempts to increase energy and water efficiencies should be well–coordinated if the benefits are to have a positive net effect on country economic development. This also highlights an opportunity for national water–energy nexus policy that can be used to influence national water–energy nexus initiatives.

While the country's has long recognised that integration was central to addressing existing energy challenges and creating new opportunities for energy generation it has not managed to link energy and water sector planning. Clearly, there can be no achieving one without the other, especially given the inter-sectoral linkages by these two sectors. There is therefore a need for a paradigm shift in terms of how the country perceives its development agenda. Focusing on energy generation primarily without coordination with water sectors will not achieve meaningful national integration nor will it fully deliver in improving the quality of life across the country. A coordinated water–energy nexus platform would have better opportunities of delivering on social and economic goals.

Conclusion

There is increasing demand for water and energy in the country due to population and economic growth. The country is characterised by economic and physical water scarcity. In 2008, for example, the country was faced with energy crises that threatened economic development, raising the need for new energy generation projects. Concurrently, there was also an urgent need to identify water resources that can be used to meet increased demands for water from various sectors, including energy generation, across the country. These challenges are now exacerbated by climate change; there is a need to develop climate resilient water and energy policies or strategies in all three spheres of government. At present, water and energy are planned without cognisance of each other.

Further reading:

To order the report, *The water-energy nexus in the context of climate change: Investigating trade-offs between water use efficiency and renewable energy options for South Africa* (**Report No. 2239/1/15**) contact Publications at Tel: (012) 330-0340; email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.