WATER AND THE ECONOMY

Transitioning to a circular economy – the role of innovation

Within the man-made water cycle, wastewater is a carrier of 50% to 100% of waste resources lost, mostly in the form of unrecovered water, energy and materials which are three key interrelated pathways to achieving circular economy principles in the water sector. Although the South African water sector has not yet fully transitioned to a circular economy, the need to respond to various challenges have placed the sector on the road to a circular economy underpinned by innovation. In this regard, water utilities need to be early adopters of technologies and business practices that support the circular economy in response to various threats and challenges the sector faces.
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In recent years the circular economy concept has received significant attention on various platforms. In contrast to the current conventional linear economic model (take-make-consume-dispose), the circular economy concept is a development strategy that enables economic growth while aiming to optimise the chain of consumption of materials. Adoption of the circular economy, however, requires significant transformation of production chains and consumption patterns in order to keep materials circulating in the economy for longer.

While there are some elements of circularity in South Africa, such as recycling and composting in the linear economy, a circular economy goes beyond the pursuit of waste prevention and waste reduction to inspire technological, organisational and social innovation across and within the value chains. In this regard, numerous potential benefits are derived from the transition to a circular economy, with innovation playing a key role in support of such transition.

While there are significant benefits associated with adoption of a circular economy, transforming the linear economic model that has been dominant for a long time is a big challenge, which entails transformation of current production and consumption patterns. However, innovative transformational technologies, such as digital and engineering technologies, in combination with creative thinking, have been identified as key factors that may drive fundamental changes across entire value chains that are not restricted to specific sectors or materials. Such a major transformation would, in turn, result in significant impacts on the economy, environment and society, with an understanding of these impacts crucial for researchers and policy-makers in designing future policies.

For the South African water sector, the current water and wastewater business cycle is predominantly based on the linear economy approach (Figure 1). In order to address current and future water security challenges in a sustainable manner,

there is a need to rethink the water and sanitation value chain and identify the role of innovation in transitioning to a circular economy. Moreover, the transitioning to a circular economy within the South African water sector is in line with the United Nations Sustainable Development Goals (SDGs). In this regard, water has a dedicated goal in SDG 6 (ensure availability and sustainable management of water and sanitation for all) and its attainment will be reliant upon contributing to and benefiting from the attainment of other SDGs, most notably in the context of the circular economy, SDG 12 (ensure sustainable consumption and production patterns). This interdependence across goals manifests at a national level in highlighting the need for greater cooperation amongst sectors, incentivised innovation and enabling meaningful engagement with citizens.

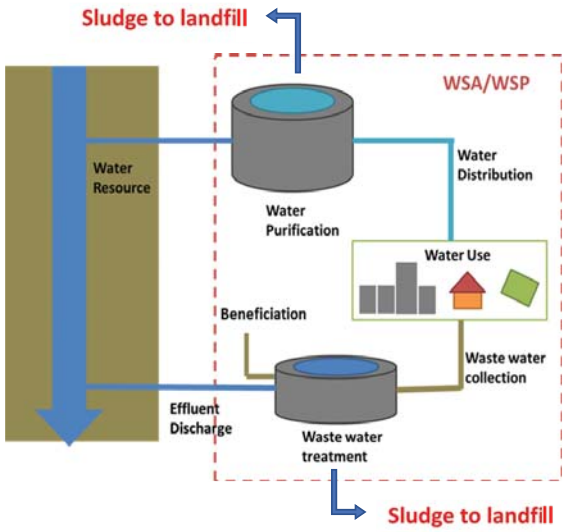

Figure 1: Linear approach for the water and wastewater business cycle

One key technology or innovation that has the potential of driving the three key interrelated pathways (water, material and energy) to achieving circular economy principles within the South African water sector is based enhanced hydrothermal polymerisation, generally referred to as polymeric carbon solid (PCS). PCS is a catalytic-driven technology that converts a wide range of biomass into a multi-use hydrochar. One of the key products is a green biofuel in which an extra 3 – 5 GJ are unlocked for every tonne of PCS biofuel produced.

In South Africa, technical pilot evaluations processing mostly municipal sludge carried out to date using sludge from wastewater treatment plants have confirmed the net gain of 3 – 5 GJ/kg using the PCS technology. Moreover, economic evaluations based on cost benefit analysis using net present value as evaluation criteria for a 50 tDS/d greenfield site suggest favourable economics for beneficial use of ash compared to disposal of ash to landfill. Depending on the energy content, the biochar can also be used as an absorption media for tertiary effluent treatment, soil conditioner and building materials. Currently, further technical and economic pilot evaluations of processing mixtures of biomass that include municipal solid waste are underway, and outcomes are anticipated to further strengthen adoption of circular economy principles by the water sector.

The feasibility of incorporation of PCS technology into the existing South African wastewater treatment infrastructure presents further opportunities for supporting implementation of circular economy principles at wastewater treatment facilities as part of sustainable wastewater management. This can have significant benefits as it has potential of catalysing conversion of current wastewater treatment facilities into future waste resource recovery centres, not only treating wastewater for effluent compliance, but fostering innovation and mutual beneficial partnerships with communities. In this regard, the conceptualisation of PCS technology as accelerator for adopting circular economy principles in the wastewater sector, representing a paradigm rethinking of the water and sanitation value chain is illustrated in Figure 2.

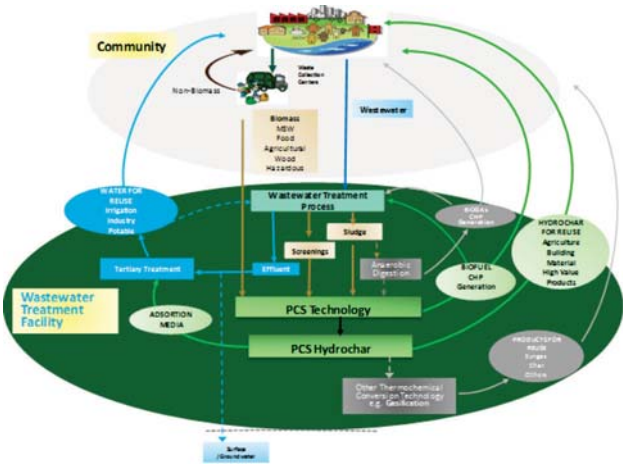

Figure 2: Transitioning to Circular Economy using PCS technology

It is believed that the use of innovation to transition to a circular economy based on the above concept has significant potential to of creating new business models and jobs, including developing new skills and investments in communities as well as reducing the carbon foot print, thereby mitigating the impacts of climate change. In this regard, municipalities need a rethink their sludge management strategies, so that they adopt disruptive innovations to benefit from resource recovery in support of circular economy principles implementation within the South African water sector.

What is meant with a 'circular economy'?
A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.