Is sustainability scalable?

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Is Sustainability Scalable?

Professor Stephen Gray, Director of the Institute for Sustainability and Innovation, Victoria University.

Professor Gray is responsible for the Institute's water research program and is actively involved in water treatment and membrane research.

Soaking rains over the east coast of Australia this spring and summer, and the construction and completion of many seawater desalination plants, has led the water industry to focus on improving bottom lines, coping with floods and creating "sustainable water systems". Indeed, the last few contributions of "My Point of View" have identified drivers for change towards more sustainable systems. These challenges include:

- A 40% increase in population over the next 20-30 years;
- Climate change resulting in sustained drier periods and extreme rainfall events;
- The need to reduce energy requirements to lower greenhouse gas emissions; and
- How to integrate more sustainable water systems into existing infrastructure, so as to reduce capital expenditure.

Rainwater Tank Energy Consumption Survey

Decentralised systems are often considered the panacea to these problems, by offering lower transport requirements for water, new non-traditional sources of water, and flexibility in how they integrate into existing infrastructure.

However, a recent survey of the energy used by rainwater tanks by the University of Technology Sydney (UTS) (http://utsescholarship.lib.uts.edu.au/iresearch/scholarly-works/bitstream/handle/2100/888/retamaletal2009waterenergynexus.pdf?sequence=4) has shown that the actual energy use varied from 0.9–4.9kWh/kL, with a typical energy use of 1.5kWh/kL. This compares to specific energy consumptions of <1kWh/kL for delivery of drinking water in most Australian capital cities (the exception being Adelaide at 1.84kWh/kL) and around 1kWh for brackish water desalination.

Clearly, while the theoretical energy required for transport of water from a rainwater tank to household end uses should be lower than sourcing it from distant supplies, this is not currently realised. There is a need to improve the design of rainwater tank systems, and the technologies used in the widespread roll out of water tanks, if lower energy water systems are to be achieved. The issue can be addressed by the use of more efficient pumps and gravity systems in low pressure applications.

These approaches need to be promoted through planning policies, so that more of the potential benefits that rainwater tanks can afford may be realised. It also underscores the need for monitoring the performance of alternative water systems, as called for by Ted Gardner in his March 2011 "My Point of View", as there can be large differences between actual and theoretical performances.

Small-Scale, High-Cost Solutions

Small-scale wastewater treatment plants, often in the basements of large high-rise buildings, are also seen by many as a more sustainable solution for suppling recycled water. Indeed, star rating systems for buildings, such as BASIX, give credit for the inclusion of such systems. While they are capable of supplying high quality water, the cost is usually considerably higher than potable water supplies, with production costs of $20/kL having been claimed in some instances. The high production costs of these systems are associated with the need for compliance monitoring and regular site visits for maintenance.

In order for these systems to be financially competitive with centralised reuse systems, improved on-line monitoring and process diagnostics are required. There has been a significant research effort for development of new sensors nationally via the Environmental Biotechnology CRC and CSIRO, as well as international efforts. As yet this has not led to significant outcomes in the reduction of operating costs for small-scale wastewater treatment systems. Perhaps it is time for a targeted research program to identify specific sensors and control strategies to reduce the operational costs of distributed small-scale reuse systems so as to lower their operating costs.

In locations where expensive augmentation of distribution and/or collection systems is required, then the use of small-scale reuse systems may be cost competitive. However, in these situations the cost of these systems should be compared against demand management and peak levelling approaches, as these concepts are also suitable under such circumstances.

Another approach to decentralised systems is to use stormwater, but to date there are very few working examples available to demonstrate the implementation issues of these systems. As the increasing interest in these systems leads to demonstration sites, monitoring programs along the lines of

Ted Gardner's approach will be necessary for us to effectively disseminate the operating knowledge gained from them.

Therefore, while small-scale distributed systems may have significant potential benefits, they still face significant challenges and have not yet been widely implemented. Instead, large-scale reuse systems and desalination plants have been used to address the shortfall in supplies.

Desalination Plants

The case of seawater desalination plants is interesting with respect to sustainable water systems, as the energy required for production makes this water energy intensive. However, the greenhouse gas emissions from Australian desalination plants are largely offset by green energy sources, and if we are willing to accept this as a valid approach to reducing greenhouse gases, then the greenhouse gas emissions associated with this water are similar to that of dam waters or from inter-basin transfers.

Furthermore, these plants do not always operate. For instance, the Sydney desalination plant operates intermittently, shutting down when the reservoirs are full and only producing water when the reservoirs are low. Such an approach to operation reduces overall energy use, but also leads to underutilisation of the asset. Similar operating protocols are also in place for the indirect potable reuse scheme in Brisbane, which only delivers water to the drinking water system when reservoirs are low and community acceptance is higher.

The flexibility of these systems to deliver water only when required comes at the expense of redundancy in the system, increasing costs. Such redundancy may also be present in small-scale water systems, for example, the use of potable water as backup for rainwater tanks or stormwater systems. Therefore, perhaps the need for redundancy in the system is something that requires an effective communication campaign as an outcome of moving towards systems that are more sustainable, cost being a trade-off for lower energy use and water security.

Future Strategies

So what does this mean for the future of water systems in Australia? We currently have seawater desalination and large-scale water recycling plants for another 20–30 years, and small-scale distributed systems still have significant challenges before they can claim to outperform large-scale systems. They also need to compete against demand management and peak levelling approaches in areas requiring significant augmentation of their networks.

However, the potential for lower-energy water transport that exists for distributed systems, and their ability to address stormwater discharges, still makes them interesting to consider. Perhaps we should use the time before the next renewal phase of our large systems to ascertain if the potential of distributed systems can be realised and how other strategies can be implemented in a more sustainable way.