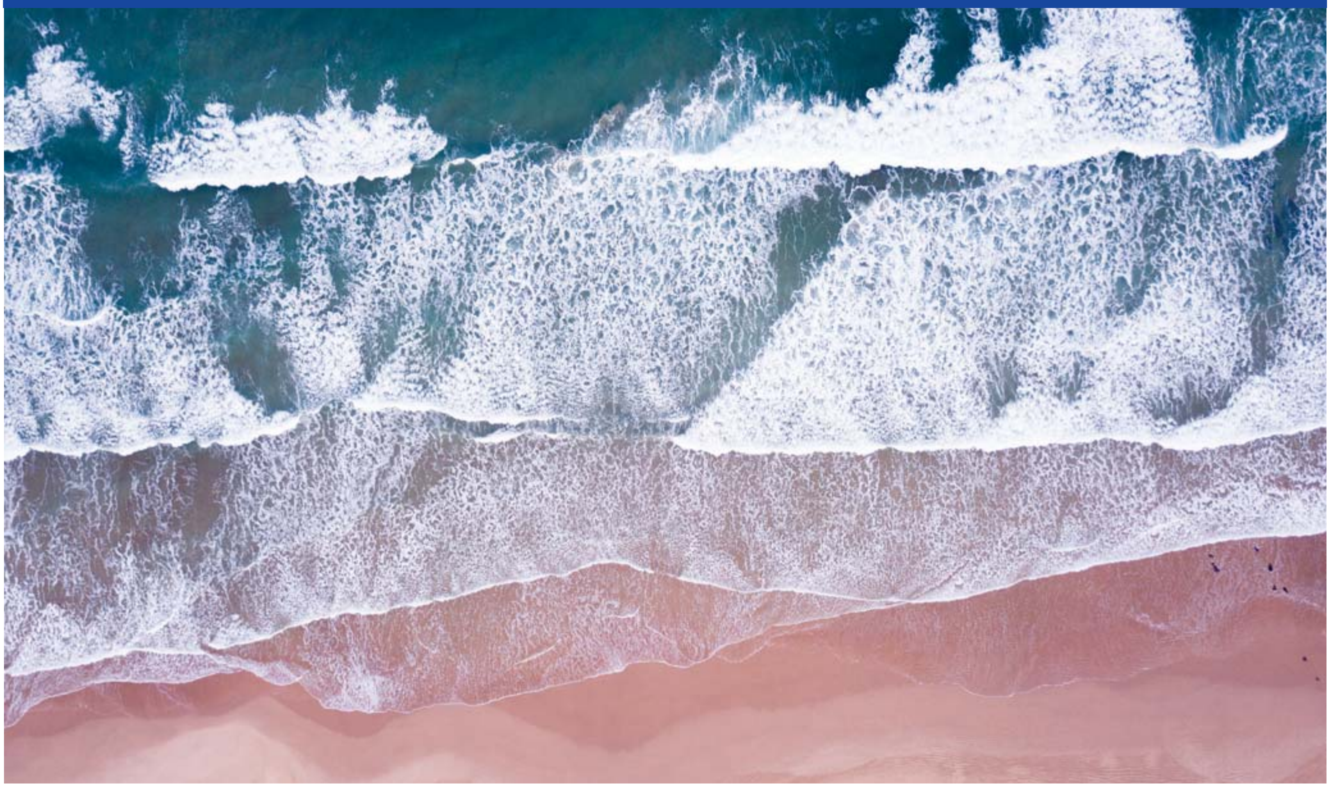
WATER INFRASTRUCTURE

Re-thinking desalination: The value proposition of water as an infinitely scalable, renewable economic commodity

There can be little doubt as to the strategic importance of man's ability to convert seawater into freshwater; it is very comforting to know that with reverse osmosis and ever-cheaper renewable energy, we can produce freshwater from a near infinite resource of seawater, especially in a time when we face daunting environmental and climate challenges. So writes Dawid Bosman from the Trans-Caledon Tunnel Authority.



But for a mature technology with such a compelling value proposition, desalination is still a rarity outside of its established market of the Middle East, North Africa (MENA) and Gulf Cooperation Council (GCC) countries. And where desalination has been adopted outside of these markets, it has frequently been relegated to a role of contingency infrastructure, used ad-hoc or even politicised as an opposition folly, but seldom given its rightful place as a highly assured, climate-independent, infinitely scalable water resource.

A strategic technology misunderstood?

Tentative and haphazard implementation strategies have not helped; examples abound of small-scale, short-term contracts that defy sound business principles, which inevitably result in poor economics and exorbitant water prices. Similarly, Day Zero emergency situations that require the design and build of a small plant in less than ten weeks will probably result in poor value for the public funds expended. One simply cannot transplant a technology that is best suited to large-scale, continuous-flow operation into a small-scale, intermittent operating environment and expect good outcomes.

When comparing the desalination water costs achieved in the mature MENA and GCC markets, characterised by stable and consistent policy environments and large-scale, continuous operation plants, with the not-so-mature Australian, US and even South African markets, where desalination is still largely regarded as drought insurance, a stark difference emerges. In the mature market, all-in water costs of $0.40 to $0.50/kl are now consistently being achieved from new seawater reverse osmosis (SWRO) projects.

In the emerging markets, the costs are invariably higher, often by several multiples. Of course, some input factors are simply not comparable, such as energy and labour costs, but these fall well short of explaining the vast disparity.

It can therefore be argued that so far, in the South African market at least, desalination has not been managed as the strategic technology that it is. However, if we consider the prominent role given to desalination in the National Water and Sanitation Master Plan, to help avert a growing national water deficit over the next nine years, then we need to urgently implement and capacitate the National Desalination Strategy of 2011 (Now appended to the National Water Resources Strategy of 2013).

Desalination in the Master Plan

It is worth noting that the National Water and Sanitation Master Plan aims to close the national water deficit through both demand and supply-side interventions; by 2030, some 2 060 million cubic metres per annum (MCM/a) in demand-side saving should be achieved through reductions in domestic consumption and reticulation losses, while a similar quantum of some 1,977 MCM/a should be added on the supply side, through augmentation coming from surface, ground, sea and reuse. Of this latter amount, some 588 MCM/a (or 30%) is earmarked to come from desalination; the sea has become a substantial element of national water resource planning.

Thus, what will this quantum of desalination look like, when it is built? Plant capacity is usually expressed in megalitre per day, or Ml/d; the thirty-odd existing plants in South Africa are typically smaller than 10 Ml/d; the largest seawater plant is a 15 Ml/d unit at Mossel Bay, and a hybrid seawater-reuse plant of 47.5 Ml/d is under development in Durban. The total existing inventory amounts to about 215 Ml/d, but many of the plants are not operational. The 588 MCM/a of new desalination capacity stated in the Master Plan translates into 1 610 Ml/d, which is some eight times larger than the current installed capacity; this capacity will need to be established over the next nine years.

Using an South African-adjusted capital cost benchmark of $1.4 million per Ml/d installed capacity (DesalData), and an exchange rate of R15 to the US Dollar, this indicates an outlay on desalination plants of about R34 billion, spread over nine years, across perhaps 10 to 15 separate projects. This will be a vast undertaking, with a total magnitude similar to Phase II of the Lesotho Highlands Water Project.

Approaching this undertaking in an ad-hoc manner is not advisable; the procurement of desalination is fundamentally different from conventional water infrastructure, especially around the placement of technical and project risk. Instead, a carefully considered to-market strategy needs to be developed and used for guidance throughout.

Towards cost-effective desalination

As a first step towards cost-effective desalination, it is necessary to know what the international cost benchmarks are; the next steps would be to explore what are the factors that drive costs up or down, and to gain an understanding of how these might be influenced.

Figure 1 below reflects the comparable "all-in" product cost benchmarks achieved by Independent Water Producer (IWP) bids on numerous large-scale desalination projects in various countries since 2000, using seawater reverse osmosis (SWRO) technology. The trend towards lower costs and a narrower spread in recent years can largely be ascribed to lower cost of capital, a decline in EPC costs and cheaper renewable energy. As a result, the current benchmark is around the $0.50 mark, well below the global average water tariff of $1.21/kl. It is ironic that desalinated water in an arid region should be cheaper than the global average water tariff.

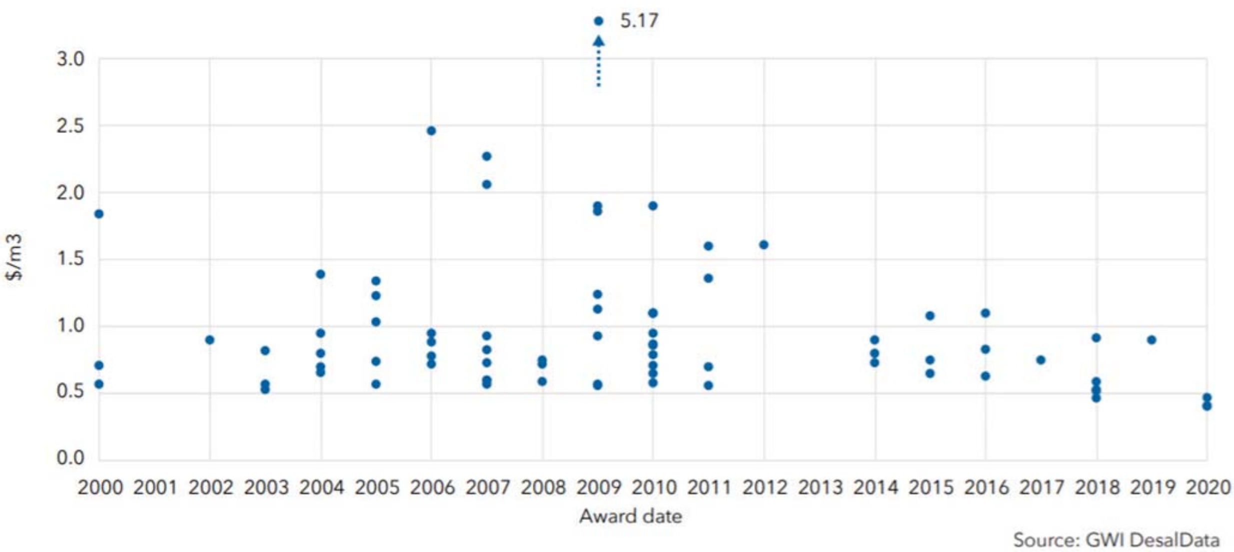


Figure 1: Price of desalinated water from IWP's since 2000 .

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The problem of course, is that these benchmarks are largely determined by data points from projects in the GCC and MENA regions: Israel, Saudi Arabia, the United Arab Emirates and so forth. The formidable challenge to the emerging desalination markets, such as South Africa, is to achieve similar prices, or just close to it. While the aim of this article is not to unpack the full dynamics of the various cost factors, the following are worth considering:

- Developers and EPC (engineering-procurement-construction) contractors value policy stability and predictability. Since South Africa cannot become a stable, mature desalination market like the UAE overnight, we could project stability to the market through policy certainty, integrity and a firm commitment to continuous off-take of the product. The antithesis would be the ad-hoc, drought insurance approach followed by most of the emerging market.

- An important element of going to the market, is to procure and contract in a manner that places risk where it can best be managed. Even though there would be a cost involved in the outplacement of risk, if it is then managed optimally, all parties will ultimately benefit. This dynamic is at play in the trend towards IWP (independent water plant) contracts, at the expense of DBOM (design-build-operate-manage) contracts.

- A strategic decision will be whether to own the desalination infrastructure, or not; this has far-reaching implications. Owning the plant does mitigate some fundamental risks, but it is the more onerous option; internal technical capacity is required to drive the complex procurement of a technology partner to design, build, operate and maintain the plant. Add to this the need for a strong balance sheet and the ability to raise considerable capital, and most South African water service authorities (WSA's) would not reach the bar, save for a few metros. The other option would be to pursue the market for independent water producers, offering a long-term concession to a site that had been properly vetted for the purpose. In this instance, the main obligations involve the site selection, a well-considered product water specification and the ability to commit to a robust, long-term water supply agreement; critical here, would be to demonstrate that tariff revenue can and will be collected from consumers.

- Further factors to consider would be the scale of the plant (ideally 150-200 Ml/d to allow good economy), contract duration (for the capital outlay to be amortised), production flexibility (a plant that can keep going through a red tide will cost more), and ideally access to low-cost renewable energy, within the range achieved by Round 4 of the REIPPP (Renewable Energy Independent Power Producers Programme) (R0.68-R0.82/kWh).

- After many years of desalination being relegated to a role of drought insurance, and frequently mismanaged in application, its time has come; it is now a prominent element of national water resource planning, as a base-load resource.

Furthermore, there is now evidence that the cost of large-scale desalination can be managed within reasonable parameters - provided that certain project-related and procurement-related guidelines are adhered to. Insight into the economics of desalination has deepened significantly over the past 18 months, largely due to the costing transparency from numerous IWP contracts awarded in the GCC region; future implementations in other markets stand to benefit from this. What is needed now is a strategic approach to establishing the planned capacity.