

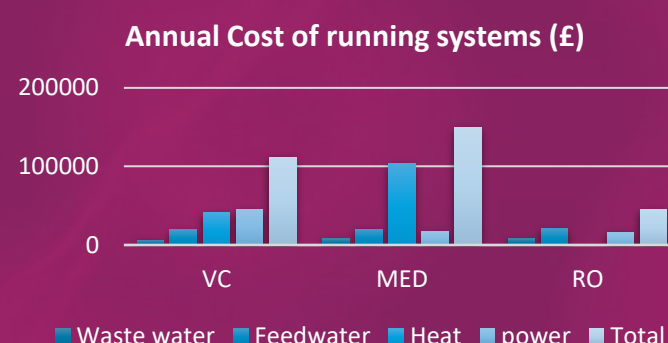
WFI Generation Reverse-Osmosis with Ultrafiltration

Delivery of a WFI generation system capable of 2000L/hr

- CGTC BMIC was set-up to support UK Covid 19 vaccine response
- Key considerations- speed of installation, available footprint, sustainability, capital and ongoing operational costs

Three technologies for consideration:

- Multiple Effect Distillation (MD) – Annual utility costs £149k
- Vapour Compression (VC) – Annual Utility costs £112k
- Cold loop Reverse Osmosis (RO) £45k



Introduction to technology or solution

There are perceived risks with membrane technology. This is mainly because the WFI produced by membrane technology isn't produced hot (+ 95oC) like distillation but is produced at ambient temperature. The perception is that the formation of biofilms is much more likely.

Our system design has been positively reviewed by both the MHRA and an independent GMP auditors

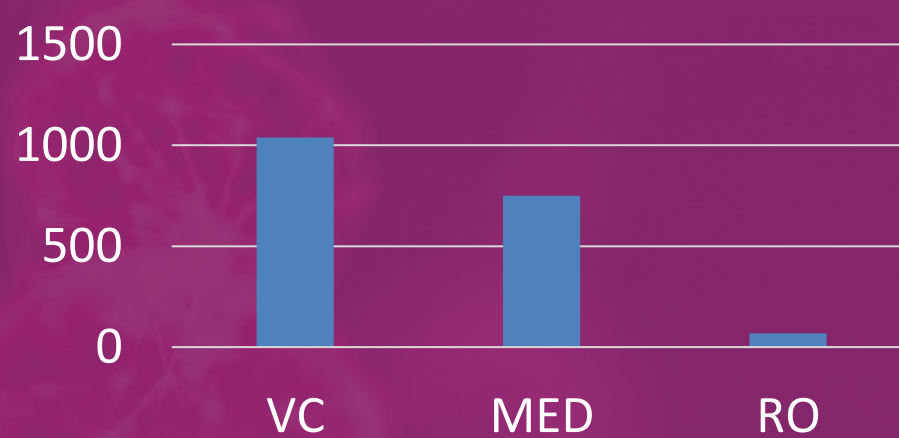
- Pre-treatment system
- Modular system utilising global leading technologies
- Twin-pass RO membranes for increased safety.
- Ultrafiltration as standard with additional Ultraviolet

Impact of solution



- Reduced OPEX costs
- Reduced Site CO2 profile
- Reduced freight CO2 profile
- Removal of existing steam plant
- WFI delivered to POU outlets within cleanrooms and labs.

CO2e/yr (Tonnes)



Considerations during implementation

- **Raw water quality** – including seasonal variations – The PQ needs to be conducted across a 12-month period to ensure quality is assessed during seasonal variations of incoming raw water quality that varies throughout the year.
- **Pre-treatment of raw water** – requires being capable of supporting the system volume required.
- **System flowrates** and **system storage capacity**.
- **Number of loops** – System distribution can be split across numerous loops and pumps to allow sectional system downtime.
- **Ozone monitoring and controls** – Our loops will be Ozone sterilised outside of manufacturing hours. The system inhibits valves from opening based on Ozone levels within water.