Clean TeQ Water Ltd

Entering the growth phase

Share Price: $0.66

ASX: CNQ
Sector: Industrials
19 August 2021

Clean TeQ Water (ASX: CNQ) is a water technology company that develops and sells customised turn-key water treatment plants to customers globally. Its core platform technology, Clean-iX, operates on the continuous ion-exchange principle. Based off Clean-iX, CNQ has built a portfolio of patented innovative technologies that seeks to capitalise on a range of verticals with an estimated combined TAM of >US$45B.

A portfolio approach to water treatment

CNQ's unique value proposition is reflected through its ability to deliver integrated solutions to address customers' water issues. This could result in operational efficiency and thereby enable customers to extract substantial internal synergies. We have also identified a number of competitive advantages that CNQ's technologies have over conventional treatment methods, which we expect to underpin customers' demand in its target markets, namely industrial brine treatment (cUS$20B), municipal water reuse (cUS$20B) and mining wastewater and metal recovery (cUS$5-10B). Furthermore, increased wastewater reuse initiatives across the world are also a strong and persistent regulatory tailwind that should drive deployment of water recovery solutions, in our view.

Optionality in graphene membrane

Since 2017, CNQ has been investing heavily in developing a novel membrane that utilises graphene oxide. By virtue of its competitive advantages over current polymeric membranes, we see CNQ's graphene membrane as a far better product, which we believe will likely disrupt the global multi-billion dollar and fast-growing micropollutant market (>$US2B). CNQ expects to launch it over the next 12-24 months. If CNQ can gain even a small market share, the incremental revenue contribution can be significant, in our view.

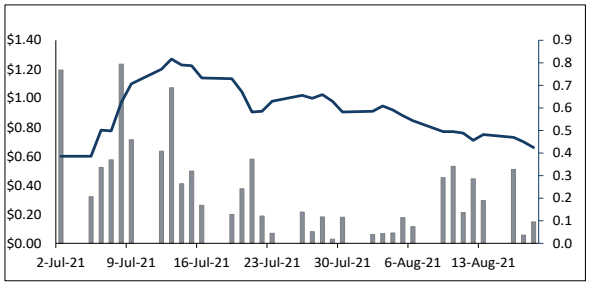
Valuation of $1.65 per share

Based on a relative valuation methodology, we estimate fair value for CNQ's water business at $1.65 – 2.18 per share. We think the recent retracement in share price is due to investors taking profits and re-directing their focus to earnings season. Given CNQ has been winning contracts and has a track record of successful project execution, we believe the momentum in contract wins will continue to build, which could result in higher-than-expected sales growth. Moreover, there is also option value in CNQ's ready-to-launch graphene membrane business, which effectively acts as a valuation support should any downside risks, as detailed on page 21, play out.

Market Cap. (A$ m)	29.5
# shares outstanding (m)	44.7
# share fully diluted	44.7
Market Cap Ful. Dil. (A$ m)	29.5
Free Float	69.4%
12 months high/low	1.45 / 0.50
Average daily volume (m)	0.2
Website	cleanteqwater.com

Source: Company, Pitt Street Research

Share price (A$) and avg. daily volume (m, r.h.s.)



Source: CommSec, Pitt Street Research

Relative valuation	
Fair value (A$ per share)	1.65 – 2.18

Source: Pitt Street Research

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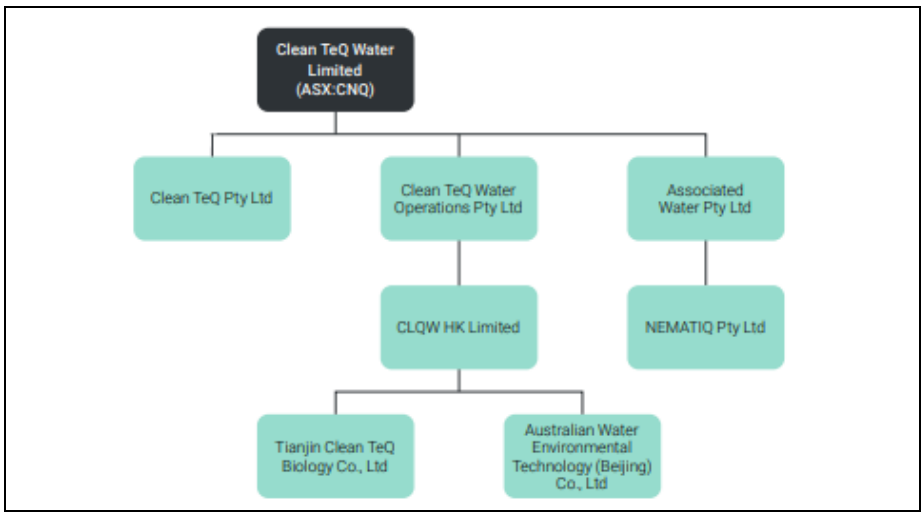
Introducing Clean TeQ Water (ASX: CNQ)

Company overview

CNQ is a global industrials company that develops and commercialises a wide spectrum of technologies for applications in water treatment and resource recovery. CNQ was recently demerged from Sunrise Energy Metals (ASX: SRL). It became a newly listed company on the ASX in July 2021, possessing a new corporate structure shown in Figure 1.

Figure 1: CNQ's corporate structure post-demerger



Source: Company, with further adjustment as per management guidance.

SRL's spin-off of its water business is well timed

When SRL became first listed on the ASX in 2007 under its former name Clean TeQ Holdings Limited, it had one simple focus which was to operate and grow its water business through the development and commercialisation of Clean-iX, a proprietary continuous ion-exchange technology designed for materials separation and purification. With this platform technology built, SRL initially targeted the mining industry by helping customers to purify and recycle wastewater as well as to extract and refine valuable metals.

Unlocking hidden value in the water business…

Realising the potential to capitalise on the vast mining industry by leveraging its Clean-iX technology, SRL set up a metals business in 2014 and acquired a mineral project now known as the Sunrise Project. This project will utilise Clean-iX to produce lithium-ion battery cathode materials aiming to capitalise on the rapidly growing electrical vehicle battery market.

Meanwhile, over the decades, SRL had also achieved significant progress with its standalone water business which saw it developing new technologies and entering into commercial scale project contracts with customers in markets unrelated to the Sunrise Project.

As the water and metals businesses have recently reached a juncture where both businesses have different operating models, growth objectives and addressable markets, SRL's board and management decided to spin off its water business so to unlock its full potential by allowing it to operate as a standalone company.

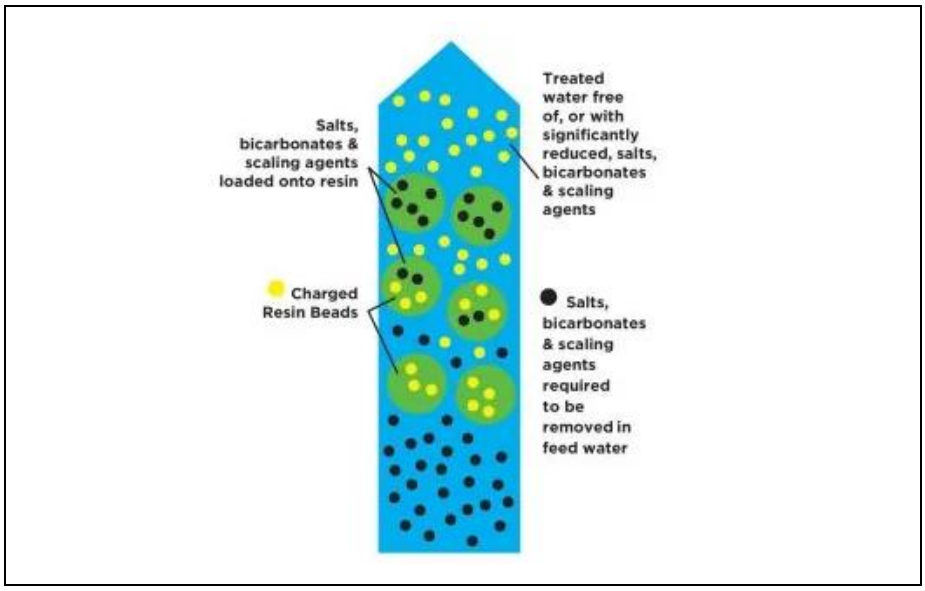
CNQ's core platform technology – Clean-iX

Clean-iX is built on the principles of continuous ion exchange, a chemical process used in applications for water treatment and metal recovery. Its base technology was initially developed in early 1950s by All Russian Research Institute of Chemical Technology and had been used in >30 mining operations predominantly for uranium and gold extraction. In 2000, SRL obtained the exclusive license to this base technology and subsequently further developed it to create its own proprietary Clean-iX technology, which can be adapted to recover and purify a range of different metals in the mining industry including precious, base and rare earth metals.

Capturing the significant water treatment market…

Apart from its application in metal recovery, Clean-iX's ion exchange process can also be applied to the significant and growing water treatment industry. In a nutshell, ion exchange simply refers to a chemical process that seeks to take away dissolved ionic contaminants from water. The process takes place between a solid (typically a resin) and a liquid (water), in which the problematic ions that come in contact with the resin will be swapped for other same charged more desirable ions available on the resin surface (Figure 2). Also, it is worth noting that resins must be properly recharged in order for the ion exchange process to happen smoothly.

Figure 2: Ion exchange process



Sources: Company

Based off its platform technology, CNQ has built a portfolio of products and services for numerous water treatment applications

Figure 3 on the next page displays the range of trademarked water treatment technologies CNQ has developed and commercialised. Please see appendix for details on how those technologies work. For now, we note the following:

A portfolio approach to capture technology value and yield substantial internal synergies…

- CNQ's portfolio approach allows it to implement **integrated solutions** to tackle customers issues, demonstrating its unique product proposition. For instance, BIONEX integrates two standalone technologies, comprising an ion exchange technology (CIF) and an encapsulated bacteria lens technology (BIOCLENS). CIF allows for selective removal of nitrates from water whilst BIOCLENS converts nitrates to nitrogen gas. Also, we think this level of integration between technologies could drive up operational efficiency and thereby allow customers to extract internal synergies.

- CNQ's **technologies can be customised** to meet the unique requirements of end customers. Given that the regulatory standards, water quality and climate conditions vary across different parts of the world, each water project need to be carefully tailored and extensively tested to ensure that robust outcome can be achieved at the lowest possible cost. In our view, CNQ's ability to tailor to customers' specific requirements is a competitive advantage and critical to gain market shares.
- **Strong product adaptability** to variable water conditions enables CNQ to compete in underpenetrated niche markets where problems are often inadequately addressed by existing technologies.

Figure 3: CNQ's portfolio of water treatment technologies

Source: Company

CNQ's technology portfolio can address multiple industry verticals

Figure 4 summarises the key industry verticals CNQ's technologies are and will potentially address. Importantly, note the wide applicability of the products diversifies CNQ's business, thereby reducing concentration of its exposure to one particular market. Further, we believe there is a likelihood that CNQ will continue to leverage its Clean-iX technology platform to innovate and develop products targeting new applications and verticals.

Figure 4: CNQ's industry verticals and applicable technologies

	Industrial brine	Municipal reuse	Mining	Micropollutant
Est. market size	US$20B	US$20B	US$5-10B	US$2B
Suitable technologies	HIROX, EVAPX, BIOCLENS	BIONEX, HIROX	CIF, DESALX	Graphene Membrane
Technology applications	**HIROX & EVAPX**: Treatment of industrial wastewater and brine for reuse and/or discharge **BIOCLENS**: Nitrates removal from brine	**BIONEX**: Cost effective nitrate treatment for reuse **HIROX**: High water recovery for reuse for potable, industrial or irrigation	**CIF**: Removal and recovery of targeted metals **DESALX**: Removal of mineral content and sulphate from water	Removal of organics from drinking water and wastewater
Stage of development	Commercialised	Commercialised	Commercialised	Pre-commercialisation

Sources: Company

What is CNQ's business model?

Building a consumable business on top of its core water treatment business…

CNQ's core business focuses on selling integrated water technology solutions to global industrial customers via a direct sales model. It initially earns a one-off contract revenue stream from working installations (median contract value of A$2-3M) followed by a recurring revenue stream from the provision of after-sales inspection and maintenance services. We also note CNQ's potential to secure higher valued contracts (cA$10-20M), underscoring its revenue upside. As per management's estimate, a pilot-scale project can take anytime between 2-6 months to complete, largely depending on the particular vertical/project. Hence, we use this time range as our yardstick to measure the company's average sales cycle. On the back of its core business, CNQ is also building a consumable business. This involves selling resins, membranes and BIOCLENS, which are consumables needed to keep the water treatment plants functioning. Accordingly, the growth of CNQ's consumable business is mainly driven by its core business. If CNQ is able to scale up its installed plant base, its consumable business should grow naturally because increased customer numbers should translate to increased order volumes for resins, membranes and lenses. As these products are repeat consumables, CNQ should generate a predictable and growing recurring revenue stream over time, in our view.

…to generate a predictable and growing recurring revenue stream

CNQ has multiple patents and extensive know-how related to its water treatment and processing technologies

Over the past two decades, SRL invested extensively in R&D and accumulated significant know-how in the ion exchange and water purification space. Post demerger, IP relevant to its water business have been transferred to CNQ, including over 10 patents and related brands and technologies. Additionally, products within CNQ's portfolio have been individually trademarked so to enhance and protect brand identity. We are also cognisant of the varying level of IP risks in different regions and their associated impact on CNQ's future operations and profitability. However, given the complexity and extensive know-how involved in installing and customising a water project to meet a customer's specific requirements, we argue the barrier to replicate is high.

Inside the growth phase – CNQ's near term focus is to grow sales of its unique water purification systems in selected sectors and regions

With a resourceful technology portfolio, CNQ is well-equipped to embark on its growth journey in the large global water treatment industry. Its recent contract wins in 2021 demonstrate continued momentum in product sales, which we believe will likely persist in the near term as management has prioritised to focus on converting near term project opportunities into new contracts. CNQ is currently working on a number of pilot scale trials, which if successful in proving the efficacy of its water treatment systems, could lead to the conversion of several large-scale project opportunities. This should underpin CNQ's near term revenues and cashflows. Also, the company's recent ramp up in marketing activities should increase its chance to identify and secure new projects.

Recent contract wins validate CNQ's business model which should drive continued uptake of its technologies

We have structured our report to focus on the target markets CNQ is seeking to address. Within each of its target markets, we then drill into CNQ's relevant technologies, competitive position and growth drivers to form a view on its investment case in the medium to long term.

Industrial brine

What is brine and why is it important to treat it?

Brine is a concentrated salt waste byproduct created every day by various industrial processes such as seawater desalination, oil and gas extraction and food and beverage processing. Depending on the specific industrial process, its composition can vary significantly in terms of its concentration of salts, nutrients and other contaminants. This means treatment processes are highly specific for every customer. When improperly treated, brine waste can cause harmful effects on 1) aquatic environment and humans if it gets discharged into waterways or 2) industrial facilities and equipment if it gets recycled for reuse. As such, proper treatment is essential and can result in environmental and financial benefits for industrial facilities across the globe.

Industrial brine treatment is a multi-billion dollar and expanding market

According to management estimates, annual market size for global industrial brine treatment market is worth >US$20B. We expect to see further market growth, underpinned by:

CNQ facing strong global regulatory tailwinds…

- **Stricter environmental regulations** – As public environmental awareness increases, brine waste discharge regulations are likely to become stricter. This should drive a leg of growth for the market as industrial customers will be required to treat brine or incur heavy fines.
- **Public pressure for water preservation** – which may result in restricted groundwater withdrawal. This encourages industrial customers to recycle and adequately treat brine streams for reuse in their industrial processes. This in turn should drive demand for brine treatment technologies.
- **Drought issues** – highlight growing water scarcity and the importance to reuse water that has been recovered from brine treatment processes. According to Environmental Defense Fund, future droughts are expected to last longer and become more severe, hence driving the need for more brine wastewater recycling.

To summarise, the above market growth drivers are important for CNQ as they highlight various tailwinds facing the industrial brine treatment market. In our view, this should result in higher customers' demand for treatment solutions including those that are currently being offered by CNQ. If CNQ can capture this growth we expect material upsides to accrue to the business over the medium to long term. This will be on top of the market share growth which we will discuss in the following sections.

Overview on conventional brine treatment techniques

CNQ's water solutions have an edge over conventional treatment methods

Figure 5 lists some of the conventional brine disposal/treatment options and highlights their pros and cons and cost implications. While these options are largely focused on brine that has been generated by desalination processes, we believe some of them such as membrane-based technology are also applied by various other industrial users.

Figure 5: Various brine treatment options for desalination plants

Brine Treatment Technique	Cost (US$/m^3)	Advantages	Disadvantages
Surface Water Discharge	0.05–0.3	Available and cost-effective for all desalination plants	Damage of ecosystem, discharge of chemicals of membranes cleaning
Fixed bed column softener	–	highly efficient with relatively low cost and energy requirements	Degradation and oxidation in some cases, discharge of excess NaCl to the aquatic environment
Solar concentrators (solar ponds)	–	Low cost, a valuable by-product	Requires a lot of maintenance, requires large land areas, needs adequate sunlight
Evaporation Ponds	3–10	Salt production, low maintenance and little operator attention	High footprint and costs,
Land Applications	0.74–1.95	Easy operation and implementation	limited to small plants
Deep Well Injection	0.54–2.65	Low energy consumption, moderate cost	Groundwater contamination
Sewer Discharge	0.32–0.66	Low cost and energy consumption, easy implementation	Limited to small size flows
Membrane-based technology (HP-RO)	0.75–0.79	High production of desalted water	High cost because of frequently membranes replacement
Forward osmosis	0.63	Efficient with high salt content	Low production of water
Thermal-based technology	0.09–1.2	Efficient with high salt content	High energy consumption

Source: Ali, M.E.A. Nanofiltration Process for Enhanced Treatment of RO Brine Discharge. Membranes 2021, 11, 212.

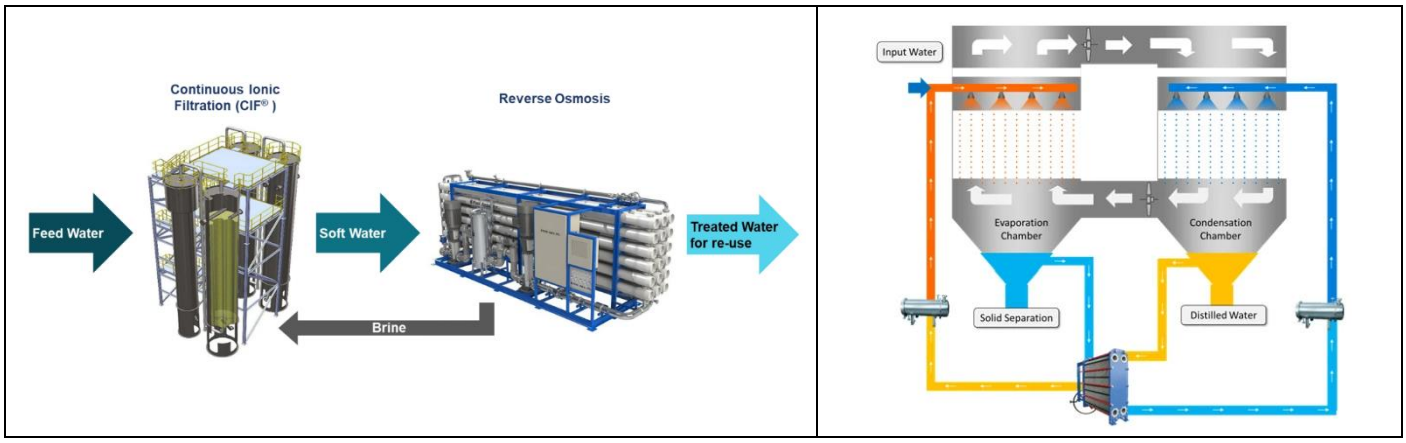
CNQ's zero liquid discharge (ZLD) offering

To allow industrial customers to achieve high water recovery and minimum waste production, CNQ offers an affordable ZLD solution that integrates several of its portfolio technologies:

Unique and differentiated technology proposition…

- **HIROX** (Ultra High Recovery Reverse Osmosis) – is a cost-efficient water treatment process that integrates CIF with RO (Figure 6). It works by firstly using ion exchange to remove specific unwanted ions such as calcium, magnesium and heavy metals from wastewater. By doing so, it can remove potential scaling of membranes and thereby make the follow-on RO process more efficient and long-lasting. This ultimately leads to the production of high purity water (>95% recovery rate) and low brine waste volumes. Recovered water can be reused for industrial applications while brine can be deployed back into CIF for resin regeneration saving chemical usage. Overall, total brine volumes are minimised, meaning lower disposal cost for customers.
- **EVAPX** – is a low energy evaporation technology. As shown in Figure 6, wastewater would initially enter the evaporation chamber where it is subsequently evaporated using dry air, leaving waste solids behind. Meanwhile, the condensation chamber would absorb the humidified air and then condense it to form distilled water. It is also worth noting that the system can recover heat energy, which results in margin upsides for customers through reduced power cost and opex. Effectively, EVAPX helps industrial customers to achieve ZLD in a cost-efficient manner. Also, it can be deployed both as a standalone technology or in conjunction with HIROX.

Figure 6: HIROX (left) & EVAPX (right)



Source: Company

CNQ's fully integrated supply chain for BIOCLENS ensures supply continuity and margin control

CNQ's technologies allow for targeted ammonia and nitrate removal

Industrial brines can accumulate contaminants that are harmful to humans and aquatic life. These include nitrates and ammonia. Excess levels of nitrates have been found to cause blue baby disease as well as algal blooms. As such, adequate removal is necessary so to ensure that the effluents can be safely disposed into the environment or reused for industrial purposes.

- **BIOCLENS** – can effectively convert high initial ammonia and nitrates concentrations (>1,000ppm) to very low target levels (<1ppm). It uses lens-encapsulated bacteria to stimulate biological reactions that seek to break down and convert ammonia and nitrates to harmless nitrogen gas. CNQ has its own lens production facility in China, thus providing supply chain assurance and continuity as well as margin control. The lenses are also repeat consumables that should result in recurring cash receipts to accrue to CNQ. We expect sales of this consumable to grow substantially over time should CNQ be able to drive up the uptake of this technology.

CNQ has a number of competitive advantages over conventional brine treatment strategies

- **Scaling resistance and lower opex** – Membrane-based technologies may experience the potential for scaling caused by alkaline and heavy metals and other contaminants in wastewater. This can impede water recovery which in turn can result in higher brine volumes, meaning higher disposal cost. CIF effectively acts as a pre-treatment for the RO and removes this scaling potential by using ion exchange to discard those contaminants and therefore allows RO to process more efficiently. This should result in higher water recoveries and lower brine volumes, translating to lower opex. Moreover, scaling can also lead to frequent membrane maintenance and replacement, resulting in higher opex as illustrated in Figure 5. This further highlights HIROX's operational cost advantage over conventional RO, in our view.

Zero Liquid Discharge is a key offering in the push for water sustainability

- **ZLD** – EVAPX's ability to convert industrial brines into high quality effluent water and solid product for disposal or for salt recovery. This technology brings many benefits including 1) relieving water shortage problems, 2) eliminating liquid components, meaning reduced disposal management cost and minimal damage to aquatic life and 3) recovering valuable semi-dry salts. The zero liquid aspect is particularly attractive for customers located in certain places (e.g., arid areas) where the cost for liquid waste disposal can be high. Further, we believe the push for sustainability and

stricter environmental and discharge regulations will likely result in more companies transitioning towards ZLD.

- **Low energy evaporation** – As shown in Figure 5, common evaporation systems have been noted as energy intensive and costly. However, EVAPX can be powered and operated by waste heat energy which in turn can be recovered during its evaporation process. This results in cost savings and fortifies EVAPX's product proposition as a cost-effective ZLD solution.
- **Ability to remove high concentrations of ammonia and nitrate** – An issue often encountered by conventional technologies, which CNQ can effectively resolve using its BIOCLENS offering.
- **High operational efficiency** – CNQ has indicated that its flowsheets can be customised and simplified. This means its systems are easy to set up and operate, highlighting their capex and opex efficiency.
- **Unique technology set-up** – HIROX's integration of CIF and RO allows for the residual brine to be reused for resins regeneration. This lessens brine disposal burden and cost.

A strong competitive position to win market share and deliver solid organic growth in the medium to long term….

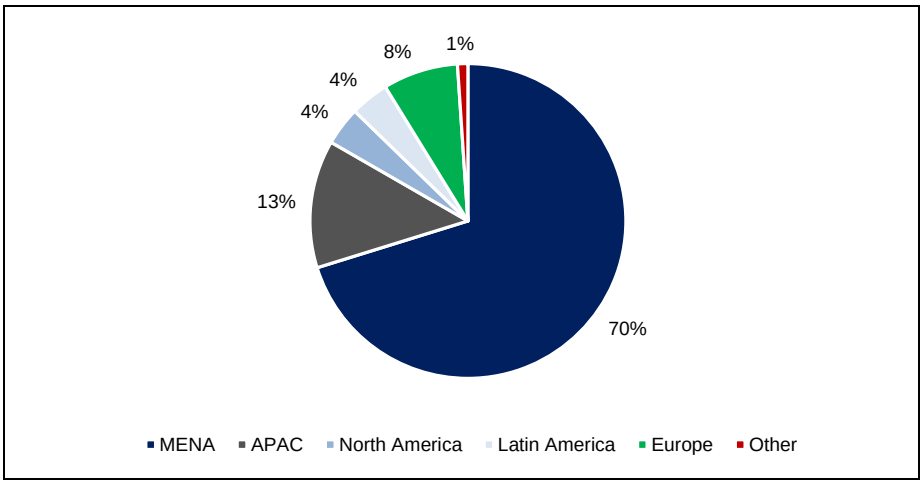
Overall, we think CNQ has a strong product proposition in the industrial brine treatment market, represented by the competitive advantages of its various offerings discussed above. We expect this to result in CNQ winning market share and thereby delivering solid organic growth in the medium to long term. Moreover, the industry tailwinds and market growth discussed earlier should provide further upsides to CNQ's future sales growth, in our view.

We expect the NESR partnership to help drive penetration in the vast MENA and APAC markets and therefore deliver another leg of growth for revenue over the medium term

CNQ has entered into a commercial partnership with National Energy Services Reunited Corp. (NASDAQ: NESR), a leading oilfield services provider in the Middle East and North Africa (MENA) and Asia Pacific (APAC) regions. We suspect that management's aim of this partnership is to leverage NESR's extensive customer network to drive penetration in the vast oil and gas brine treatment industry in the MENA and APAC regions. If CNQ can make this happen, the upside potential to its revenues and cashflows can be immense, given MENA and APAC produce >80% of global brine volume (Figure 7).

Figure 7: Global brine production by geography split

Note MENA's large brine production volume and its implication on CNQ's future revenues and cashflows



Source: Jones, E., Qadir, M., van Vliet, M. T. H., Smakhtin, V., & Kang, S. (2019). The state of desalination and brine production: A global outlook. Science of The Total Environment, 657, 1343–1356.

Municipal wastewater reuse

We expect to see an upward global trend towards wastewater treatment and reuse

Growth in the global municipal wastewater reuse market, which is estimated to be >US$20B pa, is underpinned by the increased number of municipalities, councils and businesses turning to recycled water for a specific end-use such as irrigation, agriculture, industrial applications or potable use. We think their motivation is to improve water security and sustainability. Yet, the core underlying driver, in our view, is the scarcity of water supply across the globe, particularly in arid regions. As such, we think it is imperative to work out the possible factors that contribute to water scarcity and then determine whether they will likely persist over the medium term. We think these factors are:

Our view is that these market growth drivers are structural…

- **Expected growth in population and urbanisation** – The United Nations estimates that the world's population will reach c9.7B by 2050 (vs c7.8B today, i.e., +24%). Included within this growth is the continued rise in ageing population, which is a structural factor, in our view. This means freshwater demand in uses including industry, agriculture, energy and domestic will increase substantially over the next several decades. This will place significant pressure on our already limited freshwater supplies and distribution networks.
- **Climate change** – causes changing hydrologic cycle which results in unpredictable precipitation patterns and intensity, ultimately leading to extended droughts and water shortages in some regions and severe flooding and cyclones in others. A warmer climate also amplifies the effects of water scarcity and drives up the demand for water as more water is needed for uses such as agriculture and industry cooling. Although governments across the world are working hard to mitigate and reduce greenhouse gas emissions, we think the effects of climate change will likely persist in the short to medium term.

We expect more wastewater reuse initiatives to be implemented over the medium term, which in turn should drive significant deployment of effective water recovery technologies

Given the impacts of water shortages are expected to persist in the foreseeable future, we envisage that public pressure for water conservation will continue to grow. To date, we have already seen some governments across different parts of the world introducing wastewater treatment and reuse initiatives (see below). Further, based on the current statistics showing an average global municipal effluent reuse of <5% which is heavily skewed towards water-stressed cities like Singapore and Israel, we view this is only the tip of the iceberg with many more countries expected to move towards this direction and pursue wastewater reuse.

Increased wastewater reuse initiatives are potent catalysts that are likely to drive deployment of water recovery solutions, such as CNQ's HIROX technology

- **Western Australia** – its government has set a long-term vision to recycle 30% of all wastewater in the state by 2030, increasing to 60% by 2060.
- **China** – has devised a 5-year plan (2020-2025) outlining wastewater reuse targets ranging from 25-35% in water-stressed regions. This drives the need to deploy new or upgraded treatment plants over the next few years. Based on estimates from China Ministry of Housing Data, this is a cUS$4B market opportunity.

We believe this is favourable for CNQ as these global regulatory tailwinds will drive more customers to invest in innovative and climate-independent water technologies that can perform high water recovery and recycling, for instance CNQ's HIROX technology. This could combat the effects of climate change and therefore foster longer term resilience in water availability, in our view.

How does CNQ help customers to achieve wastewater effluent reuse?

Resistance to scaling, brine minimisation and lower total cost of ownership underscore CNQ's competitive position

CNQ has developed a portfolio of technologies that combines continuous ion exchange, RO treatment and encapsulated bacteria technologies to provide customers reuse of municipal wastewater effluent. As explained earlier, its **HIROX** technology can provide high water recovery which can be then reused for various industrial and portable applications. Its competitive advantages over conventional processes such as resistance to scaling, brine minimisation and lower total cost of ownership should drive its commercial uptake, in our view. Importantly, it is worth noting that in 2020, CNQ has won a cA$16M tender to provide a large-scale water recycling plant utilising HIROX and BIOCLENS to Townsville City Council in Queensland, Australia. So far, CNQ has been engaged for the initial design component estimating cA$0.9M. Management is currently targeting award of the final EPC contract in 4Q of 2021. We see this deal as reflective of customers' recognition of CNQ's technologies and their suitability at achieving effluent reuse. More recently, CNQ won a A$3M contract for the instalment of a HIROX plant in the Middle East. The plant aims to treat bore water used for enhanced oil recovery. We are encouraged by this deal and believe that its successful completion will likely drive significant deployment of this technology across the vast oil and gas sector in the MENA and APAC regions.

Momentum in contract wins continues to build…

Apart from HIROX, CNQ also offers an alternative solution known as **BIONEX**, which integrates CIF and BIOCLENS to effectively achieve a similar goal of maximising water recovery while minimising brine consumption. Its BIOCLENS can treat trace pollutants such as concentrated nitrates in brine by converting them to nitrogen gas. We believe BIONEX's competitive advantages are 1) its capability to remove trace nutrients in wastewater, and 2) its smaller site footprint versus other biological treatment methods.

Execution of pilot programs expected to drive strong near-term sales growth

Pilot programs on cusp of converting into large-scale contracts…

CNQ is currently working on a number of pilot scale projects utilising its HIROX, BIONEX and BIOCLENS technologies for municipal wastewater treatment and reuse (Figure 8). Based on management estimates, the time to complete a pilot program varies among projects which can take anytime between 2-6 months. Our estimate shows that if we assume CNQ can prove up the efficacy of its systems for its pilot customers, CNQ should be able to secure some commercial-scale customer contracts around 1Q CY22 as each pilot program has been noted by CNQ to be directly linked to one or more large scale projects. This should drive a material uplift in CNQ's near term sales growth.

Figure 8: Selected CNQ technologies & their development status

Technologies	Customer / Location	Project / Application	Status
HIROX & BIOCLENS	Townsville City Council, Queensland, Australia	Large-scale water recycling plant utilising both HIROX and BIOCLENS	Secured initial cA$0.9m for design; targeting award of EPC contract in 4Q CY21
HIROX	South Australia	Sewage effluent reuse	Preparing pilot
BIONEX	Tianjin Steel	Steel wastewater polishing of nitrate	Hot commissioning
BIOCLENS	Tianjin Aquaculture	Aquaculture nitrate removal for water recycling	Pilot testing

Source: Company

Mining & metal recovery

Water treatment plays a significant role in the large global mining industry

Based on estimates from Research and Markets, the global total addressable market for mining water and wastewater treatment was valued at c$5B in 2018 and is expected to grow to c$8B by 2023, representing a 5-year CAGR of 11%. Market growth will be underpinned by overall growth of the mining industry, stringent wastewater disposal regulation and industry's transition towards sustainability.

What's also important, in our view, is to drill into the factors driving the importance of water treatment in the mining industry. These factors are:

27% of mining production is estimated to be at risk from water stress by 2030…

- **Availability of quality water** – is crucial because mining consumes large volumes of water, particularly during the phases involving the extraction and processing of ores. This is a growing global concern as per CNQ's data, 27% of mining production is estimated to be at risk from water stress by 2030. We believe this risk will be more common for mines located in arid regions. We also note the importance of water quality on mine sites as it affects the stability and performance of flotation circuits. As such, it is becoming increasingly paramount for mining companies, both existing and prospective, to explore avenues to enhance their water security. One of these avenues is to implement technologies that provide treated water suitable for reuse. And CNQ has appropriate offerings, in our view.
- **Mining wastewater is complex and difficult to treat** – it can be very acidic and can contain high concentrations of suspended solids such as calcium, magnesium and other heavy metals that can pose risks to human health. Mining also results in acid drainage and tailings which can severely pollute nearby water bodies if they are disposed without proper treatment. Thus, adequate treatment of mining wastewater is vital to ensure that it can be safely discharged to the environment or reused for further processing.

Potential profit stream from sales of recovered base and precious metals

- **Metal recovery** – a valuable functionality for mining companies because leached solutions and slurries can contain base and precious metals like copper and gold that can be extracted for better uses. We see two main benefits including 1) potential realised profit to offset capex and opex and 2) environmentally friendly due to lower volume of waste for disposal.

In our view, CNQ's CIF technology is strongly positioned to capitalise on the large and growing global mining wastewater and metal recovery market

As per our discussion earlier, CIF utilises ion exchange to attract and remove target ionic species from wastewater. By taking away targeted contaminants, CIF effectively allows customers to recycle a large portion of the treated water for reuse in their processing plant. Thus, CIF helps customers to strengthen their water supply and security.

Compared to conventional water treatment methods, we think CIF has a stronger competitive position due to 1) its high resistance to scaling and fouling, resulting in its ability to recover higher volumes of water, and 2) its metal recovery functionality as the targeted metal ions can be adsorbed onto resins and then further treated for recovery. Moreover, we view that CIF has a compelling value proposition, owing to its unique ability to selectively target and recover metals from mining waste streams as desired by customers.

CNQ has a track record of successful project delivery

Importantly, CIF is a proven technology that has been commercialised in multiple geographies. On delivered projects, CNQ has built a A$0.6M CIF plant for a customer in Oman to assist with their water reuse (Figure 9). In the DR Congo, a A$2.4M Clean-iX plant was built to treat 20,000 cubic meters per day of a cobalt raffinate stream. Earlier this year, CNQ was awarded a new contract to upgrade the Oman CIF plant. Elsewhere, CIF has been deployed in

a pilot program in China for the removal and recovery of copper from copper and gold mining wastewater. CNQ is currently preparing resin testing at the customer's mining site. This pilot scale trial is significant, in our view, as it strengthens CNQ's footprint in China which should likely result in new contract wins in the distant future.

Figure 9: CNQ's CIF plant in Oman

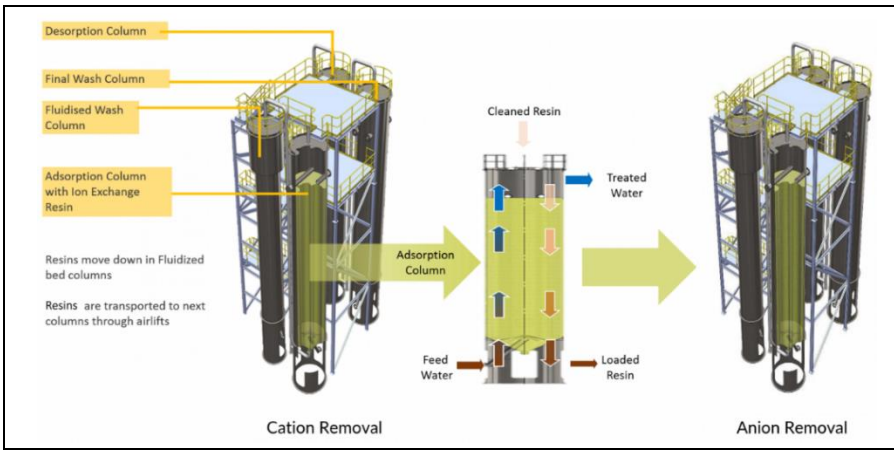
Sources: Company

DESALX demonstrates CNQ's technological flexibility…

Optionality to integrate two CIF modules to create a DESALX configuration that is useful for achieving brine free desalination as well as ZLD

DESALX, CNQ's membrane free desalination technology, is mainly applied for the removal of sulphate from mining wastewater. It comprises a two-stage CIF, where CIF 1 is aimed at removing cations such as calcium and magnesium present in feed water whilst CIF 2 is responsible for taking away anions such as sulphate (Figure 10). The resultant gypsum-based brine can be then further converted into gypsum solids by pairing it with lime participation and thereby achieve ZLD for customers. Alternatively, treated water can further undergo RO to produce quality water for reuse. In 2019, CNQ successfully proved and commercialised DESALX through its A$4.2M gold mine wastewater project in Victoria, Australia. Given the complexity of mining waste streams, we think CNQ's DESALX solution will be increasingly deployed in the industry especially considering the positive outcomes it can achieve for mining customers.

Figure 10: DESALX's operational breakdown



Sources: Company

Graphene Membrane offers optionality

Through years of R&D investments, CNQ has now reached a juncture where it is on verge of commercialising its Graphene Membrane technology

Since 2017, CNQ, through its wholly owned subsidiary NematiQ Pty Ltd, has been heavily investing in the development of a novel membrane that utilises graphene oxide. In simple terms, it is an advanced water filtration technology that is aimed at capitalising on the global multi-billion dollar and fast-growing micropollutant market.

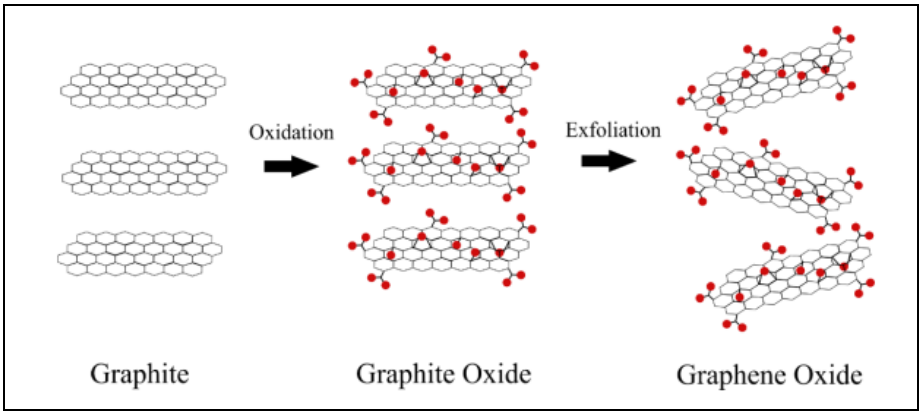
Figure 11: Graphene Membrane

Sources: Company

Patent applications filed by NematiQ to lock in its differential advantage

The proprietary process developed by NematiQ is two-fold: 1) manufacturing high-purity graphene oxide from raw graphite oxide material, and 2) applying graphene oxide to a membrane support to produce a graphene nanofiltration membrane, also known as the Graphene Membrane (Figure 11). With additional research, we have shown in Figure 12 the chemistry behind graphene oxide. On 15 June 2021, NematiQ filed patent applications related to its filtration membrane technology, which if granted, should better equip the company to win share and therefore fortify its market position, in our view.

Figure 12: Chemistry behind graphene oxide



Sources: M Zunita et al 2018 IOP Conf. Ser.: Mater. Sci. Eng. 395 012005

Commercial launch expected within the next 12-24 months

NematiQ has its own production facility based in Notting Hill, where it focuses on optimising and manufacturing high purity graphene oxide, ensuring supply assurance. Its technology has now reached the pre-commercialisation stage where the company is currently organising the scaling-up of manufacturing. Management expects to launch this product into the market within the next 12-24 months.

What is the market potential for Graphene Membranes?

Management estimates the global micropollutant total addressable market is c.US$2B in 2022, growing to US$3B by 2028, representing a CAGR of 7.0%. We think the key drivers of market growth are 1) higher demand for drinking and industrial water which in turn is driven by rapid urbanisation and population growth and 2) stringent micropollutant discharge requirements.

Global TAM of cUS$2B in 2022, growing to US$3B by 2028, representing a CAGR of 7.0%

We acknowledge the micropollutant market potential appears material, but we think it is more important to drill into its market segments so to better understand the potential applications for Graphene Membranes. We attempted to divide the micropollutant market into two segments, comprising a large-scale segment and a niche segment. The large-scale market segment deals with the removal of organic substances from groundwater and wastewater, whilst the niche segment focuses on certain industries such as food and beverage that typically consume large volumes of water in their daily production processes. In our view, customers in both of these market segments will stand to benefit from using NematiQ's Graphene Membrane and below we will explain our reasons.

Graphene Membrane has powerful competitive advantages versus conventional membrane separation technology

Based on our industry research, we note the membrane separation market is currently dominated by polymeric membranes, predominantly driven by its cost-effectiveness, good selectivity and easy processability[1]. We then further researched into a graphene-based membrane and learned its important benefits over the current polymeric membrane (see below).

Durable competitive advantages are evident in Graphene Membranes…

- **Higher water flux rate** – Graphene is noted to be thinner than polyamide thin-film composite membranes (c0.34 nm versus c100 nm)[2]. Given that water flux rate is inversely proportional to a membrane's thickness, Graphene Membranes should thereby have stronger water permeability than conventional polyamide membranes. In simpler words, it means Graphene Membranes allow water to flow through it much quicker than existing membranes. This can potentially result in lower energy usage and thereby generate substantial cost savings (lower opex) for users.
- **Higher chemical resistance** – Conventional polymer membranes often experience difficulties when operating in high chemical concentrations typically encountered in many industrial processes. However, graphene-based membranes, owing to its unique carbon composite chemistry, are more chemically resistant and therefore could work more effectively in various chemical conditions. This means graphene-based membranes could potentially become industrially relevant, which in our view reflects the technology's ability to capture its market potential.
- **Higher fouling resistance** – Due to its antimicrobial properties, graphene oxide has the operational advantage of lower membrane biofouling[3,4]. Therefore, by utilising graphene oxide as part of the filtration process, the resultant membrane should gain an edge in hindering membrane fouling. This in turn should extend membrane life, resulting in lower replacement and maintenance costs for customers.

To summarise, we view NematiQ's Graphene Membrane as a game-changer in the membrane separation space. This is evident in its competitive

[1] Fard A.K., McKay G., Buekenhoudt A., al Sulaiti H., Motmans F., Khraisheh M., Atieh M. Inorganic Membranes: Preparation and Application for Water Treatment and Desalination. *Materials*. 2018;11:74.
[2] Homaeigohar S., Elbahri M., Graphene membranes for water desalination. *NPG Asia Materials* (2017) 9, e427.
[3] Goh, P. & Ismail, A. Graphene-based nanomaterial: the state-of-the-art material for cutting edge desalination technology. *Desalination* 356, 115-128 (2015).
[4] Mahmoud, K. A., Mansoor, B., Mansour, A. & Khraisheh, M. Functional graphene nanosheets: the next generation membranes for water desalination. *Desalination* 356, 208-225 (2015).

advantages over conventional membranes, which ultimately yield operational and cost efficiencies for customers. As such, we anticipate a strong commercial uptake of Graphene Membrane when and if the technology enters the market.

Graphene Membrane is expected to strengthen CNQ's consumable business

We think NematiQ's likely business model is to sell Graphene Membranes as a repeat consumable into the micropollutant market. This will ultimately help CNQ to build up its separate consumables business and generate recurring revenues. Further, as per our reasoning above, we expect NematiQ will have initial success in building scale, which if proves to be correct, should lead to a growing recurring revenue base, in our view.

In our view, NematiQ's Graphene Membrane has an early mover advantage, which should help drive its market dominance

An early mover advantage to drive market dominance…

While graphene membranes have been extensively researched and discussed in a lab setting, their adoption in industry, which we interpret to mean the product's performance in realistic industrial water streams, appears elusive.[5,6] In contrast, NematiQ's Graphene Membrane has been produced and demonstrated at pilot scale and showed initial success in 1) achieving the commercial target molecular weight for nanofiltration (c.1,000 Daltons), and 2) a higher flux rate versus existing polymer nanofiltration membrane. Accordingly, we believe NematiQ is well-positioned to be one of the world's early graphene membrane technology providers and therefore, has an early mover advantage in capitalising on the multi-billion-dollar micropollutant market. This should provide NematiQ with an edge at gaining market dominance, in our view. Moreover, due to its competitive advantages as described earlier, we think NematiQ's Graphene Membranes will likely win share from the existing polymer membrane providers, which we believe will further fortify the company's market share position.

Graphene Membrane enables significant optionality, which we expect to underpin upside potential for shareholder value in the medium term

Embedded optionality to provide valuation upside…

We see optionality embedded in NematiQ's Graphene Membrane technology which could ultimately be worth multiples of what the market is currently paying for at the current share price level. If NematiQ can gain even a small market share, the incremental revenue contribution for CNQ would be significant, in our view. We believe it is important to emphasise on these three points 1) micropollutant market opportunity is material, 2) Graphene Membrane is at pre-commercialisation, and 3) CNQ has a strong R&D capability to make available complementary water purification technologies for customers.

[5] Kwon, O.; Choi, Y.; Choi, E.; Kim, M.; Woo, Y.C.; Kim, D.W. Fabrication Techniques for Graphene Oxide-Based Molecular Separation Membranes: Towards Industrial Application. *Nanomaterials* 2021, 11, 757.

[6] Source: Graphene Oxide Membranes Could Reduce Paper Industry Energy Costs, *Georgia Tech Research*, 22 February 2021.

Forecast for FY22

Near term sales growth is underpinned by the execution of pilot programs currently taking place in multiple geographies

In deriving sales forecast for FY22, we have used a bottom-up approach as expected contract wins can be reasonably ascertained, in our view. Figure 13 (left) shows our prediction on CNQ's expected contract wins for FY22. Given CNQ is currently working on 4 pilot programs and an average completion cycle of 4 months, we estimate it should be able to complete these pilot programs within FY22. Further, given each of these 4 pilot programs is linked to one or more large-scale projects, our base case conservatively predicts 3 contract wins (assuming a 75% conversion rate), whilst our bull case predicts 5 wins. Additionally, we note that CNQ is close to securing a contract with Townsville City Council in Queensland, Australia for the supply of a large-scale water recycling plant. Putting it together, our base case estimates 4 contract wins in FY22, bringing the number of cumulative contracts won to date to 11.

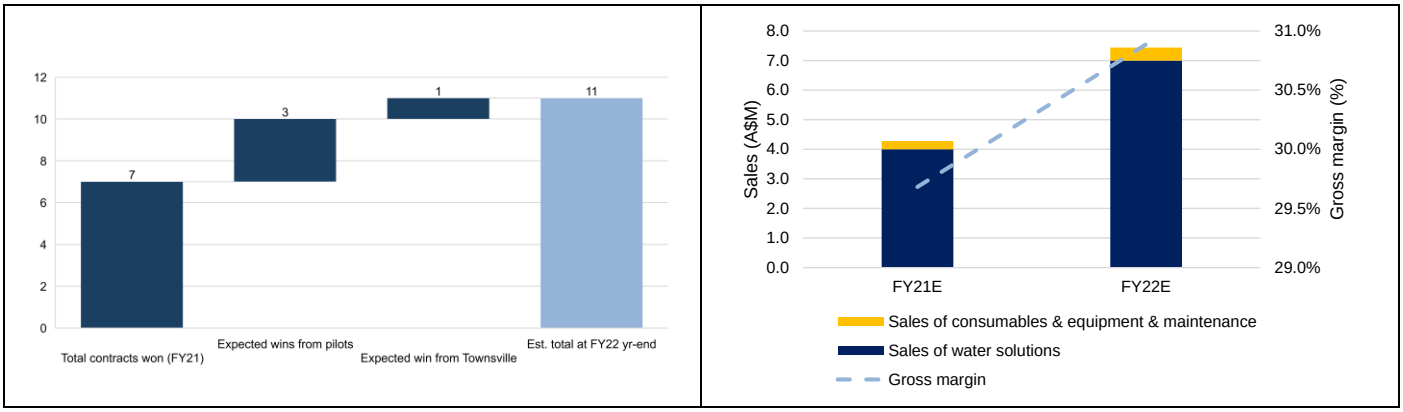
To arrive at our expected sales of water solutions for FY22, we multiply the expected contract wins by the median contract value of cA$2M. We have also averaged the numbers of contract wins in FY21 and FY22 to account for CNQ's milestone payment structure. This generates cA$7M base case. As for the consumable business, our sales are forecasted based off original contracts, which is c2-4% as per management guidance. This yields cA$0.4M. Overall, we estimate total revenue to reach cA$7.4M for FY22 (Figure 13, right).

On FY21 gross margins, we have used peer average as our yardstick (Figure 14). Upon observing their expected sales growth rates, it appears that these peers are currently in the growth phase of their lifecycle. As CNQ gradually builds up scale, we expect its gross margins to grow into the industry average for environmental and waste services comp, which currently hovers c33.3%[7]. For FY22, we have assumed a gross margin of c30.9%, which equates to a gross profit of cA$2.3M (Figure 13, right).

A$15M in cash, no debt

As of writing, we estimate CNQ has a net cash position of cA$15M. If CNQ can stick to its estimated expenditure of cA$8.0M for the first 12 months after the demerger, which is the majority of FY22, then it's clear there is ample liquidity for FY22 and as such, the risk of a dilutive equity raise is low. Beyond FY22, CNQ's likelihood of a capital raise depends on how quickly it can build up scale and thereby generate sufficient internal cashflows to self-fund its operations.

Figure 13: FY22F contract wins bridge (left), FY21F & FY22F sales & gross margins (right)



Source: Company, Pitt Street Research

[7] Source: Data from the website of Aswath Damodaran at the Stern School of Business at New York University.

Valuation

We estimate fair value for CNQ's existing water business at A$74 – 98M, with the Graphene Membrane business representing a free option with significant upside potential

In attempting to ascribe value to CNQ's existing revenue-generating business, we have used a relative valuation methodology. This is because the business runs on a volatile sales cycle which makes it difficult to forecast longer term revenues and cashflows, in our view. Also, we note the dispersion in project values which could deviate from its median cA$2-3M price point and reach as high as A$20M, as indicated by management. If this pricing upside occurs, CNQ will experience material sales growth. However, given the company is still young in its lifecycle and has limited financials available, we find it difficult to attribute a probability of success at this time. As such, we don't think the traditional, cashflow-based DCF is suitable to frame valuation in this case.

Figure 14: ASX-listed water peers

Company	Ticker	MC (AUDm)	EV/Sales				Gross Margin	Sales growth
			2020A	2021F	2022F	2023F	(most recent)	(FY20-23F CAGR)
ASX-listed water companies								
Fluence	ASX:FLC	131.2	0.7x	na	na	na	28.6%	na
Calix	ASX:CXL	503.1	35.0x	25.8x	20.0x	14.8x	27.0%	35.1%
Duxton Water	ASX:D2O	168.4	7.0x	na	na	na	41.1%	na
SciDev	ASX:SDV	150.6	8.1x	3.3x	2.0x	1.6x	21.2%	70.0%
De.mem	ASX:DEM	63.9	4.2x	2.3x	1.7x	1.4x	30.6%	44.7%
Peer average			**11.0x**	**10.5x**	**7.9x**	**5.9x**	**29.7%**	**49.9%**
Clean TeQ Water	**ASX:CNQ**	**29.5**		**3.4x**	**1.9x**			

Source: Capital IQ, Pitt Street Research

We have compiled a set of ASX-listed water companies which we regard as comparables, if not close comparables, to CNQ (Figure 14). This is because each company offers a different product to address customers' water needs, which means comparability between CNQ and its peers is not 100% certain, in our view. However, given that some of these peers share a similar market opportunity set and industry focus, plus they seem to be in the growth phase of their lifecycle, we argue these comparables do provide a reference point, from which we can gauge our valuation for CNQ's water business.

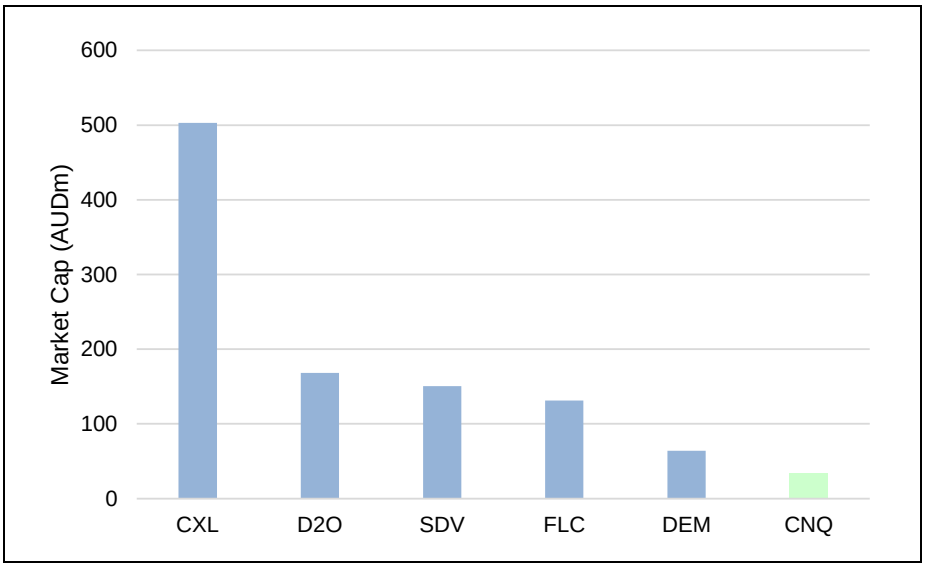
Accordingly, our EV/FY22F target sales multiple is set at 7.9x, reflecting the peer average. We note that the peer average is largely skewed by Calix (ASX: CXL) which trades at a significant premium vs its peers. We are comfortable with our target multiple as we liken CNQ to CXL in some respects, which include 1) a large TAM in the global water treatment industry, 2) a platform technology delivering multiple industrial applications, 3) products in R&D that enable significant optionality, and 4) an early-stage position in target markets.

In our view, value is in plain sight

Our bull case sales multiple attracts a 10% premium to capture some of the attributes that investors see in CXL, which we think are also applicable to CNQ. We are cognisant that CXL plays a role in developing green cement and has to date delivered higher sales than CNQ, but this need not mean that CNQ should trade at such a steep discount to CXL, as reflected in their large valuation gap (CXL is c17x greater than CNQ in terms of market cap) (Figure 15). We think CNQ's unique product proposition and competitive advantages, as mentioned in this report, will likely help the company to gain traction in its large target markets. As such, we argue that based on the current share price, investors may be underpaying for the future growth of CNQ.

An underappreciated business, as reflected in its current share price…

Figure 15: Market cap of ASX-listed water peers



Source: Capital IQ, Pitt Street Research

Applying our FY22 sales forecasts onto our target multiples, we have derived a fair value of A$1.65ps base case and A$2.18ps bull case (Figure 16).

Figure 16: Relative valuation summary

BASE CASE

Equity value determination (AUDm unless specified otherwise)	EV/Sales
Target Sales Multiple	7.9
Sales FY22F	7.4
Implied EV	58.7
Net debt (cash)	(15.0)
Equity value	**73.7**
Shares outstanding	44.7
Implied price (AUD)	**1.65**
Current price (AUD)	0.66
Upside (%)	*150%*

BULL CASE

Equity value determination (AUDm unless specified otherwise)	EV/Sales
Target Sales Multiple	8.7
Sales FY22F	9.5
Implied EV	82.6
Net debt (cash)	(15.0)
Equity value	**97.6**
Shares outstanding	44.7
Implied price (AUD)	**2.18**
Current price (AUD)	0.66
Upside (%)	*231%*

Source: Pitt Street Research

And there's also option value…

Based on our multiple-based valuation, it's clear that CNQ's water treatment business alone would justify the current share price at 66 cents. This implies investors aren't paying much for the option value embedded in the Graphene Membrane business. We think this optionality is important and should be recognised by investors, given the potential market size and the imminence of technology launch. Furthermore, we view Clean-iX as a valuable platform from which CNQ could develop additional ion exchange solutions to exploit water treatment applications and verticals. This shows the vast optionality Clean-iX has. In our view, these optionalities not only provide upside potential to our fair value estimates but also act as a valuation buffer should any of the downside risks, as outlined over the next page, eventuate.

Catalysts

We have identified the following near-term events as important facilitators of moving the current stock price towards our fair valuation range:

- Successful results from current pilot programs;
- Contract win from Townsville City Council;
- Commencement of new pilot-scale projects in existing and new markets;
- Faster-than-expected commercialisation of Graphene Membrane.

Risks

We see the following as key risks to our investment thesis:

- **Uptake risk**: There is a risk that CNQ may not able to gain traction in its target markets. There is no guarantee that CNQ will be able to secure a specific number of customer contracts and thereby generate revenues over the short, medium and long term.
- **Delay risk**: Pilot programs could take longer than expected to complete. This could push back the timing of expected revenues and cashflows.
- **Commercial risk**: There is no guarantee that the completion of pilot programs will lead to one or more large-scale projects. This risk can result in CNQ generating sales lower than our expectations.
- **Competition risk**: There is the "what if" scenario where new and/or existing competitors coming up with a better and cheaper product that seeks to address the same market opportunity set as CNQ. If this risk materialises, it can hamper CNQ's market share growth and margins.
- **Regulation risk**: Demand for CNQ's products is highly sensitive to changes in the global regulatory environment. Although regulation currently acts in favour of CNQ, any future changes could impact on the business both positively and negatively.
- **Funding risk**: If one or more of the above risks eventuate, CNQ could take longer to reach the scale needed to generate internal cashflows to fund its operations. This means CNQ will need to tap the equity and/or debt markets for a capital raise.

Appendix I – Glossary

Anion – A negatively charged atom, such as Chloride, Bromide and Sulfate.

Antimicrobial – A substance that kills or slows the growth of microorganisms.

Brine – A salt-concentrated waste by-product created daily by a number of industrial processes such as seawater desalination, oil and gas extraction and food and beverage processing.

Cation – A positively charged atom, such as Sodium, Iron and Ammonium.

EPC – Stands for Engineering, Procurement and Construction, which is a type of contract that typically involves the owner engages a contractor for the design and delivery of a project. Also widely known as the turn-key contract.

Flowsheet – A graphical chart that details a set of engineering process.

Fouling – Accumulation of materials on the membrane surface and/or within the membrane pores, which worsens membrane performance.

Gypsum – A soft white mineral consisting of hydrous calcium sulphate.

Ion-exchange – A chemical process that seeks to remove dissolved ionic contaminants from water.

Methemoglobinemia – A blood disorder where there is an insufficient level of oxygen being delivered to your cells.

Nanofiltration – A water filtration technique used to separate components contained in a liquid.

Resin – A polymer that acts as a medium for ion exchange.

ZLD – Stands for Zero Liquid Discharge, which is a water treatment process where all water is recovered and contaminants are reduced to solids.

Appendix II – Capital structure

As of report date, CNQ has c44.7 million shares on issue.

Appendix III – Clean TeQ Water leadership team

- **CEO Willem Vriesendorp** brings significant experience in the energy and clean technology space. He has garnered over 7 years of management consultancy experience with McKinsey & Company in Europe, US and Asia, focusing on the energy and clean technology sector. He also has extensive entrepreneurial experience. Willem founded a wastewater treatment company based out of Beijing, and also worked as a CFO and Head of Strategy at a carbon trading and clean energy focused venture capital firm. He has obtained a Masters in Applied Physics from Groningen University and an MBA from Insead in Paris.
- **CFO Magda Klapakis** has >25 years financial, accounting and commercial experience. Prior to joining CNQ, she held executive roles in ASX-listed companies including TALi Digital Limited and Amrad Corporation Ltd. More recently, she was the CFO at both Plexus Healthcare Ltd and Hydrogen Systems Australia. Magda completed a post graduate diploma in Accounting at Monash University and is a Fellow of the Australian Society of CPAs.
- **Executive Chairman and Chief Technology Officer Peter Voigt** is the founder of Sunrise Energy Metals and is CNQ's Executive Director and Chief Technology Officer. Peter is focused on product development and technology commercialisation and is responsible for R&D activities.

- **Lead Independent Non-Executive Director Ian Knight** has significant experience in strategising and implementing mergers, acquisitions, divestment and capital raising initiatives. He was formerly a Partner of KPMG where he held the position of Head of Mergers and Acquisitions and Head of Private Equity for KPMG Corporate Finance.
- **Independent Non-Executive Directors Sam Riggall** and **Stefanie Loader** both brings extensive experience in the mining and technology industries. Sam is the CEO of Sunrise Energy Metals. And Stefanie was recently the Managing Director of Northparkes Copper and Gold Mine for CMOC International.

Appendix IV – IP position

CNQ's core intellectual property relates to the following published patents:

US20140044615A1, *Method and system for extraction of uranium using an ion-exchange resin,* priority date 15 February 2011, invented by John Carr, Nikolai Zontov, Tony Chamberlain.

- This patent discloses a method for recovering uranium from an acidic leach solution or leach pulp in salt water using an amino-phosphorus resin, wherein the liquid phase of the leach solution or leach pulp contains greater than 3 g/L chloride ion in solution. The resin may comprise a functional group comprising an amino phosphonic group, an amino-phosphinic group, an amino phosphoric functional group and/or a combination thereof. According to the invention the leach solution or leach pulp may be generated by in-situ leaching, vat leaching, heap leaching and/or agitated leaching at ambient, elevated temperature and/or elevated pressure conditions in saline or hyper-saline water.

WO2004099079A1, *A method for producing an electrolytic solution containing vanadium,* priority date 12 May 2003, invented by Nikolai Zontov.

- This patent discloses a method of producing an electrolytic solution containing vanadium as positive and negative electrode active material, with the electrolytic solutions being suitable for a redox battery. The method includes: (1) dissolving vanadium compound(s) into solution under alkaline or neutral conditions; (2) correcting the pH to 2.0 - 5.5 using mineral acid; (3) adsorbing vanadium from this solution using a macroporous resin such as the resin described in Australian patent no. 758690; (4) washing the vanadium loaded resin with distilled or demineralised water; (5) desorbing the vanadium from the loaded resin using 1 - 6 M sulphuric acid solution containing a reduction agent such as sulphur dioxide, thiourea, sulphurous acid, oxalic acid, hydrogen sulphide, organic acids, alcohols, saccharide, and the like; and (6) separating the desorption solution from the resin to form a vanadium electrolytic solution. According to the present invention, a high purity vanadium electrolytic solution can be economically produced from raw materials including vanadium magnetite concentrate, fly ash, vanadium pentoxide, sodium or ammonium metavanadate etc.

WO2011140613A1, *Water treatment process,* priority date 13 May 2010, invented by Peter Voigt, Michael Hollitt and Nikolai Zontov.

- This patent discloses a water treatment process for substantially removing one or more ionic species from a feed water comprising an ion containing aqueous solution to produce a treated water product, the process including: (a) a sorption step, comprising contacting a solid sorbent with said feed water to produce a solution depleted in said one or more ionic species and a loaded sorbent; (b) a concentrating step, comprising concentrating an inlet stream including the ionic species depleted solution to produce a concentrate rich in said one or more ionic species and said treated water product; and (c) a desorbing step, comprising contacting said loaded sorbent with an aqueous desorbant including said concentrate to thereby desorb at least some of said one or more ionic species from said loaded sorbent.

WO2013078505A1, *A process and plant for treating water,* priority date 29 November 2011, invented by Peter Voigt, Nikolai Zontov and John Carr.

- This patent discloses a process for removing suspended particles and at least one ionic species from a feed water stream to produce a product water stream, the process includes the steps of: a) forming agglomerates of the suspended particles in the feed water stream; b) passing the feed water stream containing agglomerated particles through a bed of particulate sorbent material so as to i) sorb the ionic species from the feed water onto the sorbent to provide a loaded sorbent and ii) filter the agglomerated particles from the feed water using the bed of particulate sorbent material as a filtration medium to load the bed with the agglomerated particles, and thereby produce the product water stream; c) removing the filtered particles and the ionic species from the filtration medium; and d) re-using the regenerated sorbent in step b).

WO2007104268A1, *A method for industrial production of biocatalysts in the form of enzymes or microorganisms immobilized in polyvinyl alcohol gel, their use and devices for their production,* priority date 13 March 2006, invented by Radek Stloukal, Michal Rosenberg and Martin Rebros.

- This patent discloses a method for the industrial production of the biocatalysts with biologically active material in the form of immobilized enzymes or microorganisms which are immobilized into the polyvinyl alcohol gel, and their use based on the fact, that the active biological material, formed by the mixture of free native or pretrated (aggregated) enzyme catalyst, or production microorganism, or part of them, and the polyvinyl alcohol gel, is used for their industrial production, the mixture is gelated and shaped in a stream of drying air at the temperature of 800C to 150C, considering the extent of the biologically active material, at the biocatalyst geometrical ratio of the surface to the volume kept larger than 7 mm'1, and consequently thus prepared biocatalysts can be cultivated or stored and then use in biotechnological processes in the conditions, which ensure given biotechnological process higher productivity, higher production and enzymatic stability, long-term and repeated usage or definable process control with consequence easy separation of the biocatalyst. The industrial production device, providing optimization of the biological carrier volume and surface in dependence on biologically active material extent, consisting of a casting mechanism (17) mounted in front of a drying channel (2), through which a continuous conveyor belt (1) runs, is equipped with at least one casting head (17) with two rows of

casting needle injectors connected to a pressure tempered tank (15) and a compressor (16), the conveyor belt (1) and a drying system - the source (4) of a drying air, which is blown by means of ventilator into an air distribution system (6) with incorporated heating elements (5), which runs into the upper drying channel (2), and further the lower final drying channel (3) and a reswelling tank (7), between which a wiping and collecting device (9) is mounted, designed on the basis of mechanical wiping and high-pressure rinse, which is connected to a pipeline with integrated high-pressure pump (10) and low-pressure pump (11) running into a collecting reservoir (8) with cooling and further a rinse box (13) for continuous conveyor belt (1) final cleaning by jets connected to a low-pressure pump (14), which is connected to a rinse tank (12) by pipeline.

AU2004235839B2, *A method for producing an electrolytic solution containing vanadium,* priority date 12 May 2003, invented by Nikolai Zontov.

- This patent discloses a method of extracting vanadium-containing compounds from a mixture containing impurities, the method including the steps of: a) adsorbing anionic vanadium compounds from the mixture onto an anion-exchange substrate; b) desorbing vanadium compounds from the substrate by treating the substrate with a reducing agent containing one or both of sulphurous acid or sulphur dioxide to convert the anionic vanadium compounds adsorbed on the substrate to cationic compounds and thereby facilitating release of vanadium compounds from the substrate; and c) using a solvent containing sulphric acid at a concentration ranging from 1 to 6M to wash the vanadium compounds released from the substrate in step b) and thereby form an electrolytic solution containing sulphuric acid at a concentration ranging from 100 to 600 grams per litre (1 to 6M) and a vanadium concentration ranging from 50 to 200 grams per litre (1 to 4M) which is suitable for use in half cells of vanadium redox flow battery.

In addition, we note the multiple patents applied and in process for Graphene membranes and BIONEX.

Appendix V – Analysts' qualifications

Cheng Ge, lead analyst on this report, is an equities research analyst at Pitt Street Research.

- Cheng obtained a B.Com in Finance and LL.B from University of New South Wales, in 2013, and has passed all three levels of the CFA Program.
- Before joining Pitt Street Research, he has worked for several financial services firms in Sydney, where his focus was on financial advice.
- He joined Pitt Street Research in January 2020.

Stuart Roberts has been covering the Life Sciences sector since 2002.

- Stuart obtained a Master of Applied Finance and Investment from the Securities Institute of Australia in 2002. Previously, from the Securities Institute of Australia, he obtained a Certificate of Financial Markets (1994) and a Graduate Diploma in Finance and Investment (1999).
- Stuart joined Southern Cross Equities as an equities analyst in April 2001. From February 2002 to July 2013, his research specialty at Southern Cross Equities and its acquirer, Bell Potter Securities, was Healthcare and Biotechnology. During this time, he covered a variety of established healthcare companies such as CSL, Cochlear and Resmed, as well as numerous emerging companies. Stuart was a Healthcare and Biotechnology analyst at Baillieu Holst from October 2013 to January 2015.
- After 15 months in 2015 and 2016 doing Investor Relations for two ASX listed cancer drug developers, Stuart founded NDF Research in May 2016 to provide issuer-sponsored equity research on ASX-listed Life Science companies.
- In July 2016, with Marc Kennis, Stuart co-founded Pitt Street Research Pty Ltd, which provides issuer-sponsored research on ASX-listed companies across the entire market, including Life Science companies.

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