

30 January 2017

#### **Clean TeQ Investor Presentation**

Co-Chairman of Clean TeQ Holdings Limited (ASX:CLQ) (**Clean TeQ** or **Company**) Mr Robert Friedland will be presenting the Company at a number of investor events over the next week including the *Arlington Pre-daba Conference* in Hermanus near Cape Town on 3-5 February 2017 and *Indaba: Investing in African Mining Conference* on 6-9 February 2017 in Cape Town. Mr Friedland's presentation for the events is attached.

For more information about Clean TeQ contact: Sam Riggall, Executive Chairman or Ben Stockdale, CFO

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About Clean TeQ Holdings Limited (ASX: CLQ) – Based in Melbourne, Clean TeQ, using its proprietary Clean-iX® continuous ion exchange technology, is a leader in metals recovery and industrial water treatment.

**About the Syerston Project** – Clean TeQ is the 100% owner of the Syerston Project, located in New South Wales. The Syerston Project is one of the largest and highest grade scandium deposits in the world and one of the highest grade and largest nickel and cobalt deposit outside of Africa.

For more information about Clean TeQ please visit the Company's website www.cleanteq.com.

This release may contain forward-looking statements. The actual results could differ materially from a conclusion, forecast or projection in the forward-looking information. Certain material factors or assumptions were applied in drawing a conclusion or making a forecast or projection as reflected in the forward-looking information.



#### SYERSTON NICKEL COBALT SCANDIUM PROJECT

THE FUTURE OF ELECTRIC METALS

ROBERT FRIEDLAND, CO-CHAIRMAN February 2017

(ASX:CLQ)



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Please refer to the back of this presentation for information concerning the calculation of reserves and resources referred to herein, and the consents provide the respective Competent Persons.

For further details on the content of this presentation, please refer to the ASX releases on the Company's website.



# AN ELECTRIC **REVOLUTION IS COMING**







### **DEMOGRAPHIC TRENDS ARE CLEAR**

#### **URBANISATION – THE GREATEST CHALLENGE OF OUR TIME**

Our planet gains approximately 83 million people every year

By 2030 Earth will have a projected 8.5 billion people, of which 5 billion will live in urban areas

That is 1 billion more urban residents than we have today, resulting in massive social and environmental challenges CLEAN Source: United Nations **SYERSTON** PAGE 4 Powering innovation





# Air pollution is now the world's largest single environmental health risk

"Some 3 million deaths a year are linked to exposure to outdoor air pollution... Nearly 90% of air-pollution-related deaths occur in low- and middle-income countries...

PM<sub>2.5</sub> includes pollutants such as sulfate, nitrates and black carbon, which penetrate deep into the lungs and in the cardiovascular system, posing the greatest risks to human health."

- WHO Global Air Pollution Study, 2016



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### WHO GLOBAL AMBIENT AIR POLLUTION $PM_{2.5}$ : 10 µg/m<sup>3</sup>, PM<sub>10</sub>: 20 µg/m<sup>3</sup> (annual mean)







### **EU EMISSION LIMITS**

#### THE GENESIS OF DIESELGATE

"Diesel was seen as a good thing because it produces less  $CO_2$ , so we gave people incentives to buy diesel cars."

- Martin Williams, Former head of the UK Government's Air Quality Science Unit

> 1 Assumption: in comparison to today's average European CO<sub>2</sub> emission of 140 g CO<sub>2</sub> per km per car; penalties for exceeding CO<sub>2</sub> emissions in 2020: for 1st gram EUR 5, 2nd gram EUR 15, 3rd gram EUR 25, 4th gram and beyond EUR 95; penalties in 2025: EUR 190 for each gram

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#### EU Regulations – CO<sub>2</sub> Emissions and Penalties



Source: McKinsey & Co, Lightweight, Heavy Impact (2012)



### DIESELGATE

### ...BUT DIESEL CANNOT MEET NOX / PM<sub>2.5</sub> EMISSION LIMITS

"You have power, you have energy, you have emissions: you get to choose two of them."

- Don Hillebrand, Argonne National Laboratory and former president of the Society for Automotive Engineers

"We've totally screwed up."

- Volkswagen's U.S. CEO Michael Horn during the Dieselgate crisis

#### **Comparison of NO<sub>x</sub> emission standards for different Euro classes**



Nitrogen oxide (NO<sub>x</sub>) emissions (in g/km)

Source: EEA (European Environment Agency), 2016



## NOT JUST A THIRD WORLD PROBLEM

#### **GOVERNMENT REGULATION IS ESCALATING**

Paris, Madrid, Mexico City and Athens have announced plans to ban diesel vehicles from their cities by 2025

The German parliament has voted to ban the sale of petrol and diesel vehicles from 2030, and has urged the EU to extend the ban to the entire EU











"Car companies say they are with conventional technology ... Tougher CO<sub>2</sub> emissions targets will accelerate the push to electrification."

- Automotive News Europe, European automakers call for  $CO_2$  emissions delay, June 2015



Table Source: State of Charge, *Electric Vehicles' Global Warming Emissions and Fuel-Cost Savings* across the United States, 2012. EV efficiency assumed to be 0.34 kWh/mile based on the 2012 Nissan LEAF (note that the current Nissan LEAF achieves ~0.28kWh/mile). Production and consumption of gasoline is assumed to produce  $11,200 \text{ g CO}_2\text{e/gal}$ .

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#### WELL-TO-WHEELS EV MILES PER GALLON EQUIVALENT (MPG<sub>ghg</sub>) BY ELECTRICITY SOURCE

| Energy Source | MPG <sub>g</sub> |
|---------------|------------------|
| Coal          | 30               |
| Oil           | 32               |
| Natural Gas   | 54               |
| Solar         | 500              |
| Nuclear       | 2,00             |
| Wind          | 3,90             |
| Hydro         | 5,80             |
| Geothermal    | 7,60             |
|               |                  |

#### Even EV's charged 100% on coal have lower GHG emissions intensity than the average US passenger vehicle





## **AUTOMAKERS ARE NOW RESPONDING**

### EV'S ARE MOVING TO THE MAINSTREAM



VW



**BMW** 

Forecasting sales of 2 to 3 million pure EV's by 2025, or 25% of sales, as well as potential investment in a multi-billion euro battery plant

Forecasting 100,000 x-EV sales in 2017, and targeting EV's as 15-25% of its worldwide sales by 2025

Ten new EV models by 2025 supported by a €10 billion investment program, potentially including battery manufacturing



#### DAIMLER



#### **TESLA**

Tesla 3 was the most successful automotive prelaunch in history, with 400,000 buyers reserving a car for delivery from 2017



BP

BP is forecasting 100 million EV's on the road – circa 10% of the global car fleet - by 2035





EU regulations require all new and renovated homes to come with an EV charger by 2019

China's State Grid announced plans to build 10,000 charging stations and 120,000 poles by 2020 for major Chinese cities

Source: Reuters, 29 Nov 2016; CRI English.com, 12 Dec 2016

Volkswagen, Daimler, BMW and Ford have agreed to jointly invest in thousands of fast-charging sites across Europe





#### Simplifying the drivetrain

Electric motors are far simpler than combustion engines

Lower maintenance costs and higher reliability – there is one moving part in an electric motor

Tank-to-wheel efficiency is ~16% in a combustion engine, versus ~70% in an electric motor<sup>1</sup>

 Wells to wheels: electric car efficiency February 22, 2013: https://matter2energy.wordpress.com/2013/02/22/wells-to-wheels-electric-car-efficiency/
Electric motor and chassis images courtesy of Tesla





## **BATTERY PACK COSTS ARE FALLING**

### ECONOMIES OF SCALE AND THE EXPERIENCE CURVE



The last five years has seen a 20% pa cost reduction in EV battery pack systems

At the current rate of improvement, EV drivetrains are forecast to become competitive with combustion engines within 5 to 10 years

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## **NEW BATTERY CAPACITY IS COMING**

#### ALREADY ~US\$20B OF COMMITTED INVESTMENT

Forecasting a ~4x increase in global battery capacity over the next five years

China is now pushing for an aggressive Californiastyle Zero Emission Vehicle (ZEV) program: 8% of all cars sold in China by 2018 will be EV, and 12% by 2020

Given a 1% EV adoption rate in China today, that target translates to a 12x increase in the number of electric cars to be sold in China by end of the decade

US government policy changes on renewables and energy storage is likely to be immaterial to global growth projections



Source: Deutsche Bank, Lithium 101, May 2016



## **A RACE TO SECURE RAW MATERIALS**

#### CHINA'S AMBITIONS FOR A STRATEGIC INDUSTRY

#### A steady stream of acquisitions

| Year | Asset                                  | Purchaser                     | Focus   | Price                        |
|------|--|-------------------------------|---------|------------------------------|
| 2010 | Olaroz<br>(ARG)                        | Toyota Tsusho /<br>JOGMEC     | Li      | US\$62M + PF<br>+ Comp. Gtee |
| 2012 | Greenbushes<br>(AUS) – 100%            | Chengdu Tinaqui               | Li      | A\$815M                      |
| 2012 | Ruashi<br>(DRC)                        | Jinshuan                      | Co / Cu | US\$1,300M                   |
| 2014 | Greenbushes<br>(AUS) – 49%             | Rockwood Lithium              | Li      | US\$474M                     |
| 2015 | CMSK<br>(DRC)                          | Huayou Cobalt                 | Co / Cu | US\$52M                      |
| 2015 | Mt Marion<br>(AUS)                     | Jiangxi Ganfeng               | Li      | US\$46.6M                    |
| 2016 | Tenke (DRC) –<br>56%                   | China Molybdenum              | Co / Cu | US\$2,650M                   |
| 2016 | Kokkola<br>(Finland)/<br>Kisanfu (DRC) | China Molybdenum              | Со      | US\$150M                     |
| 2016 | SQM – 2.1%                             | Tianqui Lithium               | Li      | US\$210M                     |
| 2017 | Altura Mining<br>(AUS) – 20%           | Shaanxi J&R<br>Optimum Energy | Li      | A\$42M                       |

Cathode Material Market Share (percentage)



2014



Source: KDB Daewoo Securities, 2015

# CATHODE MARKET



## CHEMISTRY BY MARKET

### DOMINANT CHEMISTRIES FOR EV REQUIRE NICKEL AND COBALT





Still one of the highest energy density chemistries, but expect to see only steady growth as automotive and utilityscale applications grow

NCM

22%

23ktpa

(Nickel-Cobalt-Manganese)

**Experiencing fastest** growth with a good mix of energy density, power, cost and safety for automotive applications; new chemistries constantly developing

Extremely high energy density, power and manufacturing experience make it a good candidate for automotive

Source: Avicenne Energy Analysis 2014



#### (Nickel-Cobalt-Aluminium)

(Lithium-Manganese-Oxide)

Relatively low energy density (one-third of LCO), but the absence of cobalt makes this a lowcost alternative cathode material

(Lithium-Iron-Phosphate)

Reasonable energy density but lower power; lower cost raw materials are offset by poor conductivity and higher unit costs from assembly process



## **CATHODE – THE KEY TO COST**

### A LITHIUM ION BATTERY IS A CONIC BATTERY IN ALL BUT NAME



Source: Roland Berger (2012) and internal analysis. Assumes a 96Wh PHEV cell (26Ah, 3.7W) using NCM622 cathode chemistry. Cathode cost includes non-metallic materials (carbon black, binder, foil). Internal assumptions concerning split of costs assumes average long-term prices of Ni US\$7.00/lb; Co US\$12.00/lb; Mn US\$1.00/lb; Li US\$6.50/kg (as LCE).

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"The main determinants on the cost of the cell are the price of the nickel in the form that we need it ... and the cost of the synthetic graphite with silicon oxide coating."

- Elon Musk, Tesla CEO



The EV battery industry requires metal to be supplied as salts, usually as sulphates, to manufacture cathode precursors

The cost of converting metal units to sulphate form is often represented in the market price by a 'sulphate premium' paid over and above the contained metal value



## CATHODE DEMAND FORECAST

#### IMPLICATIONS FOR RAW MATERIAL DEMAND

Use of nickel and cobalt dominant chemistries is accelerating in China

Of the 10 top selling Chinese EV's using LFP chemistry, six are already converting to NCM

"We believe this potential [Chinese] subsidy plan would further promote the development of NMC over LFP in the next few years. The NMC penetration rate should climb significantly faster than we previously expected."

- Deutsche Bank, 2 Dec 2016

Source: 2015 data based on Avicenne Energy Analysis. 2025 case based on internal company estimates, utilising an EV adoption rate based on the average from five banks and industry consultant forecasts: HEV 5.7m, PHEV 2.7m, BEV 3.6m. EV applications forecast at 217 GWh. Non-EV applications forecast at 135GWh. Assumes an average battery size of 50kWh/BEV. No adjustments have been made for yield losses or process inefficiencies at pack or cell level, nor recycling rates.







# SYERSTON PROJECT









### **SYERSTON PROJECT**

#### **OVERVIEW**

Sydney and 100% owned by Clean TeQ

industry, with high-purity nickel sulphate and cobalt sulphate

- The Syerston mineral deposit is rich in nickel, cobalt and scandium, located 350km west of
- Uniquely positioned as one of the largest and highest grade sources of cobalt outside Africa
- Syerston will be the first mine developed to exclusively supply the global lithium ion battery



## WHY SYERSTON IS IMPORTANT

### PROTECTION AGAINST SUPPLY CHAIN AND REPUTATION RISK



100% auditable to the mine source

Low risk country with minimal mining and processing risk







## **SYERSTON ORE RESERVE**

#### VERY LOW MINING RISK

Over 1,300 drill holes have defined a significant nickel / cobalt / scandium ore reserve

The ore reserve is shallow (5m to 40m) and extends over a 2km horizon; simple, low risk strip-mining with no blasting





## **2016 PREFEASIBILITY STUDY**

### SYERSTON CAN EASILY SUPPORT MULTIPLE GIGAFACTORIES

| Parameter   |                         | 1             | Assumption / Ou         |
|---|-------------------------|---------------|-------------------------|
| Autoclave Throughput  |                         |               | 2.5Mtpa <sup>1</sup>    |
| Life of Mine  |                         |               | 39 years                |
| Initial operating period                                      |                         |               | 20 years                |
| Autoclave Feed Grade <sup>2</sup> (Year 3-20 average)         | Nickel                  |               | 0.80%                   |
|   | Cobalt                  |               | 0.14%                   |
| Production (Years 3-20 average)                               | Nickel sulphate         |               | <mark>85,135tp</mark> a |
|   | Cobalt sulphate         |               | 15,343tpa               |
| Production (Years 3-20 average)                               | Contained nickel        |               | 18,730tpa               |
|   | Contained cobalt        |               | 3,222tpa                |
| Recovery (Years 3-20 average)                                 | Nickel                  |               | 94.2%                   |
|   | Cobalt                  |               | 93.0%                   |
| Nickel price assumption <sup>3</sup>                          |                         |               | US\$7.50/lb             |
| Cobalt price assumption <sup>3</sup>                          |                         |               | US\$12.00/lb            |
| Exchange Rate   |                         |               | AUD/USD 0.7             |
| Total Capital Cost <sup>4</sup>                               |                         |               | US\$680M (A\$90         |
| C1 Cash Cost (Year 3-20 average) <sup>5</sup>                 | before Co credits       |               | US\$2.96/lb N           |
|   | after Co credits        |               | US\$0.89/lb N           |
| Net Present Value (NPV <sub>8</sub> ) – post tax <sup>6</sup> |                         |               | US\$891M                |
| Internal Rate of Return (IRR) – post tax                      |                         |               | 25%                     |
| Designed processing throughput rate following a 24-mor        | th commissioning and ra | mp up period. |                         |

1 Designed processing throughput rate following a 24-month commissioning and ramp up period.

2 Includes pit selection, dilution and mining factors

3 Based on bank/broker long-term consensus market pricing for metal content only. Does not include premiums that are typically paid in the market for battery-grade nickel and cobalt sulphate

4 Includes a US\$62M (A\$83M) contingency on capital costs

5 C1 cash cost excludes potential by-product revenue from scandium oxide sales and royalties

6 Post tax, 8% discount, 100% equity, real terms

| Output         |  |
|----------------|--|
| a <sup>1</sup> |  |
| s              |  |
| s              |  |
|                |  |
|                |  |
| pa             |  |
| pa             |  |
| pa             |  |
| a              |  |
|                |  |
|                |  |
| /lb            |  |
| /lb            |  |
| 0.75           |  |
| \$906M)        |  |
| b Ni           |  |
| b Ni           |  |
|                |  |

# 26-28

GWh p.a.#

500,000 Electric Vehicles p.a.\*

Definitive Feasibility Study due for completion in Q4 2017

#### Scandium credits lift NPV<sub>8</sub> to US\$1.23 billion and IRR to 30%<sup>^</sup>

# Assumes NCA chemistry with Ni and Co content by wt% within cathode active material of 48% and 9% respectively, and energy density at 1.39kg/kWh

\* Assumes average energy density per battery pack of 50kWh

^ See details in Prefeasibility Study announcement in ASX Release dated 5 October 2016



### COBALT

### A PROBLEMATIC SUPPLY CHAIN



copper and nickel mining



Percentage of global cobalt production originating in the **Democratic Republic of Congo** 



Percentage of DRC cobalt mined artisanally

Source: Darton Cobalt Market Review 2015-2016

"The majority of the cobalt is heading straight to China. Their global hold is huge."

- CRU 2016

#### Percentage of cobalt produced globally as by-product from





"While the occasional [analyst] questions the availability of enough lithium or flake graphite to satisfy soaring demand from the battery industry, everybody has overlooked or ignored the most critical mineral constraint – Cobalt. It's a truly gargantuan challenge. A Gigarisk!" - investorintel.com, March 2016



### **COBALT PRICE**

### RISING QUICKLY FROM HISTORIC LOWS

Cobalt was one of the best performing metals in 2016, with price increasing ~50% over the year

Significant upside in the event of supply disruption – China is adding to its strategic stockpiles

At Syerston cobalt is co-product, not by-product: cobalt is ~40% of Syerston's revenues at today's spot metal prices<sup>1</sup>

1. Prices taken as at 20 Jan 2017. Excludes scandium revenue.





### SCANDIUM

#### SCANDIUM WILL REVOLUTIONISE THE ALUMINUM INDUSTRY

Al-Zn-Mg-(Cu)

Small additions of scandium can give aluminum a strength approaching titanium and steel alloys, without the weight

"Addition of scandium to aluminium gives the highest increase in strength (per atomic percent) of all alloying elements"

– K. Venkateswarlu, et al, High Strength Aluminum Alloys with Emphasis on Scandium Addition, 2008

#### Scandium Impact on Aluminum Yield Strength (Mpa)



Source: Hydro Aluminium R&D Sunndal, 2012

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#### Scandium – a case study

Airbus Group's Lightrider: the world's first 3D printed electric bike

> Aluminum-scandium frame makes it lighter and stronger

The bike weighs 35kg, contains a 6kWh battery, has a top speed of 80km/h and a range of 60km

Syerston is uniquely positioned to benefit from and support the two key imperatives facing the global transport industry: electrification and light weighting



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# NEXT STEPS



## **PROJECT IS DEVELOPMENT READY**

### **KEY PERMITTING COMPLETED**





#### **STUDIES**

#### **INFRASTRUCTURE**

Prefeasibility Study completed, with Bankable Feasibility Study due for completion in Q4 2017

All key infrastructure is available, including road and rail access





WATER

EIS

**POWER & GAS** 

Environmental Impact Statement completed and approved by Government

Power and gas are within close proximity to the Project

The Project has a 3.2GLpa water allocation granted by the NSW Government





### PILOT PLANT

### EXTENSIVE PILOTING COMLETED AND SAMPLES PRODUCED

Clean TeQ has a large scale pilot plant located in Perth, Western Australia to simulate the entire leaching and extraction process at scale

A pilot campaign in October 2016 to process 20 tonnes of Syerston ore will produce nickel and cobalt sulphate samples for customer sampling and testing

Scandium samples were produced and shipped in 2016



### **INVESTMENT TAKEAWAYS**

Forty year mine life

Exceptional cobalt deposit in OECD, 100% auditable

Highly geared to emerging EV and ESS growth

World's largest and highest grade scandium resource unbeatable fuel efficiency

Key permitting in place



## **RESERVES AND RESOURCES**

### **COMPETENT PERSON CONSENTS**

The information in this document that relates to nickel-cobalt Mineral Resources is based on information compiled by Diederik Speijers and John McDonald, who are Fellows of The Australasian Institute of Mining & Metallurgy and employees of McDonald Speijers. There was no clear division of responsibility within the McDonald Speijers team in terms of the information that was prepared – Diederik Speijers and John McDonald are jointly responsible for the preparation of the Mineral Resource Estimate. Diederik Speijers and John McDonald have sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity which they are undertaking to qualify as Competent Persons as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Diederik Speijers and John McDonald, who are consultants to the Company, consent to the inclusion in the report of the matters based on their information in the form and context in which it appears.

The information in this document that relates to scandium Mineral Resources is based on information compiled by Sharron Sylvester, who is a Member and Registered Professional of the Australian Institute of Geoscientists and is an employee of OreWin Pty Ltd. Sharron Sylvester has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity which she is undertaking to qualify as a Competent Person as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Sharron Sylvester, who is a consultant to the Company, consents to the inclusion in the report of the matters based on their information in the form and context in which it appears.

The information in this document that relates to Ore Reserves is based on information compiled by Michael Ryan, MAusIMM (109558), who is a full time employee of Preston Valley Grove Pty Ltd, trading as Inmett Projects. Michael Ryan has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Michael Ryan, who is a consultant to the Company, consents to the inclusion in the report of the matters based on his information in the form and context in which it appears. Michael Ryan holds options in Clean TeQ Holdings Limited, the ultimate parent entity of Scandium21 Pty Ltd, the owner of the Project.

For further details on the content of this presentation, please refer to the ASX releases on the Company's website.



### CONTACT





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