Certain statements in this presentation constitute “forward-looking statements” or “forward-looking information” within the meaning of applicable securities laws. Such statements involve known and unknown risks, uncertainties and other factors, which may cause actual results, performance or achievements of Clean TeQ Holdings Limited (the “Company” or “Clean TeQ”), the Clean TeQ Sunrise Project (“Sunrise”, the “Project” or the “Sunrise Project”), or industry results, to be materially different from any future results, performance or achievements expressed or implied by such forward-looking statements or information. Such statements can be identified by the use of words such as “may”, “would”, “could”, “will”, “intend”, “expect”, “believe”, “plan”, “anticipate”, “estimate”, “scheduled”, “forecast”, “predict” and other similar terminology, or state that certain actions, events or results “may”, “could”, “would”, “might” or “will” be taken, occur or be achieved. These statements reflect the Company’s current expectations regarding future events, performance and results, and speak only as of the date of this presentation.

Statements in this presentation that constitute forward-looking statements or information include, but are not limited to: statements regarding the negotiation and conclusion of further offtake agreements; the settlement of completion of a term sheet from the MLA group prior to the FID; the potential investment by a strategic investor and/or additional financing; completing of final design and detailed engineering work; making a Final Investment Decision; statements relating to the timing of commencement and/or completion of construction of the Clean TeQ Sunrise Project, commissioning, first production and ramp up; and the potential for a scandium market to develop and increase.

In addition, all disclosure in this presentation related to the results of the Sunrise Project’s Definitive Feasibility Study (the “DFS”) announced on June 25, 2018, constitute forward-looking statements and forward-looking information. The forward-looking statements includes metal price assumptions, cash flow forecasts, projected capital and operating costs, metal recoveries, mine life and production rates, and the financial results of the DFS. These include statements regarding the Sunrise Project IRR; the Project's NPV (as well as all other before and after taxation NPV calculations); life of mine revenue; average annual EBITDA; capital cost; average C1 operating cash costs before and after by-product credits; proposed mining plans and methods, the negotiation and execution of offtake agreements, a mine life estimate; project payback period; the expected number of people to be employed at the Project during both construction and operations and the availability and development of water, electricity and other infrastructure for the Sunrise Project, as well as the indicative project schedule.

Readers are cautioned that actual results may vary from those presented.

All such forward-looking information and statements are based on certain assumptions and analyses made by Clean TeQ's management in light of their experience and perception of historical trends, current conditions and expected future developments, as well as other factors management believe are appropriate in the circumstances. These statements, however, are subject to a variety of risks and uncertainties and other factors that could cause actual events or results to differ materially from those projected in the forward-looking information or statements including, but not limited to, unexpected changes in laws, rules or regulations, or their enforcement by applicable authorities; changes in investor demand; the results of negotiations with project financiers; the failure of parties to contracts to perform as agreed; changes in commodity prices; unexpected failure or inadequacy of infrastructure, or delays in the development of infrastructure, and the failure of exploration programs or other studies to deliver anticipated results or results that would justify and support continued studies, development or operations. Other important factors that could cause actual results to differ from these forward-looking statements also include those described under the heading “Risk Factors” in the Company's most recently filed Annual Information Form available under its profile on SEDAR at www.sedar.com.

Readers are cautioned not to place undue reliance on forward-looking information or statements.

Although the forward-looking statements contained in this presentation are based upon what management of the Company believes are reasonable assumptions, the Company cannot assure investors that actual results will be consistent with these forward-looking statements. These forward-looking statements are made as of the date of this presentation and are expressly qualified in their entirety by this cautionary statement. Subject to applicable securities laws, the Company does not assume any obligation to update or revise the forward-looking statements contained herein to reflect events or circumstances occurring after the date of this presentation.
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<th>Agenda</th>
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<tbody>
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<td>Electric vehicles and batteries</td>
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<td>Nickel and cobalt markets</td>
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<td>Scandium – unlocking aluminum’s potential</td>
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<td>6</td>
<td>Conclusion</td>
</tr>
</tbody>
</table>
Who we are – Clean TeQ Sunrise

Sunrise is one of the few large-scale nickel and cobalt projects which is development ready and located outside Africa

**Project snapshot**

- **Sunrise is a world-class laterite mineral deposit rich in nickel, cobalt and scandium.** It is located 350km from Sydney in an established mining region.

- **Sunrise will be the sixth largest cobalt production facility globally** and the largest which is located outside Africa and Russia\(^1\)

- **Sunrise will be one of the largest nickel sulphate projects globally** which specifically produces high purity battery materials

- **Project supported by a 40+ year reserve life** with LOM C1 cash costs of negative US$1.46/lb post by-product credits\(^2\)

- **On-site processing of nickel and cobalt sulphate** with refinery capacity of up to 25,000tpa of contained nickel and up to 7,000tpa of contained cobalt

- **Sunrise is one of the world’s largest and highest grade scandium resources** with potential to produce 180tpa Sc2O3 as a low-cost by-product

- Clean TeQ is targeting a final investment decision in 4Q 2019 and first production in 2022 following a 24-30 month construction period

**Project Location**

**Key metrics (100%)**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel production</td>
<td>~19 ktpa</td>
</tr>
<tr>
<td>Reserves mine life</td>
<td>40+ years</td>
</tr>
<tr>
<td>LOM strip ratio</td>
<td>1.2:1</td>
</tr>
<tr>
<td>C1 cash costs(^2)</td>
<td>(US$1.46) / lb</td>
</tr>
<tr>
<td>Cobalt production</td>
<td>~3.5 ktpa</td>
</tr>
<tr>
<td>Autoclave throughput(^3)</td>
<td>2.5 Mtpa</td>
</tr>
<tr>
<td>Pre production capex</td>
<td>US$1,491m</td>
</tr>
<tr>
<td>NPV(^4)</td>
<td>US$1,237m</td>
</tr>
</tbody>
</table>

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\(^1\) Darton Cobalt Review (2019); \(^2\) DFS by-product credits include cobalt, scandium and ammonium sulphate; \(^3\) permitted autoclave throughput rate following 24-month commissioning and ramp up period; \(^4\) post tax NPV calculated assuming an 8% discount rate (real), long-term nickel and cobalt prices of US$7.00/lb (plus $1.00/lb sulphate premium) and US$30.00/lb respectively, and 25-years Initial Life of Mine.
Strategic metals
Implications for Japanese industry
In 2018 the US Department of the Interior published a list of 35 critical metals:

“Any shortage of these resources constitutes a strategic vulnerability for the security and prosperity of the United States.”, Dr. Tim Petty, Assistant Secretary of the Interior for Water and Science

These ‘minor’ metals are disproportionately strategic because of their importance to military capability, industrial development and/or technological innovation

In a world where we rely on electricity to power more of our energy needs, many of these metals will become increasingly important

The automotive industry is particularly vulnerable because of the impact that new technology is having on its markets
The challenge for automotive

Drawn to scale - area represents the global sales value of the commodity at today’s prices
The Japanese auto industry has spent 60 years building a dominant global position in automotive, but are significantly behind China, Europe and the US in development of electric vehicles.

Source: International Organization of Motor Vehicle Manufacturers; Alliance Bernstein
Panasonic has a strong market position in EV batteries due to its partnership with Tesla, but Japan’s influence has declined substantially since Sony’s commercialization of the first Li-ion battery.
EVs and batteries
Not all metals are created equal
Nickel and cobalt – the critical battery metals

Although nickel and cobalt are exchange traded metals, there is limited opportunity to hedge forward prices (low liquidity and short-dated forward contracts) or secure long-term supply.

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).
Nickel and cobalt Ore Reserves are limited

- Lithium resources are geologically abundant and require low capital intensity to develop – lithium is unlikely to be a bottleneck to EV development
- Nickel, cobalt and copper reserves are much scarcer – nickel, in particular, is highly capital intensive
- In Australia, it takes on average about a decade to develop a new greenfield mine from delineation of a mineral resource – exploration, drilling, test work, permitting, financing and construction

**Geology is NOT a constraint - there is enough metal in the world to service a transition to EVs, but metal prices need to rise to incentivise conversion of currently uneconomic mineral resources to new mining reserves**
Nickel and cobalt demand for EVs

Global passenger vehicle sales (2018a)

Global passenger vehicle sales (2030f)

Metal requirements for BEV batteries:

- Nickel: 650,000 tpa
- Cobalt: 90,000 tpa
- Copper: 500,000 tpa

Note: Actual figures for 2018 from Alliance Bernstein and company estimates. EVs only account for pure electric vehicles, not PHEV. Passenger vehicle sales growth 2018 to 2030 of 1.5% pa. Average cathode chemistry split of 50% NCM622, 25% NCM811 and 25% NCA in 2030 and an average battery size of 50kWh per BEV. Copper demand only accounts for copper in the battery, and not motor and other external systems (BMS, wiring, etc).
Nickel
Supply-Demand Balance and Price Forecasts
Primary nickel supply – Class 1 vs Class 2

Global Nickel Production ('000t) 2014 to 2018

- Class 1 Nickel is the only form of nickel that can be used to produce battery-grade nickel sulphate, and can come from:
  - Nickel sulphide resources
  - Nickel oxide resources (laterites) processed using hydrometallurgy

- Laterite resources, while more capital intensive to develop, have the benefit of producing Co by-product

- Class 1 Nickel supply has been declining for over a decade due to geological scarcity and low incentive prices

- Class 2 Nickel - nickel pig iron (NPI) and ferronickel (FeNi) – is not a cost-effective feedstock for production of battery-grade nickel sulphate (impurities are too high)

As EV demand grows, the supply of Class 1 Nickel continues to decline

Source: CRU
Nickel used in EV batteries today and forecast demand

This is the amount of Class 1 Nickel consumed in EV batteries today - **55kt**

By 2030 the world requires ~**650kt pa** of Class 1 Nickel for EVs and a further ~**250kt pa** for non-EV applications\(^1\)

This additional ~**900kt pa** implies a 5.5% CAGR in Class 1 Nickel supply, in a market where supply has been shrinking for over a decade

---

Source: CRU and Bernstein analysis
1. This assumes 2.5% pa growth in demand for Class 1 Nickel in non-battery applications, such as stainless and alloy steels, nonferrous alloys, plating, chemical, etc.
Class 1 Nickel stocks have declined rapidly

---

“The amount of nickel used per EV battery could more than double over the next 5-7 years. For carmakers to realise goals, nickel supply growth over the next 10 years will basically need to outperform any growth cycle in its history…

Prices need to average >$15,000/t to incentivise new investment. Risks to the nickel price appear to the upside over the next five years, mainly in response to strengthening battery-grade nickel demand.”

- Macquarie Bank, March 2019
Where will new Class 1 Nickel supply come from?

- WoodMac has identified **485kt of potential additional Class 1 Nickel capacity** in costed probable and possible new projects.

- At 90th percentile, the nickel price needs to be >$20,000/t ($9/lb) to justify development of this entire pipeline.

- It is highly optimistic to assume these projects can be developed by 2025:
  - some geographies are difficult
  - development timeframes are long
  - many projects are owned by juniors

Approx. US$40 billion\(^1\) needs to be invested in High Pressure Acid Leach (HPAL) laterite projects to produce the nickel (and cobalt) required for EV growth by 2030.

---

\(^1\) Assumess a 20% EV penetration rate by 2030, HPAL capital intensity of US$65,000/t Ni capacity and zero demand growth for non-EV applications.
Despite the projected supply shortages, nickel price forecasts remain cautious.

CRU forecasts LME nickel prices to gradually rise as new EV models enter the market, stabilising at ~$16,700/t Ni over the long-term ($7.60/lb Ni).

In addition, the premia for sulphate will average $2,900/t Ni ($1.30/lb Ni), giving a long-term NiSO4 price of $19,600/t Ni ($8.90/lb).

Wood Mackenzie’s long-term forecast for NiSO4 is similar, at $19,800/t Ni ($9.00/lb).

Average long-term consensus price at April 2019 is $18,888/t Ni ($8.58/lb) (assumes a $1.00/lb sulphate premia).

Even at these long-term forecasts, prices remain too low to incentivise sufficient new nickel production to meet EV demand growth.

Source: CRU, Wood Mackenzie and CIBC
Cobalt
Supply-Demand Balance and Price Forecasts
Cobalt uses – predominantly a chemical market

- Batteries consume 50% of cobalt production
- In 2017 only a small portion (11%) was used in EVs, the majority (37%) going to lithium ion cells in consumer electronics (3C)
- 3C applications use mostly LCO cathode chemistry, which uses cobalt oxide as the feedstock
- NCM and NCA chemistries for EV requires cobalt sulphate as the feedstock

CRU forecasts that by 2030 cobalt sulphate used in EVs will make up 52% of all cobalt demand
Cobalt thrifting and cathode chemistry

Global passenger vehicle sales (2018a)

Global passenger vehicle sales (2030f)

<table>
<thead>
<tr>
<th>Metal requirements for EV batteries:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel: 650,000 tpa</td>
</tr>
<tr>
<td>Cobalt: 90,000 tpa</td>
</tr>
<tr>
<td>Copper: 500,000 tpa</td>
</tr>
</tbody>
</table>

This internal forecast assumes rapid progress on low-cobalt chemistries (NCM811 and NCA)

By contrast, CRU’s forecast is 157,000 tpa Co by 2030 where NCM532/622 are the predominant chemistries

Note: Actual figures for 2018 from Alliance Bernstein and company estimates. EVs only account for pure electric vehicles, not PHEV. Passenger vehicle growth 2018 to 2030 of 1.5% pa. Average cathode chemistry split of 50% NCM622, 25% NCM811 and 25% NCA in 2030 and an average battery size of 50kWh per BEV. Copper demand only accounts for copper in the battery, and not motor and other external systems (BMS, wiring, etc.)

Clean TeQ  |  June 2019
• By 2030 most cobalt will be refined into chemical products, the majority of which will go to the battery sector between EVs and consumer electronics (3C)

• Total cobalt demand in 2030 is forecast to be just over 300ktpa (~200% of today’s production capacity)

• This demand profile requires, in addition to new mine development, significant investment in chemical refining capacity

• What is the outlook for mining and refining?

Source: CRU
Cobalt mine supply – where will it come from?

- Can mine supply grow quickly enough to support cobalt demand growth?
  - CRU can only identify enough projects to support 185ktpa of production by 2030
  - CRU assumes almost 80ktpa will come from as-yet-unidentified projects
  - Because cobalt is a by-product, supply growth depends heavily on copper and nickel pricing, and the DRC investment climate
  - In short, there is still significant uncertainty whether mined cobalt supply can expand rapidly enough – if it can, most of it will need to come from DRC

Source: CRU
CRU forecast - cobalt project pipeline

CRU’s list of firm, probable and possible cobalt projects highlights the difficulties

Over half of the projects are greenfield, are yet to be permitted and are uneconomic at today’s Ni and Cu prices

For DRC projects, recent legal and tax changes – increasing royalties to 10%, introducing 50% windfall taxes and requiring government participation discourage new investment

The list highlights the importance of laterite projects in Australia to diversify the supply chain

Cobalt thrifting (NCM811) and recycling become critical to market balance, but also transfers risk to nickel

Identified firm, probable and possible cobalt projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Company</th>
<th>Main product</th>
<th>Other products</th>
<th>Country</th>
<th>Likelihood classification</th>
<th>Greenfield / Brownfield</th>
<th>Start-up date</th>
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</thead>
<tbody>
<tr>
<td>RTR (Kolwezi)</td>
<td>ERG</td>
<td>Co Cu</td>
<td></td>
<td>DRC</td>
<td>Firm</td>
<td>B</td>
<td>Q4 2018</td>
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<td>Savannah (restart)</td>
<td>Panoramic Resources</td>
<td>Ni Cu Co</td>
<td></td>
<td>Australia</td>
<td>Firm</td>
<td>B</td>
<td>Q1 2019</td>
</tr>
<tr>
<td>Mutoshi</td>
<td>Chemaf</td>
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<td></td>
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<td>Firm</td>
<td>B</td>
<td>Q1 2019</td>
</tr>
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<td>B</td>
<td>Q1 2019</td>
</tr>
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<td>B</td>
<td>2019</td>
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<td>B</td>
<td>2019</td>
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<td>Skullinity (feed replacement)</td>
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<td>Russia</td>
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<td>eCobalt Solutions</td>
<td>Co Cu Au</td>
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<td>Ravenshope (restart)</td>
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<td>2021</td>
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<tr>
<td>Enterprise (cobalt circuit)</td>
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<td>Sunrise (formerly Syeronst)</td>
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<td>Jinchuan Group</td>
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<td>Comide</td>
<td>ERG</td>
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<td>Lake Johnston (restart)</td>
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<td>Nickel Shaw</td>
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<td>Possible</td>
<td>G</td>
<td>2023</td>
</tr>
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<td>Tocantins (restart)</td>
<td>Votorantim</td>
<td>Ni Co</td>
<td></td>
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<td>Probable</td>
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<td>2024</td>
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<td>Wingeltina</td>
<td>Metals X</td>
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<td>Possible</td>
<td>G</td>
<td>2024</td>
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<td>Mphahele</td>
<td>Sedibelo Platinum Mines</td>
<td>PGM Ni Co Cu</td>
<td>South Africa</td>
<td>Possible</td>
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<td>2024</td>
<td></td>
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<td>Vuruchuavanch (feed replacement)</td>
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<td>Ni Cu Co</td>
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<td>Firm</td>
<td>B</td>
<td>2025</td>
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<td>Perlat</td>
<td>Anan Resources</td>
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<td>Greenock Resources</td>
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<td>DRC</td>
<td>Possible</td>
<td>B</td>
<td>2026</td>
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<td>Jacaré (cobalt circuit)</td>
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<td>Brazil</td>
<td>Possible</td>
<td>G</td>
<td>2026</td>
<td></td>
</tr>
</tbody>
</table>

Source: CRU
Cobalt price forecasts

- CRU forecasts cobalt prices to average $75,000/t ($34/lb) over the medium term, declining after 2025 as thrifting and recycling are assumed to ease supply pressures.
- Wood Mackenzie forecasts a lower $44,000 ($20/lb) long-term average price but, like CRU, depends for its market balance on significant as-yet-unidentified volume to fill the gap.
- Average long-term consensus price at April 2019 is $57,000/t Co ($25.93/lb).

Even at these long-term forecasts, prices remain too low to incentivise sufficient new cobalt production to meet EV demand growth.

Source: CRU, Wood Mackenzie and CIBC
## Metal price impacts on EV cost

<table>
<thead>
<tr>
<th>Spot Prices</th>
<th>Consensus Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV sticker price (US$)</td>
<td>35,000</td>
</tr>
<tr>
<td>Nickel price$^{1}$</td>
<td>$14,326/t ($6.50/lb)</td>
</tr>
<tr>
<td>Cobalt price</td>
<td>$34,750/t ($15.76/lb)</td>
</tr>
<tr>
<td>Battery size (kWh)</td>
<td>50</td>
</tr>
<tr>
<td>Contained Ni (kg)$^{2}$</td>
<td>34.3</td>
</tr>
<tr>
<td>Contained Co (kg)$^{2}$</td>
<td>4.3</td>
</tr>
<tr>
<td>Value of Ni ($/EV)</td>
<td>492</td>
</tr>
<tr>
<td>Value of Co ($/EV)</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total cost of Ni/Co ($/EV)</strong></td>
<td>642</td>
</tr>
<tr>
<td>Ni/Co Cost as % of EV sticker price</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

- Increasing Ni/Co prices from spot to market consensus adds ~$250 to the cost of an EV battery (or 0.6% to the cost of the vehicle)
- Higher metal prices are not an economic obstacle to the development of EVs
- However, ownership of resources is the only way to hedge long-term price and supply risk for metals that are exchange traded

“The simple fact is that the EV revolution will not happen at today’s commodity price deck.”

— Alliance Bernstein, 4 March 2019

1. Spot and consensus nickel prices assumes a $1/lb sulphate premium, nil for cobalt.
2. Metal content assumes NCM811 chemistry
Scandium

Unlocking aluminium’s potential for global transport
Aluminium is the dominant lightweight material for global transport

- Light-weighting initiatives are leading to enormous growth for aluminium components in transport:
  - CO$_2$ emissions and fuel efficiency standards
  - Cost savings in aerospace: Buy-to-Fly and delivery backlogs
  - Recycling materials (cf composites)
- Functional performance demands from customers are driving the aluminium industry to develop new, higher-cost alloy combinations to compete with high strength steel – this leads to substitution risk
- Scandium plays a unique role in optimising both cost and performance for aluminium alloys
How scandium makes aluminium better and cheaper

In addition to being the most potent strengthening element in aluminium, scandium provides several benefits.

- **Increased strength**
- **Increased fatigue & corrosion resistance**
- **Enhanced formability & increased crushability**
- **Increased weldability**

**Without scandium**
- Broader adoption of aluminium in auto leading to significant weight savings
- Dramatic improvement of component life
- Increased quality and reliability of auto crash parts
- Removal of rivets simplifying production and reducing weight

**With scandium**
- 13% reduction in weight for the F-150 by adopting aluminium

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Clean TeQ | June 2019
Scandium allows aluminium to replace high strength steel

- Scandium adds significant strength to many of the alloys used in automotive (3xxx, 5xxx, 6xxx and 7xxx) and aerospace (2xxx, 5xxx and 7xxx)
- This strengthening impact allows more high strength steel components to be replaced with aluminium – a key to weight reduction
- Clean TeQ’s work in 6xxx series alloys is of particular importance, as it provides a pathway for standardisation of alloys used in vehicles, eliminates costly processing steps and improves recyclability
- Clean TeQ has a comprehensive test program with OEMs and alloy companies on the application of scandium in automotive

Notes: 1: Hydro Aluminium R&D Sunndal, 2012. 2: Work completed by Clean TeQ.
Case study: Sc is to aluminium, as Nb is to steel

- Forty years ago the niobium market was a niche market, until the discovery of Araxa, the world’s largest and lowest cost niobium resource – Brazil is now the world leader in niobium alloys
- Niobium, when added to steel in very small quantities, provides significant strengthening and corrosion resistance, allowing steel to be used in a number of different industries and applications
- Scandium will provide the same catalyst for aluminium, providing lighter and cheaper parts in a range of new or higher-spec applications

Source: H. Mohrbacher. Intl. Symp. on New Developments in Advanced High-Strength Sheet Steels, AIST, 2013, p. 319-32
Building the scandium market

- Historically:
  - Scandium has been caught in a cycle of high prices, leading to low demand, leading to high prices. Most companies price scandium oxide (the traded form of scandium) at USD$2,000-3,000/kg.
  - Relatively high amounts of scandium (0.2-0.3%) have been used in aluminium, which adds significant cost to the base aluminium alloy.
  - China dominates current production, with scandium now listed on USA and Europe’s “Critical Raw Materials List”.

- Scandium can provide higher performance parts at lower prices than the alternatives:
  - Clean TeQ’s Sunrise Project is one of the leaders in the new scandium market, producing scandium as a by-product from nickel and cobalt production, at prices <USD$1,000/kg, or 40% of historical prices.
  - This also removes any apparent “critical supply risk” from those industries and companies looking to adopt aluminium-scandium.
  - Recent development work led by Clean TeQ with global universities has demonstrated that scandium can provide the same benefit at 0.05-0.1%, or 30% of what was previously required.
There are significant potential applications for aluminium-scandium in transport:

**Pistons**
Higher strength scandium containing alloys with improved performance at temperature.

**Radiator**
Scandium containing brazing alloys to allow for thinner sheets to be used reducing weight and increasing heat transfer coefficient.

**Bumper & Crash Structures**
Higher strength 6xxx and 7xxx alloys with scandium means replacement of heavy steel bumpers with no compromise on safety.

**Panels & Doors**
Scandium increases formability allowing more unique shapes to be used in car designs.

**Main Body**
Higher strength auto alloys with scandium means consolidation of alloy types for frames.

**Body Nodes**
Higher strength auto alloys with scandium means consolidation of alloy types for nodes.

**Fuselage Panels**
Use of AlMgSc alloys can reduce weight and increase performance compared to 2xxx alloys and provide new manufacturing processes.

**Wing Panels**
Use of AlMgSc alloys can reduce the weight of wing panels, open up new manufacturing processes, including the ability to form and weld panels.

**3D Printed Parts**
Scandium containing powders allow for weight saving to be maximised without compromising strength.

**Welded Structures**
The reduction or elimination of rivets from manufacture provides enormous weight saving potential, as well as reduction in manufacturing time.

**Wheels**
High strength scandium containing alloys allow for thinner, lighter wheels to be forged with the possibility of new forming technologies.

**Seat Frames & Tracks**
Lighter and higher strength extrusions will allow for a significant weight reduction in seat assemblies.

**Extrusions**
Scandium can increase the strength and reduce surface recrystallization, producing a stronger, lower cost extruded part.

**Warm Temp Applications**
Better performance of Al alloys with scandium at temperature will eliminate the requirement for titanium.

Similar opportunities exist in marine, space and rail.
How scandium buys its way into global transport

If scandium improves the functional properties of a final product, reduces material input costs or allows the alloy to be processed more easily, it will have significant value in use.

The key is identifying where value in use is maximised.

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1. Illustrative for high performance 6xxx or 7xxx automotive alloys.
Clean TeQ's Sunrise Project is a globally significant deposit for scandium – along with Sumitomo Metals and Mining and MCC.

- Scandium is produced as a by-product, making production costs very low, with initial production estimated at 85tpa scandium oxide (easily expandable 2x).
- Scandium production can be easily increased as the market demand grows.
- The JORC-compliant scandium resource at Sunrise is sufficient to support 20-40Mt of Al-Sc alloy production.

Other significant recent scandium suppliers

- Initial 7.5tpa capacity coming online at their Coral Bay Project
- Initial 20tpa capacity Ramu Project

Australian Scandium Resource Estimates, tonnes Sc$_2$O$_3$
Clean TeQ is a global leader in aluminium-scandium alloy development. We have developed an extensive network in transportation, as well as our own fundamental research programs. An investment in Clean TeQ provides access to these partnerships and programs. While we have several confidential development programs, below are some of our public partnerships.

### Publicly announced Industrial partners & programs:

- **Joint cooperation on development of aluminium-scandium alloys for automotive and aerospace**
- **Development of extruded parts for commercial aircraft**
- **Market development and integration for aluminium-scandium master alloys**
- **Supply and recycling process for scandium-containing 3D printing material**
- **Development of scandium-containing alloys for aluminium buses (targeted for new electric buses)**

### Internally funded development programs:

- **High-strength low-alloyed automotive alloy design.** This fundamental work is shared with the industry to accelerate development and adoption in automotive.
- **High-strength scandium-containing welding wire.** Alloy design and production of wire to provide to customers for rapid testing for commercialisation.
What scandium means for Japanese industry

- While the market is still small, the potential is enormous (see the niobium market)
- Electrification of the global economy will require more aluminium servicing a wider range of functional applications
- Japan has an opportunity to become the dominant supplier of scandium-containing aluminium alloys for the global transport sector through a vertically integrated supply chain
- Areas where Japanese industry would benefit from scandium:
  - Potential to become the global hub for mine-sourced scandium refining
  - Development of scandium master alloy production (few companies globally have this capability)
  - Production of high-value scandium-containing alloys
  - Adopting aluminium-scandium alloys in automotive or aerospace components
  - Vertical integration of one or more of the steps above for a significant competitive advantage
Conclusions

The challenges facing metal supply from the widespread adoption of EVs is not yet well understood, despite enormous investments currently being made in new battery and EV capacity. Electrification requires light-weighting solutions for the transport sector.

The key conclusions are:

1. As EV demand grows, nickel and cobalt prices must move substantially higher over coming years to ensure adequate supply;

2. Apart from China, the auto and battery industry has shown little inclination to address raw material supply risks by securing raw materials for their supply chains;

3. Auto makers that own or control the supply of key battery metals will build a dominant industry position that will be difficult to overcome; and

4. Electrification of the economy means light-weighting becomes imperative for both aerospace and automotive, positioning scandium as the most important specialty alloy for developing stronger and lighter materials.
Management bios

Sam Riggall- Chief Executive Officer
Mr Riggall is Chief Executive Officer of Clean TeQ Holdings Ltd, an Australian and Canadian-listed technology company focused on development of resources to service new energy and materials markets. He is also a non-executive director of Syrah Resources Limited, the world’s largest graphite miner, and VRB Energy, one of China’s largest vanadium redox flow battery manufacturers. Mr Riggall was previously Executive Vice-President of Business Development and Strategic Planning at Ivanhoe Mines Limited where he led the successful negotiation with the Mongolian Parliament of a 50-year Investment Agreement for the Oyu Tolgoi copper/gold mine, and where he was a director of Oyu Tolgoi LLC. For over ten years Mr Riggall worked in a variety of global roles in the Rio Tinto Group covering industrial minerals, project generation and evaluation, business development and capital market transactions. He brings significant insight to the impact of disruptive technologies on metals and energy markets and has a strong track record of identifying and building value through innovation in the resources sector.

Stephen Grocott- Chief Technical Development Officer
Dr Grocott is Chief Technical Development Officer of Clean TeQ Holdings Ltd. He is also a non-executive director and past Chair of AMIRA International, the world’s largest broker of minerals industry R&D and is Adjunct Professor with RMIT University’s Centre for Advanced Materials and Industrial Chemistry. Prior to joining Clean TeQ, Dr Grocott was previously Chief Advisor – Processing with Rio Tinto, in charge of the Group’s processing technical support, process development and major project capital reviews. Prior to his 9 years with Rio Tinto, he held a similar role in BHP Billiton where he was Global Technology Manager – Minerals Separation & Hydrometallurgy where he led the Group’s Minerals Separation & Hydrometallurgy technical development. Dr Grocott has more than 30 years’ experience in mining and minerals processing technology and process development and is a world authority in the processing of nickel, alumina, copper and uranium as well as experience with rare earths, titania, tailings, environment, oil shale and sensors & analysers. He created many technologies which are now in commercial use in operations around the globe.

Timothy Langan- Principal Metallurgist, Scandium Alloy
Dr. Langan is the Manager of Scandium Alloy Development for Clean TeQ and is working with industrial partners to guide, develop and focus research efforts on aluminum-scandium alloys at universities, including Deakin University, Michigan Technological University, Monash University and Chongqing University. Dr. Langan has extensive experience in aluminum alloy development. Working at Surface Treatment Technologies (ST2), he developed a family of advanced corrosion resistant weldable scandium containing aluminum alloys. Dr. Langan joined ST2 after working as a Technical Director of Ashurst Technologies Corporation. In this capacity, he was instrumental in developing US markets for materials technology from the Former Soviet Union, particularly Ukraine. Before joining Ashurst, Dr. Langan was Group Leader, Special Programs Group, in the Advanced Alloys Department at Martin Marietta Laboratories in Baltimore, Maryland. In this position he co-invented a family of aluminum-lithium alloys known as Weldalite™ alloys and worked with engineers at Martin Marietta, NASA and Reynolds Metals to successfully use the alloy to build the Super-lightweight tank, which first flew as the space shuttle main fuel tank in 1998. While employed at Martin Marietta Laboratories Dr Langan earned his Ph.D. and M.S.E. in Materials Science and Engineering from The Johns Hopkins University. Research for his Ph.D. dissertation focused on developing heat treatments that optimize the performance of advanced aluminum-lithium alloys for use in space launch vehicles.