



SYERSTON PROJECT  
AUSTRALIA

Clean TeQ Holdings Limited  
(ASX:CLQ)



Sam Riggall  
Executive Chairman  
9 – 10 June 2016

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Any information in this document that relates to Exploration Results, Mineral Resources or Ore Reserves for the Syerston Scandium Project is based on information compiled by Sharron Sylvester, who is a Registered Professional Geoscientist (10125) and Member (2512) of the Australian Institute of Geoscientists, and a full time 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 her information in the form and context in which it appears.

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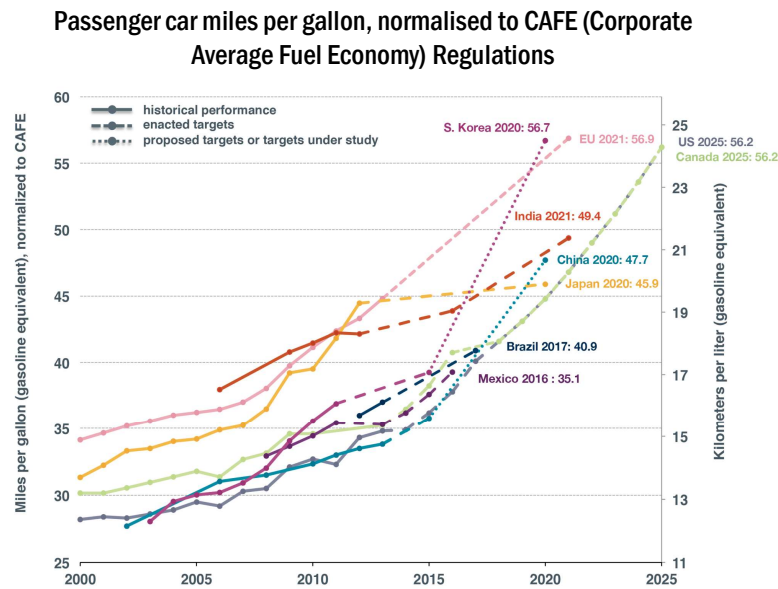
A red Ford pickup truck is shown from a front-three-quarter view, parked on a dark asphalt road. The truck is illuminated by a soft, low-angle light source, likely the setting or rising sun, which creates a warm glow and highlights the contours of the vehicle. The background consists of a hazy, open landscape with some distant hills or mountains under a twilight sky. The overall mood is serene and professional.

# THE MARKET IMPERATIVE

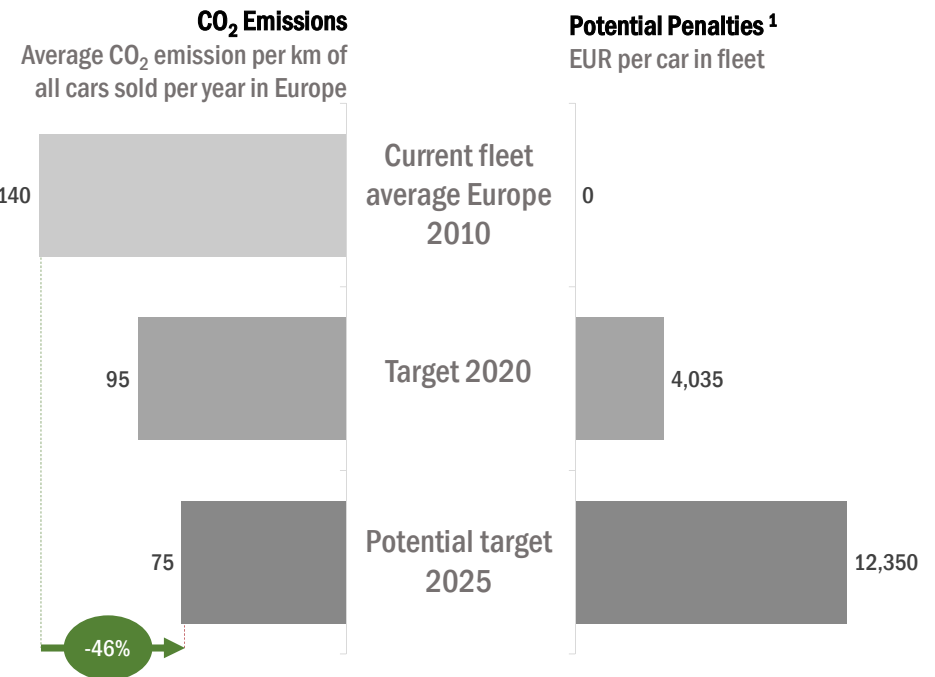
# THE WORLD NEEDS LIGHTWEIGHT SOLUTIONS

## THE IMPERATIVE DRIVING THE GLOBAL TRANSPORT INDUSTRY

### Increasing Fuel Efficiency Targets



### Increasing CO<sub>2</sub> Emission Limits



CAFE regulations source: The International Council of Clean Transportation (enacted or proposed targets)

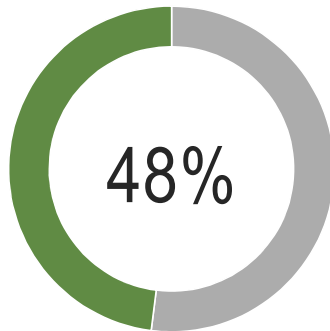
CO<sub>2</sub> emission penalty source: McKinsey

<sup>1</sup> Assumption in comparison to today's average European CO<sub>2</sub> emission of 140g CO<sub>2</sub> per km car; penalties for exceeding CO<sub>2</sub> emissions in 2020: for 1<sup>st</sup> gram EUR5, 2<sup>nd</sup> gram EUR15, 3<sup>rd</sup> gram EUR25, 4<sup>th</sup> gram and beyond EUR95; penalties in 2025: EUR190 for each gram.

# ALUMINIUM IS A CRITICAL LIGHTWEIGHT MATERIAL

ALUMINIUM IS TRANSFORMING THE WAY WE BUILD CARS AND PLANES

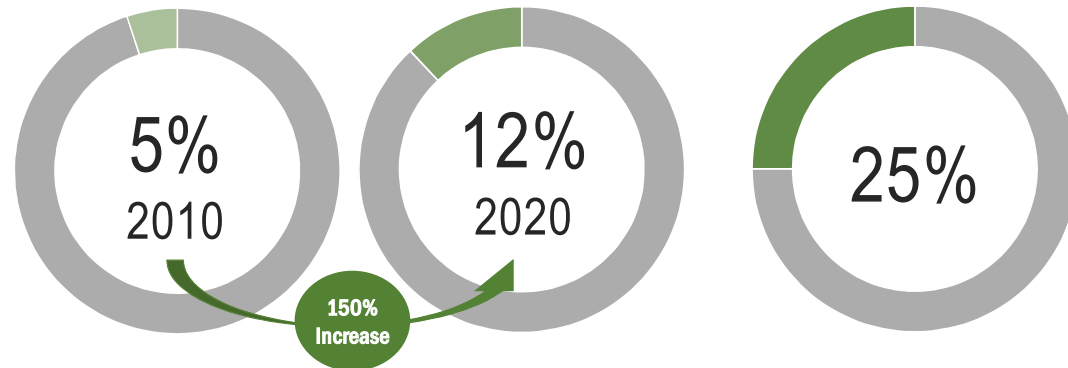
## AEROSPACE



### Aluminium in Aircraft Materials

Aluminium is 25% lighter than high strength steel and 75% cheaper than carbon fibre, well established in providing the lowest cost light weighting material available today.

## AUTOMOTIVE



### Aluminium in Automotive Materials

Aluminium is quickly being recognised as an important material for reducing the weight of cars. In many cases the learnings of the aerospace industry are being used to produce lighter, stronger aluminium components in automotive.

### Aluminium in the Ford F150

Ford's F150 is a model for the industry. Aluminium was critical in the F150 reaching its fuel efficiency requirements. The F150 is Ford's #1 selling vehicle and a driver of the Group's profit.



# SCANDIUM

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# SCANDIUM: THE MOST POTENT ALLOYING ELEMENT

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## STRONGER

Scandium increases the strength of aluminium alloys allowing for less material to be used.



## WELDABLE

A key benefit for transport, weldable aluminium will fundamentally change the way we build cars and planes, which are currently riveted.



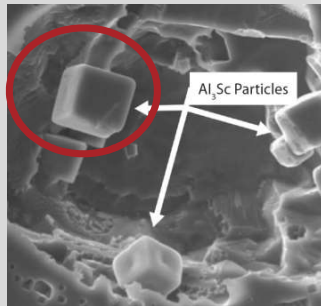
## CORROSION RESISTANT

Higher corrosion resistance means thinner material can be used, lower maintenance and longer service life.

# SCANDIUM: GRAIN REFINER

The micro structure of aluminium is **fundamentally changed** when scandium is added:

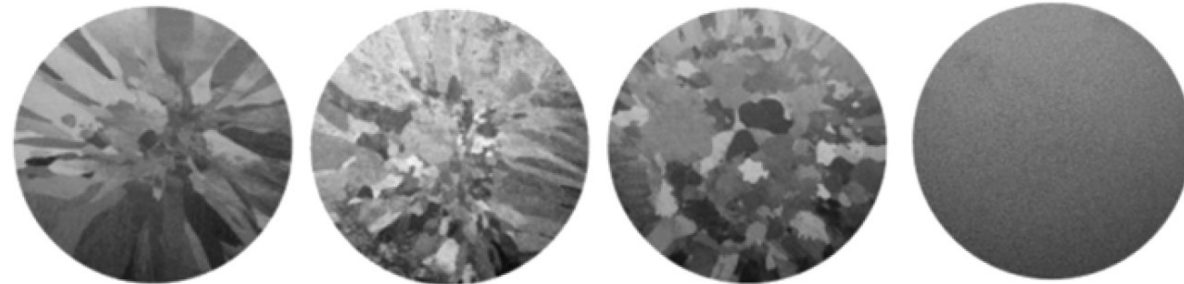
Cuboid Structure of  $Al_3Sc$ :



Source: AMG Aluminum

This leads to finer grains of aluminium being formed. The implications of this “grain refinement” on the performance of the alloy, including strength and weldability are enormous.

Source: Zhang et al, 2013

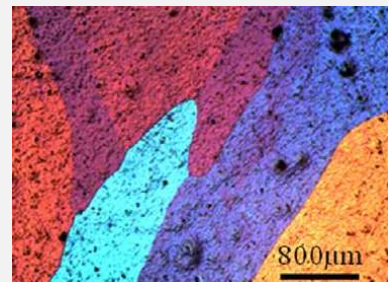


0.05% Sc

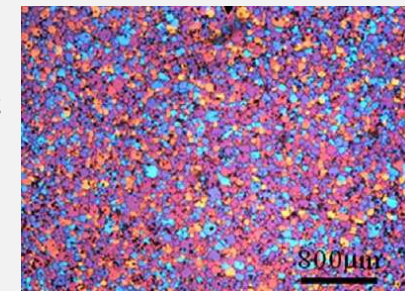
0.2% Sc

0.5% Sc

0.7% Sc



Effect of Sc Addition on Grain Refinement

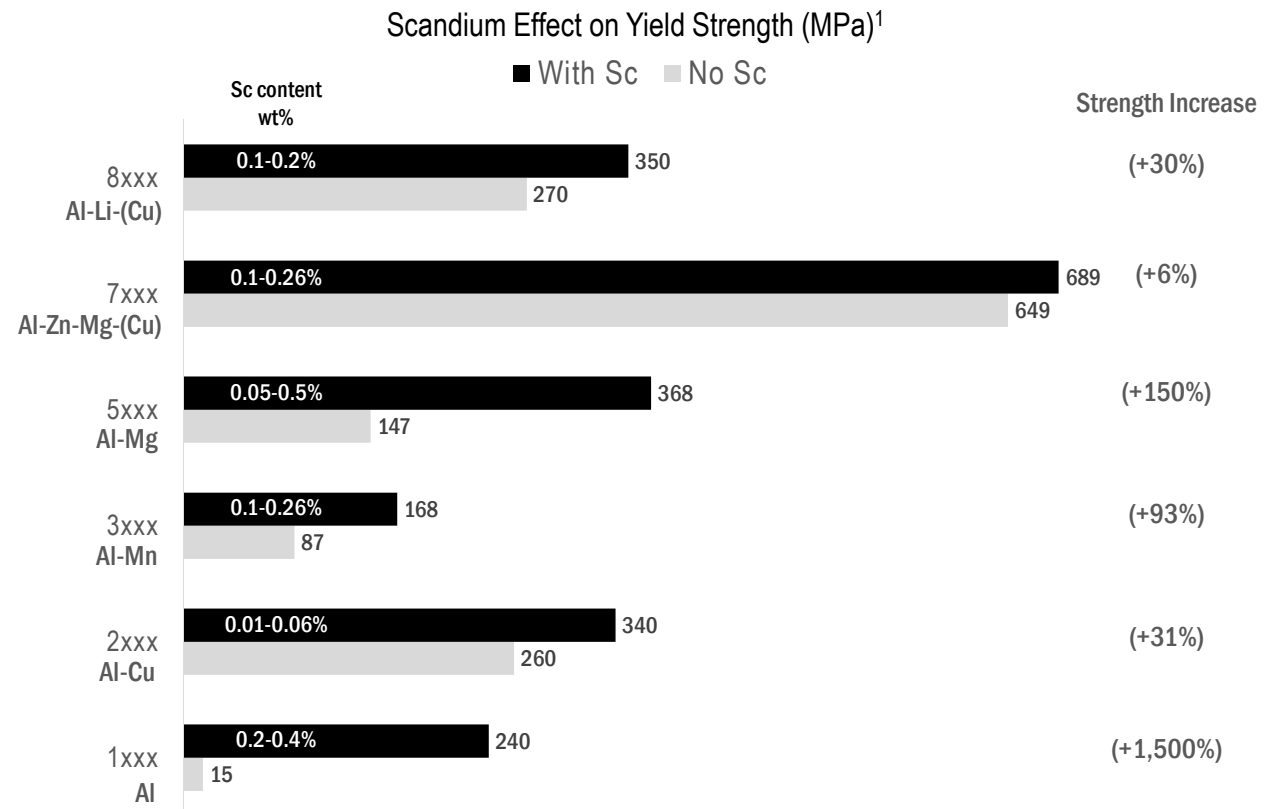




# STRENGTH WITH SCANDIUM ADDITION

“ 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



# AEROSPACE

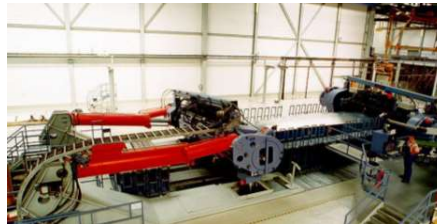
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# AlSc ALLOYS: LOWER “BUY-TO-FLY” RATIO

AlSc ALLOYS + NEW PRODUCTION PROCESSES = LOWER MANUFACTURING COST

**Example: Fuselage**  
The functional benefits of AlSc alloys allow the *creep forming* process to be applied, significantly reducing the number of manufacturing steps required.

**Previous:**  
*Conventional stretch forming and riveting:*



22  
Process  
Steps

**Future:**  
Creep forming +  
AlScMg alloy :



9  
Process  
Steps



Potential Aerospace  
Application of AlMgSc +  
Creep Forming

# MATERIAL AND FUEL SAVINGS

## CASE STUDY: AIRBUS A380



### A380 Material and Fuel Savings

Operating Empty Weight	280,000 kg
Aluminium content – 60% of OEW	168,000 kg
Al-Sc alloy weight savings <sup>1</sup>	4,956 kg

Fuels savings (US\$/pa) <sup>2</sup>	~US\$4.5 million
Fuel savings (US\$/life of aircraft)	~US\$90 million

### Airbus and Boeing Order Books<sup>3</sup>

	Airbus	Boeing
Order Pipeline (units)	6,430	5,689
Estimated Al requirement (tonnes)	234,000	212,000
Estimated weight savings with Al-Sc (tonnes)	6,900	6,200

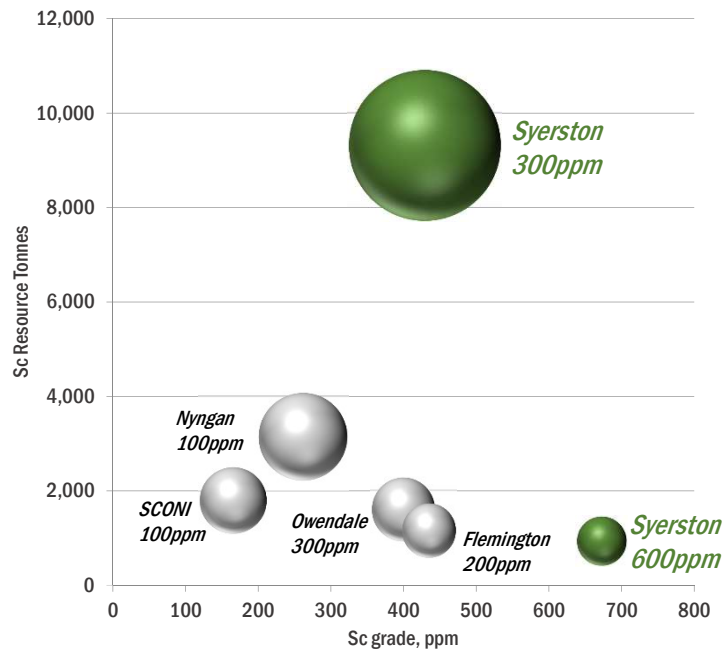
Fuels savings (US\$/pa)	US\$6.2B	US\$5.6B
Fuel savings (US\$/life of aircraft)	US\$124B	US\$112B

1. Assumes fuselage constitutes 65% of Al content with a 4% weight saving from use of Al-Sc alloy (source: Aleris and internal estimates). Remaining 35% of Al content is other parts, of which Al-Sc alloy enables a 1% weight reduction.
2. Fuel savings calculated as 45,000lt/kg over 20 year aircraft life (source: Roland Berger, 2013). Jet fuel cost estimated as long-run average of US\$0.40/lt (source: IATA)
3. As at 30 June 2015. Adopts identical assumptions as per 1 and 2 above, but adjusted by individual aircraft model and specific aluminium content.

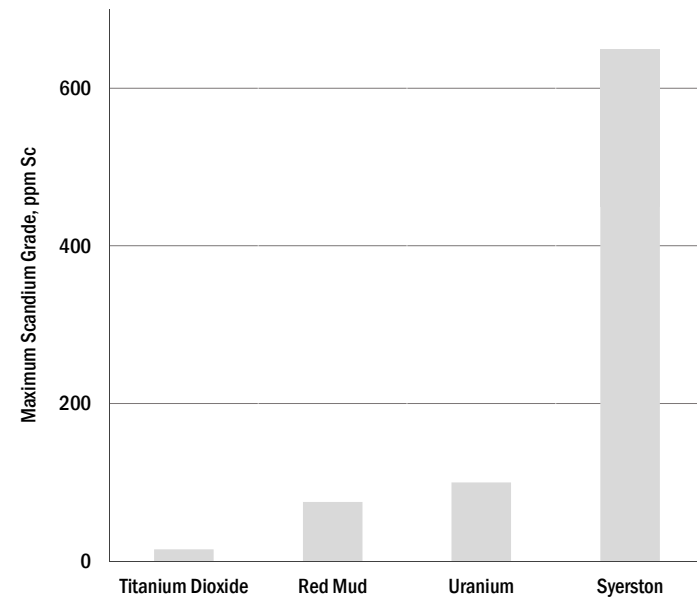
# SCANDIUM SUPPLY

## AUSTRALIA: THE WORLD'S FIRST MINEABLE SOURCE OF LOW-COST SCANDIUM

Australian Scandium Mine Comparison<sup>1</sup>:



Grade Estimates for Other Scandium Sources<sup>2</sup>:



<sup>1</sup> Measured and indicated JORC resources shown at stated Sc cut-off.

<sup>2</sup> Based on internal estimates



# CLEAN-iX<sup>®</sup> PILOT PLANT

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## WESTERN AUSTRALIA

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

Recent operation included processing of 12 tonnes of Syerston ore to produce scandium samples for offtake partners.

# CONTACT

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Sam Riggall  
Chairman



Clean TeQ Limited  
Ferntree Business Park  
2 Acacia Place  
Notting Hill VIC 3168  
AUSTRALIA

[www.cleanteq.com](http://www.cleanteq.com)

M: +61 448 044 556

E: [sriggall@cleanteq.com](mailto:sriggall@cleanteq.com)