



WHY ALUMINIUM?

Why Aluminium?



A VITAL ECONOMIC CONTRIBUTOR

£6.8 BILLION

in GVA generated annually for UK economy from the wider aluminium sector



97,000+ people employed by the aluminium sector nationwide



HIGHLY RECYCLABLE

75%

of all aluminium ever produced is still used in some form



95%

less energy required to produce recycled aluminium (compared with primary aluminium)



ENABLING SUSTAINABILITY ACROSS INDUSTRIES

8G OF CARBON EMISSIONS

saved per kilometre for each 100kg reduction in a car's mass, thanks to aluminium-driven lightweighting



UP TO 50% REDUCTION

in a building's energy consumption with intelligent façades incorporating aluminium systems



UP TO 40% REDUCTION

in the foil thickness of packaging without jeopardising content quality



Aluminium - strategic metal for society

Aluminium is unique among all other metals, in that its alloys, engineering and metallurgical properties have been systematically designed and developed through the application of metallurgy, within its short history of just one century, in response to known engineering gaps and to the specific needs of society. It is a developed, not a discovered metal.

From its inception, matching its developments aluminium has been recycled not consumed, so beyond doubt leads and is at the forefront of the "Circular Economy".

Truly the holistic and versatile properties of aluminium are establishing it as global designers' metal of choice, substituting and displacing other strategic metals, materials, plastics, and carbon fibre.

Today, further advances in the metallurgy of aluminium are facilitating the design of innovative designs in every facet of society, in packaging, architecture, transport and life sciences and the harnessing of energy.

Fundamentally, aluminium is a light metal, 33% the density of steel, so through the correct application of design it can match the engineering strength of steel, while offering a 40 to 50% weight saving. Weight saving not only in product application, but through its entire life cycle from ore shipping and transportation.

The low melting point of aluminium, 660°C, coupled with its extreme liquid fluidity dominates intricate automotive castings, powertrain, combustion or electric motors, gearboxes, and braking, all coupled with weight savings.

Weight for weight aluminium has 200% the thermal and electrical conductivity of copper. Radical rethinking that has resulted in virtually all air conditioning systems being manufactured out of aluminium. In the United States aluminium wiring is displacing copper.

ONE BILLION TONS OF ALUMINIUM HAVE BEEN REFINED DURING ITS SHORT HISTORY.

The ability at moderately high temperatures to be readily extruded sets aluminium apart from all other metals. The ultimate "Net Shaping Process", most versatile of all metal forming process; designers can put metal where they need it".

Combining extrusion with the thermal properties of aluminium created heatsinks; without heatsinks, semiconductors and electronic chips cannot function. Hence aluminium is powering laptops, i-Phones and virtually every electronic device.

Conversely, the aluminium properties at extremely low temperatures have enabled the industrialisation of cryogenics.

Aluminium naturally forms a protective oxide, alumina; a hard, self-healing barrier to the environment, which bestows the highest corrosion resistance and longevity of most metals. Thus, given its short history some of the earliest aluminium products are still in original, prime condition.

One billion tons of aluminium have been refined during its short history, of which 75% is still in use and 50% in "first use", testament to its engineered and metallurgical properties.

Efficient buildings & construction

Energy, heat, light, and electricity are as critical to the survival of humanity as food or water. Energy cannot be created nor destroyed, it can only be stored, converted, released, radiated, or dissipated.

Global warming, through the entrapment by greenhouse gases within the atmosphere of dissipated heat energy, is a non-disputed fact. Greenhouse gases, significantly carbon dioxide, are the combustion products of fossil fuels, burnt to convert/release the stored energy of the sun.

Global warming is the change in the climatic equilibrium; so, droughts, heat, deep cold winters, torrential rain, flooding and changed ocean currents.

The population of our blue planet is predicted to increase by three billion people by 2050. All will demand a comparable standard of food, clothing, shelter/building, environment, transportation and critically energy. Concerted decarbonisation by all nations might arrest greenhouse warming, however the demand for energy will be insatiable, particularly by the expanding population.

Radically, we need to construct using minimal energy, energy efficient buildings to provide comfortable environments.

Energy is required to extract the raw building materials, to transport, refine the materials, to construct and fabricate buildings, to maintain and service the buildings. Effectively buildings are stores of energy. Thus, through efficient building design and construction, we can significantly offset/reduce energy demand, so store rather than dissipate.

Aluminium is a light metal, so low shipping and transport footprint, low handling, erection, low fabrication energy and simple mechanical assembly. Red mud by products of aluminium refining are replacing mined minerals such as laterite and lithomarge in high strength concrete.



WE NEED TO CONSTRUCT USING MINIMAL ENERGY, ENERGY EFFICIENT BUILDINGS TO PROVIDE COMFORTABLE ENVIRONMENTS.

Aluminium offers high strength to weight ratio. Land is at a premium so cities will rise upwards; the strength and lightweight of aluminium enables roomy, airy living spaces. Aluminium does not burn nor contribute to fire. The low “Young’s” modulus of aluminium gives it elasticity to survive earthquakes. Lightweight, large span bridges reduce impact on the environment. High-strength lightweight aluminium with its cryogenic properties can withstand heavy arctic snow falls.

Aluminium does not ring, it is an effective environmental and society noise barrier.

Aluminium does not pollute water so buildings can be designed to harvest rainwater.


Combining extruded aluminium with glazing maximises natural light, reducing artificial light. Natural light exposure produces vitamins so healthier occupants. High reflectivity allows shielding from light and heat or more importantly through focusing the correct application of heat and/or light. Through brise-soleil screens extreme day summer heat can be excluded whilst maximising winter light.

Applying the high formability of aluminium to its thermal conduction results in innovative natural or low energy air conditioning systems.

Simplest yet most efficient aluminium foil cavity wall insulation, once installed forgotten for ever.

Combining efficient building design with aluminium heat pumps and air conditioning allows heat to be collected during summer and pumped, stored within the earth’s crust, to supplement the natural stored heat for heating in winter. Effectively the storage of heat is almost energy neutral and it removes and dissipates heat from and back into the environment.

Aluminium building and components can be factory fabricated and assembly line built into prefabricated modules, with all services preinstalled. High efficiency, low cost with assured quality. Simplified, safe construction sites, rapid assembly, minimal environmental damage.



RECYCLED ALUMINIUM USES ONLY 5% OF THE ORIGINAL ENERGY, 5% OF THE ORIGINAL WATER AND AIR. TRULY A LOW ENERGY CIRCULAR ECONOMY.



Aluminium is frequently termed an electric battery, so the longer buildings stand the greater the saved energy. Given the remarkable corrosion resistance of aluminium, no ultraviolet light degradation, no erosion, impervious to acid rain or the environment, buildings can have proven design lives exceeding eighty years. Potentially the lowest energy footprint of any materials. Aluminium exposed to regular rain fall is virtually maintenance free.

At the end of life buildings are large structures of known aluminium alloys largely free from pollutants so optimal for recycling. Recycled aluminium uses only 5% of the original energy, 5% of the original water and air. Truly a low energy circular economy.

Electromotive

Some of the least appreciated properties of aluminium are revolutionising power storage, transmission, distribution, electromotive drives, and propulsion.

Aluminium weight for weight has 200% the thermal and electrical conductivity of copper.

Lightweight aluminium, high voltage cross country transmission lines are reducing the load on pylons, so increasing spacing, and thus reducing environment impact.

Anodised aluminium forms a surface oxide an electrically insulating ceramic, potentially reducing plastic insulation.

Aluminium does not burn nor will contribute to a fire.

Aluminium is impervious to and not degraded by ultraviolet light.

Capacitors are electronic devices that block the transmission of direct current passing AC; no electronic device can function without them. The superior dielectric properties of anodised aluminium enable the ultra-miniaturisation of capacitors, so i-Phones and laptops.

Aluminium foils are critical components of automotive lithium batteries.

Highly reflective, corrosion resistant foils insulate and protect against thermal damage from radiant heat.

Motive power batteries are just like humans - fragile, prone to shock damage, susceptible to high "G" forces, full of corrosive fluids, cannot tolerate heat, poor performers when cold and overweight. Lightweight, high strength, low Youngs modulus, corrosion resistant aluminium will not be an alternative for electric vehicles, it will be mandatory.

Replacing copper with aluminium wiring in a family car saves 12kg of weight.

The high thermal conductivity of aluminium enables downsized space saving busbars and switch gear to carry high currents.

Aluminium is non sparking so no stray ignition risks.

Corrosion resistant aluminium trucking is non-magnetic with infinite interior and long exterior environment service lives, even when uncoated.

Lightweight, non-magnetic, intricate extrusions and castings facilitate lightweight high strength drive motors, cases and housings.

At the end of life all aluminium is recyclable.



**AT THE END
OF LIFE
ALL ALUMINIUM
IS RECYCLABLE.**

Sustainable living

Aluminium is truly a strategic metal that dominates every aspect of society and is evident in our living spaces, our close environments and certainly in the home.

Domestic and white goods draw on every property of aluminium, not least its formability, easy of working, availability, durable, strong, light and aesthetically pleasing.

Innovative products personified without limits, in any aspect of living that feed comfort, communicate, entertain, capture the imagination, eye, and mind.

High thermal efficient cooking utensils, lightweight pots, and pans.

Aluminium corrosion resistant and powder coated freezers, fridges, and cookers.

Aluminium cases shield us from microwaves of ovens.

LED lighting, cases, and reflectors.

Air conditioning.

Decarbonised central heating will rely on ground heat pumps.

Television and satellite dishes.

Mobile phone and lap top cases.

Corrosion maintenance free long life double glazing windows, facades, and conservatories.

Filter coffee pods.

Every electronic device from televisions to mobile phones employs heat sinks and capacitors none can function without.

All newspapers, books, magazines, screen printed signs, cartons, boxes, and decorative finishes depend on litho plate aluminium.

Take away food containers, even the seal on your source bottle, are aluminium.

Aluminium is not consumed but it is recycled without loss of properties, at a fraction of its original refining energy, so the optimal metal for very short finite life consumer and white goods. No water pollution, no volatile organic compound emissions.

Sustainable epitome of the circularly economy.



**ALUMINIUM
DOMINATES EVERY
ASPECT OF SOCIETY
AND IS EVIDENT
IN OUR LIVING
SPACES, OUR CLOSE
ENVIRONMENTS AND
CERTAINLY IN
THE HOME.**

ALUMINIUM

strategic metal for society

ELECTROMOTIVE

- Lightweight battery containment
- Hybrid & battery vehicles
- High voltage transmission
- Trunking & cabinets
- Busbars & switchgear
- Traction motors
- Capacitors
- Batteries

EFFICIENT BUILDING & CONSTRUCTION

- Bridges
- Horticultural
- Stadiums
- Industrial
- Skyscrapers
- Windows & doors
- Facades
- Cladding
- Thermal insulators & reflectors
- Heat & noise screens

PACKAGING

- Beverage cans
- Vacuum packs
- Foil packs
- Infinite life food containers
- Sterilised pouches
- Food & confectionary wrapping
- Pressurised containers
- Pharmaceutical "lidding" bacteria proof

ALUMINIUM MOST ABUNDANT METAL IN EARTH'S CRUST

LIGHTWEIGHT TRANSPORT

- Bicycles
- Automobiles
- Buses
- Trains
- Marine
- Aircraft
- Space travel
- Skylab
- Heavy good vehicles

SUSTAINABLE LIVING

- Photovoltaics
- Lighting
- Smart phones
- Laptops
- White goods
- Cooking utensils
- Litho newspaper print
- Air conditioning
- Heat pumps
- Cryogenics

INFINITELY RECYCLABLE

- Proven circular economy
- Established recycling infrastructure
- Stored energy
- 95% energy saving
- No loss of properties
- No land fill
- No biohazards
- No water pollution
- No toxic gases

MEDICAL & LIFE ESSENTIALS

- Flocculant, fresh drinking water
- Adjuvant, vaccines
- Cryogenics
- Medical gas production
- Skeleton frames
- MRI scanners
- Survival blankets
- Hospital equipment
- Stethoscopes

Lightweight transport

Fundamentally, whether it is a bicycle, car, train, aeroplane or Mars-lander, the primary facets of all transportation modes are the same and opposing "speed, safety, comfort, payload and fuel efficiency". Secondary considerations are status symbol, evocative styling and pleasing to the eye. A further contradiction is that all modes are subjected to high service loading, high fatigue stresses and extremes of climate, yet are designed for very short finite lives, with high reliability and minimum maintenance.

Population growth, ever shrinking globalisation, will result in a proliferation in transport, matched by expectations of higher transportation speeds. Proliferation that can only be supported by higher fuel efficiencies and alternative fuels.

Global warming is demanding decarbonisation and the elimination of green-house gases so the use of alternative non fossil fuels.

Electric propulsion using electricity generated by renewable sources is certainly attractive but its range is restricted and the batteries add significant weight. Electric propulsion will only be possible using the weight savings of aluminium. Non-magnetic aluminium will not interfere with electric traction motors. Aluminium lightweight wiring offers substantial weight reduction.

Hydrogen combustion propulsion using gas produced by electrolysis, again using renewable source electric, builds on the well-established combustion and turbine engine technology/industry. Hydrogen propulsion will only be possible through the cryogenic properties of aluminium.

From the earliest days of mechanised transport lightweight aluminium with its fuel saving potential has been a consideration. In 1899 Karl Benz presented the first sports car with an aluminium body, and in 1903 the Wright brothers Flyer used an aluminium crankcase, first use in aircraft construction.

Intricately cast, lightweight aluminium dominates drive chain, internal combustion, hydrogen propulsion or electric motor, cases and housings, gearboxes, and braking systems.

Environmental Priority Strategies "EPS" in product design is a practical method for calculating environmental load. In a typical car it is already possible to replace 182kgs of steel components with 82kgs of aluminium, each 1kg of aluminium in a car reduces carbon dioxide emissions by 20kgs in its use phase. The environmental benefits of aluminium are even more significant when its "Total Life Cycle" is analysed. This considers, production of metal transportation, forming, assembly joining, protection, service, recycling, and recovery. Aluminium has a low melting point, high formability at moderate temperatures becomes semi super-plastic is extremely extrudable and readily forged. If a steel car bonnet is replaced by an aluminium reduces weight is reduced from 18 to 10kgs, applying EPS, the total load on the environment for the steel bonnet is 60% greater than for the aluminium one.

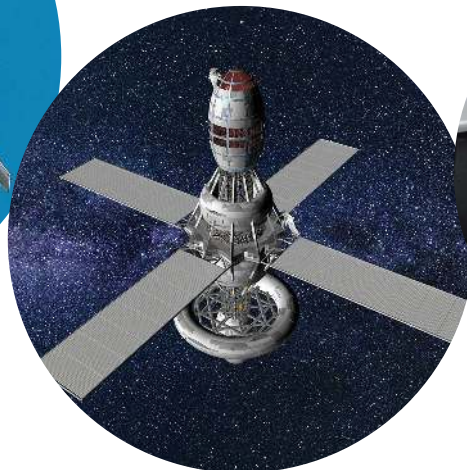
Aluminium given its low Youngs modulus absorbs twice as much energy per kg compared with steel. It can increase the energy absorption capacity of a vehicle's front and back-end crumple zones for

improved safety, without increasing the vehicle's weight.

Interior comfort is the first consideration of any occupant, heat levels and humidity, high thermal conductivity, corrosion resistant aluminium enables the maximum efficiency, lowest weight air conditions system. Low density aluminium with its low Youngs modulus and sound deadening properties is a major consideration when reducing Noise, Vibration Harshness "NVH".

Aluminium offers exceptional natural corrosion resistance and can be used in many transport applications without protective coatings. It has natural high heat, light reflectivity and can support highly decorative, lustre coatings. Highly polished and anodised it out preformed chrome, other vivid colours are possible.

Since 2015, the "End of Life Vehicles Legislation" sets a target that 95% of all raw materials, including metals must be recycled or reused. The aluminium recycling infrastructure recovers all in process scrap in addition to end of life and indeed captures and recovers metal from the drosses of smelting processes. Aluminium is the epitome of the closed loop economy.



**ALUMINIUM
GIVEN ITS LOW
YOUNGS MODULUS
ABSORBS TWICE
AS MUCH ENERGY
PER KG COMPARED
WITH STEEL.**

Medical & life essential

Quietly in the background, unnoticed, the holistic properties of aluminium support medicines, medical equipment and certainly save lives.

When you drink fresh water from a tap, it has probably been purified through aluminium flocculants.

Aluminium-containing adjuvants have been used for over 90 years to enhance the immune response to vaccines for Hepatitis A & B, Diphtheria, Tetanus, Haemophilus, Influenzae type B and Pneumococcal.

Surgical scalpels and instruments are sterilized and sealed in aluminium pouches, impervious to air and ultraviolet light. Such sterilized instruments are factory packed, critical for first responders, field hospitals and in the developing countries.

Pharmaceutical drugs sealed by "lidding" aluminium foil, have almost infinite lives.

Harnessing the corrosion resistance and thermal properties of aluminium, air conditioning systems provide hospitals with clean, filtered, temperature and humidity controlled pure atmospheres. No risk of fungal infection spread.

The cryogenic properties enable the production, liquification, storage and distribution of life-saving oxygen and of anaesthetic gases. Drugs, tissues, and vaccines can be stored at ultra-low temperatures.

Thermal aluminium blankets keep bodies hot.

High reflective aluminium maximises lighting.

Buildings, ceiling, partitions, trolleys, beds are all manufactured from lightweight corrosion resistant aluminium.

Lightweight walking sticks, support frames.

Sterilisable stethoscopes.

Invariably the non-magnetic, corrosion resistance properties of lightweight aluminium are used to manufacture instrument cases, internal frameworks and mechanical structures of most instruments and scanners.



THE HOLISTIC PROPERTIES OF ALUMINIUM SUPPORT MEDICINES, MEDICAL EQUIPMENT AND CERTAINLY SAVE LIVES.

Packaging

Look around you, see, reach out your hand and touch, be dazzled. Aluminium dominates the entire world of packaging, whether it is the foil seal on your toothpaste, the beverage can, your takeaway food container, oven ready meal, wrapping foil, the package containing your medicine pills or the dogs food pouch. Brightly coloured, durable, strong, accident proof, safe packages; infinitely recyclable, no water, no ocean pollution.

Aluminium is an absolute seal to gases, liquids and impervious to air. Bacteria proof, a total barrier to light and ultraviolet light, no degradation, so protects and extends the useful life of foodstuffs and pharmaceuticals for years. Perfect for vacuum packs or strong enough for pressurised cans. Totally odourless and will not taint food.

Aluminium is an excellent conductor of heat, optimising the chilling or heating of the contents rapidly with minimal thermal gradients. No wasted energy heating the container. Absolutely optimal for sterilizing the contents. Aluminium packaging resists a wide range of temperature, from the ultra-cold to the very hot, no risk of cracking, melting or burning. Aluminium packaged

products can be stored in the coldest deep freeze and heated in the hottest oven or exposed to the vacuum of space.

The low weight of aluminium offers reduced weight, saving energy in transport and carrying in a shopping bag.

Most foods and drinks have no adverse effects on uncoated aluminium, so there is no contamination. With very acid or alkali ingredients a wide range of food-contact coatings are available affording full protection to the contents.

Aluminium foil and can stock are compatible with all printing processes so that the contents of the foil or the can be attractively presented, no chalking or degradation, no release of plasticisers.



PERFECT FOR VACUUM PACKS OR STRONG ENOUGH FOR PRESSURISED CANS.

Infinitely recyclable

Today's industrialised society consumes the natural resources of our blue planet at an average rate of 44kg per person per day; those who subsist closer to the land consume 14kg. In the past fifty years society has consumed more resources than in the entire evolution of mankind.

We can assume that the subsistence existence will change towards industrialisation, with the population of the world predicted to increase to 9 billion people by the year 2050. At today's consumption rate, that society will require the resources of six blue planets to sustain the population.

Global warming is affecting every creature on this planet, with some environmentalists even postulating that the climate is already on the brink of irreversible catastrophic change. Decarbonisation and the total elimination of other greenhouse gas emissions can perhaps save the planet.

The extraction of metals, global shipping, primary smelting and refining, and more so of minerals, are major emitters of greenhouse gases.

Aluminium is the most common metal in the earth's crust, constituting 8.07%. However, like all metals aluminium is a finite resource, with bauxite reserves estimated at 27.5 billion tons. Given predicted demand of aluminium of 95 million tons by the year 2030 the bauxite reserves will sustain 74 years of primary production.

The global average production of 1kg of primary aluminium consumes 14KWh of electricity and releases 12kg of carbon dioxide. In Europe with significant electricity generated by renewable sources, per 1kg of primary aluminium, the carbon dioxide emissions are reduced to 4kg.

Each kilo of aluminium is thus stored energy.

Aluminium has a short history of just one century and with its transition from a precious rare metal to a strategic metal for society it

has been recycled; indeed 75% ever refined is still in use, a fact that can be only envied by other metals and beyond comprehension by plastics.

Aluminium is the most recycled metal in the United Kingdom with 70% of cans, 95% of automotive components and 96% of architectural scrap recycled. Recycling is supported by a well-established recovery infrastructure. Aluminium is too valuable a resource to be consigned to land fill.

Aluminium is leading the circular economy with 800,000 tons recycled in 2019 and 1.600,00 tons predicted for 2030. In Europe by 2050, 50% of all aluminium produced will originate from recycled scrap.

Sustained demand for aluminium will be matched by recycling.

Recycling uses only 5% of the original energy, only 5% of the water during production of primary aluminium. Recycling the aluminium from an A320 aircraft at the end of its life saves 300 tons of carbon dioxide. Recycling does not emit "Volatile Organic Compounds", toxic gases, nor pollute water or produce biohazards.

Aluminium has one of the lowest melting points of all metals, 660°C, and one of the lowest densities. When melted during recycling, lighter metals such as lithium float to the surface, heavier metals such as iron sink, and higher melting point metals such as iron do not melt. Simplistically, segregated and sorted single alloy grade scrap is simply melted, purified and produced as the same alloy grade.

Recycled aluminium is indistinguishable from primary alloy. Chemistry is impossible to differentiate, processing and heat responses are identical, as indeed are mechanical properties, and corrosion performance is comparable.

Fundamentally, aluminium is recycled not consumed.

