



# Aluminium in Bridge Constructions

The story of the first aluminium bridge in 30 years in Norway

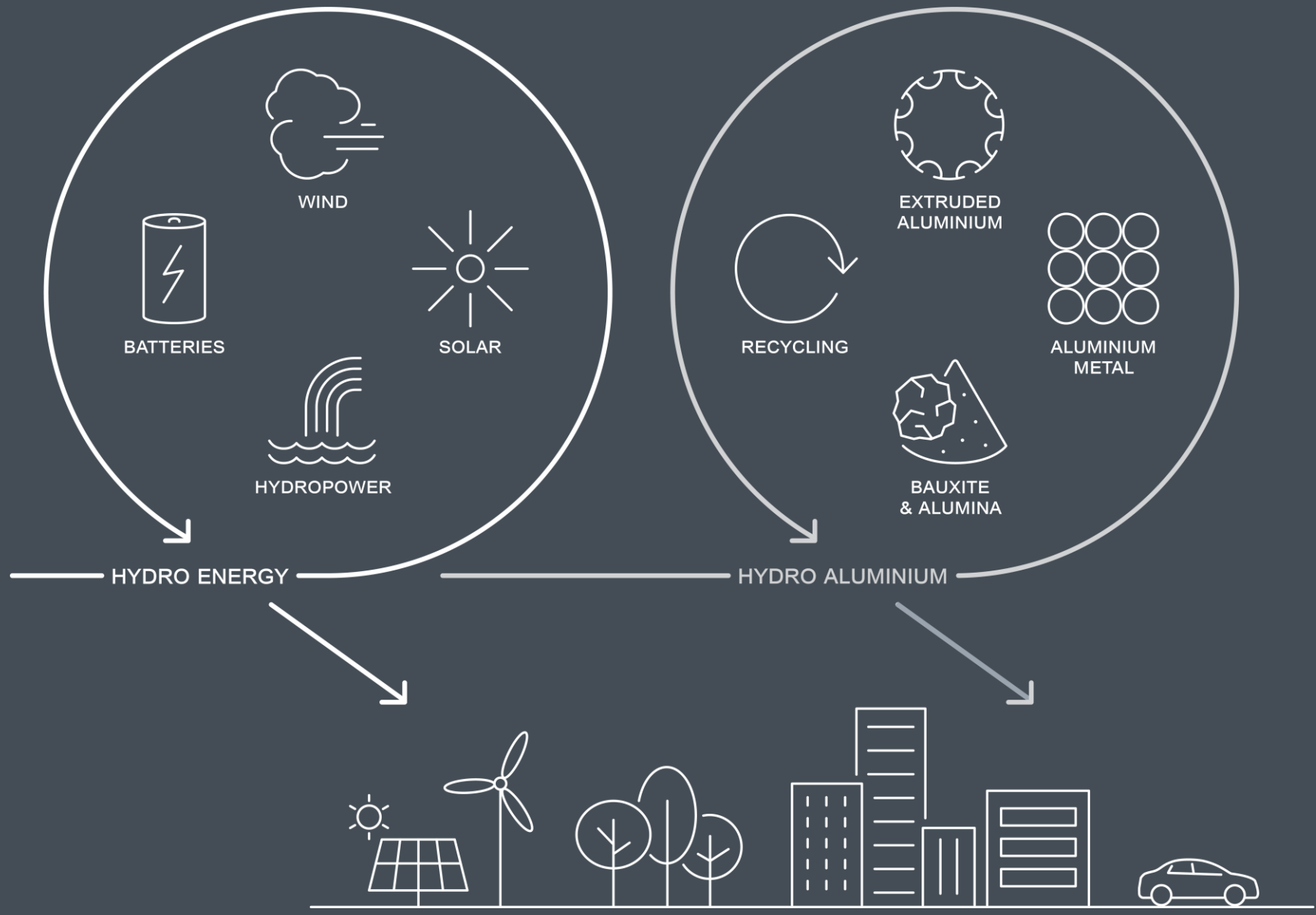
# Objectives of the pitch

- Hydro
- Aluminium
- Bridges in aluminium
- The Hangar aluminium bridge , Trondheim, NO
- Why aluminium in Bridges?

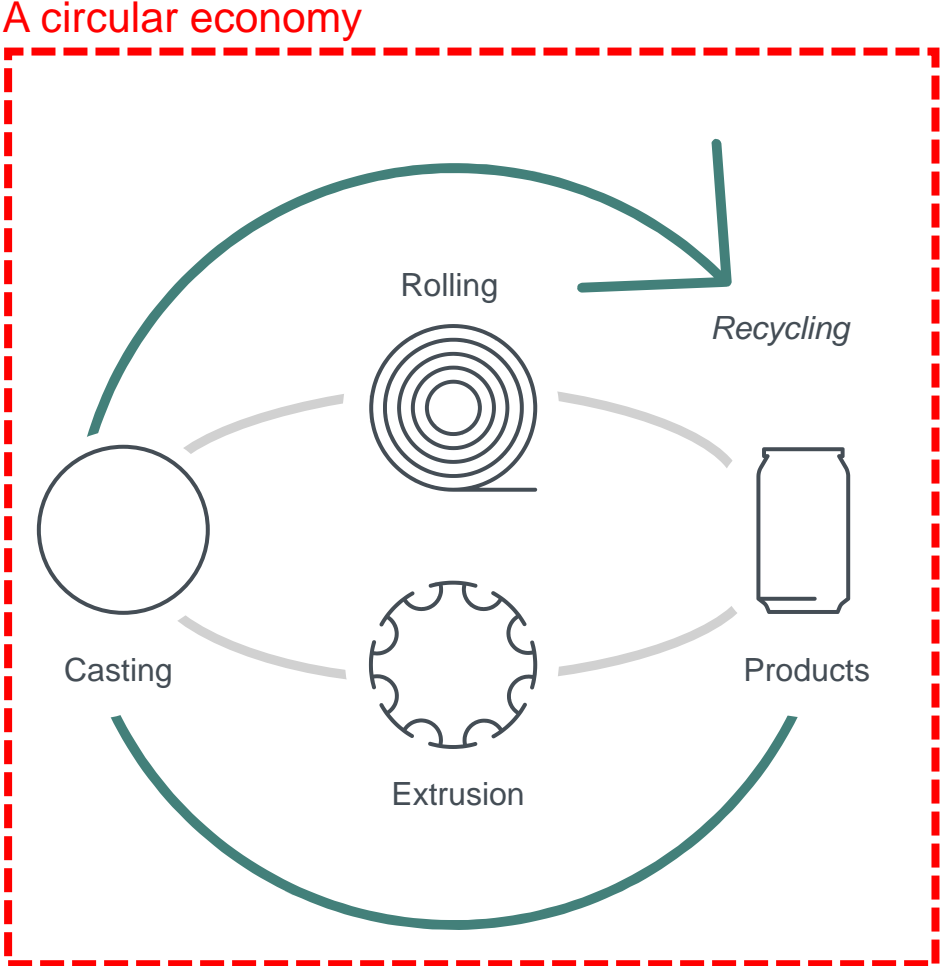
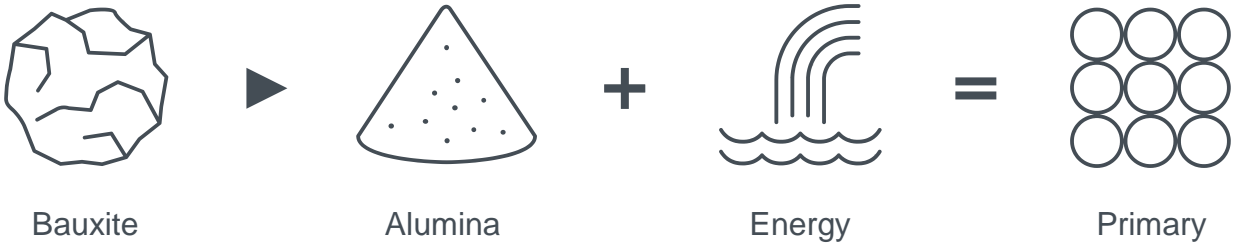




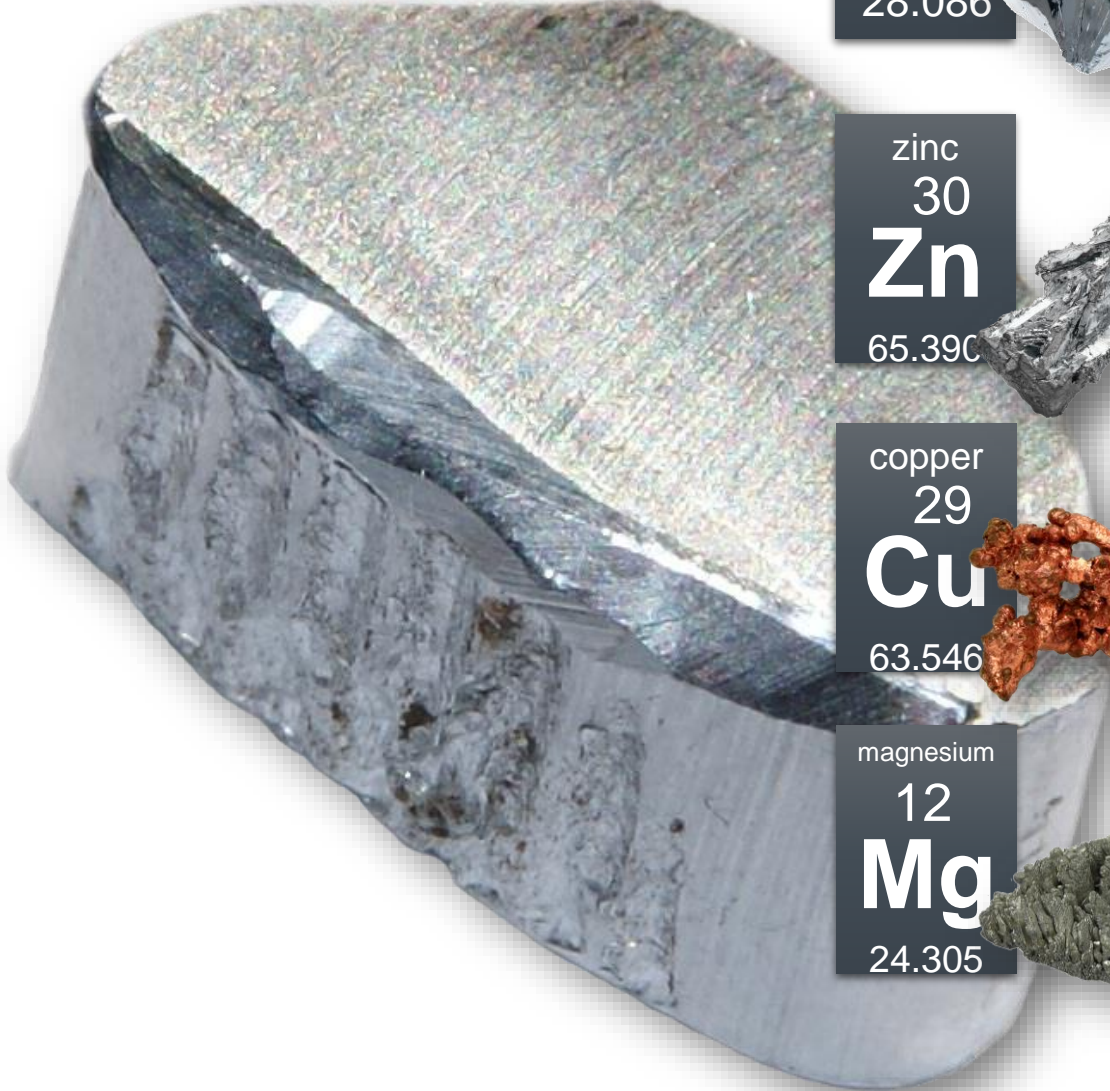




# Aluminium lifecycle



aluminum  
13  
**Al**  
26.982



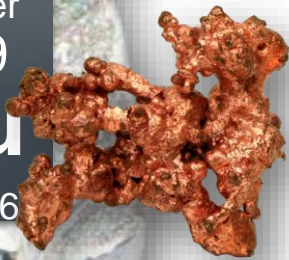
silicon  
14  
**Si**  
28.086



zinc  
30  
**Zn**  
65.390



copper  
29  
**Cu**  
63.546



magnesium  
12  
**Mg**  
24.305



# Why aluminium?

Hydro's strategic direction aims to realize full potential of aluminium's strong qualities and versatility



## Aluminium

- ✓ Lightness and strength
- ✓ Durability and formability
- ✓ Corrosion resistance
- ✓ Conductivity
- ✓ Recyclability
- ✗ Energy-intensity



## Steel

- ✓ Strength and durability
- ✓ Recyclability
- ✓ Price
- ✗ Weight
- ✗ Corrosion
- ✗ Energy-intensity



## Copper

- ✓ Conductivity
- ✓ Corrosion resistance
- ✓ Recyclability
- ✗ Price
- ✗ Weight
- ✗ Energy-intensity



## Composites

- ✓ Lightness
- ✓ Strength
- ✗ Price
- ✗ Recyclability
- ✗ Climate footprint
- ✗ Energy-intensity



## PVC

- ✓ Lightness and formability
- ✓ Corrosion resistance
- ✓ Price
- ✗ Climate footprint
- ✗ Recyclability
- ✗ Durability

# Infinitely recyclable – a high recycling rate

One of the world's largest energy reserves, increasingly utilized through urban mining and recycling



**75%**

of all aluminium  
ever produced  
still in use

**5%**

of original  
energy use  
to recycle

**>90%**

recycling rates  
of aluminium  
in automotive  
and construction





# Green Deal

## Call for a sustainable industry

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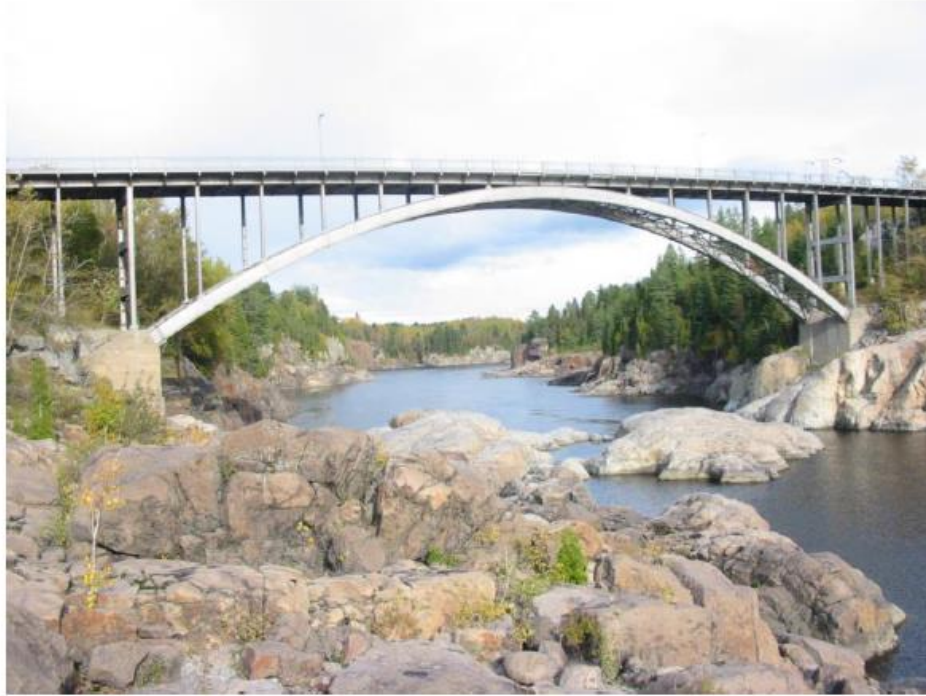
Policy Makers

**From oil industry scrap**

**.....to an aluminium bridge**



# Historic aluminium bridges



Arvida 1950



Forsmo 1995









**Hydro**

# Joining forces to make the world's longest aluminium bridge a reality

## The Langenuen-suspension bridge study



What could be the longest aluminium bridge in world: 1,720 meters, 1,250 meters of which would be aluminium, equivalent to 8,000 to 10,000 tonnes

- New study shows how an aluminium bridge could be a cost-efficient and climate-friendly alternative for the new coastal highway in Norway.
- The project relates to the Langenuen Bridge, just south of Bergen on the west coast of Norway. The Langenuen Bridge is part of a \$47 billion proposal to link together Norway's rugged western coastline and is the nation's largest and toughest infrastructure project yet: The E39 Mega Highway.
- The main span of the Langenuen suspension bridge is around 1,250 meters, and with an aluminium deck, it would become the longest and largest aluminium bridge in the world. By replacing steel with aluminium, the dead weight of the bridge would be reduced by several thousand tonnes. And having lighter weight has a positive cascading effect on the bridge's other components, such as towers and cables.
- [Video of the project](#)

•2016 – Request from Statens Vegvesen for Hydro to be involved in bridge development – Focus other materials – Case Langenuen bridge crossing initiated by cost and Sustainability.

•2016- 2019 - Langenuen Study by Dr.Techn Olav Olsen shows aluminium can be used for Langenuen bridge crossing

•2020 – Olav Olsen - AERODYNAMIC STABILITY test report [Langenuen - Rapportør – OneDrive \(sharepoint.com\)](#)

•2020 – DNV – Local FE analysis Langenyuen AL bridge girders. [3 party reports – OneDrive \(sharepoint.com\)](#)

•2021 The start of the Alubridge project: <https://www.sintef.no/en/projects/2020/alubridge-robust-design-and-efficient-production-of-durable-and-sustainable-aluminium-bridges/>

•2021 – 2023 Astrup Study -Assessment of Aluminum Girder Concept for the Langenuen Bridge [3 party reports – OneDrive \(sharepoint.com\)](#)

•2021 – 2024 - Multiconsult doing a detailed feasibility study of utilizing aluminium for the bridgecrossing. [Langenuen – OneDrive \(sharepoint.com\)](#)

•2023 – Bridge studies in works x3 (Grørdøla bridge, Hangar Bridge, Grøtta Bridge)

•2024 Joined a Canadian project focusing on using aluminium in highway bridge crossings. WSP and AluQubec in project lead.

•2024 – Start delivering material to the Hangarbridge (35Ton) 100%Post-consumer scrap from old oil rig Gyda. Completed June 2025: [Denne aluminiumsbrua kan utløse et nytt industrieventyr for Norge | Statens vegvesen](#)

•2024 Contract won on project for Grøtta bridge 25 meter (approx. 36 ton): <https://www.doffin.no/notices/2024-105325>

•2024 – Negotiation in last stages for replasing Risnes bridge (103 meter) with an aluminium bridge (Approx 250-300T) : [https://www.metalsupply.no/article/view/1075627/vurderer\\_a\\_bygge\\_brueer\\_i\\_aluminium](https://www.metalsupply.no/article/view/1075627/vurderer_a_bygge_brueer_i_aluminium)

•2024 – Ongoing discussions for Romfo Bridge (120 meter) in aluminium



# Low carbon aluminium reinforced concrete bridge

## Grødola Bridge in Sunndal Norway



This 18-meter-long aluminium-reinforced concrete bridge crossing the Grødola River in Sunndal replaced a stone bridge. The bridge utilizes recycled aluminium reinforcements and thinner concrete slabs, cutting emissions up to 80%. Using aluminium instead of steel reinforcement in concrete is truly a technical revolution.

### Advantages of aluminium-reinforced concrete:

- It can become a construction material with an extraordinarily long service life without maintenance
- It can be designed by strength level rather than durability
- Seawater can be used as mixing water where fresh water is in short supply
- Alkali-reactive aggregate can be used – even sand dredged from the sea
- It requires less energy and CO2 emissions to produce
- Because aluminum is durable, there is no need to protect the reinforcement with a large covering of concrete

### External references:

- [Green and everlasting concrete is no longer a distant dream – SINTEF](#)
- [Ny bru i Sunndal med framtidens betong reduserer CO<sub>2</sub>-utslepp med 80 prosent – NRK Møre og Romsdal – Lokale nyheter, TV og radio](#)
- [Denne byggemetoden kan redusere 70 prosent av klimautslippene \(tekna.no\)](#)





# Grøtta Bridge in Rauma to be built in Aluminium

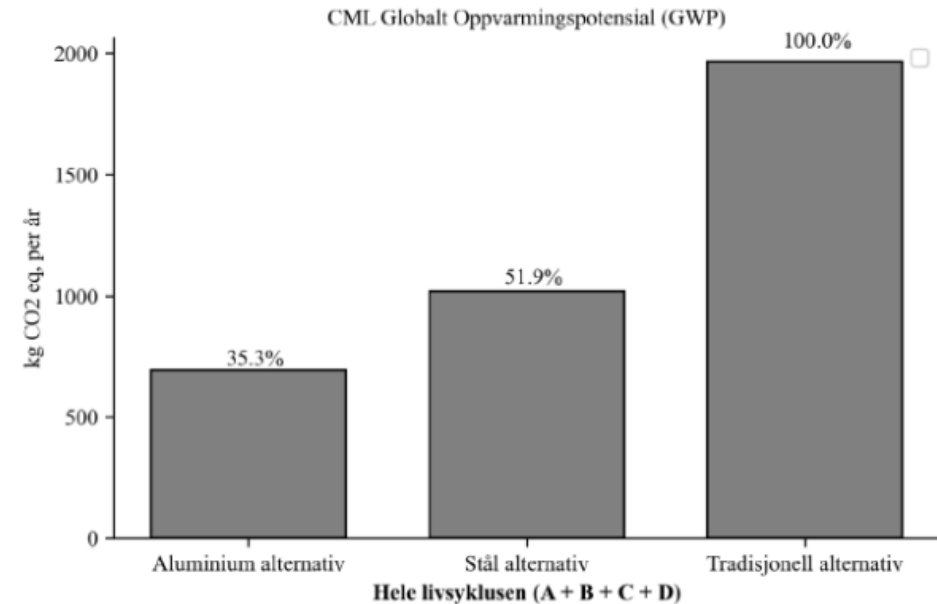


Very first all aluminium bridge based on profiles. 25 M

The new county road bridge in Rauma municipality will very likely be the first road bridge to be built with aluminum profiles. The Forsmo bridge in Grane in Nordland was the first aluminum bridge intended for car traffic when it came into place in 1994. But this is built as a box bridge with internal trusses, all in aluminium.

By using aluminium, this bridge in Rauma is expected to have lower greenhouse gas emissions than a concrete and/or steel bridge, over the entire life cycle. In addition, by using aluminium, it will result in lower operational and maintenance costs than the alternatives that were investigated. This will be the first bridge in Norway built by using extruded aluminium profiles when completed in 2025/26.

Aluminum has a high emission of CO<sub>2</sub> in the production phase, but if one includes the operating phase and final phase in the calculation, the total emission of greenhouse gases is lower than for steel and concrete



Figur 1: Utslepp i CO<sub>2</sub>-ekvivalent per år i alle faser (A+B+C+D) for alle brutypene.

# The hangar bridge in Trondheim can set the standard for aluminum bridges of the future

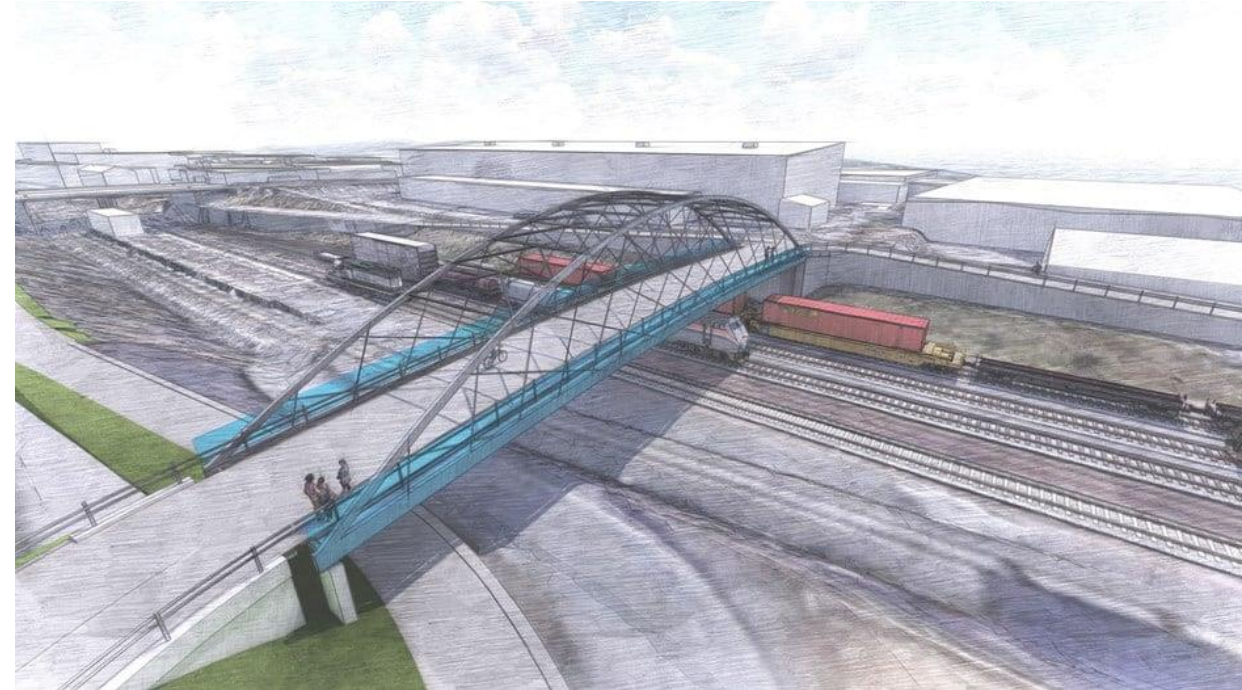
The knowledge breaker for aluminium in bridges for Road authorities in Norway by using 100% Post- Consumer scrap

Aluminum is more climate-friendly than concrete, and the "pilot bridge" Hangarbrua, which will be built in aluminium, will provide useful experience that can set a new industry standard.

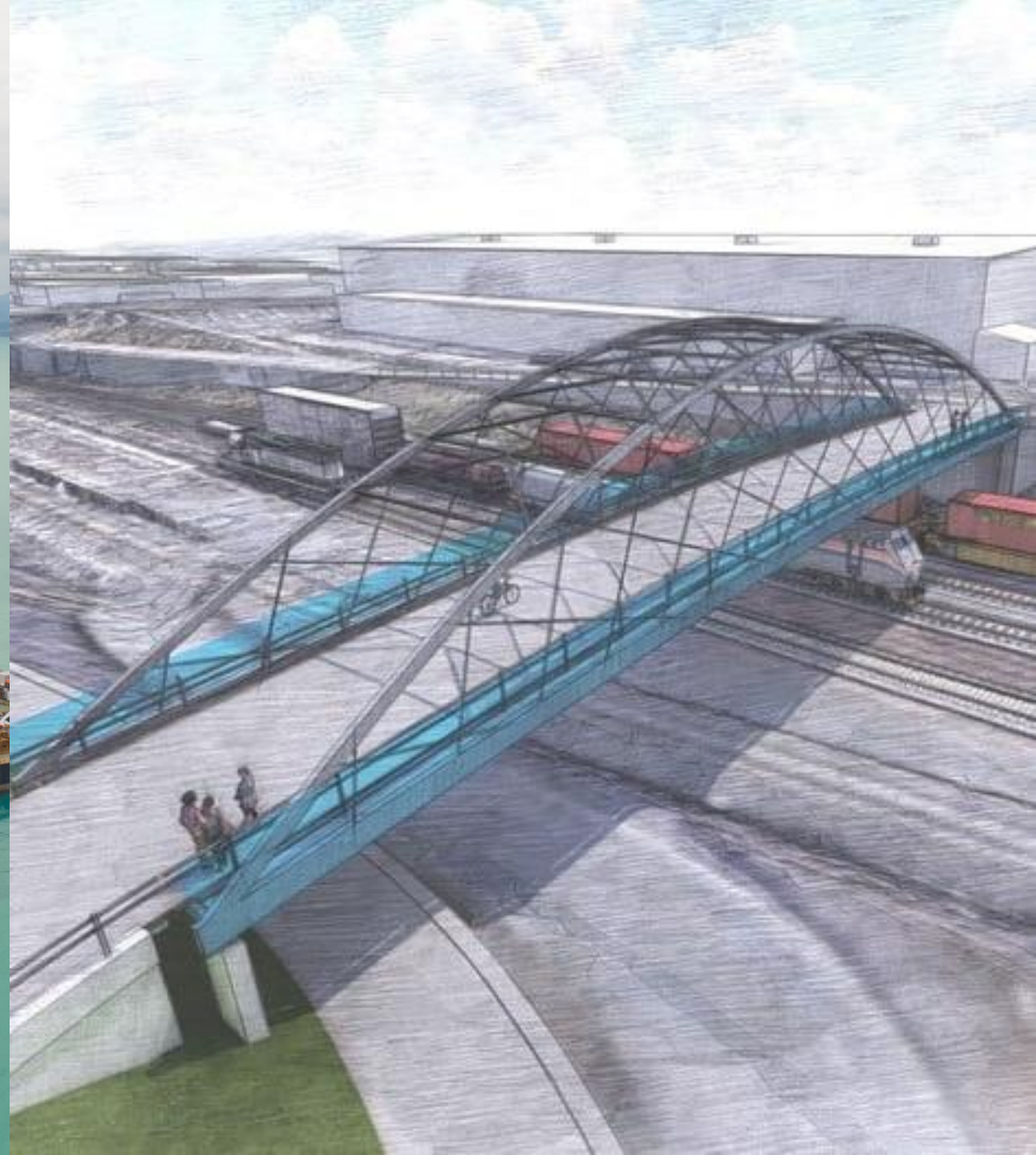
Hangarbrua is a new pedestrian and bicycle bridge that will cross the railway at Leangen station on the Gildheim-Leangbrua cycle route section. The length of the Hangarbrua is 55 metres.

Advantages of aluminium in this project:

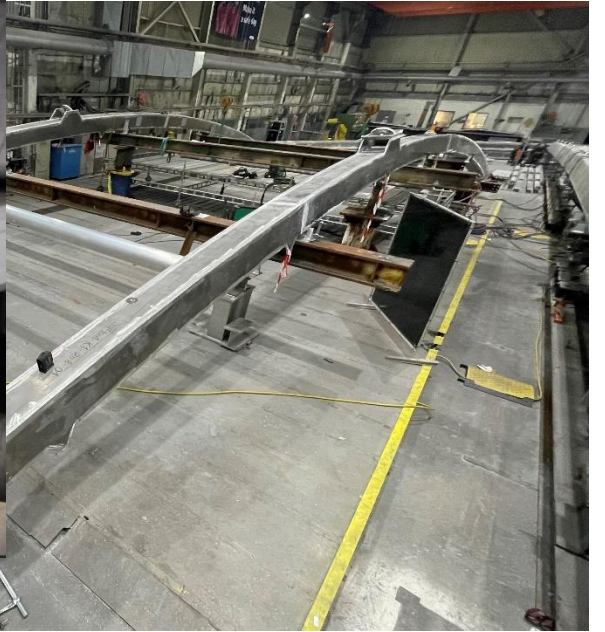
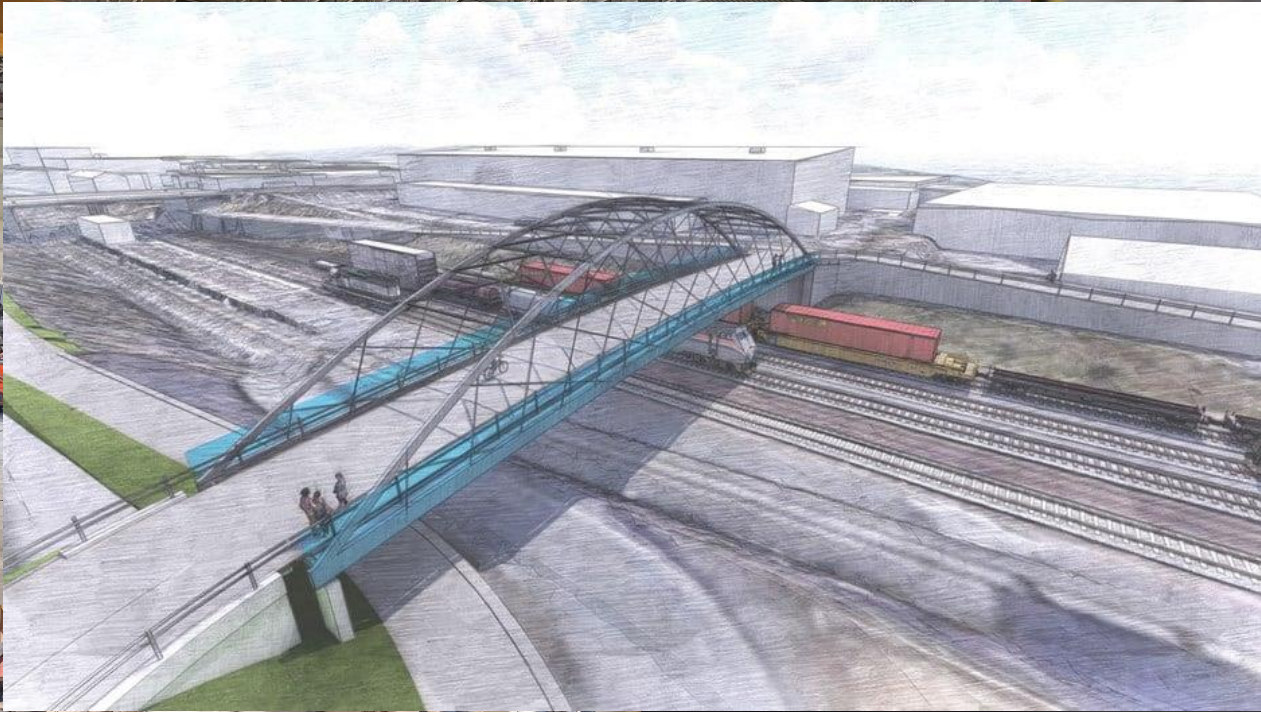
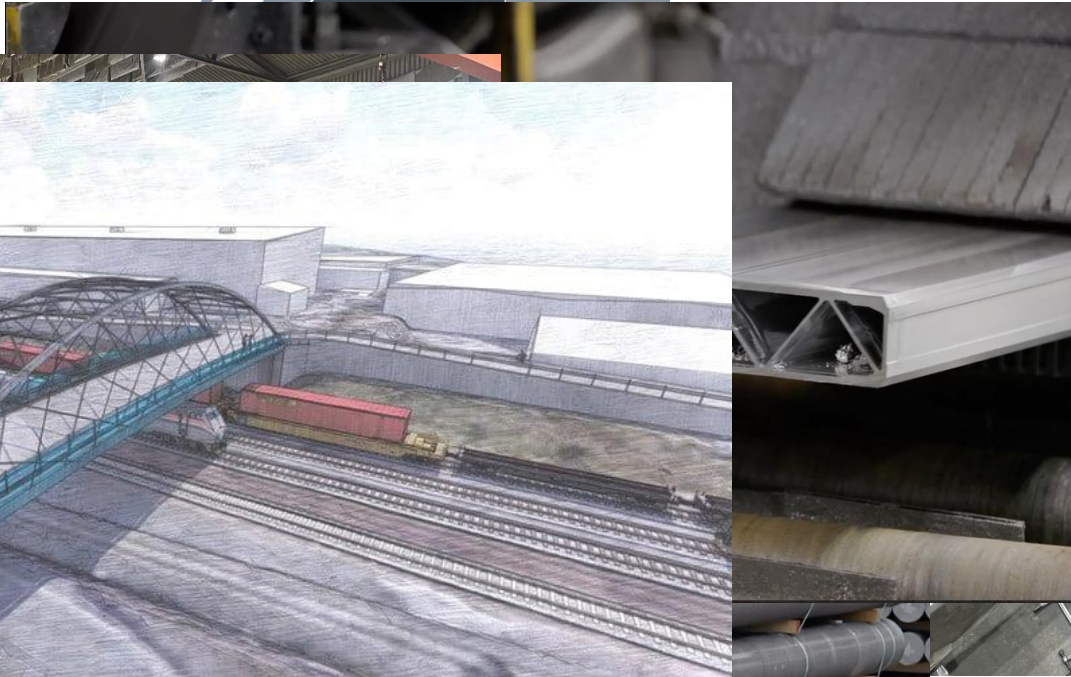
- Faster to build
- Lower weight
- Ease of maintenance
- Lower costs
- Long life material (does not rust)
- Material with a large proportion of recycled material
- Unique possibilities to shape and adapt (reacts well to heat)











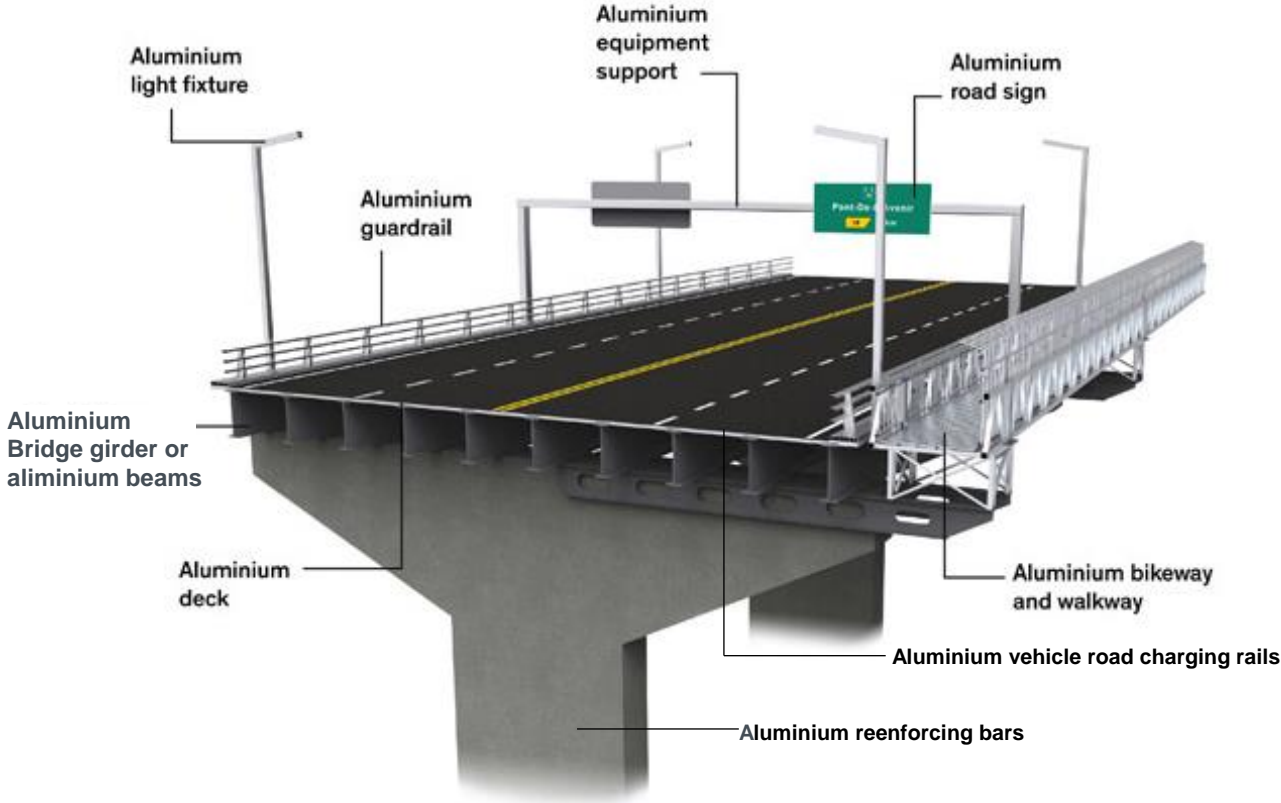


# Aluminium bridge technologies are strong alternatives to traditional steel and concrete constructions because:

- Lower carbon footprint with the use of renewable energy and recycled material
- Potential cost savings in build
- Lower maintenance costs lead to lower lifecycle costs (LCC)
- Time is saved with pre-assembly options for bridge decks or bridge replacement, therefore requires less welding (Fabrication)
- No need for paint or surface treatment
- Decreased dead load allows old bridges to be widened on existing substructure
- The metal can be easily and profitably recycled, End-of-life/CoC
- Aluminium facilitates rehabilitation versus replacement



# Where can aluminium be used?





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Advanced aluminum bridge building technologies that provide a clear advantages over traditional steel and concrete constructions.

# Publications

- [Concept Development of an Aluminum Pedestrian Bridge \(ntnu.no\)](#)
- [NTNU Open: Investigations on the Development of a Cost Model for Large Infrastructure Elements, Exemplified by the Proposal for an Aluminium Suspension Bridge over the Langenuen Fjord in Norway](#)
- [NTNU Open: Parametric modelling of a suspension bridge with an aluminium girder - Buffeting response and flutter stability](#)
- [NTNU Open: Aerodynamic Stability of a Suspension Bridge with an Aluminum Girder - Wind Tunnel Testing and Numerical Predictions](#)
- [NTNU Open: Comparative Life Cycle Analysis of the Langenuen Fjord Crossing](#)
- [NTNU Open: Parametrisk modellering av ei hengebru med brukasse i aluminium - Buffetingrespons og flutterstabilitet](#)
- [NTNU Open: Shape optimization of an aluminium girder for a long-span suspension bridge: Aerodynamic stability, buffeting response and suppression of vortex induced vibrations](#)
- [NTNU Open: Aerodynamic Stability of a Suspension Bridge with an Aluminum Girder - Wind Tunnel Testing and Numerical Predictions](#)
- [langenuen-suspension-bridge-aluminium-girder-alternative.pdf \(shapesbyhydro.com\)](#)





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**ALUMINIUM**