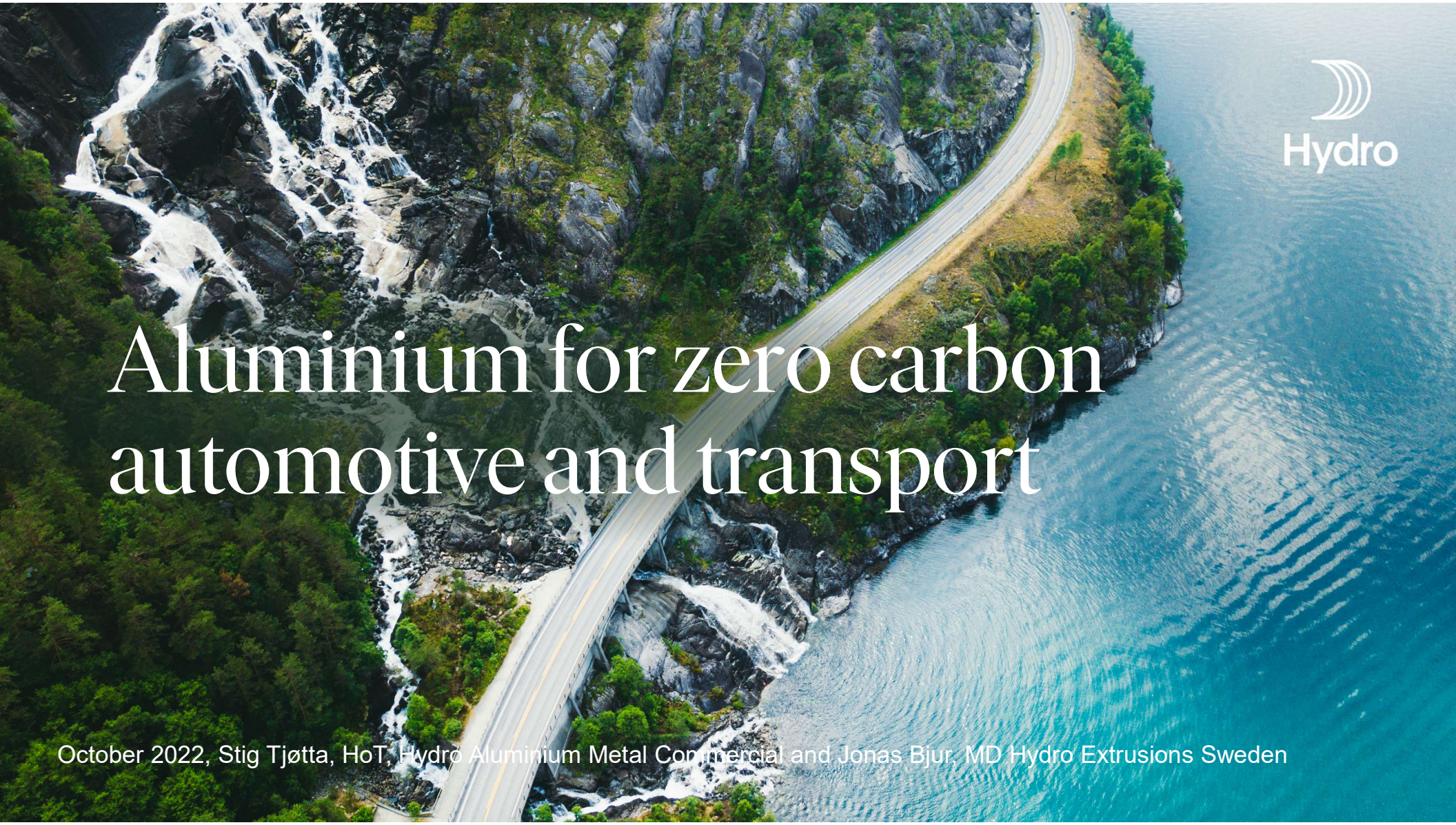
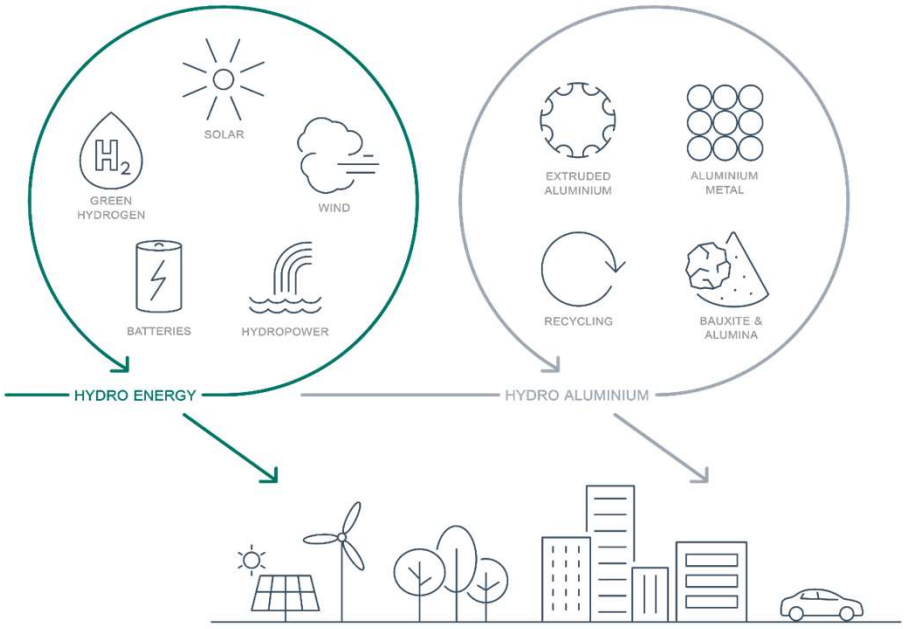


Aluminium for zero carbon automotive and transport

October 2022, Stig Tjøtta, HoT, Hydro Aluminium Metal Commercial and Jonas Bjur, MD Hydro Extrusions Sweden

This is Hydro

With a Norwegian heritage and a strong European foothold – and an ambitious sustainability agenda



- Europe: In more than 20 countries
- Globally: 30000 employees at 140 locations in 40 countries

Hydro's long-term dedication in the automotive industry

Hydro

Megatrends affecting Automotive production

Megatrends impact the way we live and move around

By 2050 the global population will reach 9.7 billion people*[1]

More traffic

By 2050 68% of the global population will be living in cities, up from today's 55%*[2]

Urbanization

Transportation sector accounts for 14% of global CO_2 emissions and 28% in the US*[3]

Demand for lighter and lower emission cars

Electrification

Source: 1) United Nations 2019 2) United Nations 2018 3) EPA 2010

Hydro

Aluminium trend in Automotive

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

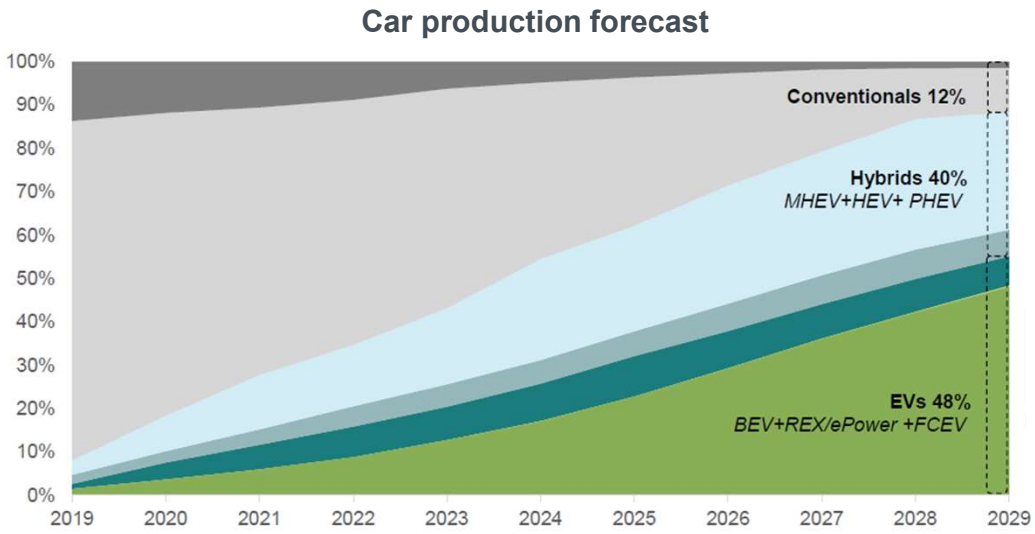
5%

of original energy use to recycle

>90%

recycling rate of aluminium in automotive

Lightweighting of EV's creates strong demand for aluminium in Automotive



Source: IHS, DuckerFrontier/European aluminium 2019 (European production)

Average aluminium content in cars

179 kg

▼

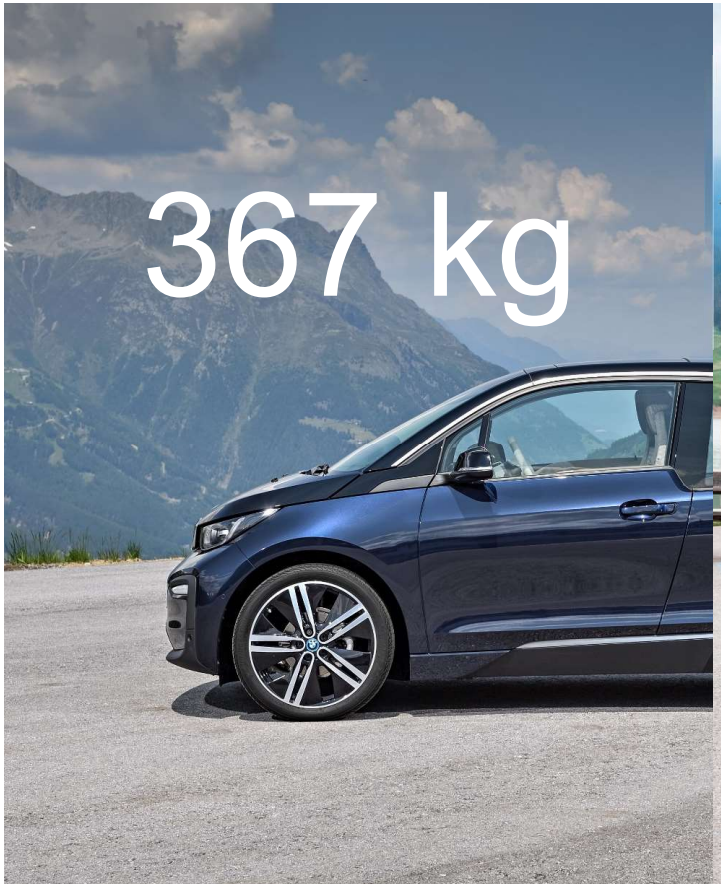
199 kg

By 2025

The EV trend will drive further use of aluminium

- New heavy components are used in electric vehicles (batteries)
- The demand on general structural applications is increasing
- Weight saving will still be in focus
- Increased need for thermal solutions drive additional use of aluminium

BMW i3



Audi e-tron

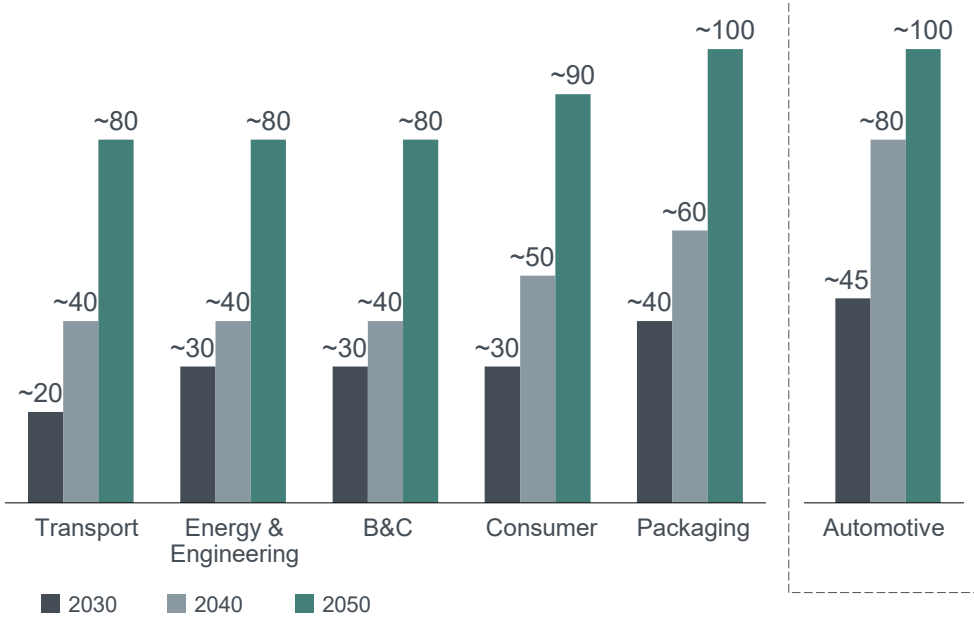
Data source: DuckerFrontier/European aluminium 2019
Photo credit: BMW Group, Audi

Expecting strong demand for greener aluminium

Ambitious abatement targets driving demand in all sectors but especially Automotive OEMs

Share of greener [1] aluminium demand per segment

% greener of total aluminium demand



OEMs are pushing for ever more ambitious life-cycle decarbonization targets

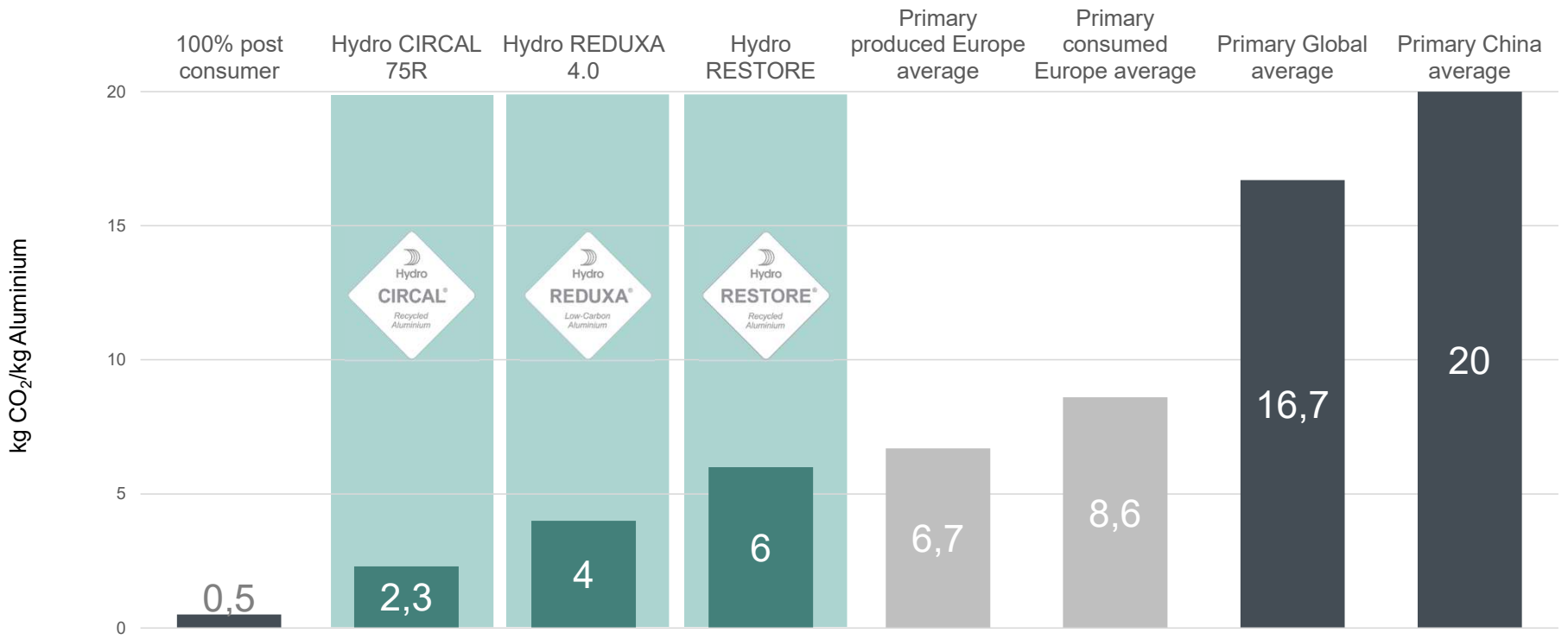
	Timeline to achieve target	Decarbonization target: Scope 1 & 2	Decarbonization target: Scope 3 upstream
Porsche	2030	100%[1]	100%[1]
GM	2040	100%[1]	-
Ford	2050[1]	100%[1]	100%[1]
Mercedes-Benz	2039	100%[1]	100%[1]
BMW	2030	80%	22%
Volkswagen	2050[1]	100%[1]	100%[1]
Volvo	2025	40%[1]	25%[1]
Toyota	2050	90%[1]	100%[1]
PSA	2034	20%	-

1) Greener aluminium includes “near-zero” tCO2/t, <2 tCO2/t and 50%+ PCS-aluminium
Source: McKinsey market analysis (high level estimate)

Hydro

Hydro’s path to zero carbon aluminium

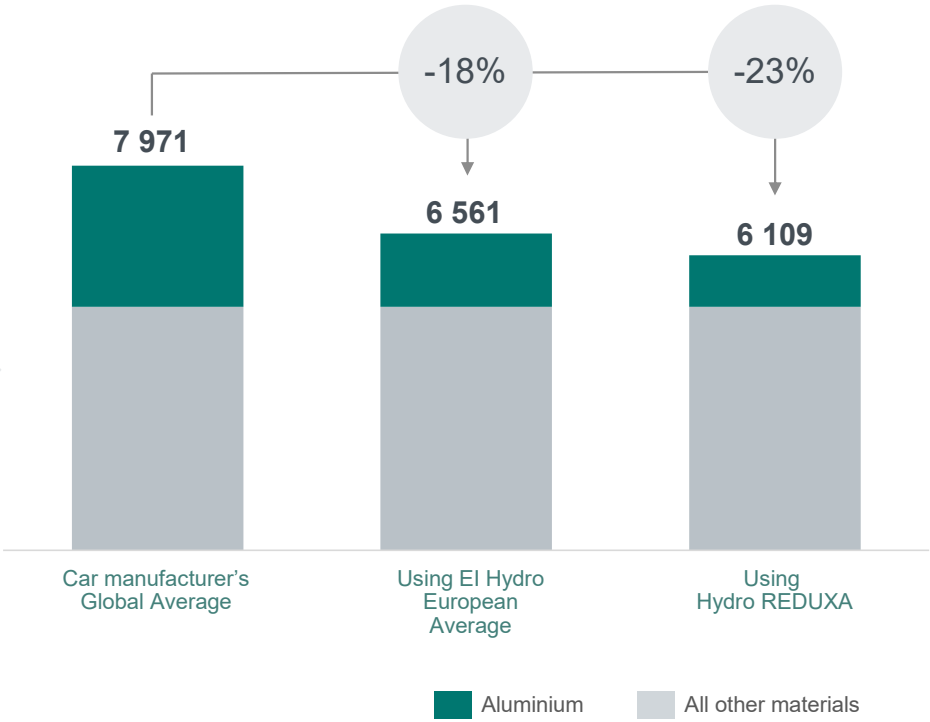
It matters where and how aluminium is produced



Sources:
Hydro internal analyses
European averages: EAA 2018
Global average: IAI 2018
China average: IAI 2017

The first part of the path to zero already exists

Replacing current aluminium in a standard SUV with Hydro REDUXA can reduce the CO2 footprint by 23%

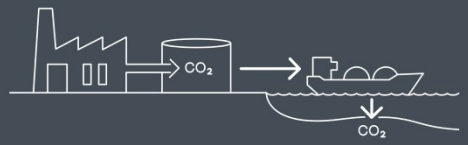


Source: Hydro internal calculation
Current average content used: 12 kg CO2 / kg Al
EI Hydro European Average: 5,7 kg CO2 / kg Al
Hydro REDUXA: 4,0 kg CO2 / kg Al
Photo credit: iStockphoto

Three steps towards carbon free aluminium

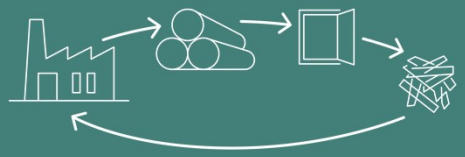
First near-zero PCS volumes produced in 2022, industrial pilot for zero-emission primary aluminium production by 2030

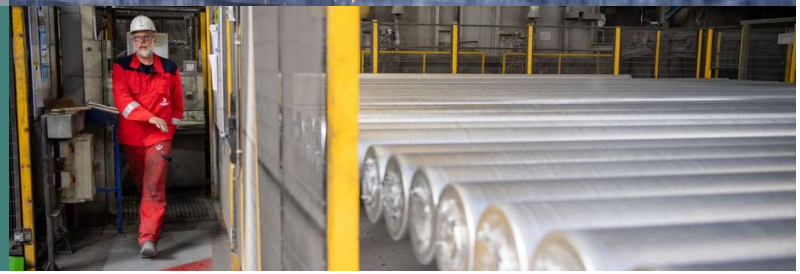
CO_2 capture and storage



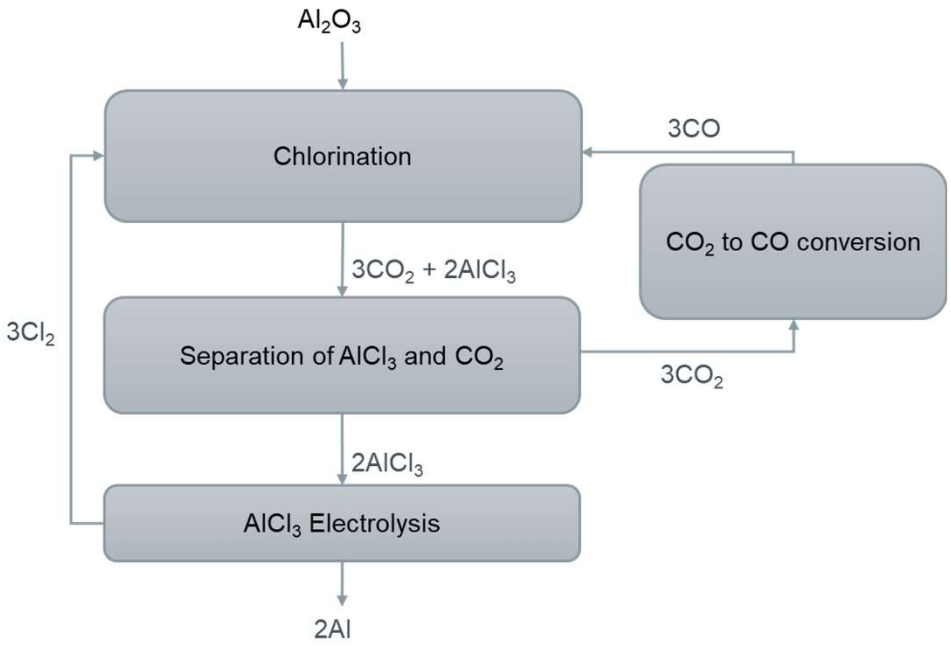
HalZero – emission-free electrolysis technology

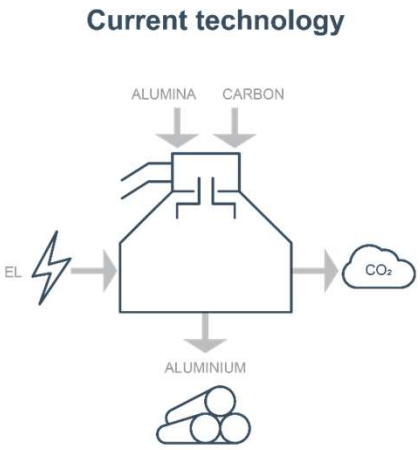
Recycling of post-consumer scrap

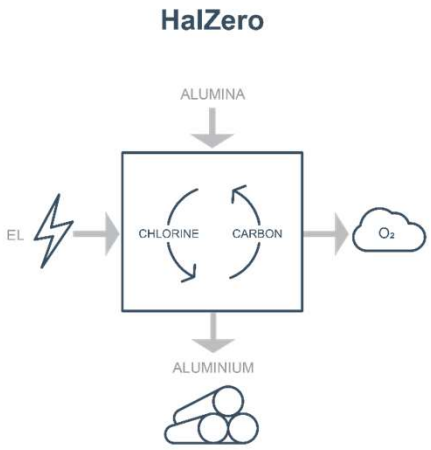




HalZero – a new zero-carbon technology for production of primary aluminium





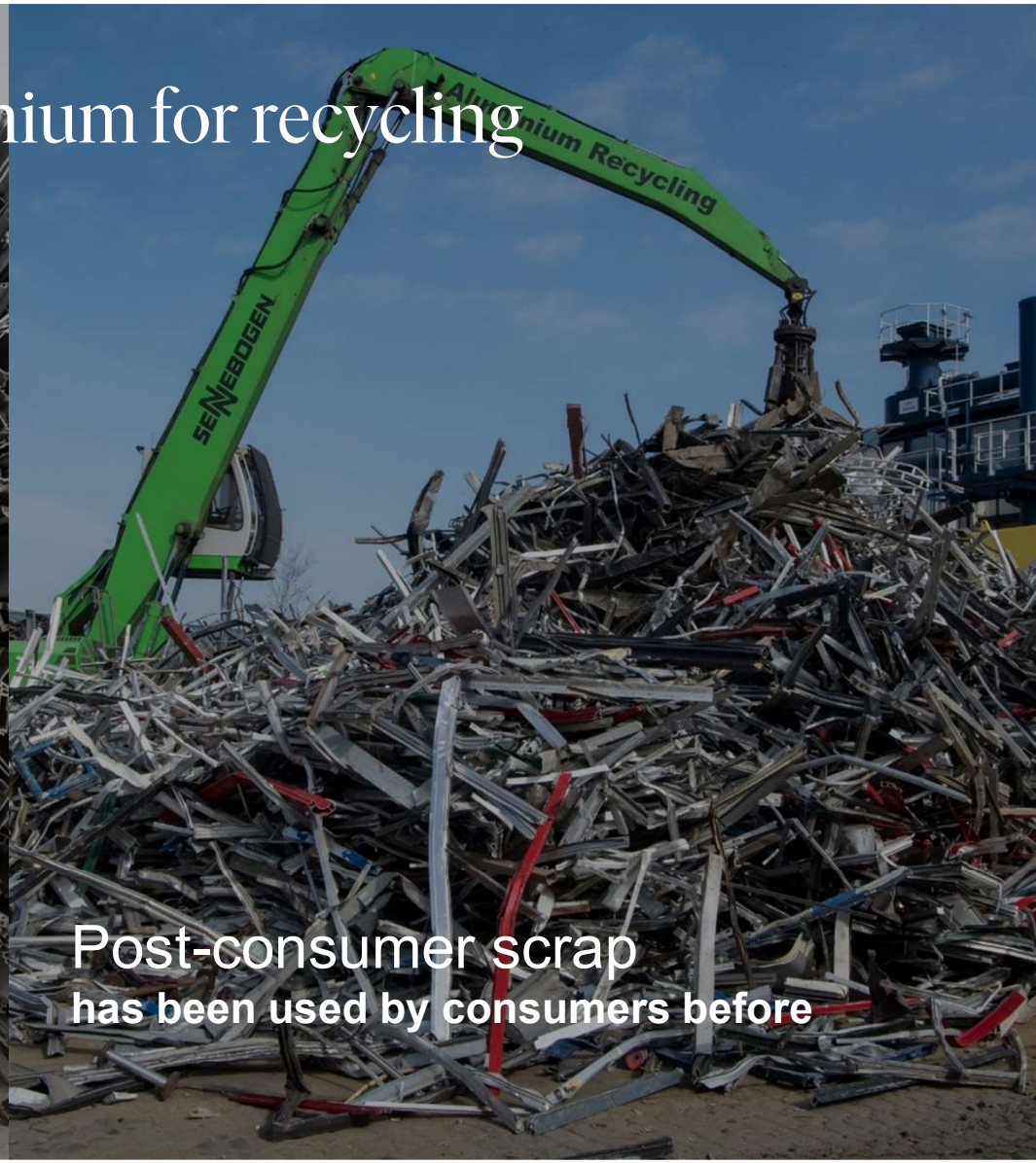


Chlorination: $Al_2O_3(s) + 3CO(g) + 3Cl_2(g) = 2AlCl_3(g) + 3CO_2(g)$
Al-electrolysis: $2AlCl_3 = 2Al + 3Cl_2$
CO_2-electrolysis: $3CO_2 = 3CO + 1.5O_2$

There are two sources of aluminium for recycling

Pre-consumer scrap

has never been used in a product



Post-consumer scrap

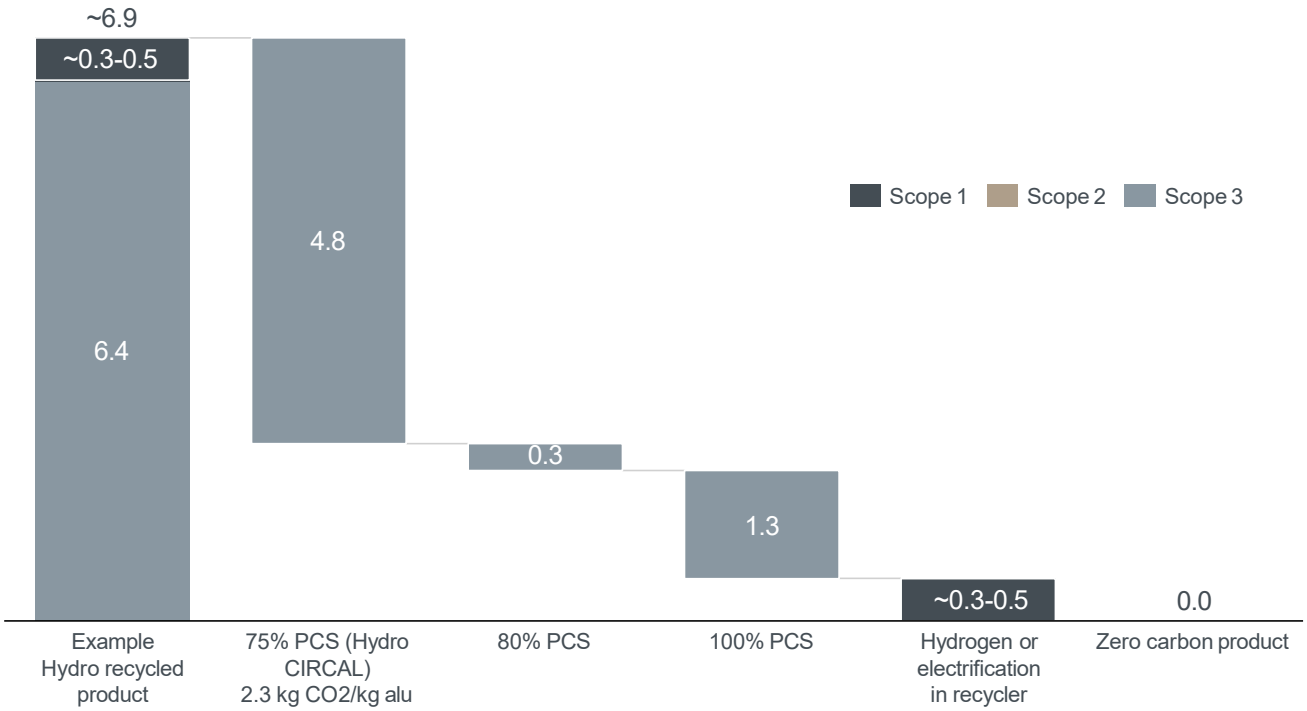
has been used by consumers before

Circular path producing near zero volumes by 2022

Post Consumer Scrap (PCS): scaling up volumes in line with market demand

PCS Decarbonization

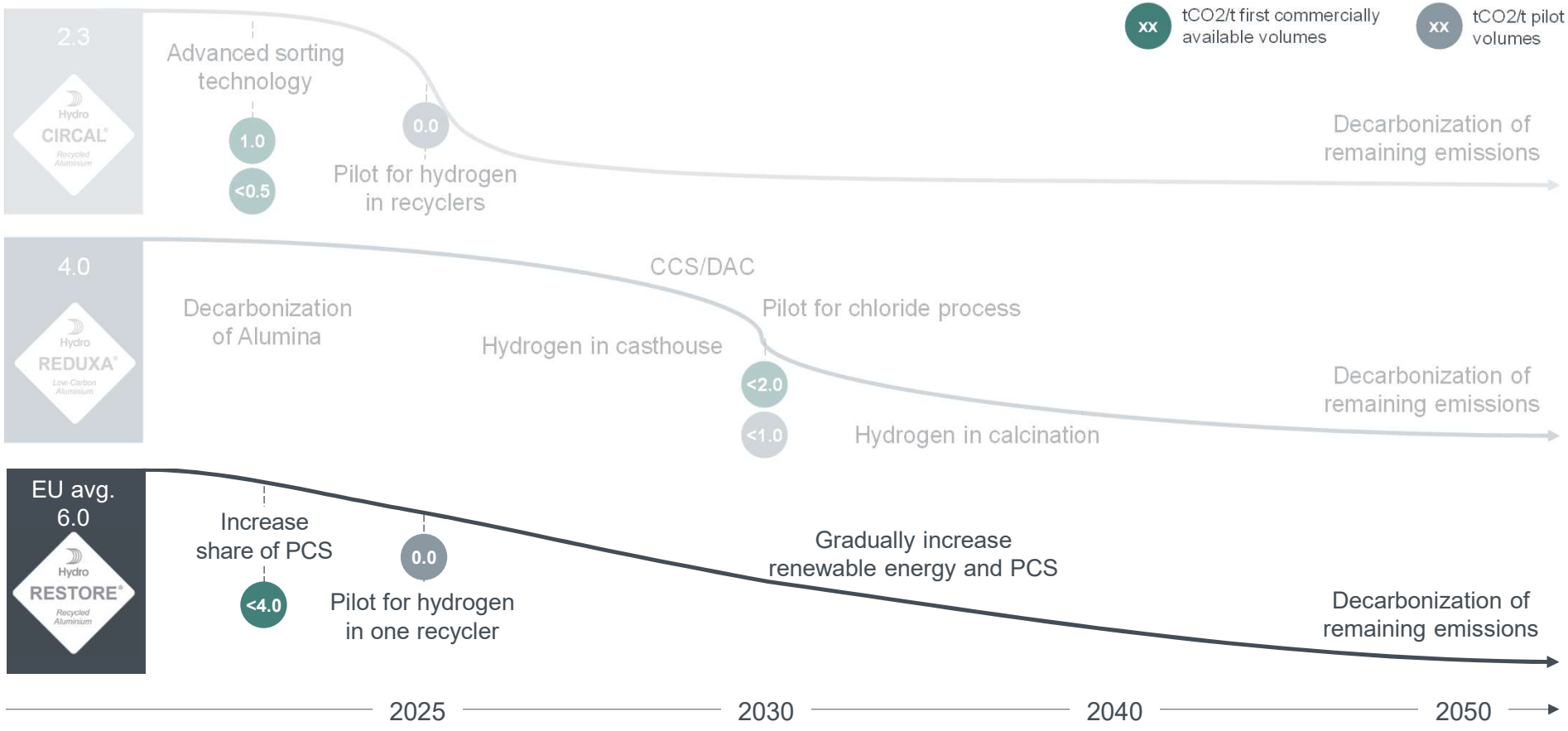
Tonnes CO2e / tonne aluminium



- Going deeper in the scrap pile to lift profitability
  - Laser-based sorting (LIBS)
  - Screw extruder
- Recycling friendly alloys
- Renewable fuel for scrap melting
- Scrap sourcing
- Customer collaboration

Parallel product roadmaps for current products

Ultra low carbon aluminium available through PCS recycling now



* CCS = Carbon capture and storage, DAC = Direct air capture, PCS = Post-consumer Scrap

Hydro

Eliminating CO_2 in the extrusion process

No. 1 in the global aluminium extrusion industry

Hydro Extrusions

Present in

35

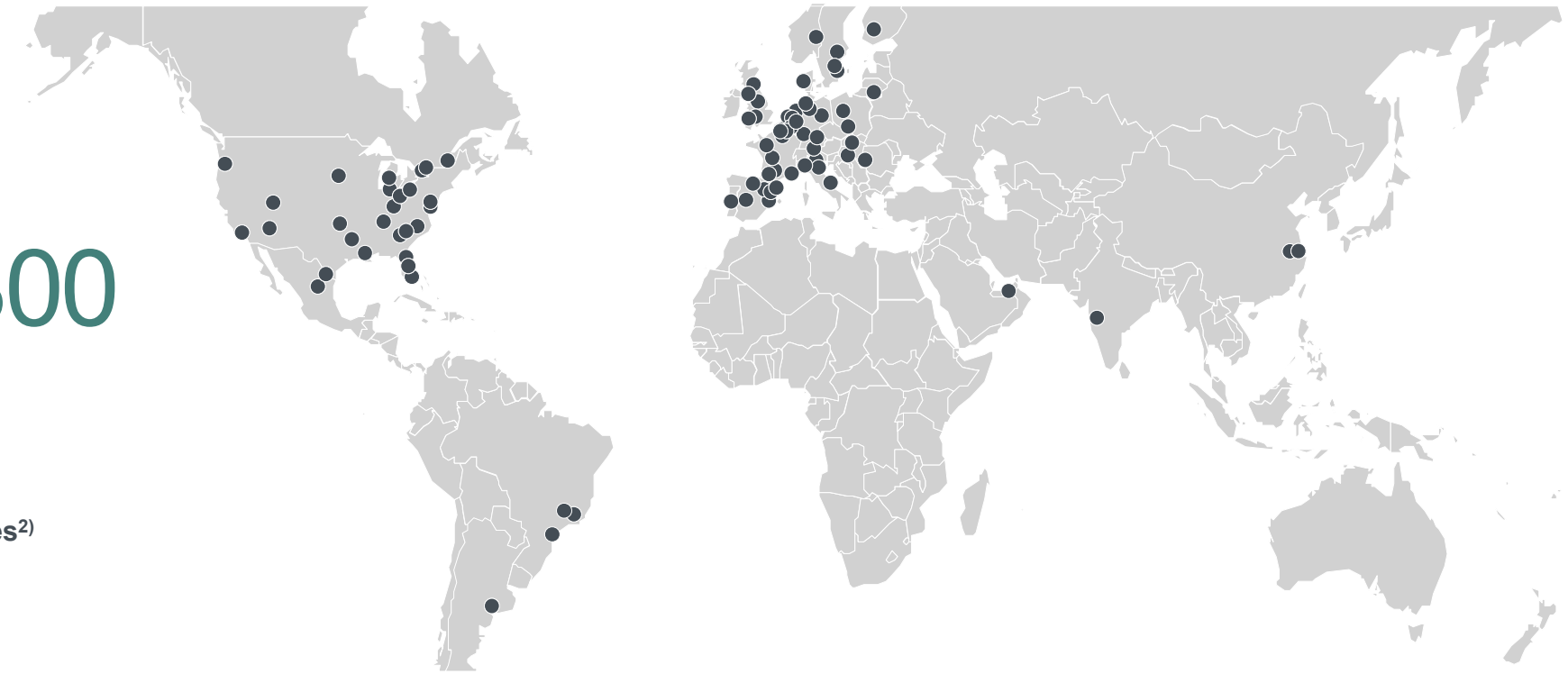
countries

21 300

people [1)]

1.3

Million mt sales[2)]

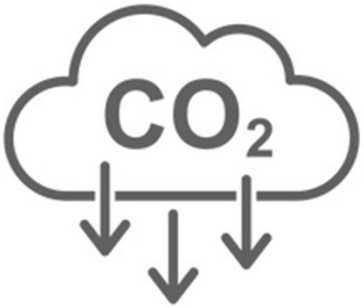


1) Permanent employees as of end-2021
2) Total sales in 2021

Hydro areas of expertise within Automotive

CHASSIS	Antivibration	ABS / Brakes	Subframes
BODY & CLOSURES	Body-In-White	Doors	Crash Management System
INTERIOR	Sunroof	Luggage Cover	IP Beam
EXTERIOR	Roof Rails	Side Trims	Decorative Parts
POWERTRAIN	Heat Exchangers	Engine Parts	Wheels
E-MOBILTY	Battery Solutions	Engine Housings	Power Electronics

“Greener Extrusion Sweden” pilot project



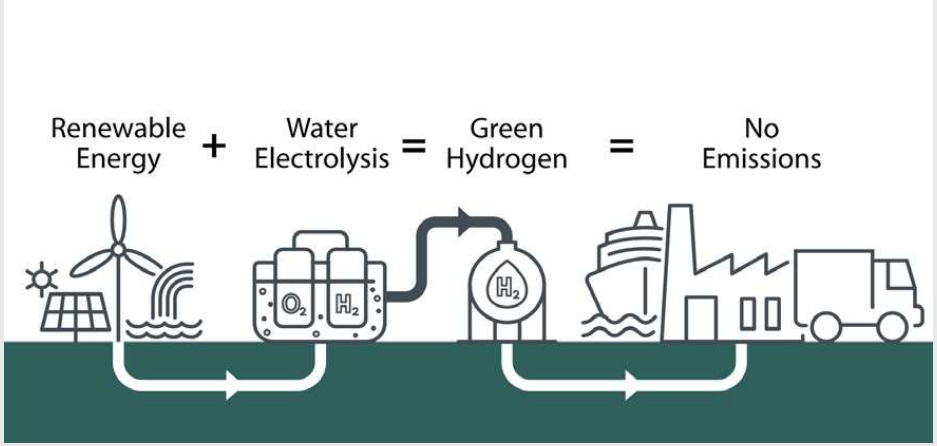
Emissions from the plants reduced to 0

By reducing, producing and offsetting electricity consumption

By fuel switching from LPG to Hydrogen

The project affects the full energy solution of Hydro’s locations in Sweden (Vetlanda, Sjunnen and Finspång)

Pilot to build the world's first CO2 emission free extrusion and remelt plants



The project aims to combine dedicated;

- Hydropower production (existing on site)

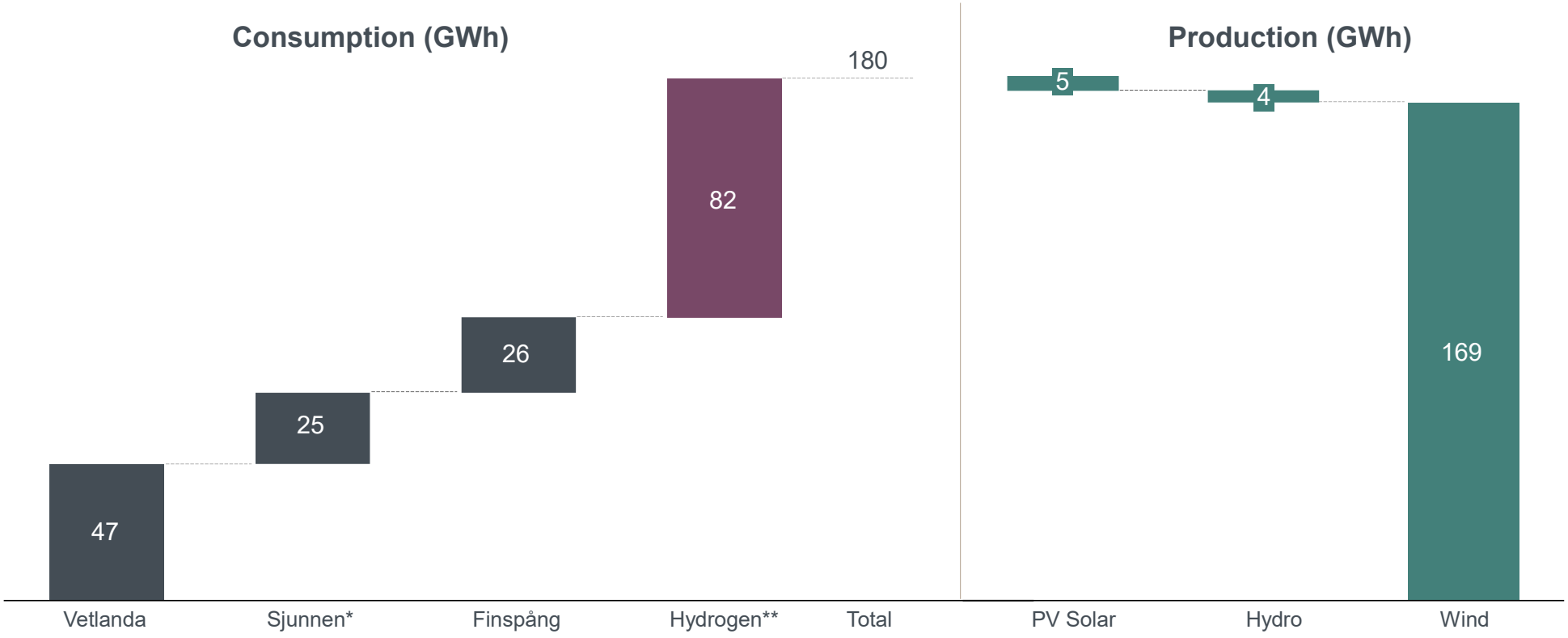
with

- Solar power
- Wind power
- Battery Energy Storage Solutions (BESS)
- Hydrogen production

Targeting a full energy transition to 100% locally produced renewable energy

Removing carbon emissions through renewable energy

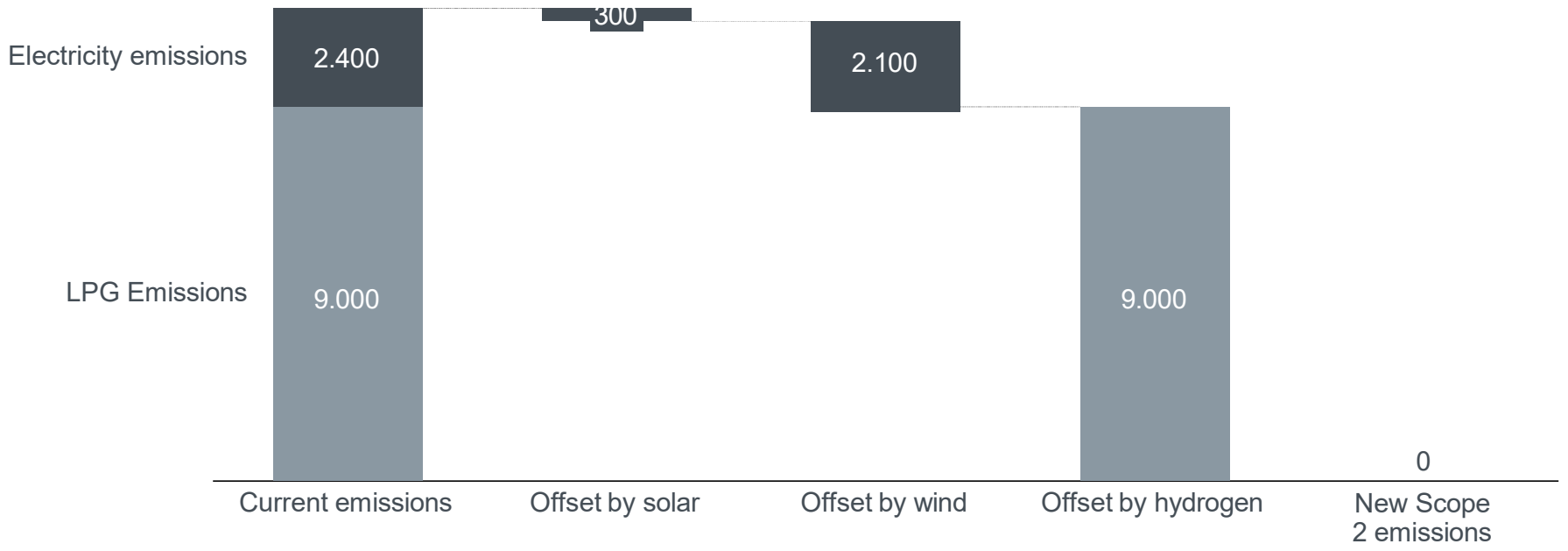
The new energy mix will source 100% renewable energy from wind and behind-the-meter solar



* Assuming the re-melter upgrade planned for 2022 adds an additional 50% electricity consumption. This is the assumed consumption excluding the behind-the-meter hydro power plant.
** Partly external sales of Hydrogen

The project aims to eliminate our CO_2 emissions

Enabling grid emissions to be reduced to zero. By using this energy for Hydrogen production, emissions from LPG can be completely offset

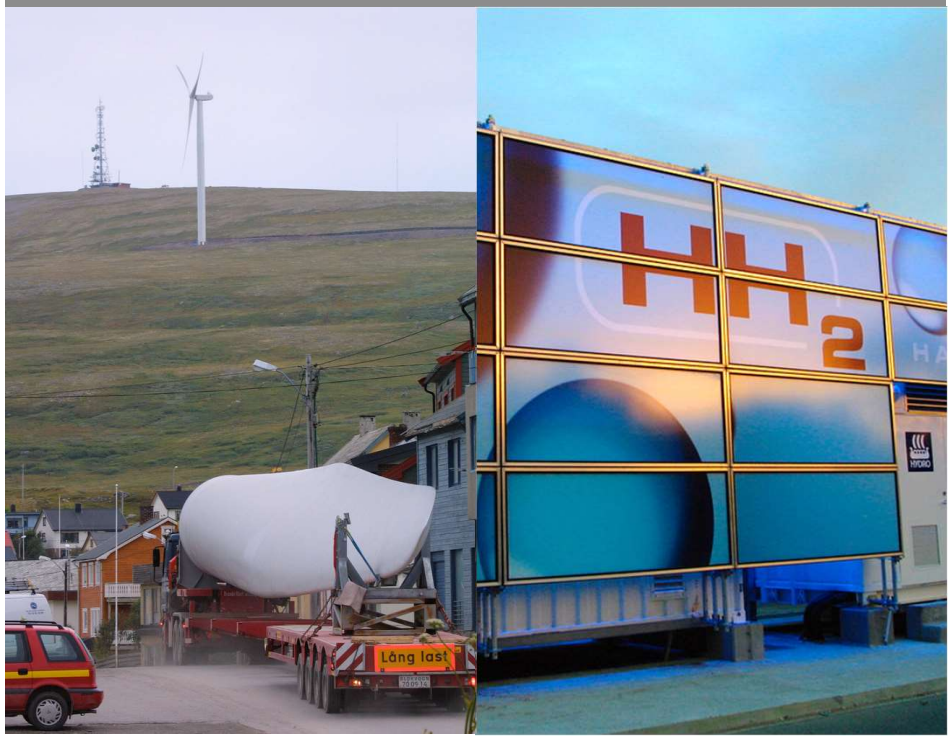


Assuming 27kg/MWh in CO2 emissions as per https://www.nowtricity.com/country/sweden/. Average for 2020.
Current emissions are 38kg/MWh as per https://app.electricitymap.org/zone/SE
LPG assumed to emit 3 ton CO2 per ton LPG as per this study

Pilot project in two steps towards zero

Step 1 (2023)
Solar + Battery energy storage system

Step 2 (2025)
Wind + Hydrogen




Aluminium is part of a carbon emission free future
Light and strong
Adaptable to fit any application
Infinitely recyclable
Clear roadmap zero emissions

Hydro

Industries that matter