Fluid Dynamics
Heat Exchange Solutions since 1981

Kelvion THERMAL SOLUTIONS

25-27 Star Crescent Hallam
Victoria 3803 Australia
Local: 1300 58 58 59
Int'l: +61 3 8786 4900
E: sales@fluiddynamics.com.au
W: www.fluiddynamics.com.au

Kelvion Thermal Solutions (KTS)

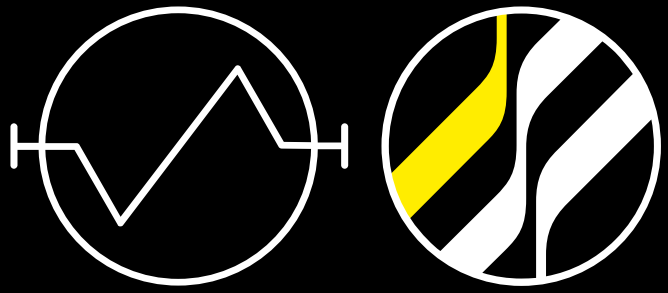
HYDROGEN CARBON & CAPTURE

Kelvion THERMAL SOLUTIONS

KELVION – A TRIBUTE TO LORD KELVIN (1824 - 1907)

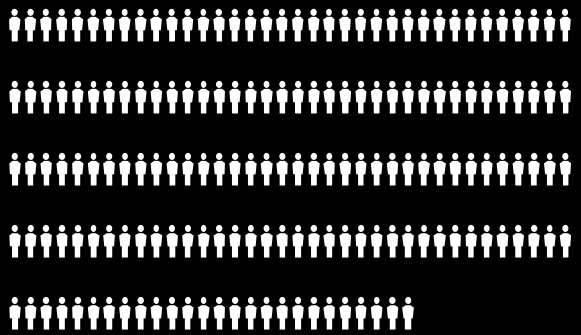
Lord Kelvin formulated the laws of thermodynamics and absolute units of temperature are stated in kelvin, in his honor.

OUR LOGO – INSPIRED FROM THE SCHEMATIC FOR HEAT EXCHANGER



SALES BRANCHES WORLDWIDE

1,200 EMPLOYEES – WORLDWIDE



YOUR MARKETS ARE OUR MARKETS

KELVION HAS A LONG HISTORY

2022 Reorganization of Kelvion into Product and Project Business

2015 With the new name, the former GEA Heat Exchangers is writing its own history as Kelvion.

2014 GEA sells the Heat Exchangers Segment to Triton.

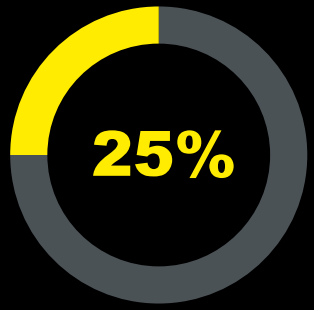
2010 Reorganization of GEA's 9 Divisions into technologically distinct Segments. The largest segment is the Heat Exchangers Segment.

1999 In April 1999, GEA was acquired by mg technologies AG

1920 Foundation of GEA in Bochum by Otto Happel sen.

Kelvion THERMAL SOLUTIONS

THERMAL MANAGEMENT IN H_2 LIFE CYCLE



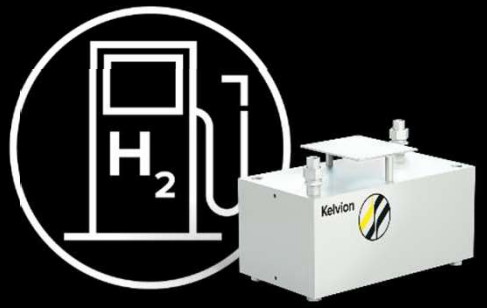
of electrolyze capacity
is heat to be dissipated.

100MW electrolyze capacity
→ 25MW heat to be
removed from the process

10 kWh of heat dissipated
per 1kg of liquefied H_2

**Regular liquefaction capacity
5 – 50t/day**

**➔ 2-20MW of heat
dissipation /day**



Every dispenser for hydrogen
fueling station needs K°Bond
style heat exchanger

**7,800 Hydrogen Refueling
Stations installed globally by
2030**

Kelvion THERMAL SOLUTIONS

FOCUS AREAS

Production

Air Fin Coolers
USP: Groovy / Diesta

Cooling towers
smallest footprint

Desublimators
Unique technology for carbon capture

Heat recovery
wide range & experience

Distribution

K°Bond
Diffusion bonded heat exchanger with highest pressure resistancy

Integrated Solutions & Utilization

HYDROGEN LANDSCAPE

Electrolysis

nel · iGas energy · GINERELX · AsahiKASEI · IPS ORGB FEST · TOSHIBA · AsahiKASEI · Hytron · Enapter · GREENHYDROGEN.DK · PROTON ON SITE · thyssenkrupp · TELEDYNE ENERGY SYSTEMS, INC. A Teledyne Technologies Company · GINERELX · SIEMENS · HYDROGENICS SHIFT POWER | ENERGIZE YOUR WORLD

Fueling stations

TRUE ZERO · AIR PRODUCTS · atawey ANYTIME, ANYWHERE, ENERGY · HRS HYDROGEN REFUELING SOLUTIONS · FIRST ELEMENT FUEL · Resato

H_2 Liquifaction

Air Liquide · fives Industry can do it · Atlas Copco · Linde · AIR PRODUCTS · Kawasaki Kawasaki Heavy Industries, Ltd.

EPC's

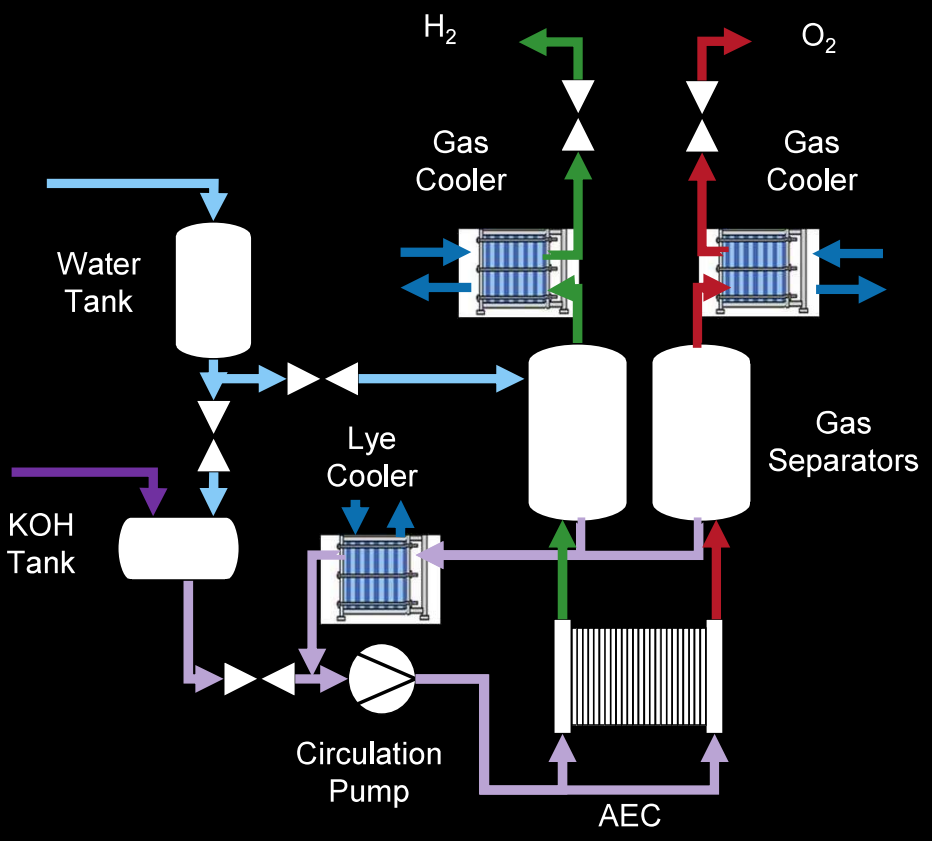
Worley energy | chemicals | resources · Technip · MITSUBISHI HEAVY INDUSTRIES, LTD. · SAIPEM · WOOD GROUP · amec foster wheeler · JGC · SNC·LAVALIN

Fuel Cells

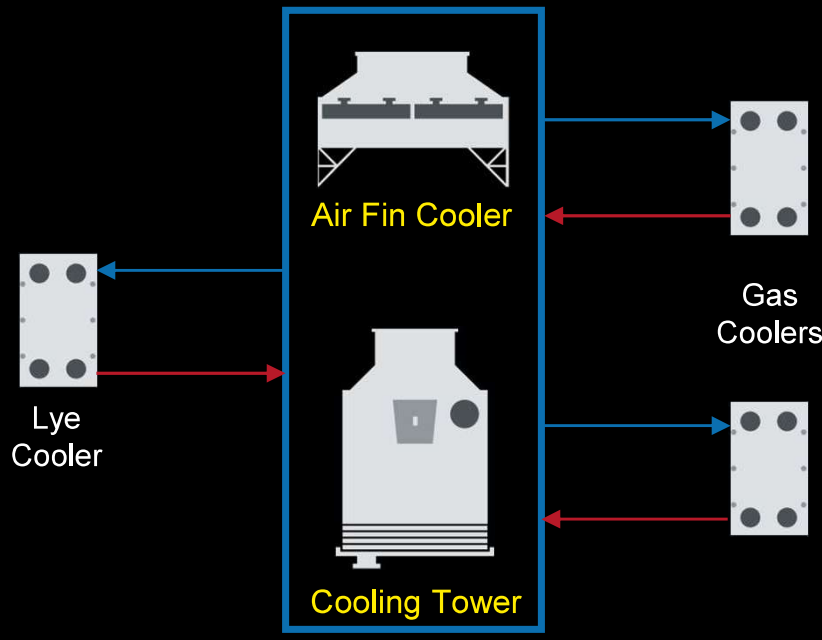
fuelcellenergy · PLUG POWER · DOOSAN · BALLARD · Fuji Electric · Cummins · BOSCH · sunfire · HEXIS · NEW ENERGY GENERATION SOLID POWER · Bloomenergy

Kelvion THERMAL SOLUTIONS

CENTRAL COOLING SYSTEM



Alkaline electrolysis process



Heat to be dissipated with central cooling system using Air Fin Cooler or Cooling Tower

Kelvion THERMAL SOLUTIONS

IDEAL FOR MEDIUM AND LARGE SCALE

It is a perfect solution for large scale up electrolyzer plants, resulting with smallest footprint, lowest fans number and highest efficiency.

OPTION 1: CENTRAL COOLING – COOLING TOWER

Basis

- Capacity 0.5 MW to 100 MW per cell
- Application: cooling Water utilities
- Applicable to all regions
- Minimum approach temp. 4°C (considering wet bulb temperature)

COOLER DESIGN

Lowest CAPEX HX solution

Less fan power consumption than Dry cooling system

1 to unlimited fans QTY (1 per cell)

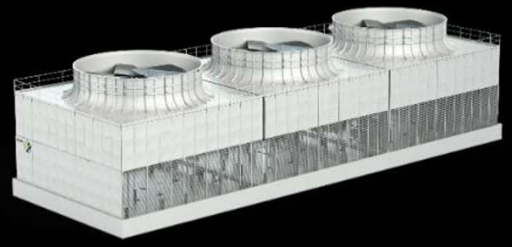
Optimized HX footprint

Fluid Dynamics
Heat Exchange Solutions since 1981

Kelvion THERMAL SOLUTIONS

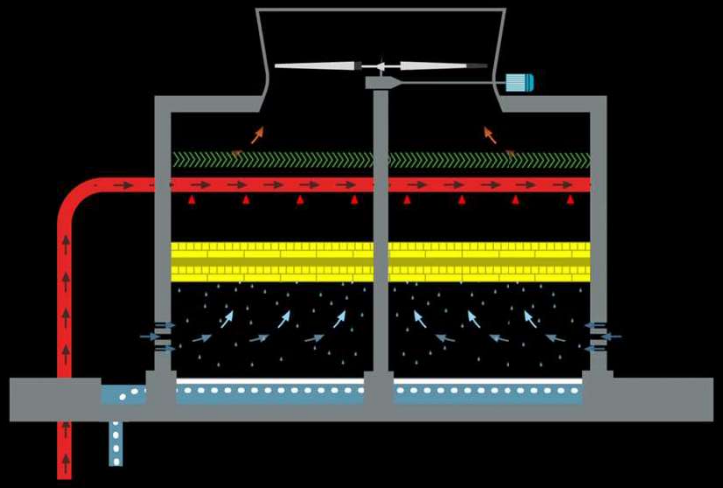
OPTION 1: CENTRAL COOLING - COOLING TOWER

PRINCIPLE EVAPORATIVE COOLING

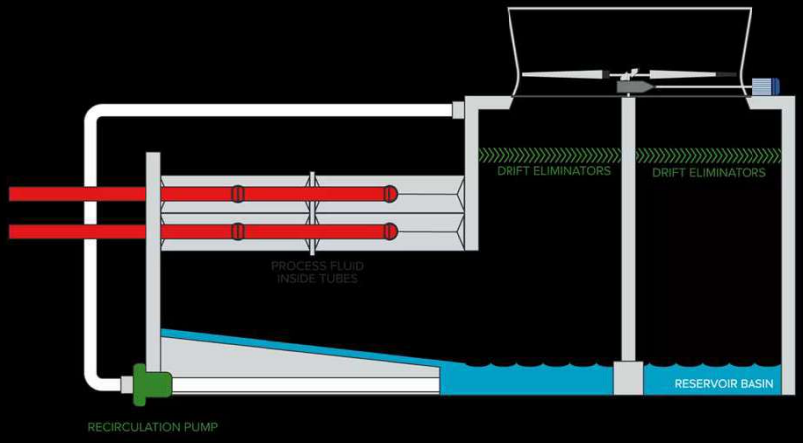


- Evaporative cooling is natural process using water as cooling medium
- Transferring “waste” heat by sacrificing 1% water flow into the atmosphere
- Working principle in open counter flow (picture), open cross-flow or closed loop (water cooling an internal tube bundle)
- Pre-assembled or field-erected

Open Loop



Closed Loop **TUNDRACEL**



OPTION 2: CENTRAL COOLING – AIR FIN COOLER

Basis

- Capacity 1 MW to 7500 MW
- Application: Water / Water Glycol or hydrocarbons
- Applicable to all regions
- Minimum approach temp. 7°C
- Humidification system can apply when water is available

COOLER DESIGN HINTS

Groovy Finned Tubes

2 to 4 large fans and motors per bay

Optimized installed motor power with Groovy/DIESTA

Reduction of CO2 emissions

Bundles and bays designed as per plot requirements

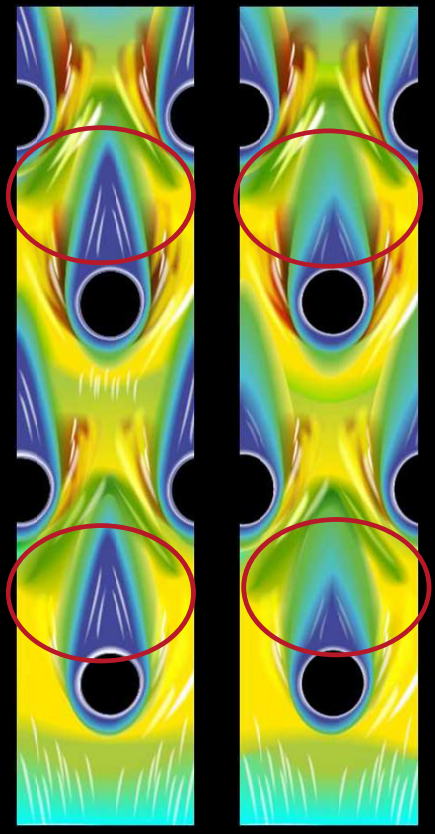
Plot restrictions can drive the design

Kelvion THERMAL SOLUTIONS

AIR FIN COOLER – DIESTA TUBE / GROOVY FINS

FIN SHAPE

- Reducing “dead zone” by air guidance
- Increasing turbulences on tube and air sides
- More than 20% increase of air side heat transfer coefficient at equivalent fan power



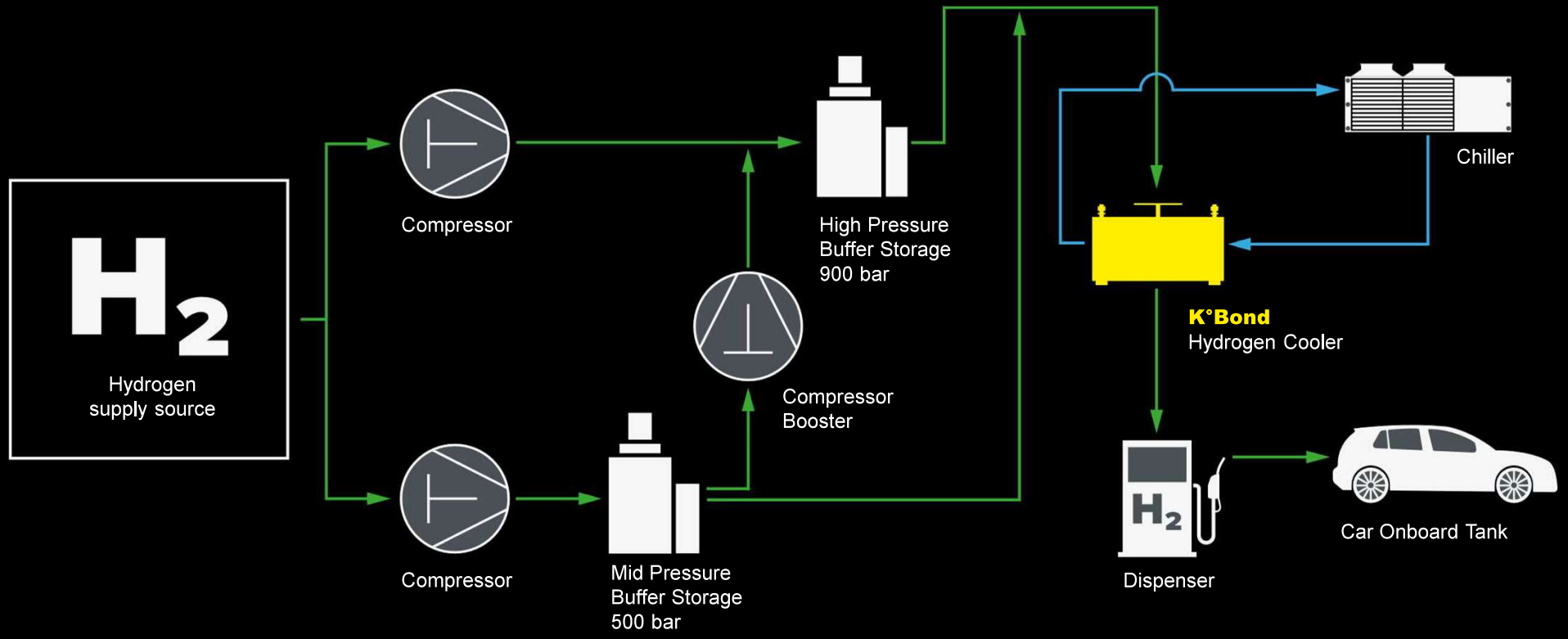
Kelvion patented technology

Smaller units

Over 5000 bundles installed worldwide

Kelvion THERMAL SOLUTIONS

HYDROGEN REFUELING STATION (HRS)



Kelvion THERMAL SOLUTIONS

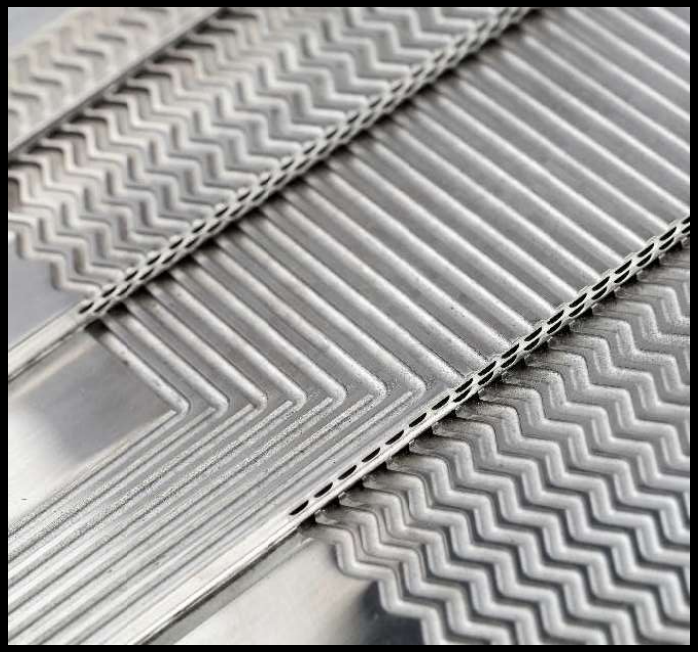
K°BOND FOR HRS

Heat exchange coefficient
Gas / Liquid : up to 4,000 W/m2K
Liquid / Liquid : up to 10,000 W/m2K

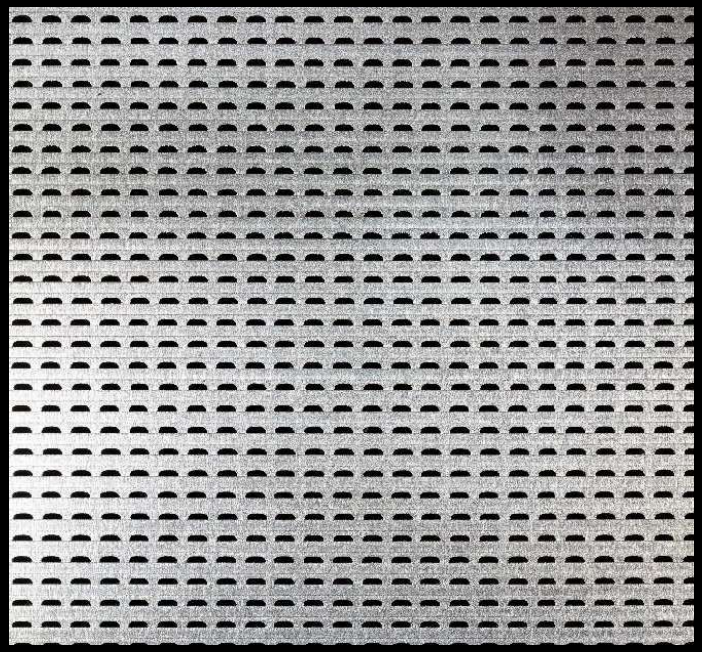
Heat exchange area
Approx. 700 to 1,400 m2/m3
(depending on the design pressure

- **Standardized Design**
- **Suitable for "T40 Cooling" according to SAE J2601**
- **Increasing reference list, also, in Truck Filling**
- **Highest safety level without leak risk**
- **Cooling medium Therminol D-12, Flagotherm or CO_2**
- **Can be installed inside dispenser unit**
- **High resistance to cyclic services**
- **Design pressure up to 1050 Barg**

K°BOND – WHAT IS INSIDE?



Straight and zig zag micro-channels

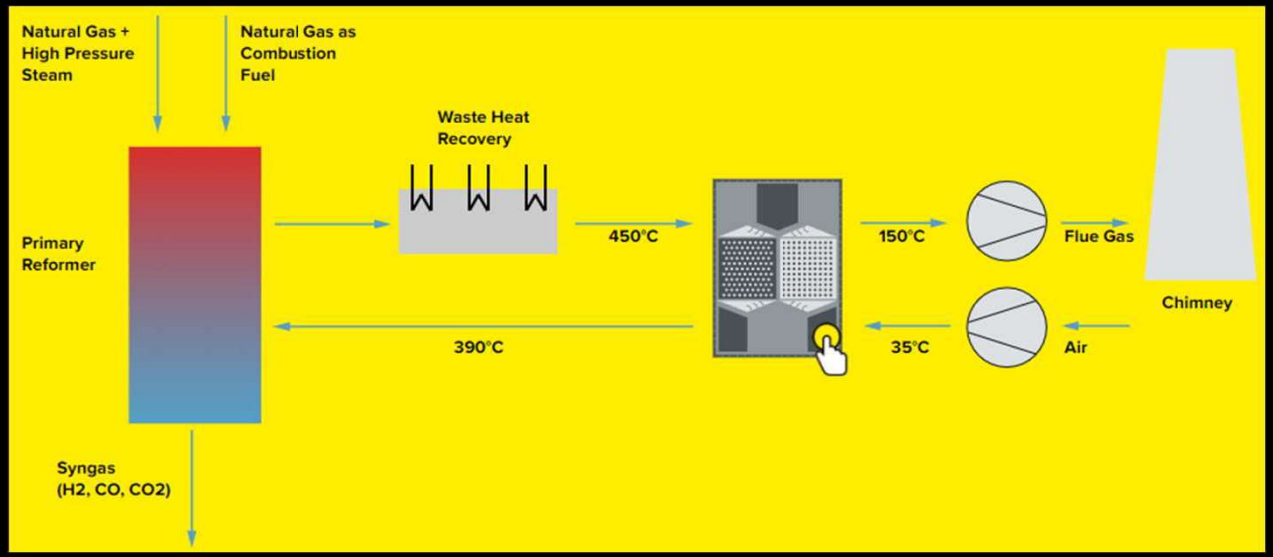


Channels of
~ 1- 3 mm height &
~ 2 – 6 mm width

Welded Header for media supply

Kelvion THERMAL SOLUTIONS

HEAT RECOVERY FOR HYDROGEN PRODUCTION



Steam reforming, or steam methane reforming, is a method for producing syngas (hydrogen carbon monoxide, some carbon dioxide) through the reaction of hydrocarbons with water. Commonly natural gas is the feedstock. The main purpose of this technology is to produce hydrogen, also known as grey hydrogen. The reaction is represented by this equilibrium: $CH_4 + H_2O \rightleftharpoons CO + 3\ H_2$

REKULUVO combustion air preheater recovers valuable heat from the waste gas line and feeds it directly back into the system.

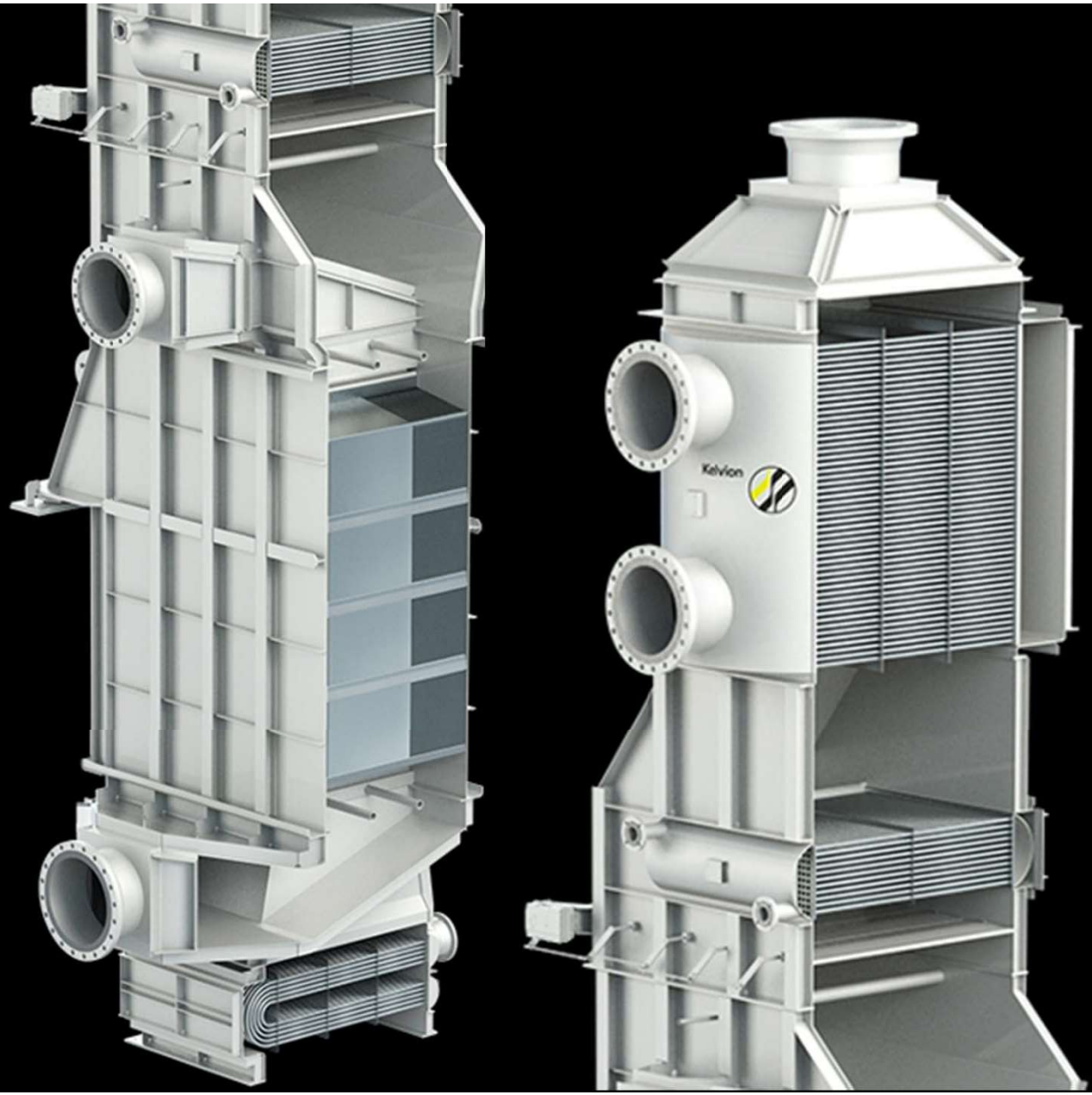
Kelvion THERMAL SOLUTIONS

INTEGRATED SOLUTIONS

We provide additional equipment around our cooling units to achieve requested duty in specific site environment.

We provide full engineering support including thermodynamics and structure.

We are flexible with design and scope of supply to meet your needs for fast moving hydrogen projects.



Kelvion THERMAL SOLUTIONS

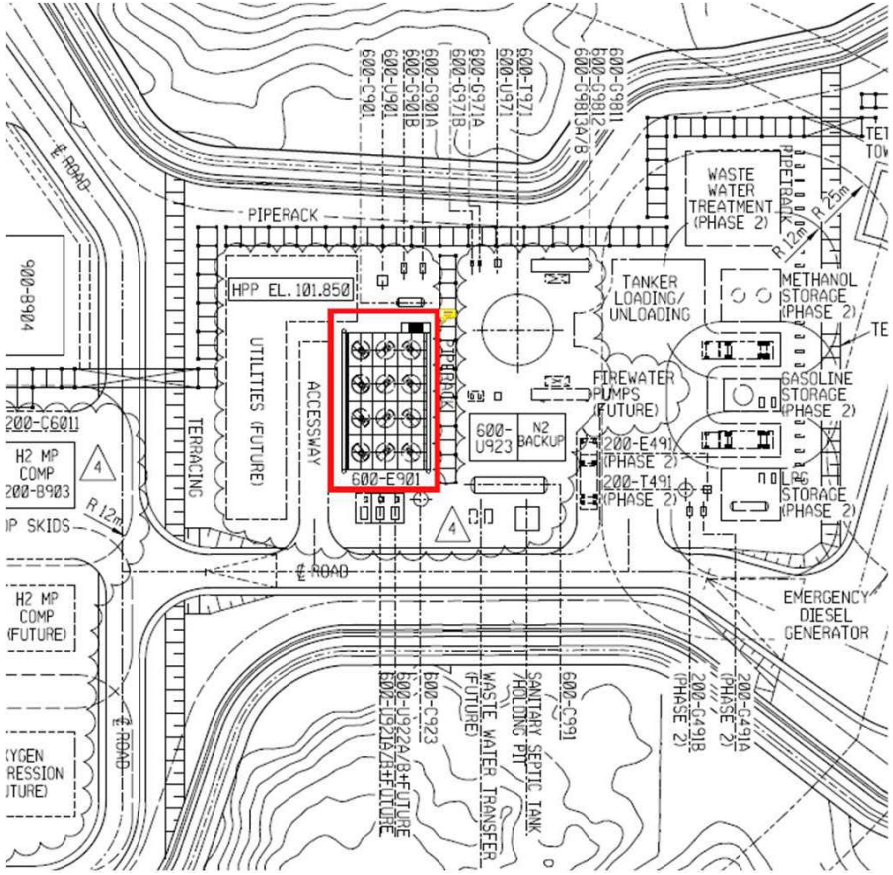
Kts integrated solution for FCE

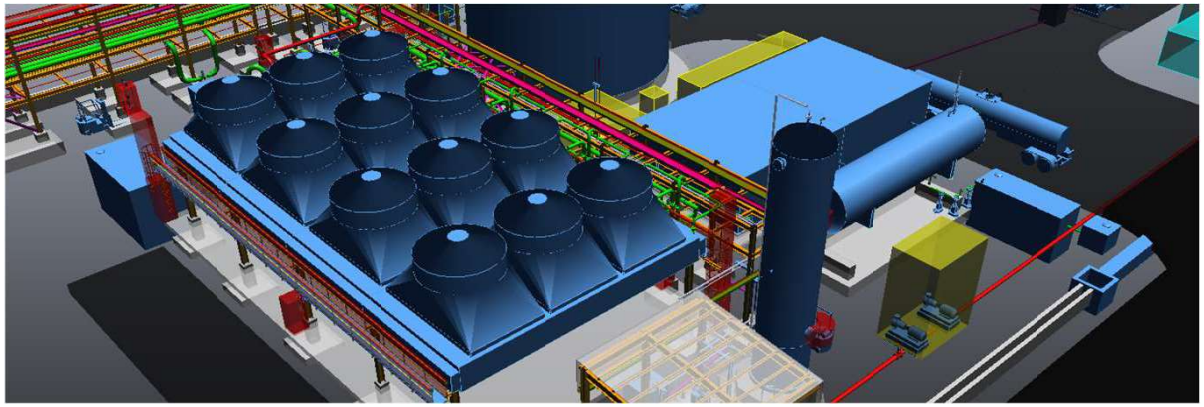
Assembled column, ready for packing

Installation in Long Beach, CA

Neom project
Kelvion scope of supply

- **Air Fin Coolers -** Part of compressor package,
- **Cooling Towers** will be linked to actual electrolyser





Fluid Dynamics
Heat Exchange Solutions since 1981

Kelvion THERMAL SOLUTIONS

Kelvion Thermal Solutions for

CARBON CAPTURE & STORAGE

FLUE GAS COOLING

Rekuluvo/Rekugavo
Flue Gas Cooling

AMINE CO_2 REMOVAL SYSTEMS

Air Fin Cooler
Lean amine cooler

K°Flex
Thermosyphon Reboiler

CCS BY DESUBLIMATION

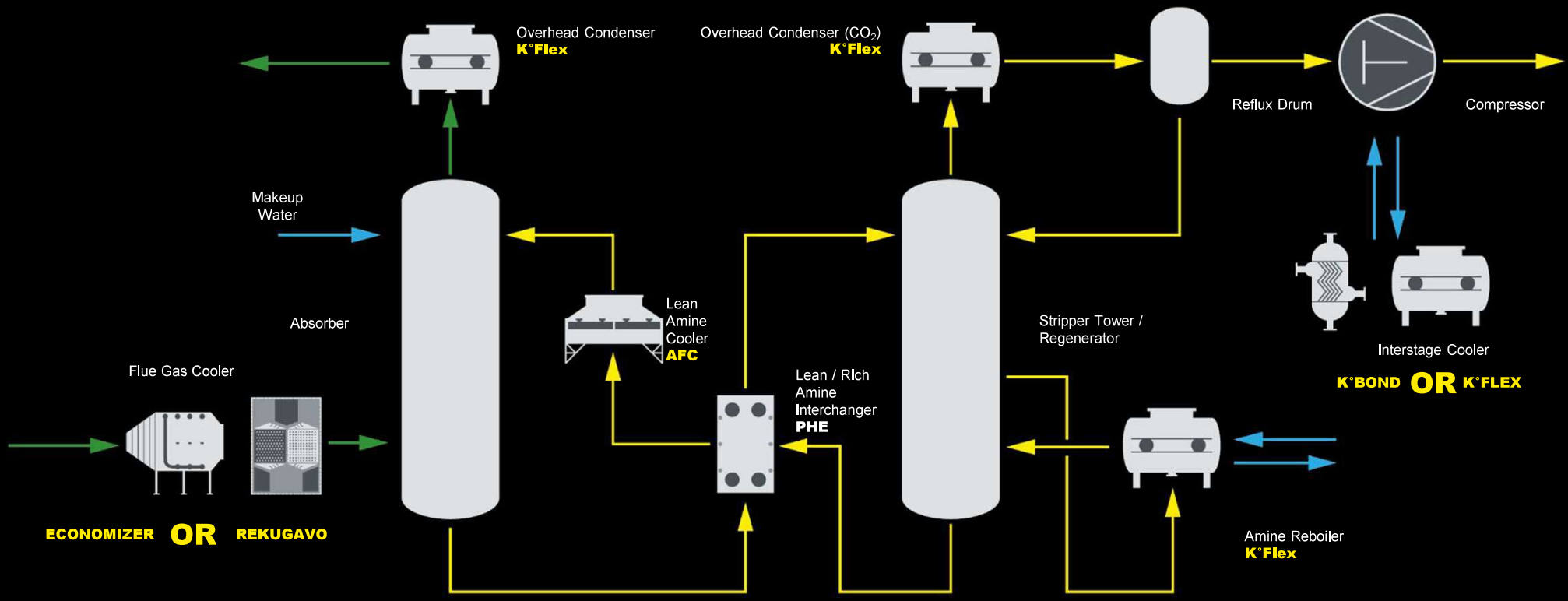
Desublimators
Direct exhaust gas capture

CCS ABSORBER

Cooling Tower
Direct air capture

Kelvion THERMAL SOLUTIONS

Most popular way
CARBON CAPTURE AMINE SYSTEM

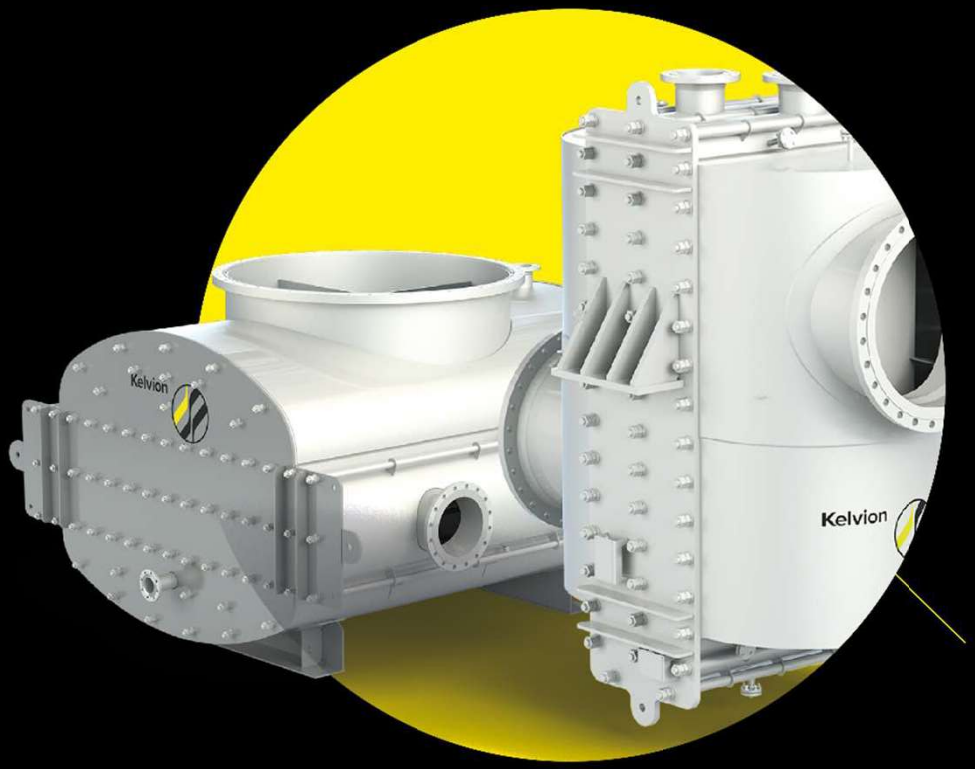


Kelvion THERMAL SOLUTIONS

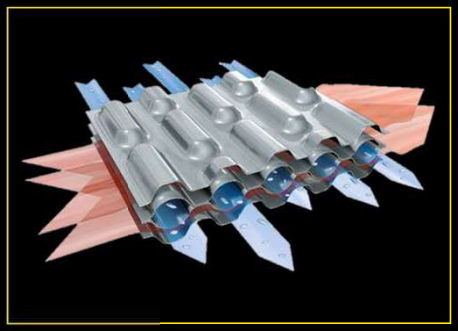
K°Flex

BASIS

- K°Flex **Standard Pressure Range** from Vacuum to 40bar.
- K°Flex **HP for High Pressure Range** from 40 to 100 bar (shell pressure up to 100 bar).
- Tested under cyclic conditions.
- Low pressure drops, high flow rates.
- Designed for high differential pressures on the wave side.
- Fluids with particles can be handled in tube side.
- Asymmetric plate channels ideal for phase changes.
- Compact size.



K°Flex Standard &
Low pressure vacum
condenser



K°Flex Plate Pairs:
Tube diameter: 6 + 9 mm
Wave gap: ~ 3 mm

Kelvion THERMAL SOLUTIONS Direct air CCS

KTS – „ABSORBER”

Direct Air Capture Innovation Centre in Squamish, B.C.

Kelvion THERMAL SOLUTIONS

CARBON CAPTURE BY DESUBLIMATORS

GOOD TO KNOW

- Desublimators are not “regular” heat exchangers
- The purpose of desublimators is material separation through phase change
- Desublimation is a thermodynamic material separating process
- Desublimation can be an attractive alternative to adsorption, absorption or cyclon separation methods.

No chemicals or solvents included

Liquid CO_2 allows for easy storage

No atmospherical emissions

Highest possible separation performance

High availability & almost free from maintenance

WHAT IS DESUBLIMATION

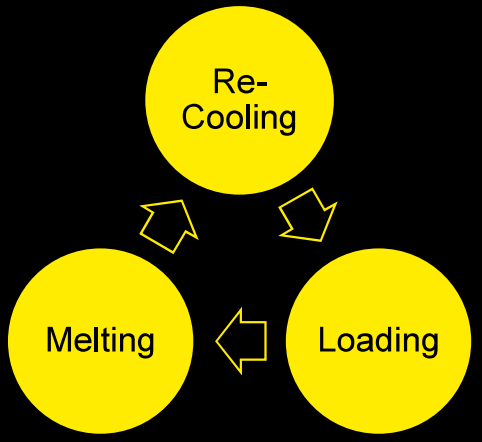
Results of the cooperation between CSIRO, RUB and Kelvion:

- Concentration of CO_2 at gas inlet: 20 %
- Concentration of CO_2 at gas outlet: < 0,5 %

Industrial Desublimation

Desublimation is a thermodynamic method for material separation and therefore an alternative to absorption and adsorption

Batch Process:



Kelvion THERMAL SOLUTIONS

THANK YOU

Fluid Dynamics
Heat Exchange Solutions since 1981

Kelvion THERMAL SOLUTIONS

CONTACT

Mike Surridge

1300 58 58 59

msurridge@fluiddynamics.com.au

fluiddynamics.com.au

Fluid Dynamics
Heat Exchange Solutions since 1981

Kelvion
THERMAL SOLUTIONS

OUR VISION

HEAT X-CHANGING THE WORLD WITH SUSTAINABLE ENGINEERED SOLUTIONS