ENERGY **RECOVERED**

GREEN ENERGY AND TEMPERATURE CONTROL SYSTEM

Likido Green Energy

The Future of Low Carbon Heating & Cooling [AHR Expo USA]

CE UL

Rev 1.0 2022

RIADA

Likido®ONE

Our unique CO_2 based high-temperature heat pumps provide heating and cooling without the need for combustion or the burning of fossil fuels, reducing energy consumption by up to 75%.

Likido®ONE

Likido®ONE, answers, perhaps the biggest challenge that the UK (and the rest of the world) faces when it comes to meeting our obligations under the Paris Climate Change Agreement; How do you de carbonise the industrial heating and cooling sector that depends so heavily on fossil fuels?

Combustion of the planet's reserves of fossil fuel is becoming increasingly socially unacceptable as pollution levels grow and the long-term effects become more apparent. Heating or cooling of products and intermediates in the most efficient and least environmentally damaging way is critical to both the environment and business profits.

Combustion emissions, from burning fuel for the production of low and high-grade heat, drying/ separation, space heating and electricity generation for own use accounted for 85% of manufacturing emissions.

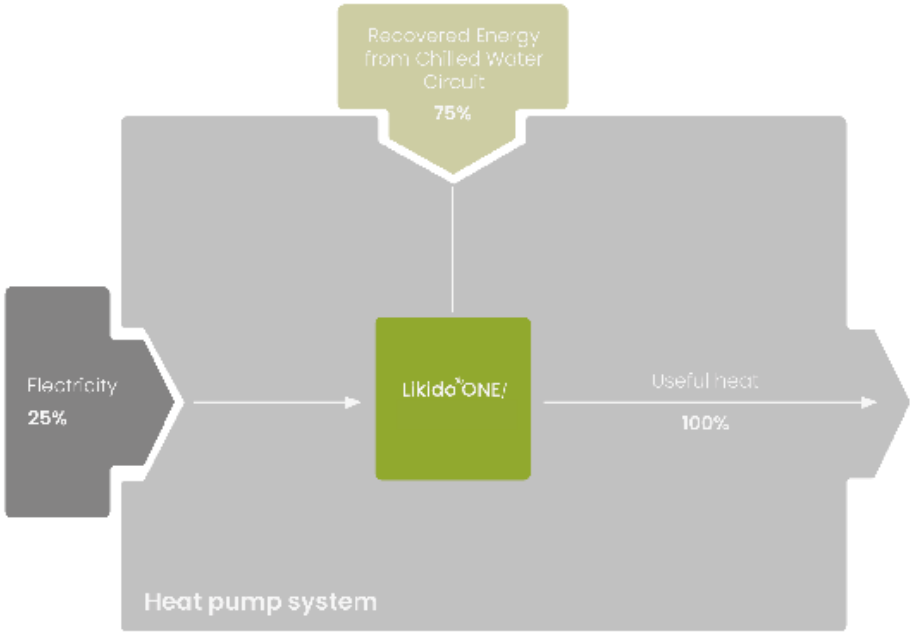
"Energy systems need to prepare for multiple and complex emerging risks. Increasing frequency and severity of extreme weather events, weather-dependent and intermittent energy supply's, requiring new storage options and digitalisation bring new opportunities. But they also present new cyber security threats and data integration challenges"

Likido®ONE offers a unique, secure system that can be Installed easily alongside existing or new installations and help solve customers' energy concerns, i.e. Reducing energy consumption; Reducing carbon emissions and increasing sustainability, and finally reducing the cost of energy supply and increasing operational profitability.

Likido®ONE is the world's first high-temperature process heating and cooling system, designed specifically for use in an industrial process environment. Operating in a combined heating and cooling mode, the system aims to reset the world's expectations for industrial heating and cooling systems by using a non-toxic, non-flammable, environmentally friendly, inert, CFC/HFC free "natural refrigerant" to safely provide **160kW** of high-grade heating plus **120kW** of low temperature, for an electrical input of just **37kW**. [A coefficient of performance or COP 1:8].

The ability of Likido technology to be used to generate heat, low pressure and clean steam, cooling and low temperature refrigeration between -45....145°C means potential application areas are enormous. The systems use supercritical CO_2, a natural, low-cost working fluid which overcomes the CFC/HFC issue and enables higher discharge temperatures.

In many manufacturing processes, significant amounts of heat are often wasted, while a simultaneous demand for thermal energy exists on site. By taking this waste heat and boosting the temperature to a useful level, Likido technology can be a highly effective way of optimising the efficiency of site processes.



CO_2

Likido®ONE advantages and why we use Carbon Dioxide

Many people perceive high pressure Carbon Dioxide [CO_2 or R-744] as a working fluid in refrigeration systems as new technology, this perception is incorrect. CO_2 was a widely used refrigerant in the late 19th century until the advent of low-pressure Freon working fluids were patented & introduced in the early 20th cntury.

What's new is the fact that few people are familiar with the benefits, safety aspects, usage & application design requirements of CO_2 refrigeration plant. Fewer still are aware of the potential of a CO_2 based heat pump like Likido®ONE to produce high temperature heat energy to replace hot water heaters, electric heaters and steam boilers.

The global warming potential (GWP factor) of the most commonly used HFCs is about 1300 to 3500 times higher than that of CO_2. Due to this fact, the HFCs have been implemented in the Kyoto Protocol and Paris Agreement to the United Nations Framework Convention on Climate Change, together with CO_2, methane and NOx.

Carbon Dioxide (CO_2 - R-744)

Carbon dioxide has been identified as a promisi alternative to conventional working fluids in a number of applications due to its favourable environmental and thermophysical properties.

1 **Non-toxic, Non flammable, natural -** Carbon dioxide can be regarded as an almost ideal working fluid since it is non-toxic, non-flammable and neither contributes to ozone depletion nor global warming.

2 **Lower cost** - Carbon dioxide refrigerant is far less expensive than synthetic refrigerants. There is no impending legislation phasing out carbon dioxide so it can be viewed as a long-term refrigerant and has significant value in reducing companies carbon footprints.

3 **Higher efficency** - Carbon dioxides is more energy efficient and has better heat exchange then a standard HFC based system. Carbon Dioxide also has a low compression pressure ratio which can improve volumetric efficiency.

4 **Smaller footprint** - Carbon dioxide is a very dense refrigerant with a high volumetric efficiency and hence allows the pipe size and compressor swept volume to be much smaller than an equivalent HFC system. CO_2 Compressors can even be up to ten times smaller than ammonia compressors.

5 **No F-Gas registration requirement** - Carbon dioxide is not subjects to the EU F-Gas Regulation 517/2014 will phase down the supply of hydrofluorocarbons (HFCs) to the EU market by 79% by 2030 compared to average levels in 2009-2012.

Hot Water

Likido®ONE For your HotWater needs now and for the future

Each year, 8,000–18,000 people in the United States are hospitalised with Legionnaires' disease – which is sometimes fatal. Water treatment is essential, but proves to be expensive while involving a lot of industrial chemicals.

Mixing hot water and pool water in boilers has a strong bactericidal effect, dramatically reducing maintenance and water treatment requirements.

However, the hot water flow temperatures available from both air and ground source heat pumps are too low (approx. 50-60°C), for industrial processing and commercial building such as hotels, hospitals and hotels that must address public safety.

The working fluid of these systems use is also harmful to the environment and is currently being phased out under the Kigali Agreement, which saw wealthy countries including the USA, Japan, and European nations begin to phase out synthetic HFCs in 2019. China is set to phase out synthetic HFCs in 2024 whereas India and other countries are targeting 2028.

Likido®ONE is exempt from the European F Gas regulations, which are aimed at controlling and phasing down CFC/HFC gases in refrigeration systems.

Likido technology dramatically reduces the energy consumption by over 75% of even the most efficient hot water heating systems and provides chilled water simultaneously.

Tourist's water consumption is higher than a resident's water consumption. A European tourist consumes around 300 litres per day compared with a European resident consumption of 100 – 200 litres per day, averaging approximately 150 litres.

There are a number of reasons for higher tourist water consumption in accommodation enterprises, including maintenance of grounds (irrigation), daily room cleaning, daily laundry, maintenance of swimming pools, intensive kitchen activities, and a 'pleasure approach' to showers and baths.

The average energy use by hotels is in the range 305-330 kWh/m2/yr. In warmer climates air conditioning is the largest single end-user of energy, accounting for approximately half of the total consumption.

Domestic hot water is commonly the second largest user, accounting for around 17 per cent of the total energy demand of a hotel.

Most of this energy is derived from fossil sources making the hotel sector's contribution to global warming and climate change an estimated annual releases of between 160 and 200 kg of CO2 per m2 of room floor area.

By using the cooling tower as an energy source, and harvesting kW's of energy that would normally be lost to atmosphere and using it to provide heat energy, we at the same time produce "free" cooling, and enable the cooling tower not to work as hard.

Hotels

Case Study
A 300 Room
5 Star Hotel

Technical Details

Number of Rooms: 300
Occupancy Rate: 80%
Hours of Hot Water Usage per Day: 18 hrs
Running Hours / Year: 6,570 hrs/year
Average Rooms Size: 35 m2
Hotel Hot Water Usage: 54,000 Litres/Day
Hot Water Load: 203 kWh
Hot Water Usage: 3,000 Litres/Hour
Initial Water Temp: 12 °C
Final Water Temp: 70 °C
Cooling Tower Outlet Temp: 22°C
Cooling Tower Inlet Temp: 30°C
Normal Recovery Time: 1.5 hrs
Natural Gas Price / kWh = $0.044
Electricity Price / kWh = $0.13

Using conventional boiler with an efficiency of 78% the total energy consumption for heating hot water is 1,534,680 kWh / annum. **[5,236.5 MMBTU/year]**

1

86% - Energy Savings - Using a Likido®ONE CO_2 heat pump potential savings 1,716 MWh [3,412 MMBTU/Year] which equates to a saving of over 86%, and therefore create Resilience against volatile fuel markets.

2

364 Tonnes CO_2eq Lower Emissions - Carbon emissions are calculated to be dramatically reduced, helping hotels, hospitals and manufacturing organisations reach their sustainability goals.

3

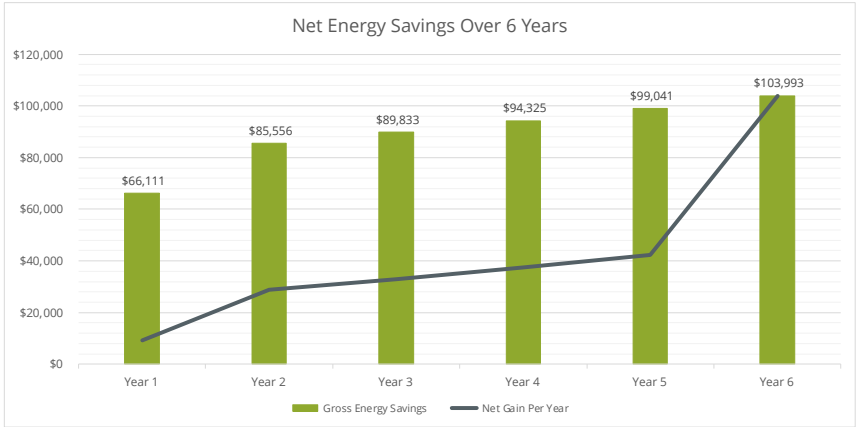
$6,500/month fuel savings - Rapid pay back on capital investment. Fast track leasing available to maximise return on investment. Online cloud based secure monitoring of fuel savings, maintenace and performance criteria.

4

920 MWh/Year [131,000 refrigeration tons] of recyled energy - Recovered from the chilled water return to the central chiller system used for AC purposes. Saving 460 MWh/year of electricity consumption.

5

$538,000 Gross energy savings over 6 years. - Net energy savings after leasing cost, excluding tax credits and incentives $255,000.



Data Centres

Liquid Cooled Servers

1 off Likido®ONE will cool 84 NVIDIA Tesla® V100 Tensor Core 32GB GPU's in 6 racks. = 168 kW of cooling but will provide 225 kW of Heating at 90°C for an Electrical Power input = 56kWe - Partial PUE = 1.25 | Partical DCiE : 80% | 2,365,200 kWh Total Running Costs Per Year @ $0.09/kWh = $223,000 per year

Likido®ONE Liquid Cooled Data Centres + Heat Recovery

Likido technology saves datacenter operators on two of their most expensive operation costs **Energy** and **Water** consumption.

Likido Likido cooled systems don't use water via evaporative cooling and energy rejected from cooling the IT infrastructure is recycled and reused to provide either heat or more cooling depending on the datacenter location.

Datacenter's that use adiabatic economisers where water sprayed directly into the air flow, or onto a heat exchange surface, cooling the air entering the data centre, the evaporation results in water loss.

A small 1 MW data centre using one of these types of traditional cooling can use around 25.5 million litres of water per year. According to a US Department of Energy report, the WUE of an average Datacenter is 1.8L per 1 kWh.

Liquid cooling – immersion cooling is a relatively new cooling technique that submerges computer equipment in a non-conductive fluid. Heat is removed by circulating liquid into direct contact with hot components, then through cool heat exchangers. The benefit of this approach over direct-to-chip liquid cooling is that all of the server heat is captured by the liquid, so fans can be eliminated from the servers.

iKu:l 2 is a sealed liquid-cooled chassis enclosure that simply converts standard air-cooled servers to liquid-cooled servers. With a few minor modifications – like removing the fans – off-the-shelf, air-cooled servers can be dropped into the Ku:l 2 chassis enabling them to be deployed as liquid-cooled servers.

The entire server is encapsulated inside the Ku:l 2 chassis where dielectric coolant is pumped through the in-chassis plate heat exchanger and precision delivered to CPUs, GPUs, memory and other critical components via an in-chassis manifold

Advantages of Liquid Cooled Servers

Sealed chassis creates a controlled environment that is impervious to dust, gases and humidity.

Increased Server Density, More servers per rack. more flexible locations possibilites.

Near silent operation.

No hot/cold aisle & containment - For datacenter with immersive liquid cooling, the server and CRAH/CRAC fans are eliminated, therefore there is no concern for air-flow management, and no need for cold/hot aisle layout and containment..

***Heat Recovery** from servers is removed via an isolated water loop to the Likido®ONE heat pump where the waste heat is "lifted" to a more usable temperature and recycled to provide space heating, hot water or even additional IT or space cooling via an absorption chiller.*

Heating & Cooling

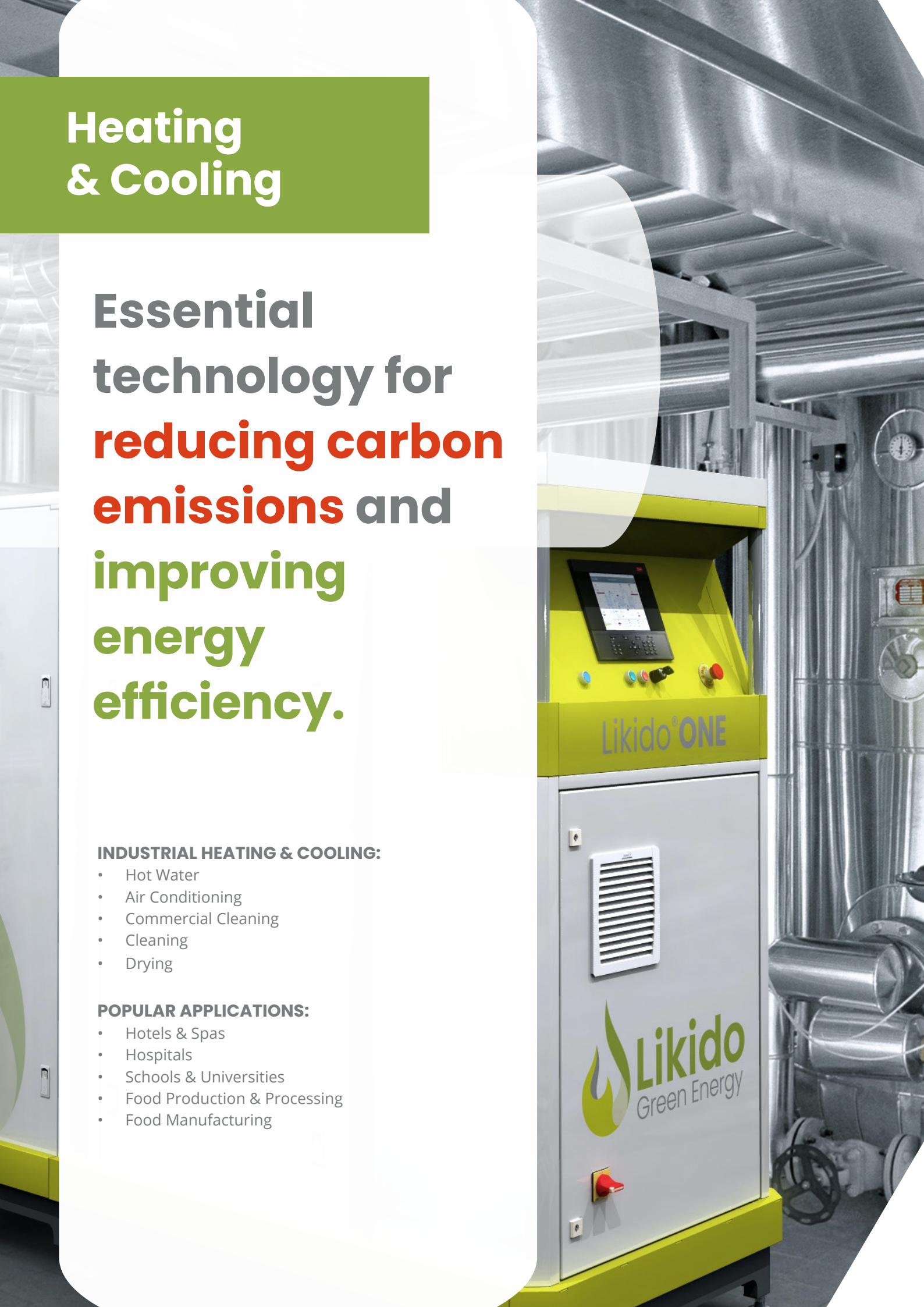
Essential technology for reducing carbon emissions and improving energy efficiency.

INDUSTRIAL HEATING & COOLING:

- Hot Water
- Air Conditioning
- Commercial Cleaning
- Cleaning
- Drying

POPULAR APPLICATIONS:

- Hotels & Spas
- Hospitals
- Schools & Universities
- Food Production & Processing
- Food Manufacturing



Advanced Heat Pump Technology

Likido®ONE provide heating and cooling that replaces traditional water heaters, steam boilers, cooling towers or chillers.

Likido®ONE helps support the global initiative of transitioning to Net Zero by 2050 as a leading renewable energy and sustainable technology innovator.

1

HOT & COLD COUPLING.
Likido®ONE heat pump systems are a promising technology for use in many applications that link to local heat networks, where hot and cold coupling is a necessity (IT, server cooling, district heating, and more).

2

COST & ENERGY EFFICIENT.
Likido®ONE can save thousands of dollars every year on energy bills and reduce carbon emissions while increasing energy efficiency. Many areas offer tax credits or other incentives for installing environmentally-friendly appliances.

3

F-GAS EXEMPT REFRIGERANT.
Likido®ONE uses R744 Carbon Dioxide (CO_2), a non-toxic, non-flammable, and eco-friendly natural refrigerant that's CFC and HFC free. R744 has an ozone-depleting potential (ODP) of 0 and a global warming potential (GWP) of 1.

Our Mission is to be the market leader in natural carbon dioxide-based heating and cooling systems, changing the way people think about energy in the process.

Likido®ONE Specifications

Likido®ONE units are designed and constructed in a modular format with high quality, proven components to EN 378 to 4: 2016, and the EU Machinery Directive (2006/42/EC) and EN ISO 12100 Safety of machinery.

Operational performance	4 Cylinder Unit	6 Cylinder Unit
Model:	**Likido®ONE 160-4-120-ITE (CO_2)**	**Likido®ONE 350-6-300-ITE (CO_2)**
Working fluid:	**100% CO_2 [R744a]**	**100% CO_2 [R744a]**
Heating Capacity		
Heating capacity range at OUTLET temp:	**192 kW**	**375 kW**
Heating INLET temp:	Max inlet temperature 50°C	Max inlet temperature 50°C
Heating OUTLET temp:	30°C - 145°C	30°C - 145°C
Heating fluid medium:	Water or Water/Glycol solution	Water or Water/Glycol solution
Max. Heating fluid flow rate:	Max 17.6 GPM [1.1 L/s]	Max 79.2 GPM [5.0 L/s]
Cooling Capacity		
Cooling capacity range at OUTLET temp:	**146 kW**	**285 kW**
Cooling INLET temp:	12°C [Min inlet temperature -30°C]	12°C [Min inlet temperature -30°C]
Cooling OUTLET temp:	6°C [Max outlet temperature -35°C]	6°C [Max outlet temperature -35°C]
Cooling fluid medium:	Water or Water/Glycol solution	Water or Water/Glycol solution
Max. Cooling fluid flow rate:	Max 96.9 GPM [6.1 L/s]	Max 198 GPM [12.5 L/s]
Electrical Demand		
Source	Grid or Renewable source	Grid or Renewable source
Number of Compressors	One	One
Compressor Control Type	VSD	VSD
Electrical power supply	460V/3 - 60Hz	460V/3 - 60Hz
Electrical classification - EN60529	IP55	IP55
Frequency Range	30-66Hz	30-66Hz
Length [mm]	2,430	2,430
Width [mm]	1,000	1,980
Height [mm]	1,980	1,980
Transport Weight [kg]	1,250	2,350
Operating Weight [kg]	1,280	2,378
Refrigerant Quantity [kg]	18	28
Performance		
COP Heating	4.3 for hot water at 70°C	4.3 for hot water at 70°C
COP Cooling (EER)	3.2 for chilled water at 12/6°C	3.2 for chilled water at 12/6°C
COP Total (Combined)	7.5	7.5

The performance values specified are quoted in accordance with DIN EN 14511 and DIN EN 12900

Likido reserve the right to make technical or production-related changes to the pictures, Drawings, weights and dimensions stated in our brochures.

Contact Info
www.likido.net
Email stuartcox@likido.net
Tel +44 (0)131 6100 800
UK Mobile +44 7983 239540

Jamie Hillis (UK)
Sales Manager
Email: jamie.hillis@likido.net
Mobile UK : +44 (0) 7939 842438
Office US: +1 (858) 529 9910

Anthony Pagnotti (US)
VP Customer Implementation
Email: apagnotti@dalrada.com
Mobile US: +1 (570) 650 6260
Office US: +1 (858) 529 9910