

# Clean Energy & Industrial Gases Group Kia Ora! NZGA

Presentation for NZGA Conference 28<sup>th</sup> of July , 22





#### **Main Company**

**Executive Management** 

Headquarters

Date of Establishment

**Registered** Capital

Net Sales, cons. Fiscal Year (thru June 2020)

No. of Employees (June 2020)

Stock Exchange Listing

**Core Business** 

#### NIKKISO Co., Ltd (Japan)

Toshihiko Kai (President & CEO)

Yebisu Garden Palace Tower Tokyo | Japan

December 26, 1953

JPY 6.544 bn (USD 59.5 M)

JPY 165.8 bn (USD1.5 B)

8,708 (cons.)

First Section of Tokyo Stock Exchange 74,286,464 issued shares

Industrial Division Aerospace Division Precision Equipment Medical Division

## Nikkiso Clean Energy & Industrial Gases Group Factsheet





#### NIKKISO CE&IG - HQ

Executive Management	Peter Wagner (President & CEO) Koichi Miyamae (Executive VP) Mark Gaines (VP of Finance & Business Control)
Headquarters	Nikkiso Cryogenic Industries, Temecula, CA USA
Date of Establishment	April 17, 2017
Registered Capital	USD 420M
Net Sales 2021	USD 276M
No. of Employees	Approx. 936
Subsidiaries / Represented Countries	20 / 15
Main Production Sites	9 (Australia, China, Germany, India, Japan, South Korea, UK, USA-4)
Core Business	Cryogenic machinery (centrifugal and reciprocating pumps), heat transfer devices (ambient air and process vaporizers), process plant (air separation units, gas generators, liquefiers), and turnkey solutions and services for various industries

# NIKKISO CEIG WORLDWIDE MAP





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## Industrial Division and CE&IG Group Formation





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SALES AND SERVICE CENTERS

## **Clean Energy & Industrial Gases Group - CORE SOLUTIONS**







#### **Process Plants / Solutions**

- Small Scale LNG and H2 Liquefaction
   Plants
- Industrial Gases Plants
- 60% to 70% N. American Market Share
- Waste Heat Recovery / CHP
- LNG Import Terminal Engineering and equipment supply
- Turboexpander Copyright © 2019 NIKKISO CO., LTD. All rights reserved.

#### **Pumps / Turboexpanders**

- Largest range of cryogenic pumps Centrifugal and reciprocating pumps
- Air, NG, and Liquid Expanders
- Largest Experience and installed base

#### Heat Exchangers/Vaporizers

- World Leader in Gas Fired Vaporizer Systems
- Product Integration
- Largest Ambient Vaporizers in the World!

## **Clean Energy & Industrial Gases Group - CORE SOLUTIONS**





## LCNG FUELING SATIONS

- > 100 LCNG Fueling Station
- > Turnkey Solutions





### LH2 FUELING STATIONS

- > 400 pumps in Hydrogen
- > 10 LH2 Fueling Station
- Up to 1000 Bar
- Turnkey Solutions

#### AFTERSALES SOLUTIONS

- ALL Brands Pump Services
- ALL Brands Turboexpander Services
- Exchange/Overhaul Agreements
- Long Term Maintenance Agreements
- Upgrades/Redesigns (Pumps/Expanders)
- Field Services



Nikkiso continues our commitment to lead the change to a healthier world - Introducing the world's first liquid hydrogen (LH2) bunkering facility. Nikkiso's European Cryogenic Pumps Unit has partnered with clean energy solutions company <u>Unitrove</u> to lay the groundwork for zero-emissions marine fueling infrastructure at ports throughout the world.

<u>Unitrove</u> will showcase this liquid hydrogen bunkering solution including Nikkiso cryogenic pumps at the United Nations <u>COP26 - UN Climate Change Conference</u> in







# **Cryogenic Products and Solutions**

# NIKKISO





# Nikkiso Expander Application Technology (NEAT)

Organic Rankine Cycle (ORC)

# The Molecule of concern

0

0

0



**2. Climate change / greenhouse effect** 

3. Realization of the consequences

##

**1. Industrialization resulted in greenhouse gases** 

С

0





# Some Green Initiatives

#### CM style

#### \$13.6B record-breaking solar park rises from Dubai desert

Published 25th April 2019



# SIEMENS © Search tor ... Our levers Siemens will be carbon neutral by 2030

How will we manage this?





Siemens Energy Efficiency Program

Distributed energy systems







Rich history of geothermal energy usage

# Geothermal power: Pioneers Italy and Iceland

 First geothermal steam engine installed in 1904, direct steam usage, it powered five light bulbs.... Today about 770MW



 Today about 700 MW installed geothermal capacity on Iceland which is now 100% renewable



# ORC cycle and how it works



- Like a water Rankine cycle, but with organic fluid
- Fluids: Refrigrant, Pentane, Butane, Propane....
- Specially suited for temperatures between 80°C to 250°C (175°F to 500°F)
- Efficiency benefits at low temperature sources
- No fresh water needed,
- Closed loop, simpler and more efficient than water steam
- <u>New Tech very low temperatures: Water-Ammonia</u> <u>Binary Cycle, called "Kalina-Cycle"</u>



### Nikkiso ORC systems









Streamlined and simplified application solution

Reliability 25+ years

Customized and upgradable

Sustainable solution

Emissions leakages

Advantage of utilizing inflow radial turbine in ORC Process

#### **Organic Rankine Cycle Applications**

#### Medium enthalpy and low enthalpy geothermal resource

- Brine temperature of 240 C (464 F) or less
- Single or multiple Power trains upto 5- 25Mw can go higher or lower
- Air cooled or water cooled condensers

#### Waste Heat

- Gas Turbine Exhaust
- Gas Engine Exhaust
- Process Heat

#### **Cold Energy**

• LNG Receiving Terminals



#### Geothermal Energy Recovery Schematic





## Waste Heat Energy Recovery Schematic





#### Cold Energy Recovery Schematic

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- LNG cold energy is utilized to condense an intermediate fluid
- The intermediate fluid is vaporized by heat of sea water
- Saturated vapor enters turbo expander and expands to condenser pressure
- Liquid intermediate fluid is pumped back to evaporator



#### **Turbine (Expander) Technologies**

- Axial Turbine
  - Fixed Geometry
  - External actions to meet variations
  - Throttling or Bypass
- Radial Outflow Turbine
  - Fixed Geometry
  - External actions to meet variations
  - Throttling or Bypass
- Radial Inflow Turbine
  - Variable Geometry
  - Internal actions to meet variations
  - Adjusting variable inlet guide vanes



# Turbine latest (Expander) Technologies "NEAT"





• Flow enters axially and exits axially



Radial Outflow Turbine

• Flow enters axially and exits radially



 Flow enters radially and exits axially

### Inflow Radial Turbine, Expander



Typical Pressures: 5-30bara (70-450PSIA) Typical flow rates: between 50-5000t/h Typical temperatures: 80°C-250°C (175-500°F) Typical power between 500kW (650HP) and 25MW



Variable Inlet Guide Vanes



Expander performance at fixed speed and isentropic enthalpy drop



Efficiency of RIT vs AT







A simulation studies suggest that radial inflow turbine, turbo expander, could produce up to 7.5% more cumulative electrical power in certain conditions



Note: Studies was made for a geothermal ORC Power Plant in Turkey with the design ambient temperature of 15 C

#### Island mode operation/Isolated grid operation





Conditions before, during and after island mode operation

## Nikkiso Turbo



- Nikkiso Turbo background goes back to the 1970s with Airco Division and ACD Turbo
- ACD Turbo expanded its market to include natural gas and petrochemical after being acquired by Nikkiso
- ACD Turbo product line for air separation was divested to Air Liquid in 2021
- Nikkiso Turbo team for NG and PC has expanded its personnel and activities to design and service high power turboexpander-compressors
- Prime equipment and AMS for ECs with active magnetic bearings (AMB) are available
- Nikkiso Turbo has also developed and bidding expander with integral gearbox for ORC systems

#### Turboexpander with Variable Inlet Guide Vanes

- Externally actuated
- Non-galling
- Provide swirl to drive expander wheel





### Turboexpander with Variable Inlet Guide Vanes







### Turboexpander Compressor, Oil Bearings





#### Turboexpander Compressor, Active Magnetic Bearings





#### Turboexpander with Integral Gear







### Waste Heat ORC





#### Waste Heat ORC Power Production Potential- NG Compressor Stations



#### 60.0 1 Gas Turbine 2 ident. Gas Turbines Linear(1 Gas Turbine) 50.0 Linear(2 ident. Gas Turbines) 40.0 Output (MW) 30.0 ORC Power 20.0 1257 10.0 •• 0.0 50.0 100.0 150.0 0.0 200.0 250.0 300.0

Est. ORC Power Output from Gas Turbine Exhaust

Output for 1 or 2 identical gas turbines

Data consisted of 50 gas turbines:

- GE Energy
- GE Oil & Gas
- Rolls Royce
- Siemens
- Solar

#### Assumptions:

- Exhaust gas specific heat 1.100 j/gC
- Min. allowed stack temp 150 °C
- 15%WH2P conversion
- Comp. Stations with > 11 MW

Compressor Station Power Rating (MW)

# **Turboexpander Variable Inlet Guide Vanes**









### Geothermal ORC- 2 x 25 MW Plant-Turkey





## Waste Heat Recovery ORC- 2 MW Plant – Canada





## Waste Heat Recovery ORC- 2 MW Plant Canada





### Learnings this week



#### Why not scrub Co2 and sell it to beverages and H2S for Acid manufacturing





# Nikkiso Green Hydrogen Technology



- pressure and product purity
- \*\*\* Additional power required

#### Question for my Otago DBA research here



Can EAAS (Equipment as a service) work for our industry

Argument's sake you don't pay for the expanders or main equipment you pay per usage per hour? I am taking this onboard with my management so we can help support the industry which is capital

intensive. We are happy to work on a project like that as well to support.



# Apologies tendered Dr. Reza Agahi





EFFECTIVE APRIL 1, 2021 Irvine, CA – Nikkiso Cryogenic Services is planning to expand its Turbo business in Oil & Gas Industries in addition to the current Industrial Gas Industries. We are pleased to announce that Dr. Reza Agahi will join Nikkiso Cryogenic Services Team as the Vice President of Turbo Business Development. Dr. Agahi has more than forty years of experience in turboexpander design and applications. NCS welcomes Reza to Nikkiso family and looking forward to serving its clients in more ways than before.



# Tēnā koutou!

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