Geothermal Energy Machinery & Systems

Louis Mann

November 19, 2025

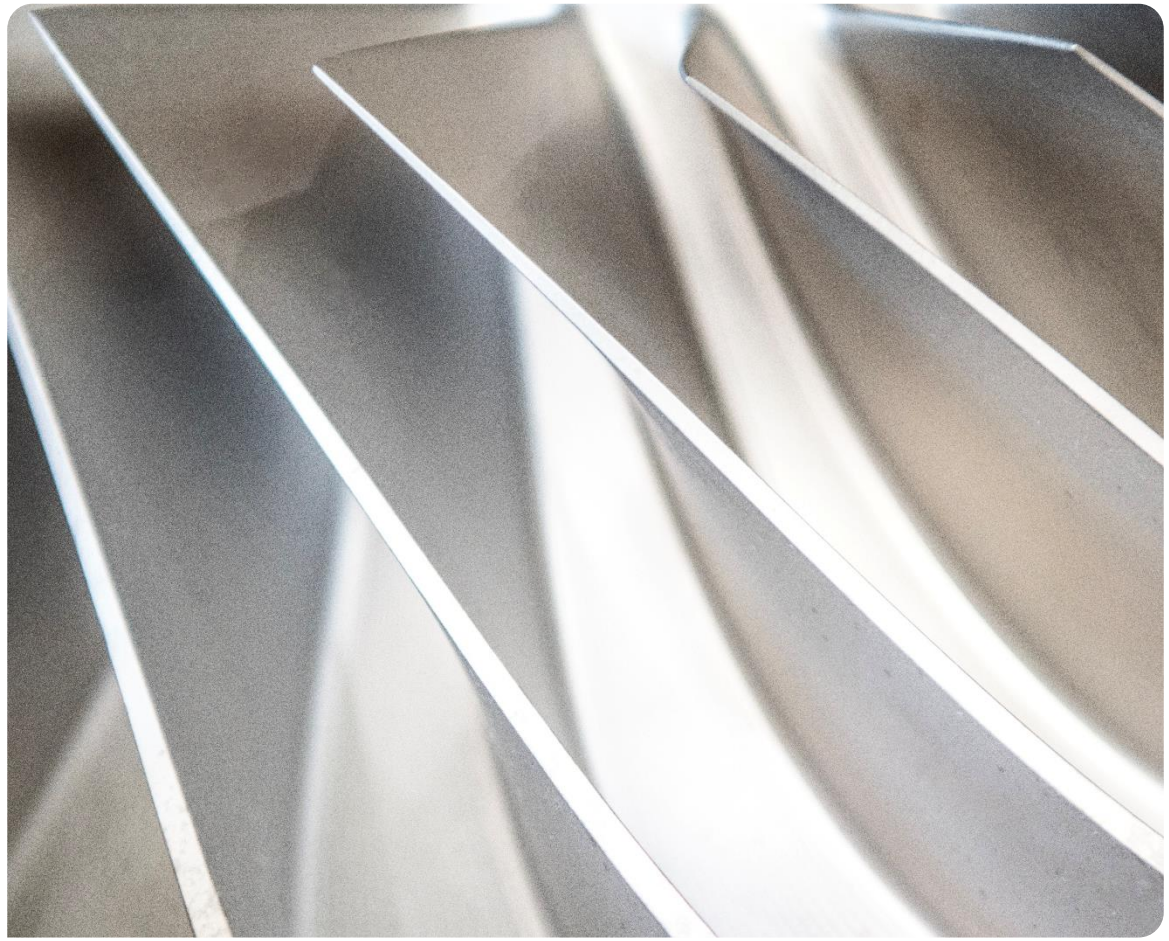
This is Atlas Copco Group

55 000 employees in | **73** countries

Established in **1873** Stockholm, Sweden

Customers in about **180** countries

A decentralized Group with **24** divisions across **4** business areas



Organization

Board of Directors

President and CEO

Group Management

Compressor Technique

- Compressor Technique Service
- Industrial Air
- Oil-free Air
- Air and Gas Applications
- Medical Gas Solutions
- **Gas and Process**
- Airtec

Vacuum Technique

- Vacuum Technique Service
- Semiconductor Service
- Semiconductor
- Semiconductor Chamber Solutions
- Scientific Vacuum
- Industrial Vacuum

Industrial Technique

- Industrial Technique Service
- Motor Vehicle Industry Tools and Assembly Systems
- General Industry Tools and Assembly Systems
- Chicago Pneumatic Tools
- Industrial Assembly Solutions
- Machine Vision Solutions

Power Technique

- Power Technique Service
- Specialty Rental
- Portable Air
- Portable Power and Flow
- Industrial Flow

Global Structure

Gas and Process Division

Headquarters: **Cologne**

Sales, Application and Production Center USA

Atlas Copco Comptec LLC

Voorheesville, New York, USA

Acquired in 1980

Sales, Application and Production Center China

Atlas Copco Process Equipment Co., Ltd.

Shanghai, China

Established in 2010

Sales, Application and Production Center Korea

Atlas Copco Korea
Gas and Process

Busan, Korea

Established in 2021

Sales, Application and Production Center Europe

Atlas Copco Energas GmbH

Cologne, Germany

Acquired in 1984

Sales, Application and Production Center USA

Atlas Copco Mafi-Trench LLC

Santa Maria, California, USA

Acquired in 2007

Sales, Application and Production Center India

Atlas Copco Ltd.
Gas and Process Applications

Pune, India

Established in 1997

Solutions for protecting global climate and human health

Technologies are required to support **New, Emerging** and **Sustainable Energy Sources**

Increased amount of **CO_2 & sCO_2, H_2, Renewable and Energy Storage related projects**

Expanders / Compressors in H_2 Liquefaction and BOG

Expanders / Compressors in CCUS and sCO2

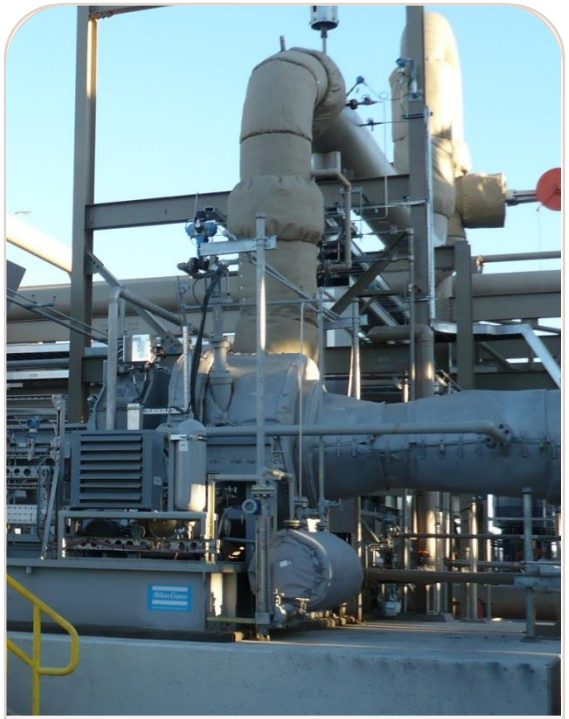
Steam Compressors / MVR & Heat Pumps

Expanders / Compressors in **ORC** / WH2P / LDES

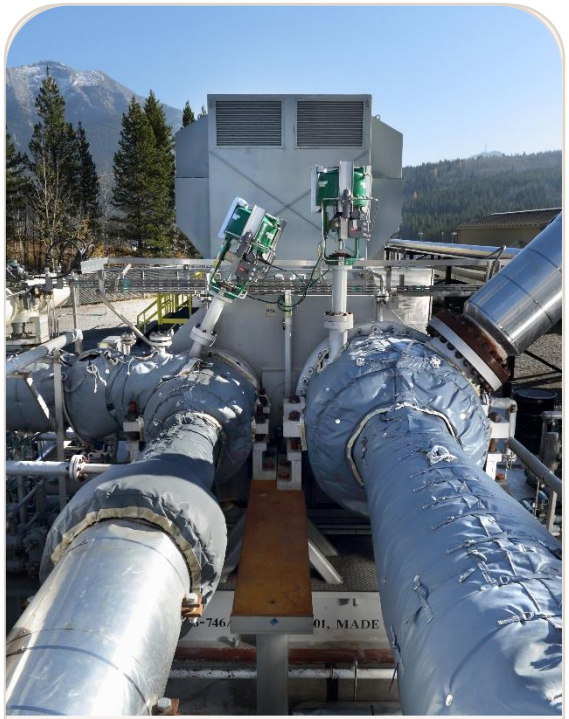
Atlas Copco Expanders in ORC

Decades of Experience in Binary ORC Plants

Single-stage Expander EG10
10MW, i-Butane, USA, 1982



Single-stage Expander EGI8
15MW, i-Butane, USA, 2007



Two-stage Expander EEGI4/6
7.3MW, Butane, Canada, 2013

Twin Expander EEGI8
27MW, Butane, Turkey, 2018

Demand for Larger Plants

ORC projects trending upward in size

"Think bigger than the 10-50MWs we're seeing!"

Lucia Tian, Head of Advanced Energy Technologies, GRC, 2025

Google

"100 MWe maximize(s) benefits in balance with diminishing returns to scale."

Enhanced Geothermal Shot Analysis for the Geothermal Technologies Office, 2023

NREL Transforming ENERGY

"At 500 MW, Cape Station is ushering in a new era for enhanced geothermal energy."

Capestation.com

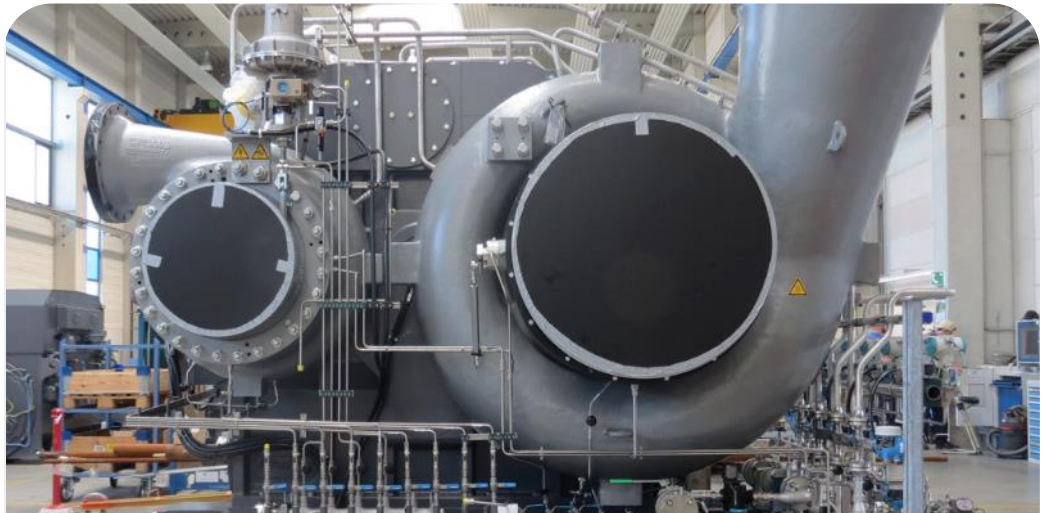
FERVO ENERGY

Image courtesy of RayGen

Large Plants, Large Machines

A clear shift in the energy transition

- CCUS
- Heat Pumps
- Energy Storage



Atlas Copco

Atlas Copco GAP US Investments

For larger machinery, delivered locally

Santa Maria, California

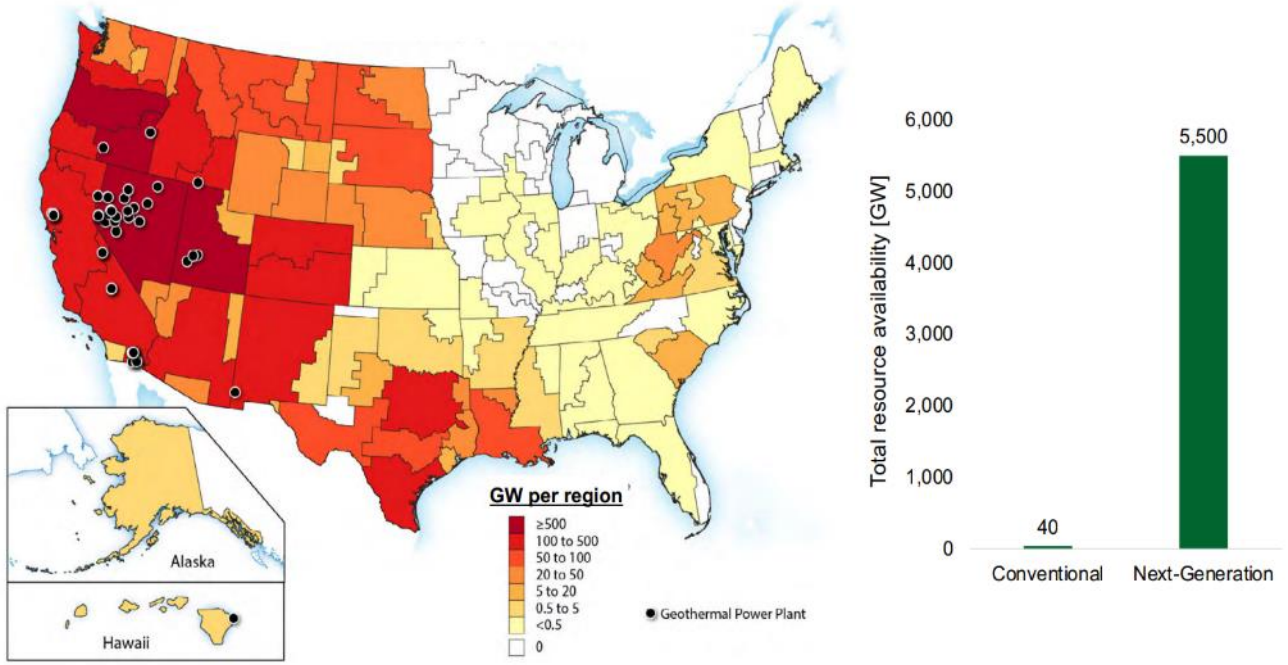
- Atlas Copco Mafi-Trench
- 48,000-square-foot lease expansion
- Lease start 2025

Albany, New York

- Atlas Copco Comptec
- 63,000-square-foot new build expansion
- Construction completion 2026

Next Gen Geothermal

Moving toward higher power and higher temperature



Source: Pathways to Commercial Liftoff: Next-Generation Geothermal Power, DOE, March 2024

- **Next-generation geothermal** unlocks resources in common environments, increasing accessibility and commercial potential
- Traditional ORCs ran at **120 to 180 C** and delivered up to roughly **20 MWe per module**
- Next gen geothermal targets **150 C and above** and scales to **100 plus MWe plants**

High Power and High Temperature

Fluid choice impact on machinery size

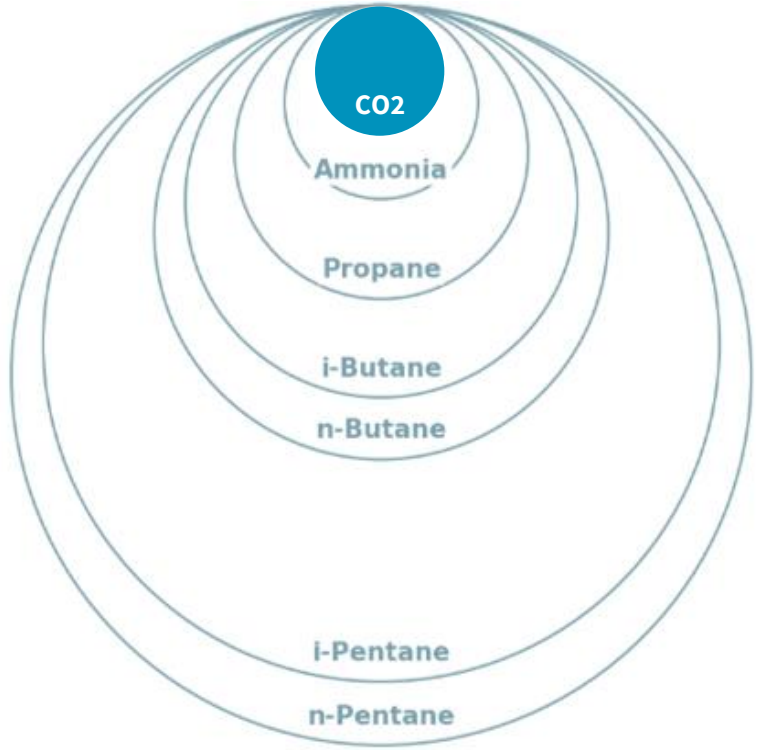
- Machinery size increases directly with power
- Fluid choice creates step changes in size due to discharge volume

↑ Enthalpy → More stages
↑ Tcrit → Larger exit area
for similar fluids

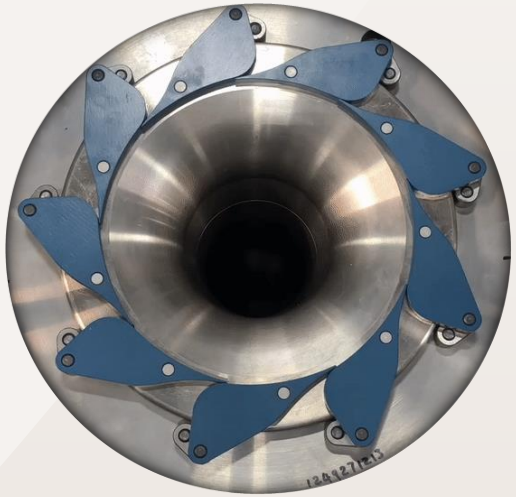
DiPippo Study: 130 C turbine inlet, 50 C condensing

Fluid	Formula	Molar mass	Tcrit (°C)	Psat @ 40 °C (bara)	Relative exit area
Ammonia	NH_3	17.0	132	15.6	1.0
Propane	C_3H_8	44.1	96.7	13.7	2.3
i-Butane	i-C_4H_{10}	58.1	135	5.31	4.1
n-Butane	C_4H_{10}	58.1	152	3.88	5.5
i-Pentane	i-C_5H_{12}	72.2	187	1.56	12.2
n-Pentane	C_5H_{12}	72.2	197	1.16	14.6

Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact, 3rd ed., pp. 333-336.

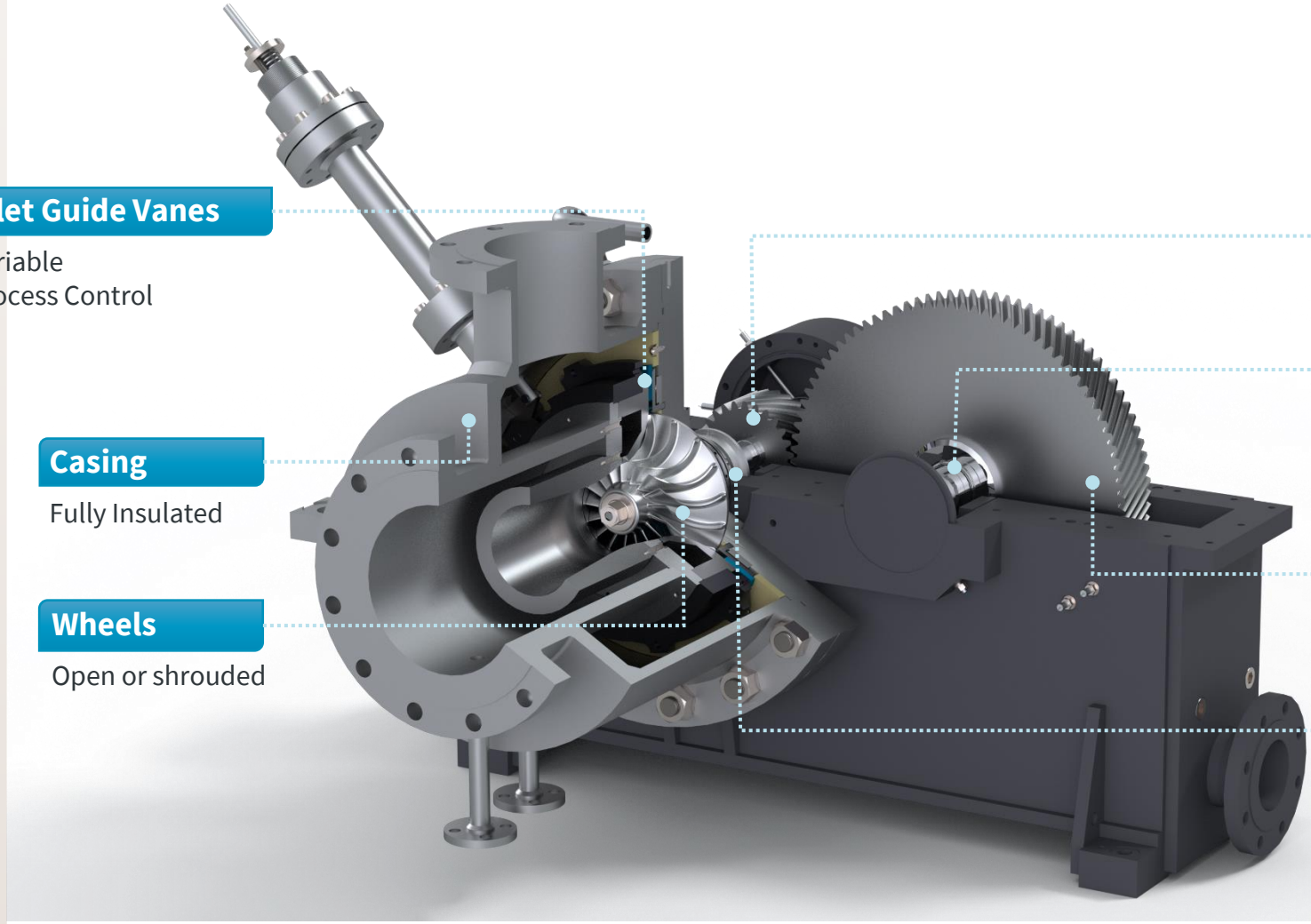


Integrally Geared Radial Inflow Expander



Variable IGV Benefits

- Island Mode
- Dispatchable power
- Depleting resource temperature
- Variable rejection temperature



Inlet Guide Vanes
Variable
Process Control

Casing
Fully Insulated

Wheels
Open or shrouded

Pinion
High-Speed

Bearings
Tilting-pad

Bull Gear
Low-Speed

Shaft Seal
Dry Gas Seal
Oil Seal

Radial Inflow Pathways at High Power and Temperature

Two scaling options when reaching the limits

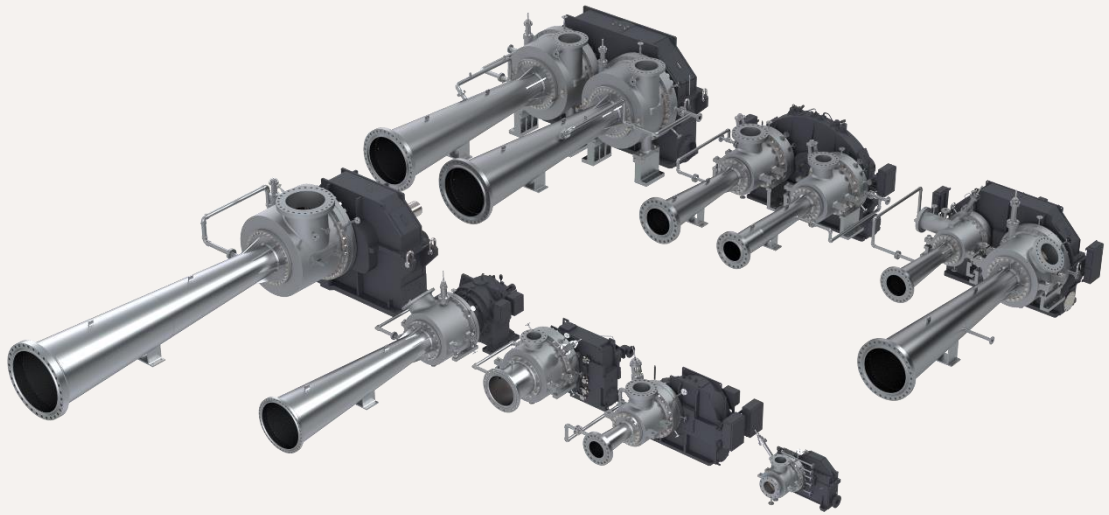
Change working fluid

- Consider transcritical or supercritical cycles for greater power density

sCO2 Compander
Compressor Inlet:
80 bar, 28 C
Expander Inlet:
223 bar, 275 C
Power: 2MWnet

Add Machines

- Series stages driven by enthalpy / Mach no.
- Parallel units driven by volumetric flow



Ongoing Improvements

Advancing options for next gen duty

Higher Mach Numbers

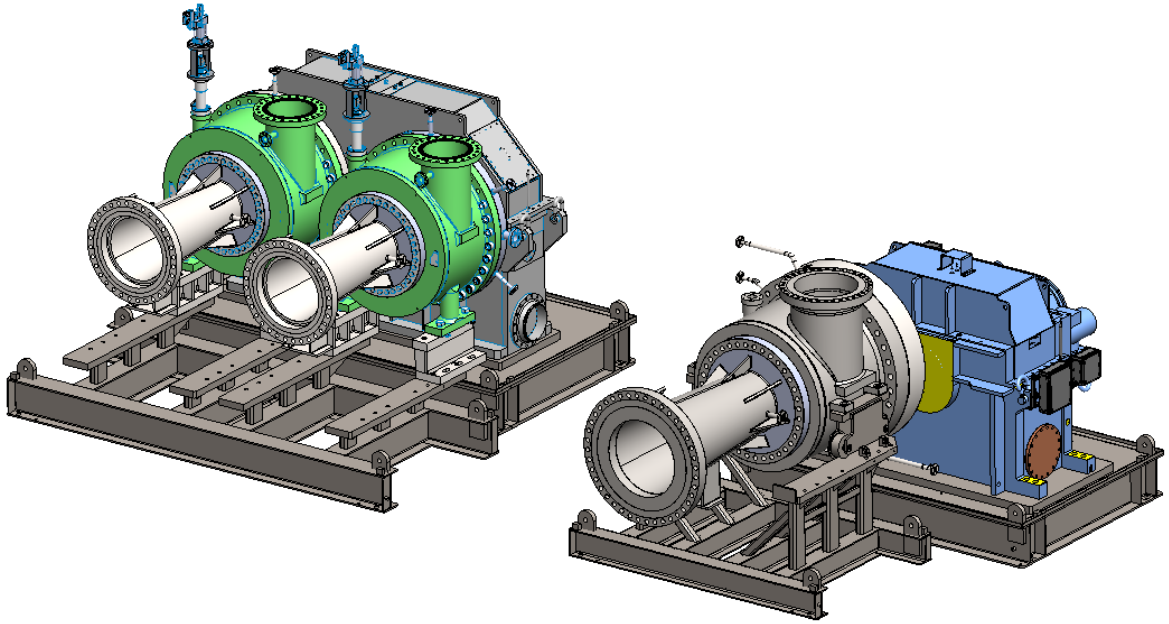
- Mach 1.5+ proven in full-scale field testing (2024)

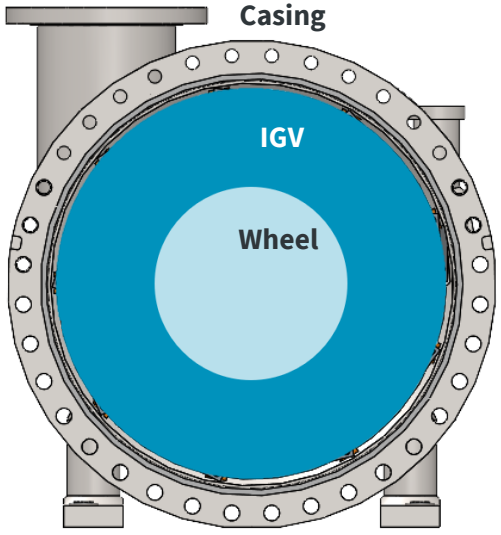
Higher Flows

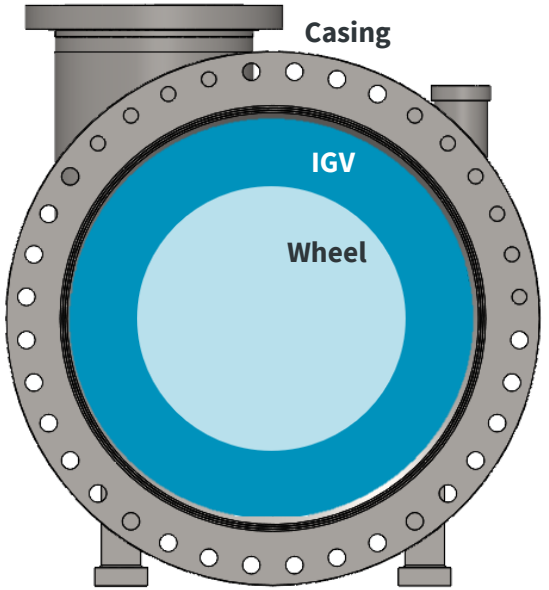
- Upsized flow capacity within existing housing footprint
- Eliminates parallel units for equivalent flow
- New size enables single-pinion ratings up to 40MW

Even Higher Flows

- Assessing axial and hybrid axial arrangements







Key Takeaways

Image courtesy of RayGen

- ORC projects are trending toward higher power and higher temperature
- Fluid choice and flow capacity guide the machinery needed for each project
- Radial inflow is moving into higher capacities, with axial stages offering potential to extend flow
- **Work with machinery partners early to shape the expander solutions your projects need**

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Thank you!

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