



## Centrifugal Hydrogen Compressor

THE ULTIMATE ONE After Half  
Century of CHALLENGES  
For A BRIGHTER FUTURE



## Centrifugal Hydrogen Compressor for European Hydrogen Pipeline



Kawasaki carry out development of Centrifugal Hydrogen Compressor for European Hydrogen Pipeline

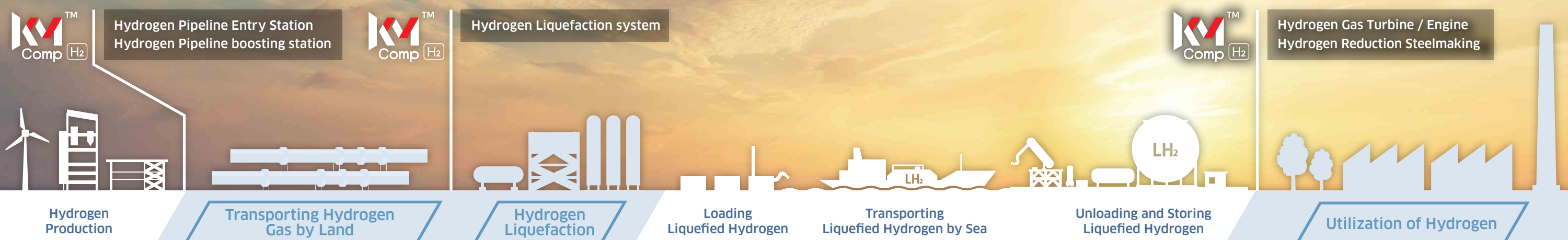
Elemental technology development is supported by Japanese Government "Green Innovation Fund"

- A North Africa and Southern Europe
- B Southwest Europe and North Africa
- C North Sea
- D Nordic and Baltic Regions
- E East and Southeastern Europe



## Kawasaki Hydrogen Road

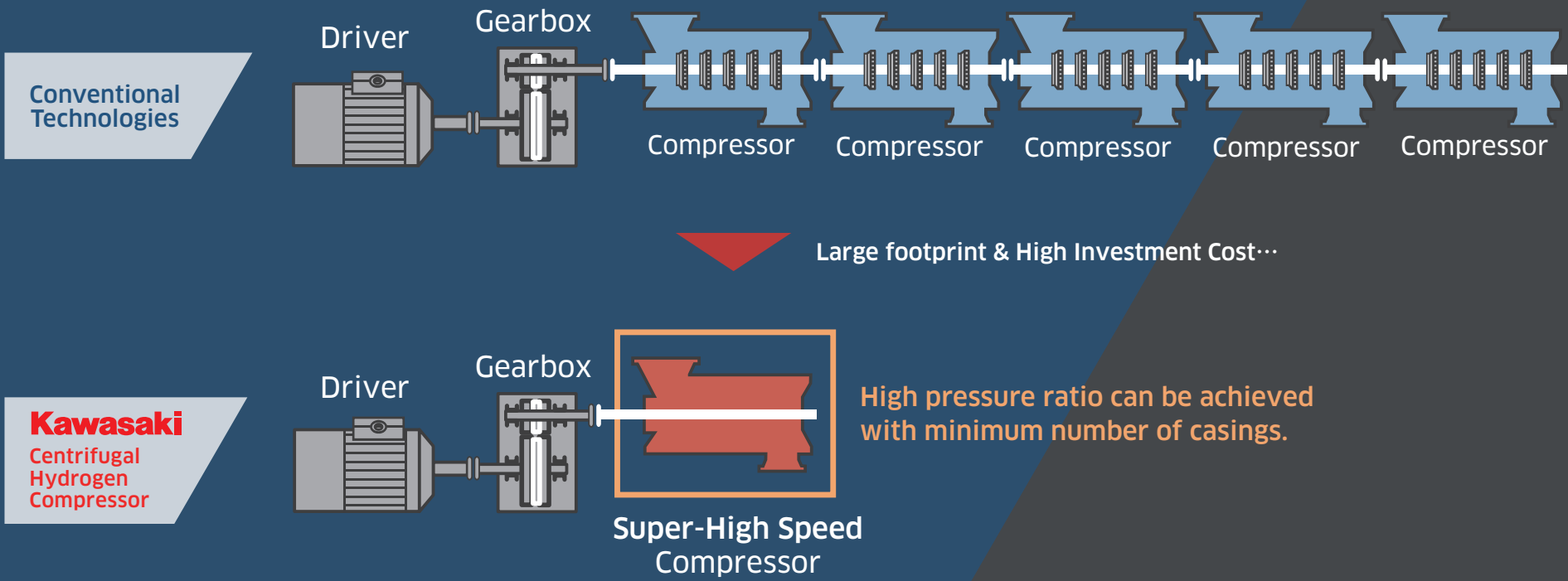
Reference image of the use of centrifugal hydrogen compressors





# What makes Kawasaki Hydrogen Compressor Special ?

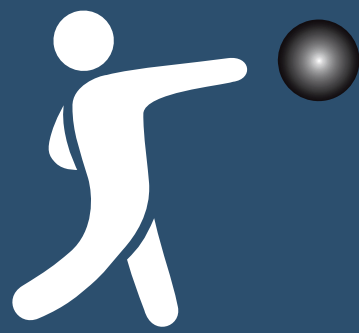
As the demand of hydrogen energy increases in the world, it is expected that large capacity of pure hydrogen (100% H<sub>2</sub>) needs to be compressed at a high pressure ratio of 2 or even higher, which was not seen in the energy market before. With conventional technologies adopted in traditional hydrogen services such as those in refineries, the footprint and investment cost required for hydrogen compression would be a burden for the energy suppliers. We are pleased to propose an alternative and the ultimate solution, which is under Kawasaki's major development project supported by Japan's Green Innovation Fund and to be available for you soon.



## The Challenge in H<sub>2</sub> Compression by Centrifugal Force

Imagine... Which is harder to throw it far away?

Cannonball  
(Hydrocarbon)



Ping-Pong Ball  
(Hydrogen)



Hydrogen is the lightest gas that exists in the world. It requires more energy than other gases to compress by centrifugal force.

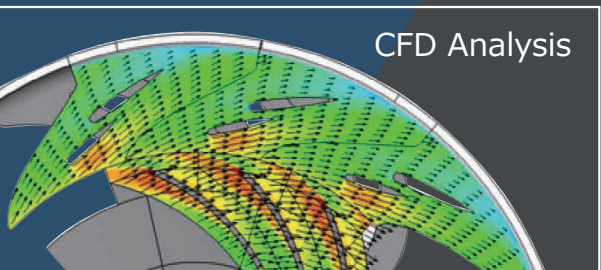
### Key Technologies

#### Material Selection Suited for Severe H<sub>2</sub> Environment

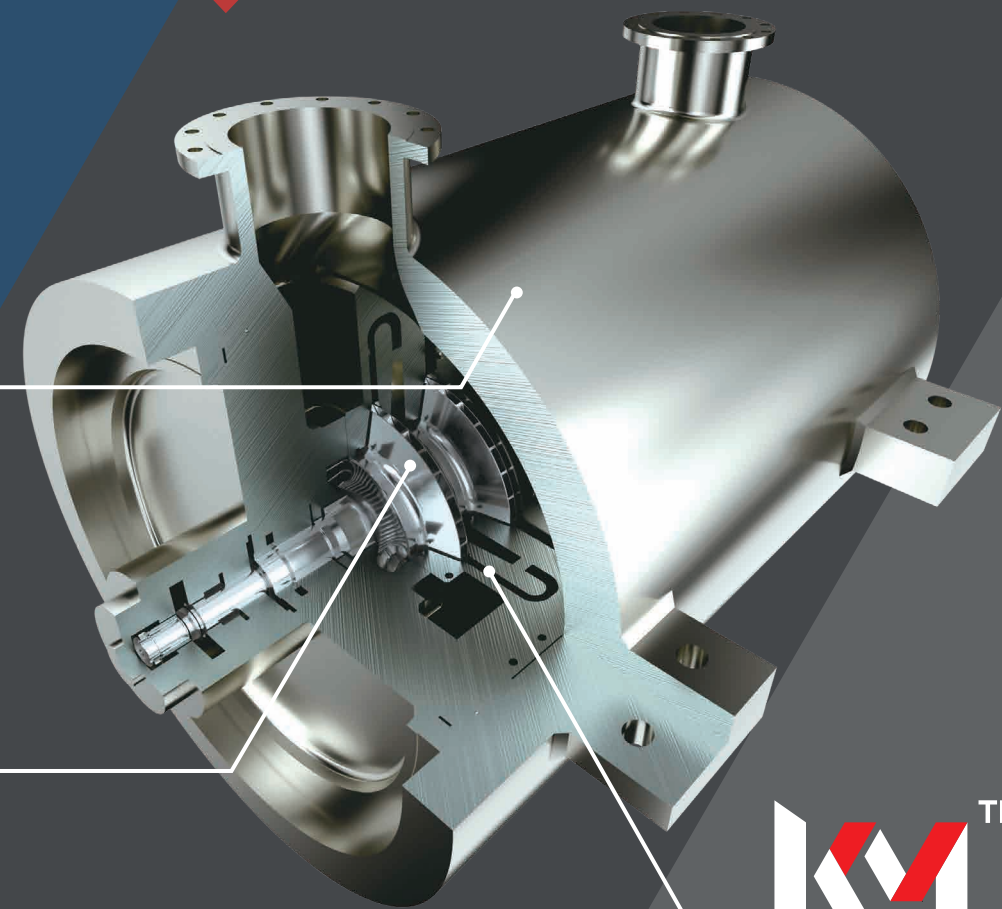
Since H<sub>2</sub> particles are small enough to permeate solid metals, it could give damages to materials exposed to severe H<sub>2</sub> environment. Utmost care shall be taken for material selections in the gas passage of compressors in H<sub>2</sub> services.

#### Super-High Speed Rotation with Multiple Impellers

For rotating machinery design having multiple impellers between bearings, it is a challenge to run the rotor system STABLY and ROBUSTLY at a SUPER-HIGH SPEED. If you fail, the prices you have to pay are high vibration, abnormal noise, damages to the parts, etc.



CFD Analysis



#### Optimized Aero Performance for the Intended Use

Inefficient operation makes no sense. However, for centrifugal compressors, aero performance and mechanical performance have competing interests and it is always a challenge to fulfill the requirements for both.

## 3 Powerful Reasons to Choose Kawasaki Centrifugal Hydrogen Compressor

### 1 Large Capacity Aimed for Future Hydrogen Demand

Instead of installing reciprocating type, adopting centrifugal type compressors enables discharging and transporting larger volume of hydrogen, which is expected to meet the needs in hydrogen infrastructures.

### 2 High Pressure Ratio for Hydrogen Services in a Competitive Configuration

A super-high speed rotor system backed by Kawasaki's comprehensive rotor dynamic technologies accumulated over decades enables us to offer a competitive configuration for pure hydrogen services requiring high pressure ratio without sacrificing reliability of the machine.

### 3 Enhanced Efficiency for Energy Saving

To follow our policy to put weight on efficient operation for energy saving, Kawasaki does not make exception to optimize aero-dynamic design for pure hydrogen services, while achieving large capacity and high pressure ratio.



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## Centrifugal H<sub>2</sub> Compressor for Liquefaction System

Kawasaki is challenging to develop Large-Scale H<sub>2</sub> Liquefier with Japanese Government's financial support. There are 4 major developments including Next-Generation H<sub>2</sub> Compressor (centrifugal type).

### Next-Generation H<sub>2</sub> Compressor for Deep Cooling Refrigerating Process

### H<sub>2</sub> Liquefier Cold Box

