

# Cooperation potentials in H2 Technology - Germany and Korea

## “Green Long Endurance Drone Solution for Better Tomorrow”



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CEO

*Doosan Mobility Innovation*

# US Virgin Islands in November 2019



Nov 2020

# Requirements for emergency delivery in USVI

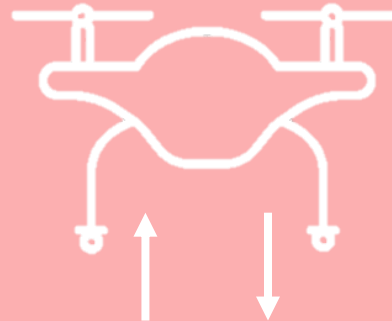
1

Long Distance Flight



2

Multi-copter drone for safe delivery



Vertical  
Takeoff/landing

3

Pollution-free  
energy source



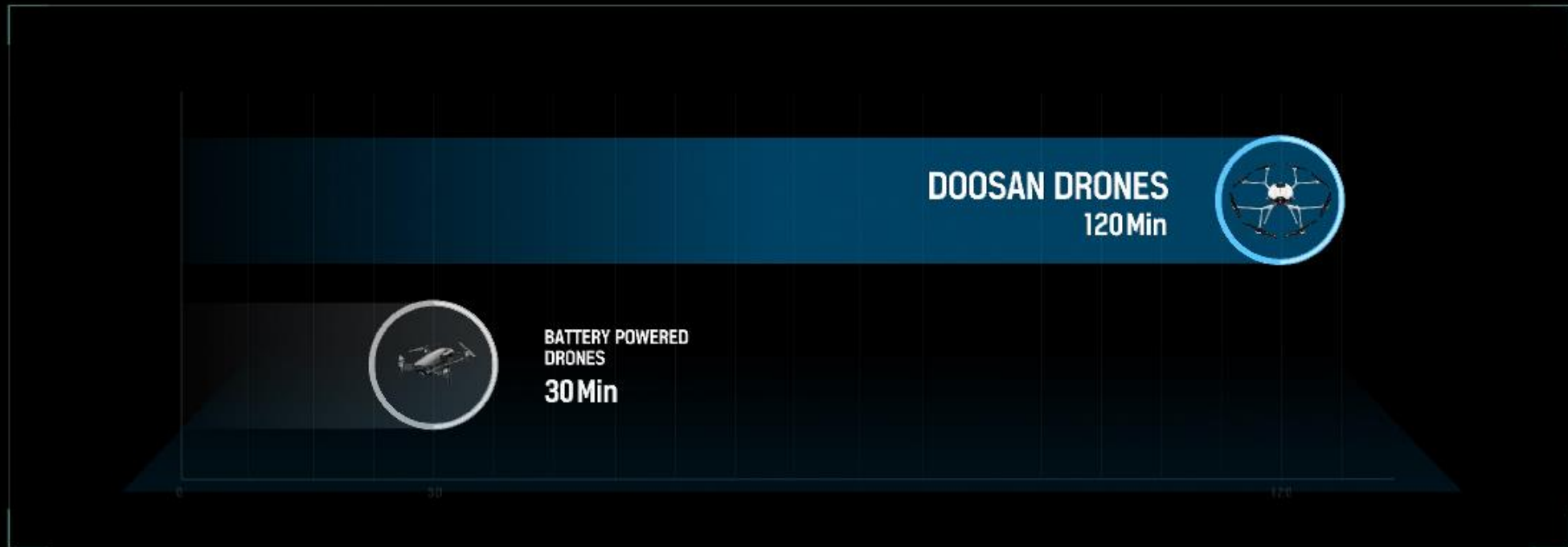
# Solution: Clean long-endurance drone solution with hydrogen fuel cell technology

**DS30 & DP30**



# Value proposition of hydrogen fuel cell tech (1/2)

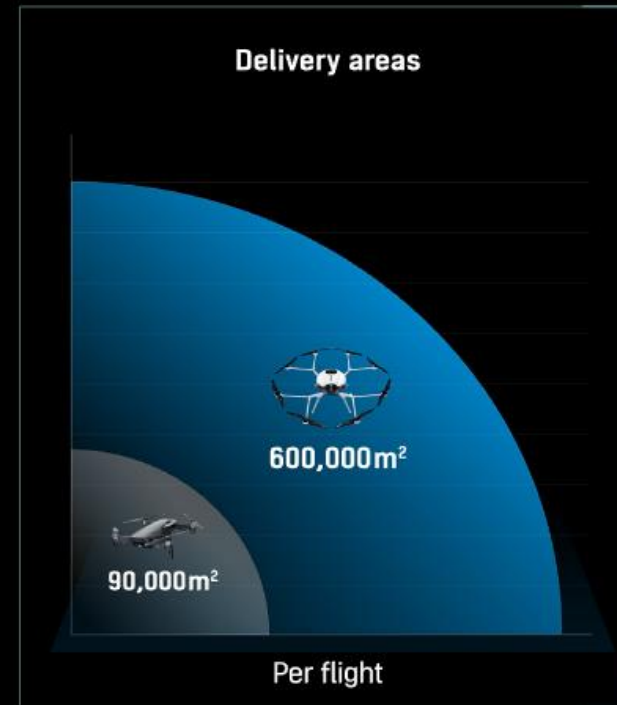
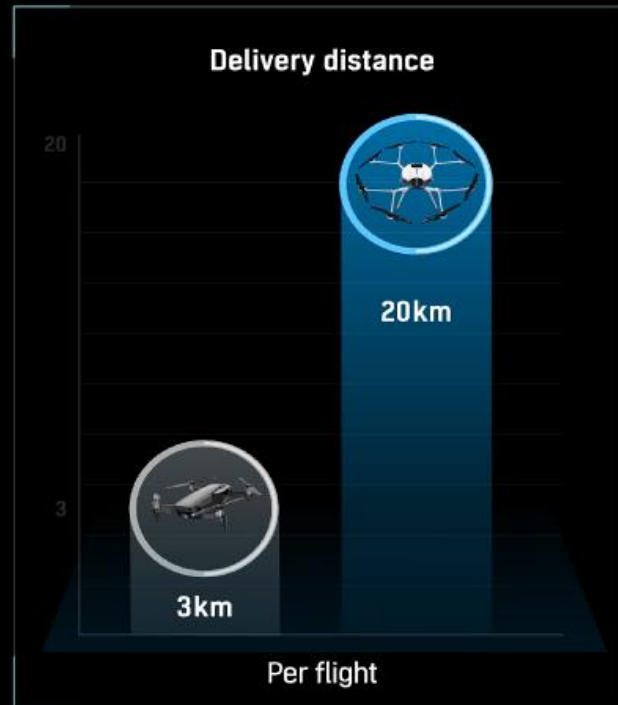
## FLIGHT TIME



# Value proposition of hydrogen fuel cell tech (2/2)

## DELIVERY APPLICATION

Fuel cell VS. Battery





# What if drones can fly hours, not minutes?



Broadcast (TV Program/  
Communication/Disaster)



Regular Inspection  
(Energy/Utilities)



Emergency Aid  
(Blood/Vaccine/Medicine Kit)



Monitoring (Environment/  
Traffic/Facilities/Border)



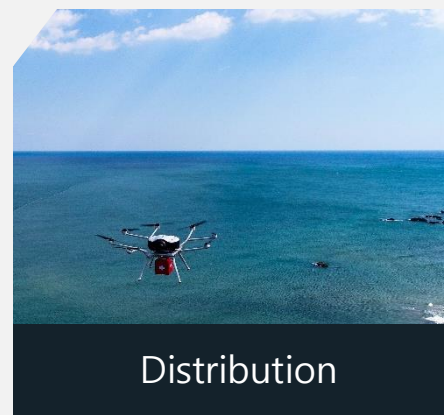
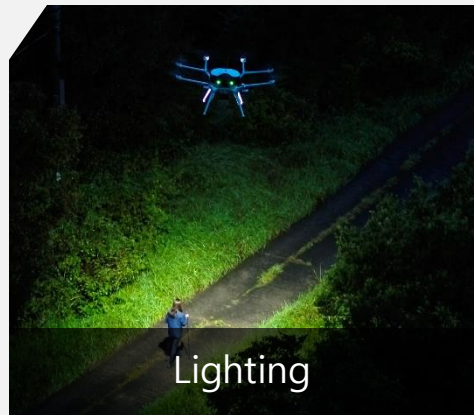
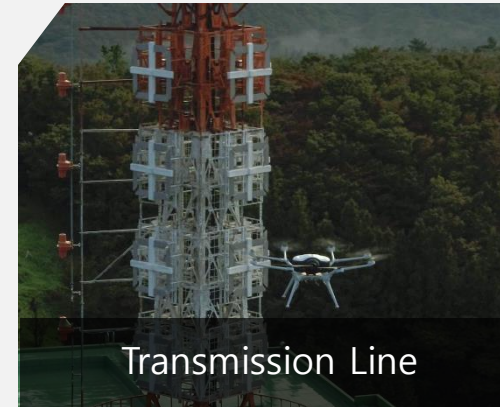
Mapping (Real Estates/National  
Territory/Construction)



Logistics (Islands/Remote  
sites/Low Infrastructure)



# What if drones can fly hours, not minutes?





# What if drones can fly hours, not minutes?

## Jeju Special Self-Governing Province

### Emergency drone delivery

#### ✓ Vision

Establish an emergency supplies delivery system

#### ✓ Milestone

- Delivered facial masks to island residents to prevent COVID19
- Delivered AED to climbers to prevent cardiac arrest



### DMI's Role

- Provide an emergency delivery service in areas with little access to existing transportation such as mountains & islands

### Next Steps

- Provide a regular emergency delivery service with the Korea Fire Department
- Develop a fully autonomous delivery service

# What if drones can fly hours, not minutes?

## Solaseado 100MW Solar Power Plant

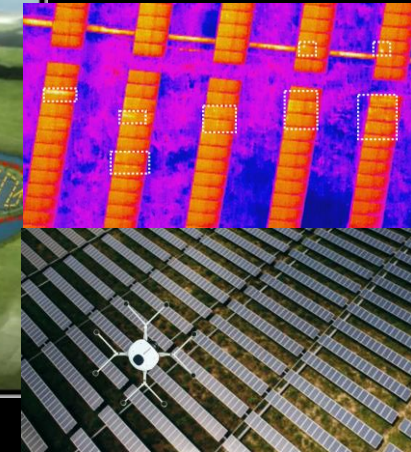
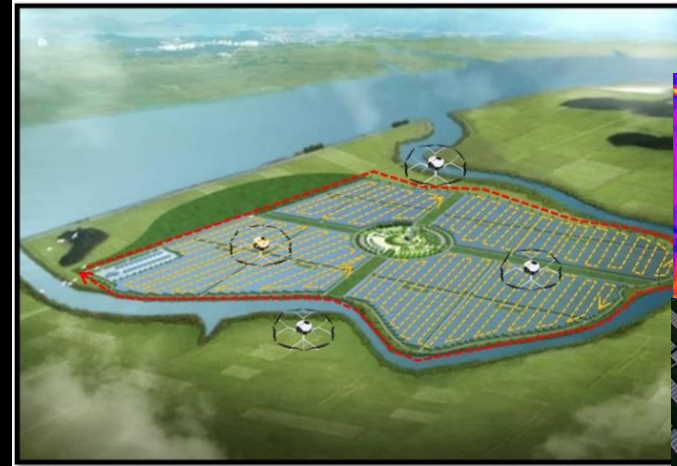
### Solar Farm Inspection Solution

#### ✓ Vision

Autonomous inspection and analysis  
S/W solution for large scale solar farm

#### ✓ Milestone

- '19: Development of Operational Service Design & AI Model
- '20: POC & S/W Release
- '21: Commercialization



### DMI's Role

- Develop total Solar Farm inspection solution including thermal image mapping flight mission & AI image analysis model

### Next Steps

- Stability Check for inspection solution
- Conducting POC and Commercialization in US
- S/W Release date: Nov. '20

# What if drones can fly hours, not minutes?

## Korea Electric Power Research Institute

### Transmission Tower & Line Inspection

#### ✓ Vision

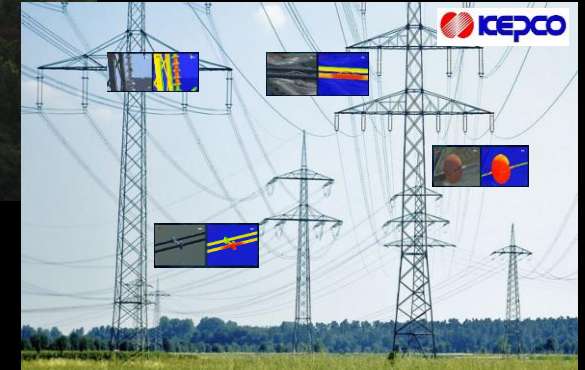
Develop power tower & line inspection using HFC drones with automatic flight & analysis

#### ✓ Milestone

- Automated mission planning (safe distance & line following)
- Video & Image analysis

### DMI's Role

- Provide hydrogen fuel cell drones enabling over 7 miles round trip for inspection



### Next Steps

- Applying AI Model for automated image analysis
- Integrating solution for US market  
(Target POC: 2021 1Q~)



# What if drones can fly hours, not minutes?

## Korea Gas Corporation

### Oil & Gas Inspection Project

#### ✓ Vision

Build drone monitoring service to prevent major accidents or illegal construction

#### ✓ Milestone

- '20: Service design & 25 miles pipeline POC
- '21: System enhancement
- '22: Commercialization nationwide

#### DMI's Role

-Supply periodic drone monitoring services with long flight time drones and the data management server using LTE



#### Next Steps

- Integration of Swarm flights & Obstacle Avoidance functions
- Development of AI Model for detecting sink holes or pipeline cracks

# DMI with Korean Government

## Ministry of Trade, Industry and Energy

### Drone Delivery Pilot Project

#### ✓ Vision

Build a drone delivery service platform in areas lacking infrastructure

#### ✓ Milestone

- '19~'20: Design a drone delivery system & Operate POC
- '21: Enhance the system
- '22: Commercialization

### DMI's Role

- Develop an integrated hydrogen drone with the payload of 8kg
- Integrate it with a delivery system (e.g. Precision landing, Intelligent control system)



### Next Steps

- Internalize logistics drone technology including swarm flight, sense & avoid, encryption etc.
- Participate in governmental logistics projects

# DMI with Korean Government

## UAM Team Korea

### K-UAM Road Map

- ✓ Vision  
: New Paradigm of Time and Space by Transportation Innovation
- ✓ Milestone
  - ~'24: Laws and Regulation Setup  
Pilot Project
  - ~'29: Commercialization of initial  
routes at the major base points
  - ~'35: Expansion of flight routes in  
urban areas
  - '35~:Realization of autonomous flight  
and full commercial operation

### DMI's Role

- Member of industrial stake holder w/Hyundai Motors, Hanwha systems and KAL
- Aircraft Design and its Cost Modeling



### Target

- to reduce commuting time and related social cost by 70%
- to create \$1.3 billion worth in market , 160K jobs and added value of \$1.1 billion



# Doosan's long endurance drone solution



DP30

World's first commercialized fuel cell drone,  
applied to various applications that require a long flight

**Rated Power: 2.6 kW**



DS30

Optimized model for fuel cell powerpack

Max flight time 120 mins

Max payload 4.5kg



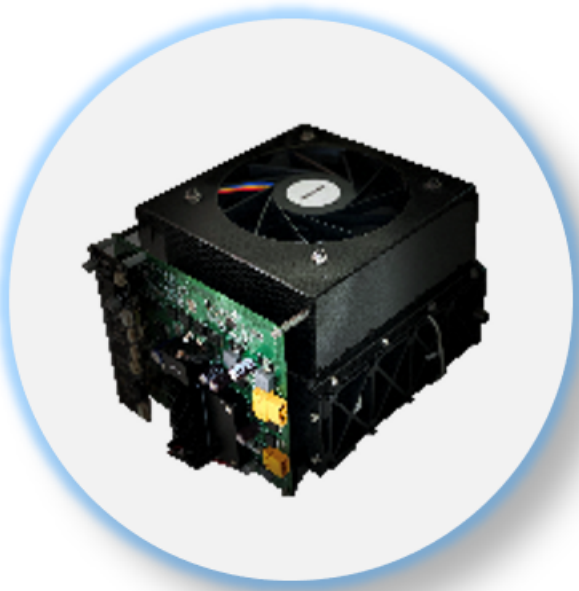
DT 30

Highly reliable model optimized for harsh  
industrial environment

Max flight time 110 mins

Max payload 3kg

# Doosan's long endurance drone solution



**DM015**

DM015, with less weight and rated power, was constructed in compact size to fit inside any airframe



**DJ025**

**The world's first hydrogen-powered VTOL**

- Max flight time **259min\***
- Max payload **4.2kg**
- Model co-developed with partner
- Release in DEC. 2020

\*The flight time is the basis for the use of 10.8L hydrogen cylinders, when using large cylinders, flight time is increased



**DZ015**

**Long endurance Helicopter suitable for wind resistance**

- Max flight time **190min**
- Max payload **1.0kg**
- Model co-developed with partner
- Release in DEC. 2020

# Reliability is the key for industrial products

## Safety Test



150M Drop Test



Penetration Test



Fire Test



Internal Pressure Test



DOT



Transports  
Canada

TC



Transportable  
Pressure  
Equipment  
Directive

TPED



ISO 11119-3:2013



ANSI/CSA HGV3.1-2015



ANSI/CSA HPRD1-2013



ANSI NGV 2-2007



KGS AA311 2017



AISL-TAC-1109-01

1yr, 1000hr warranty



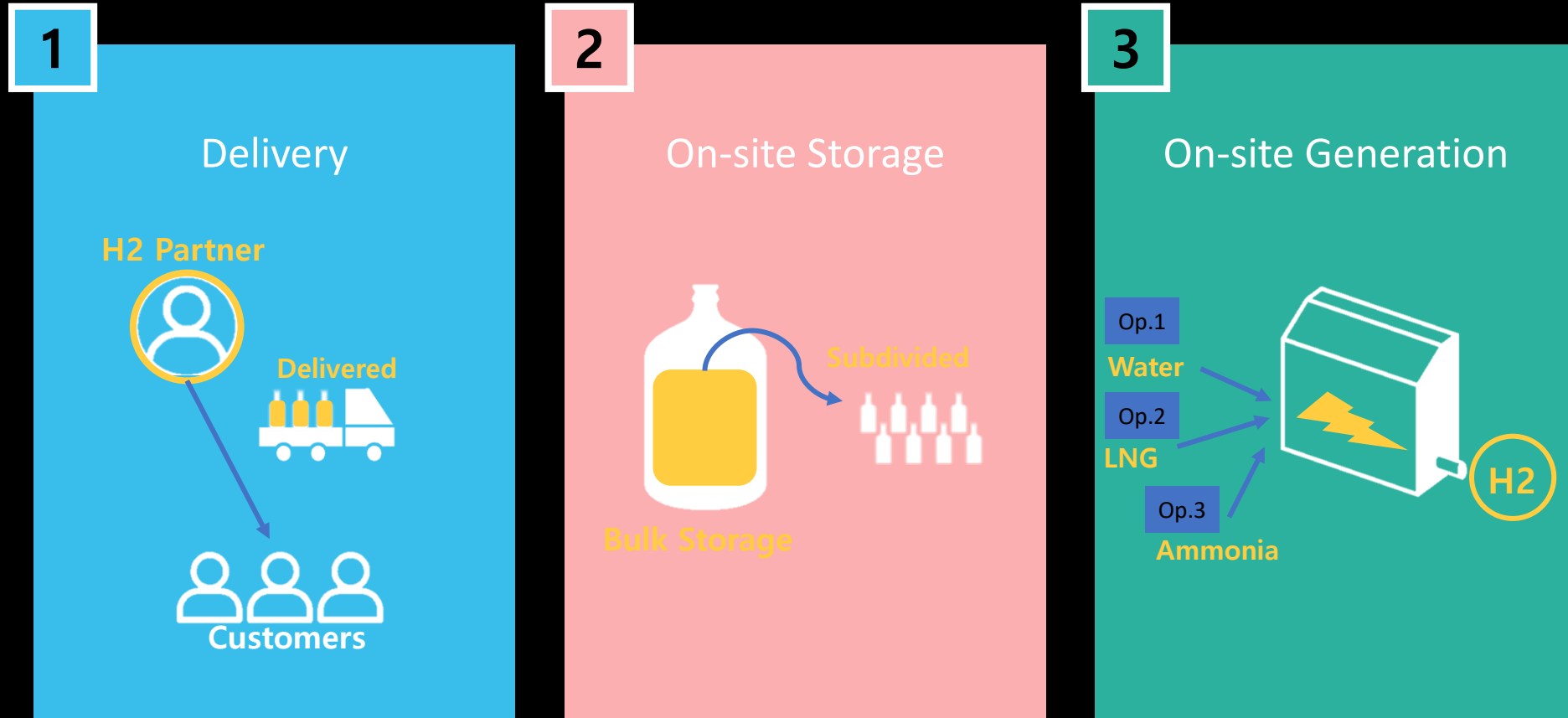
Real-time monitoring



Nov 2020



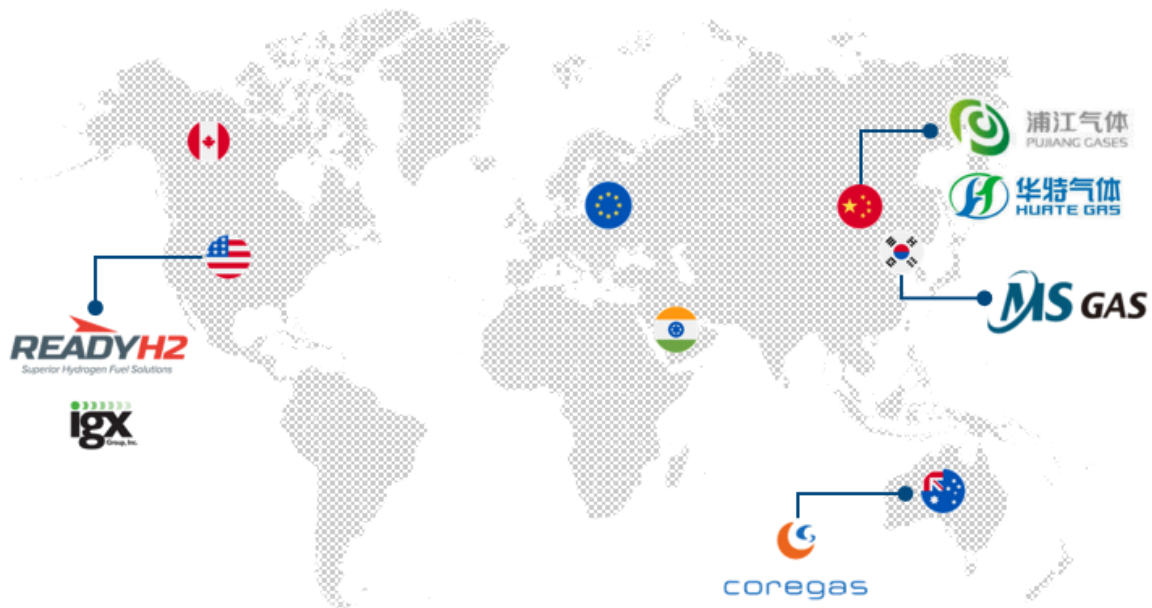
# DMI Hydrogen Supply Customized for Customers



# DMI Hydrogen Supply Customized for Customers

## Hydrogen Suppliers for DMI

DMI currently has hydrogen supply networks in Korea, the U.S, China and Australia, and will be expanded to Canada, Europe and India by 2022



## Hydrogen Supply Solution



### 1 ORDER

- Customers can order hydrogen via PC or Mobile

### 2 DELIVERY

- Hydrogen supply partners deliver hydrogen tanks at the time you want
- Hydrogen suppliers have large capacity charging facilities



### 3 REPLACEMENT

- Hydrogen cylinders can be easily replaced within 30 seconds

### 4 STORAGE

- Large quantities of hydrogen cylinders can be stored in outdoor spaces, no special care is required



# Power for tomorrow



Doosan Mobility Innovation

