

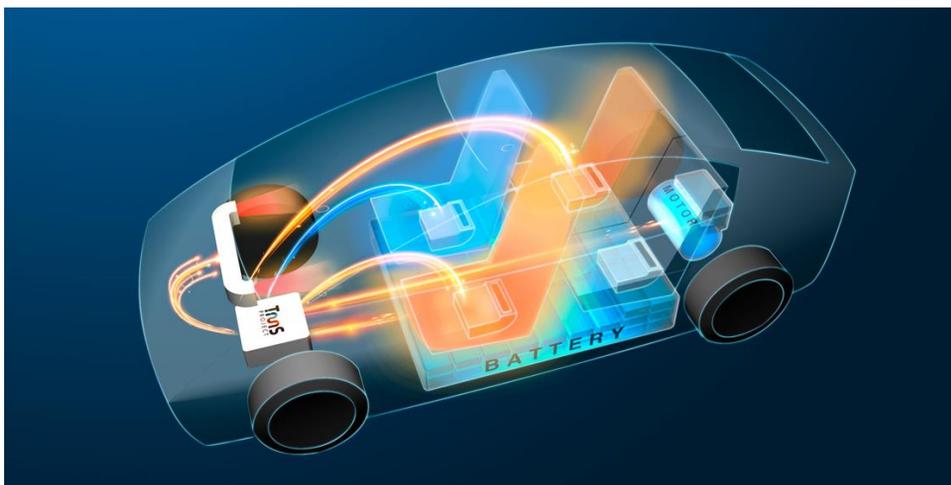
## Integrated Thermal Management System (ITMS) brings a new future for electric vehicles

Manage thermal energy, creating the future  
to run further



The automotive industry is accelerating electrification of vehicles due to increasing environmental awareness and tightening of environmental regulations across the world. Since no exhaust heat from engine is available on electric vehicles, the drive battery consumption increases during heating and cooling, which leads to a decrease in cruising distance. This is a major challenge for electric vehicles to be solved.

Sanden is developing new technologies that will contribute to extending the cruising distance and improving passenger comfort by effectively utilizing the thermal energy of electric vehicles in an integrated manner.



### For example...

A car that can travel 450 km when driving without heating  
If heating is used in the middle of winter, the car may only be able to travel 225 km

## ITMS allows efficient use of heat to increase driving range

### Strong Points

- The exhaust heat from the powertrain, including motor and inverter, is recovered significantly, and the recovered heat is utilized effectively applying Sanden's heat pump technology.
- The thermal energy obtained through the above process is also used to cool and heat the battery so that its temperature can be kept at an optimal level to maintain the performance.
- By adopting a secondary loop water circuit, the combination of heat pump system and coolant heater provides optimal temperature control even at extremely low temperatures of  $-15^{\circ}\text{C}$  or lower. The heat pump system will also be modularized to help automakers improve their productivity.
- Sanden optimizes the thermal management of an entire cooling and heating system of vehicle, including an air conditioning system and other relating equipment, to provide a comfortable space using less energy.

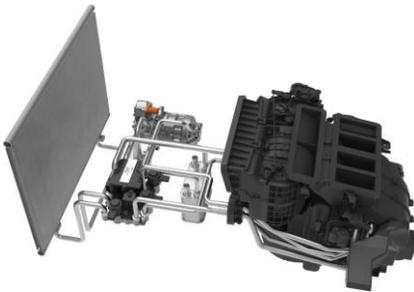
## ITMS Variation

Currently, ITMS2.0 and ITMS3.0 are being developed based on the direct and indirect method approach. We provide appropriate solutions according to the purpose and application depending on the size and specifications of the vehicle.

In addition, to promote the introduction of ITMS, we are actively engaged in proposal activities, such as giving lectures to automobile manufacturers on ITMS technology and its effectiveness.

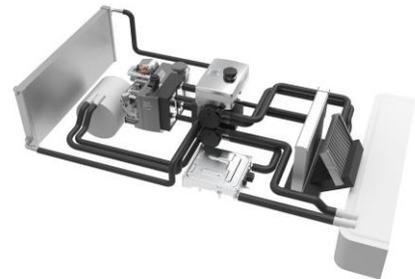
### ITMS2.0

ITMS 2.0 is the **direct system**, which puts the refrigerant directly into the air conditioning unit. It is highly responsive and **can cool and heat quickly**.

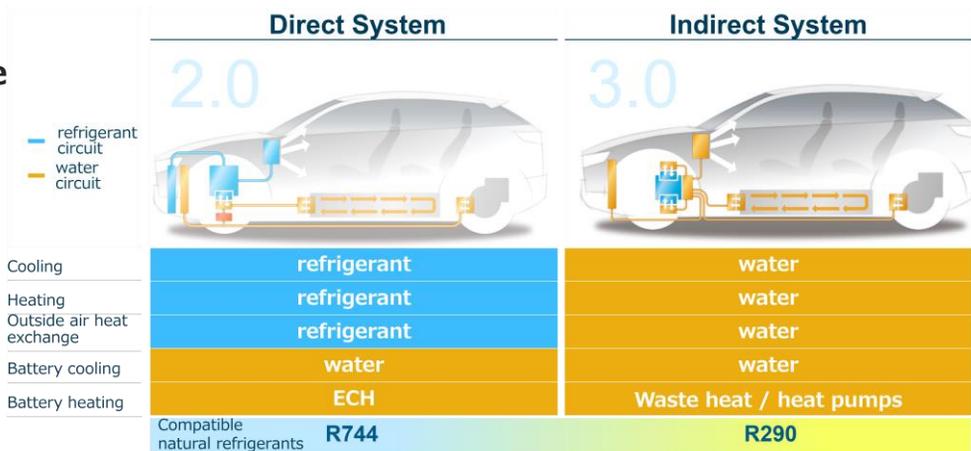


### ITMS3.0

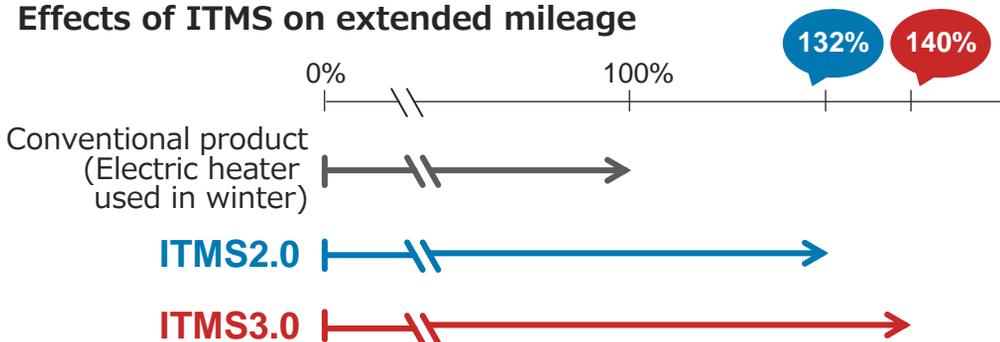
ITMS3.0 is an **indirect system**, which minimizes the amount of refrigerant in a system that uses propane gas as the refrigerant, which is **PFAS compliant with environmental regulations**.



### Basic Conce



### Effects of ITMS on extended mileage



Note: This is an example of the effect of improved cruising range. The effect varies depending on driving conditions, etc.

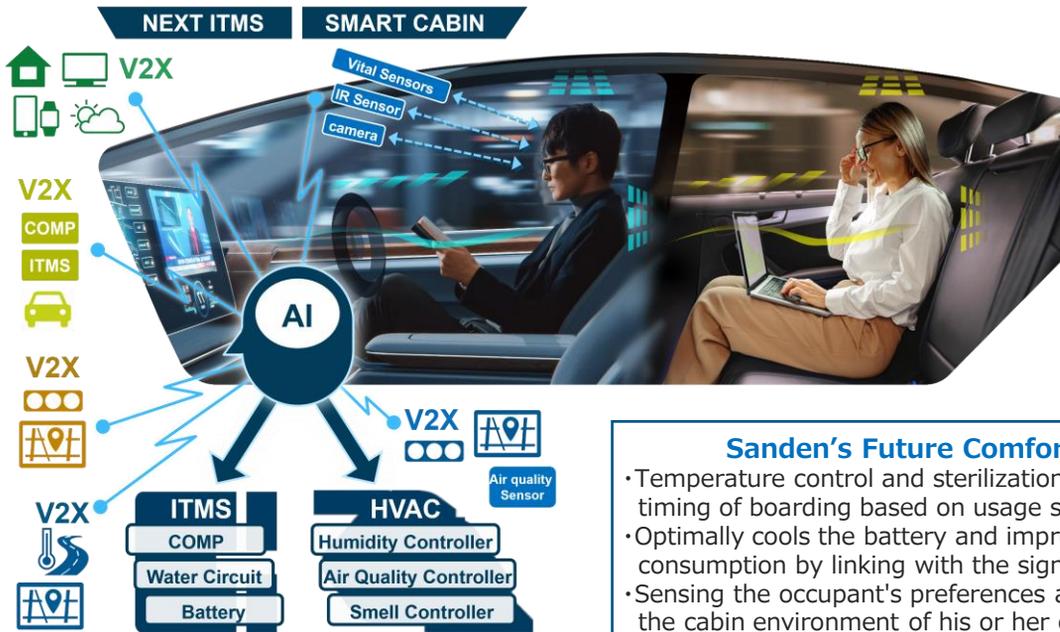
# The Future of ITMS

## NEXT ITMS & Smart Cabin

Leveraging the synergy of the Hisense Group, we will provide new value.

**In the next-generation ITMS**, Sanden will use **AI technology**, which is being researched in collaboration with a university, will learn every situation in advance and pursue comfort tailored to more personalized situations, evolving into **the smart cabin that will provide ultimate comfort to future car users with a total solution.**

Cutting-edge technology creates "ultimate comfort" for personalized situations



**Sanden's Future Comfort Fulfilled by AI**

- Temperature control and sterilization in advance by learning the timing of boarding based on usage status of home appliances
- Optimally cools the battery and improves electricity consumption by linking with the signal system
- Sensing the occupant's preferences and preferences to create the cabin environment of his or her choice
- Learning data from ITMS for efficient control to further improve power consumption

## Showcasing Sanden's technology to the world

In order to let people know about the evolution of ITMS, we exhibited at the Japan Mobility Show 2023 in Japan and CES 2024 in the U.S., where we received positive feedback from a wide range of visitors.



We will continue to evolve from vehicle air conditioning to integrated thermal management systems, working to create value by integrating vehicle air conditioning and equipment cooling and temperature control systems to provide new value in the future mobility scene.