

# DEVELOPMENT OF ELECTRIC POWERTRAIN FOR NEW MODEL HYBRID SPORT UTILITY VEHICLE

Chris Lang

Senior Engineer

MDX Hybrid System Project Leader

Honda R and D Americas, Inc.

## **1. Background**

### **1.1. Honda Sport Hybrid Lineup**

### **1.2. Overall configuration**

## **2. Operation of SH-AWD**

### **2.1. Drive modes**

### **2.2. Integrated Dynamics System (IDS) mode**

### **2.3. Torque vectoring**

## **3. Configuration of IPU and PCU**

### **3.1. Body commonality and crash concept**

### **3.2. IPU mounting and cooling concept**

### **3.3. Underfloor PCU concept**

### **3.4. HEV component ground protection concept**

## **4. Conclusion**

# 1. Background

## 1.1. Honda Sport Hybrid Lineup

## 1.2. Overall configuration

# 2. Operation of SH-AWD

## 2.1. Drive mode

## 2.2. Integrated Dynamics System (IDS) mode

## 2.3. Torque vectoring

# 3. Configuration of IPU and PCU

## 3.1. Body commonality and crash concept

## 3.2. IPU mounting and cooling concept

## 3.3. Underfloor PCU concept

## 3.4. HEV component ground protection concept

# 4. Conclusion

# Honda Sport Hybrid Lineup



# Overall configuration and specifications

## MDX Sport Hybrid

V6 3.0 L Engine



Twin Motor Unit  
(TMU)



PCU-Power  
Control Unit  
(motor controller)



IPU-Intelligent Power  
Unit  
(battery pack)



7-speed DCT  
with built-in motor



System power [kW]		<b>239.6</b>
System torque [Nm]		<b>391.1</b>
Engine	Power [kW]	192
	Torque [Nm]	296
Front motor	Power [kW]	35
	Torque [Nm]	148
Rear motor	Power [kW]	27(x2)
	Torque [Nm]	73(x2)
Battery	Type	Li-ion
	Voltage [V]	260

## 1. Background

1.1. Honda Sport Hybrid Lineup

1.2. Overall configuration

## 2. Operation of SH-AWD

2.1. Drive modes

2.2. Integrated Dynamics System (IDS) mode

2.3. Torque vectoring

## 3. Configuration of IPU and PCU

3.1. Body commonality and crash concept










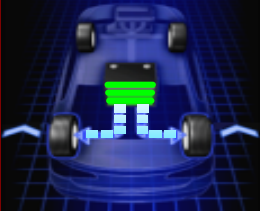



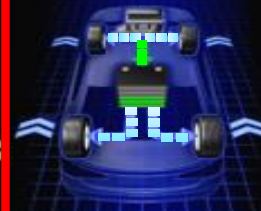
3.2. IPU mounting and cooling concept

3.3. Underfloor PCU concept

3.4. HEV component ground protection concept

## 4. Conclusion

# Drive modes

 <p><b>EV Launch</b> Launch acceleration</p>	 <p><b>Engine Drive</b> Gentle acceleration</p>	 <p><b>EV Cruising</b> Low-speed cruise</p>	 <p><b>Power Acceleration</b> Aggressive acceleration</p>	 <p><b>Engine Cruising</b> High-speed cruise</p>	 <p><b>Regeneration</b> Deceleration</p>	 <p><b>AWD Mode</b> Slippery condition</p>
 <ul style="list-style-type: none"> <li>• Rear motor drive</li> </ul>	 <ul style="list-style-type: none"> <li>• Engine drive</li> <li>• Efficient generation</li> </ul>	 <ul style="list-style-type: none"> <li>• Rear motor drive</li> </ul>	 <ul style="list-style-type: none"> <li>• Engine drive</li> <li>• Motor assist</li> </ul>	 <ul style="list-style-type: none"> <li>• Engine drive</li> </ul>	 <ul style="list-style-type: none"> <li>• Front &amp; rear regeneration</li> </ul>	 <ul style="list-style-type: none"> <li>• Engine drive</li> <li>• Front generation</li> <li>• Rear motor drive</li> </ul>

# Integrated Dynamics System (IDS) mode

Integrates & instantly tunes several vehicle dynamic systems

**Dynamic Mode**  
Integrated Dynamics System

Comfort  
Normal  
Sport  
Sport +

**Powertrain**

Mode	Throttle Response	7DCT / EV assist	SH
Comfort	Standard	Standard	Standard
Normal	Standard	Standard	Standard
Sport	Standard	Standard	Aggressive
Sport +	Aggressive	Aggressive	Aggressive

**Chassis**

Mode	Steering	Damper
Comfort	Enhanced	Enhanced
Normal	Standard	Standard
Sport	Aggressive	Aggressive
Sport +	Aggressive	Aggressive

**Sound**

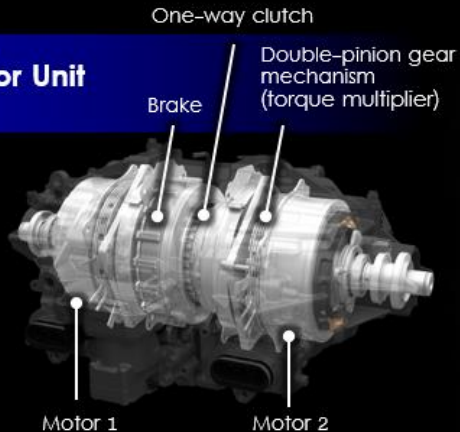
Mode	ASC
Comfort	Standard
Normal	Standard
Sport	Aggressive
Sport +	Aggressive



# Torque vectoring

## Compact, high-output motor unit for instant, precise torque vectoring

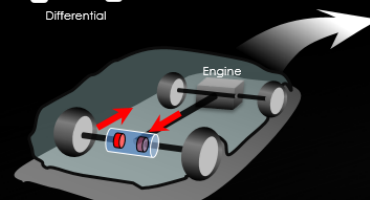
### Twin Motor Unit



Maximum power 36 + 36 hp @ 4,000 rpm  
Maximum torque 54 + 54 lb-ft @ 0-2,000 rpm

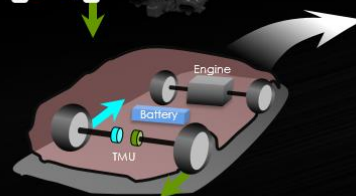


### Mechanical torque vectoring SH-AWD



Most effective when accelerating while turning

### Sport Hybrid torque vectoring SH-AWD



100% effective at any moment; always available

## 1. Background

1.1. Honda Sport Hybrid Lineup

1.2. Overall configuration

## 2. Operation of SH-AWD

2.1. Drive modes

2.2. Integrated Dynamics System (IDS) mode

2.3. Torque vectoring

## 3. Configuration of IPU and PCU

3.1. Body commonality and crash concept

3.2. IPU mounting and cooling concept

3.3. Underfloor PCU concept

3.4. HEV component ground protection concept

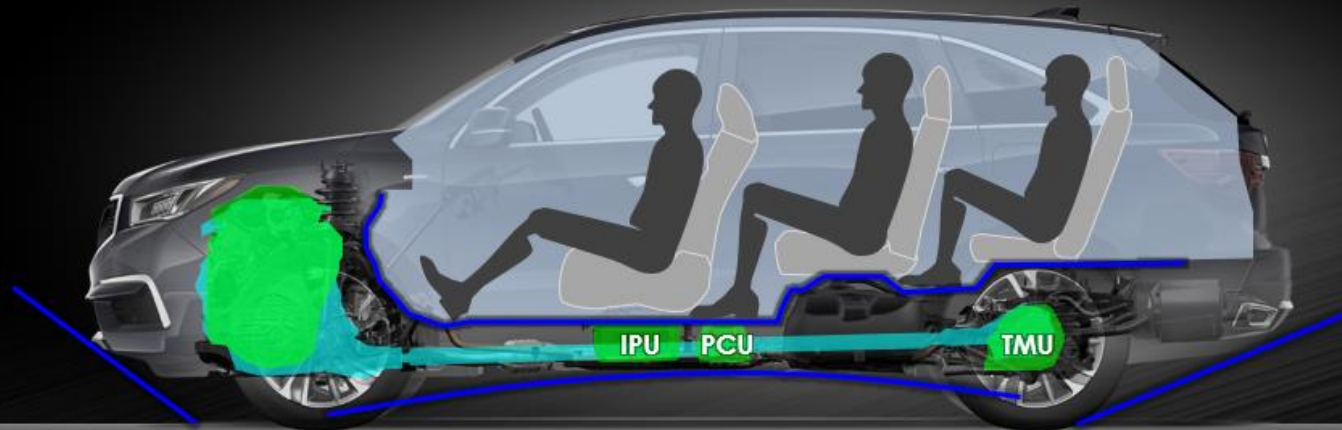
## 4. Conclusion

# Configuration of IPU and PCU

## No Compromise Cabin

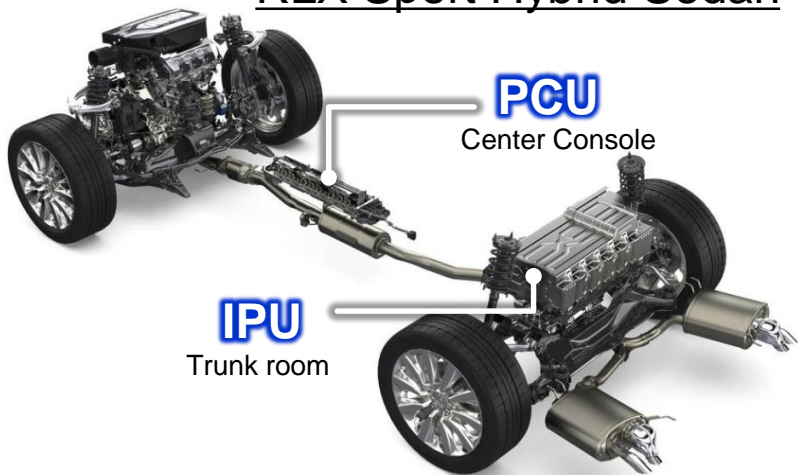
**Same interior space & versatility as non-hybrid counterpart**

■ Sport Hybrid  
■ Petrol

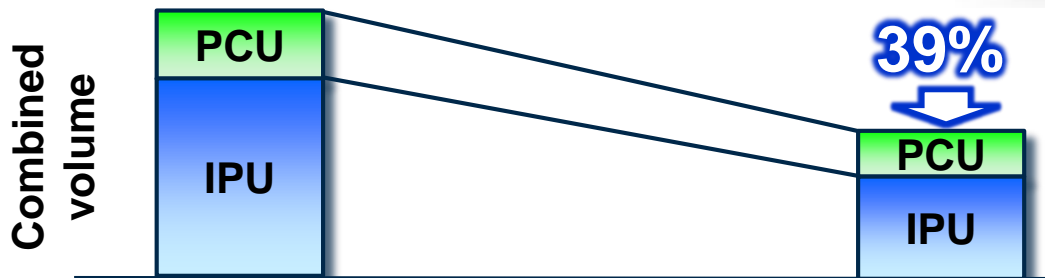
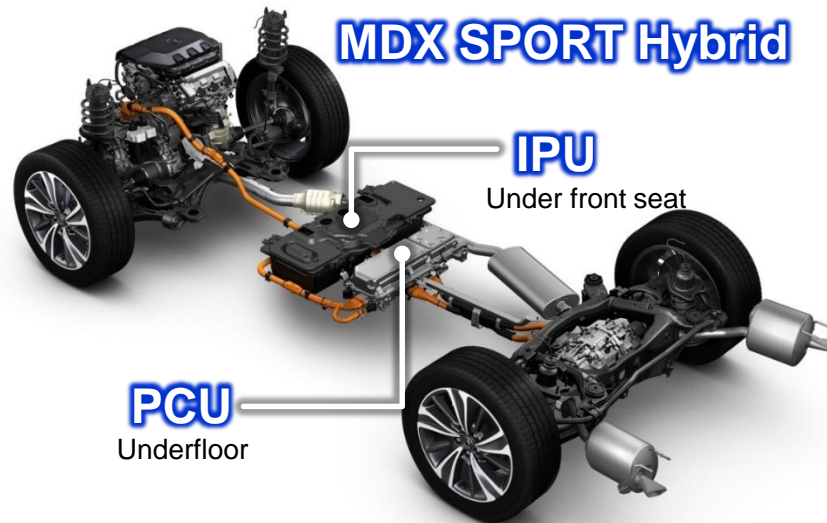


# Configuration of IPU and PCU

## RLX Sport Hybrid Sedan



## MDX SPORT Hybrid



## 1. Background

1.1. Honda Sport Hybrid Lineup

1.2. Overall configuration

## 2. Operation of SH-AWD

2.1. Drive modes

2.2. Integrated Dynamics System (IDS) mode

2.3. Torque vectoring

## 3. Configuration of IPU and PCU

**3.1. Body commonality and crash concept**

3.2. IPU mounting and cooling concept

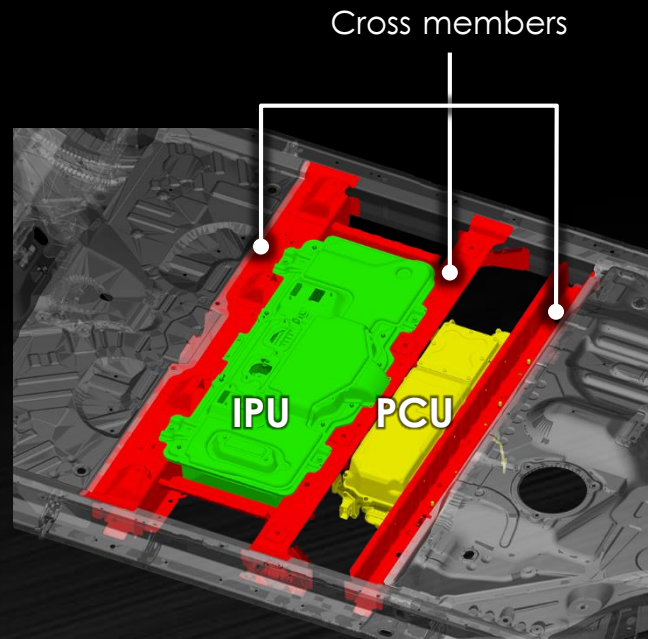
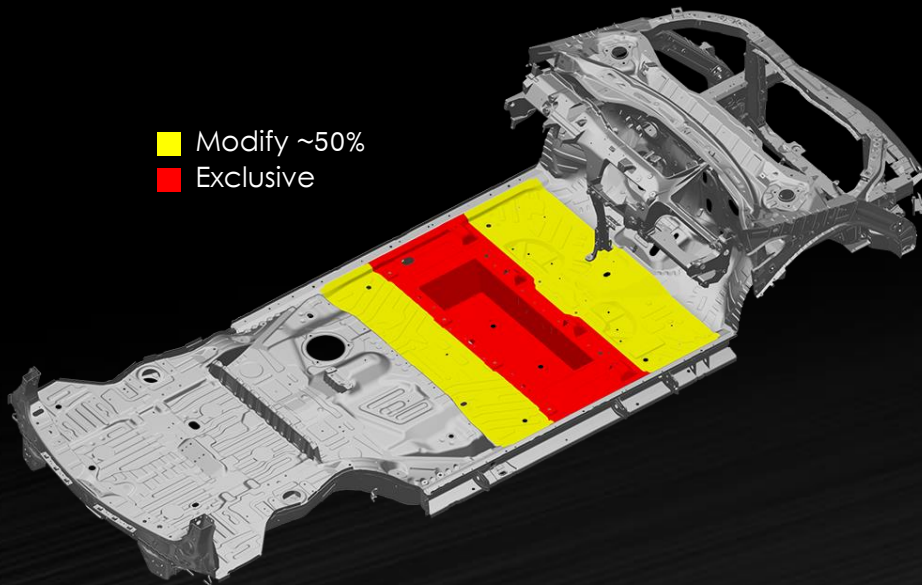
3.3. Underfloor PCU concept

3.4. HEV component ground protection concept

## 4. Conclusion

## Floor modifications for IPU and PCU mounting

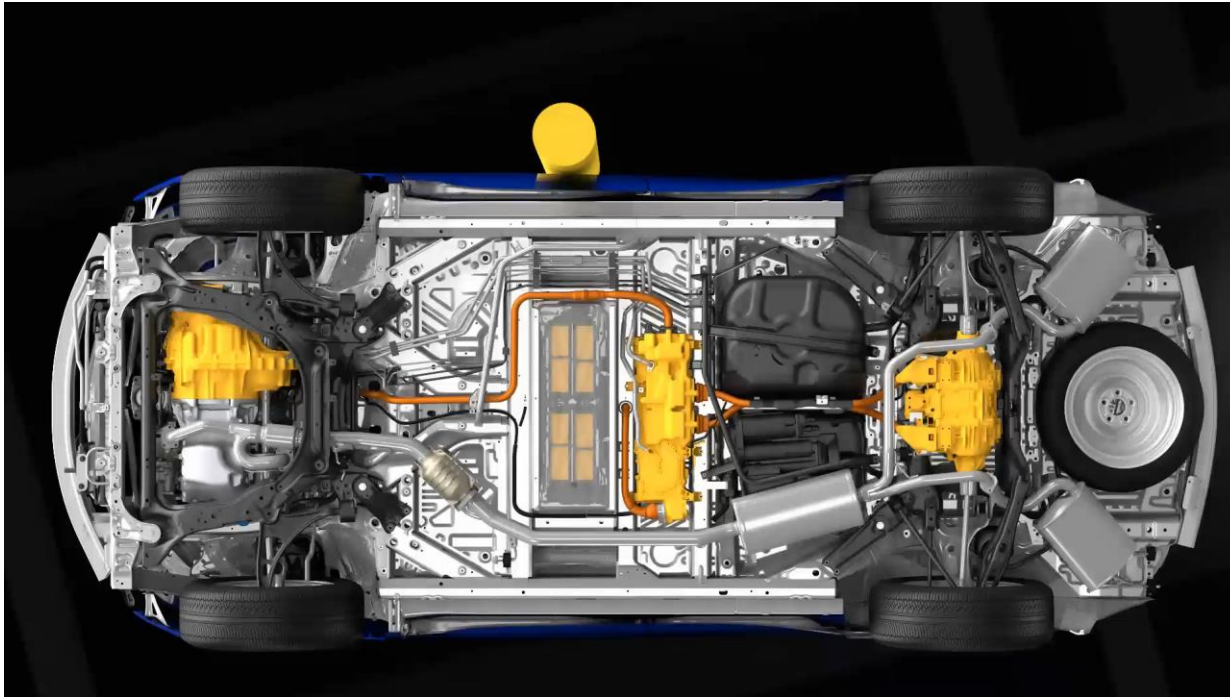
- Modify ~50%
- Exclusive



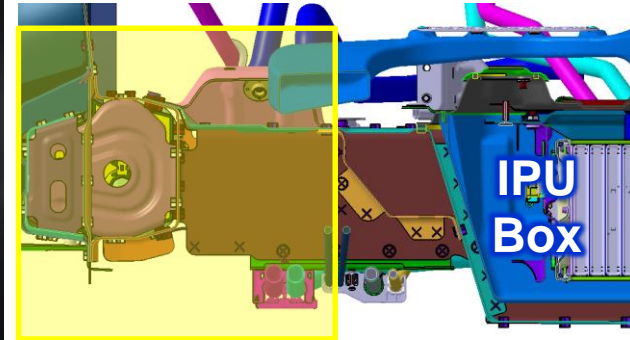
High rigidity cross members helps protect IPU & PCU

# Side Crash Protection of IPU

Bottom view of Side Pole Test



IPU side crash intrusion zone



Crush zone

## 1. Background

1.1. Honda Sport Hybrid Lineup

1.2. Overall configuration

## 2. Operation of SH-AWD

2.1. Drive modes

2.2. Integrated Dynamics System (IDS) mode

2.3. Torque vectoring

## 3. Configuration of IPU and PCU

3.1. Body commonality and crash concept

**3.2. IPU mounting and cooling concept**

3.3. Underfloor PCU concept

3.4. HEV component ground protection concept

## 4. Conclusion

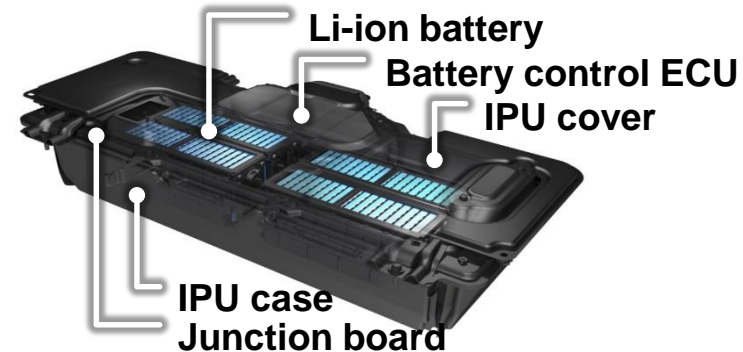
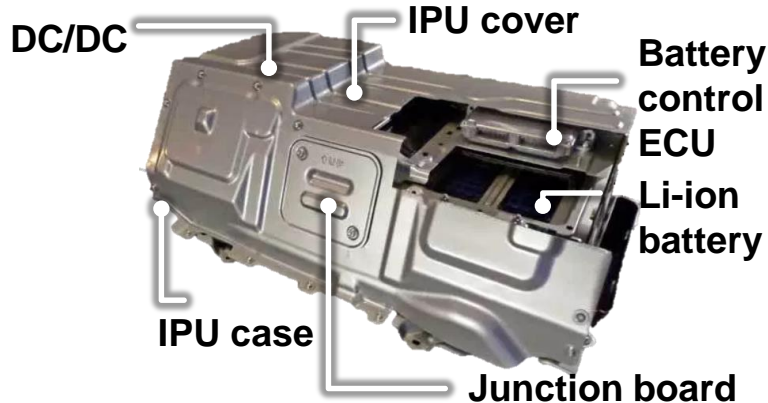


# Structure of the IPU

## Sedan Hybrid

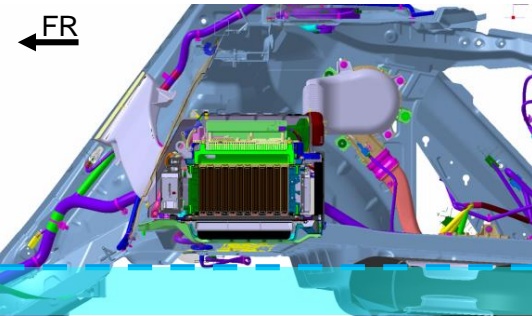
## MDX SPORT Hybrid

Maximum output [kWh]	1.1	1.1
Total voltage [V]	259.2	259.2
Li-ion battery cell type	EH5	EHW5
Number of cells	72 (12x6)	72 (18x4)
Main components	IPU cover/case Battery control ECU Junction board DC/DC Converter	IPU cover/case Battery control ECU Junction board
Total volume [L]	102	44

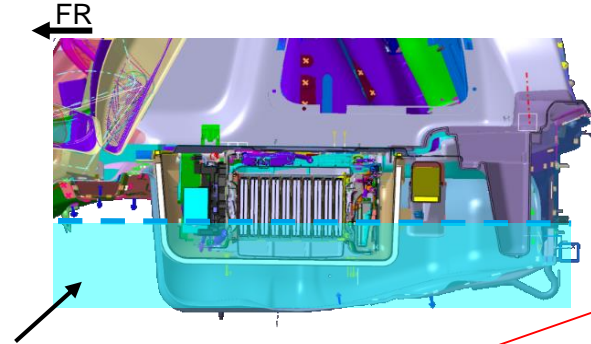


# Structure of the IPU

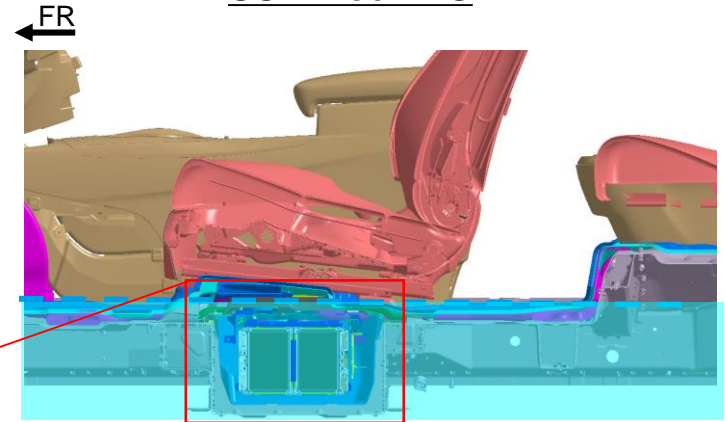
Trunk IPU



Spare Tire IPU



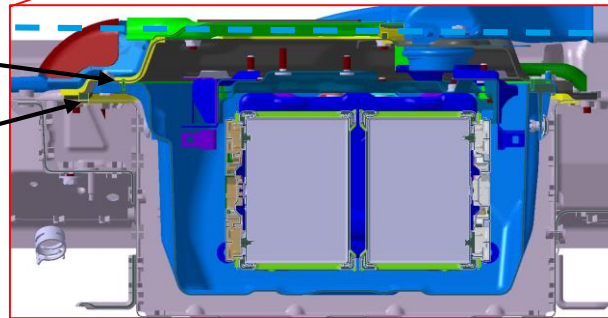
SUV Floor IPU



Water Line when submerged up to side sill

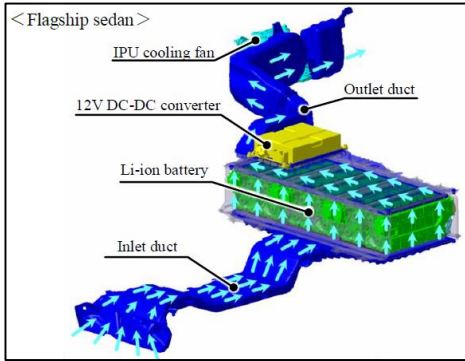
Case to Cover W/P seal

Cover dust seal to body

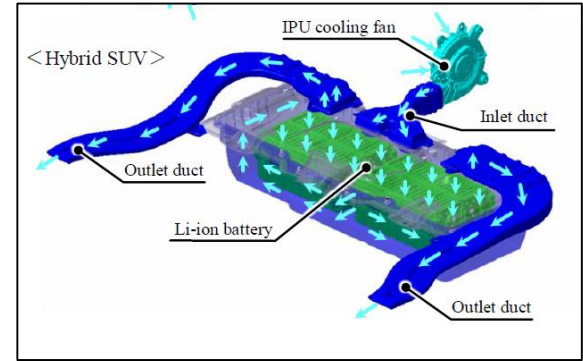


# IPU Cooling Concept

Sedan “Pull” type cooling system

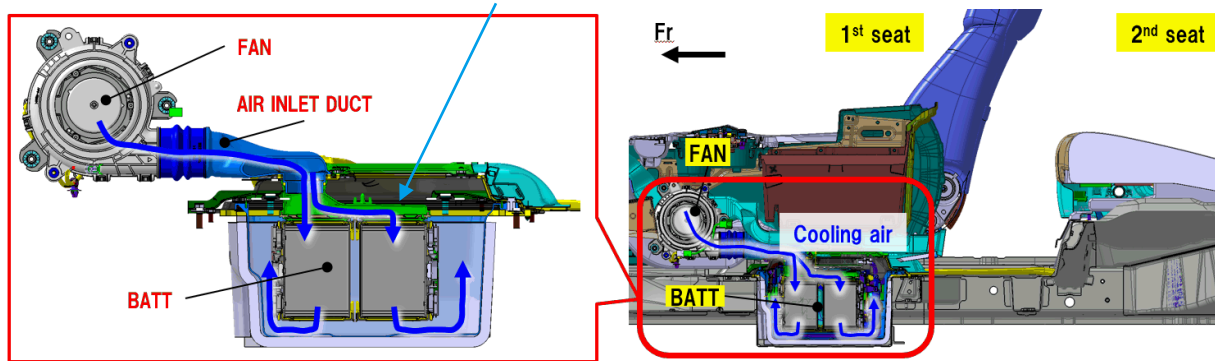


**MDX SPORT Hybrid**  
“Push” type cooling system



Inlet ducts are sealed directly to battery modules

“Push” type configuration



## 1. Background

1.1. Honda Sport Hybrid Lineup

1.2. Overall configuration

## 2. Operation of SH-AWD

2.1. Drive modes

2.2. Integrated Dynamics System (IDS) mode

2.3. Torque vectoring

## 3. Configuration of IPU and PCU

3.1. Body commonality and crash concept

3.2. IPU mounting and cooling concept

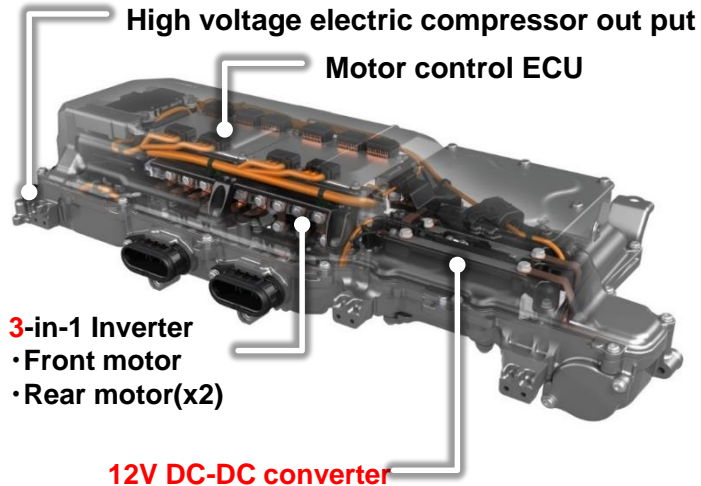
**3.3. Underfloor PCU concept**

3.4. HEV component ground protection concept

## 4. Conclusion

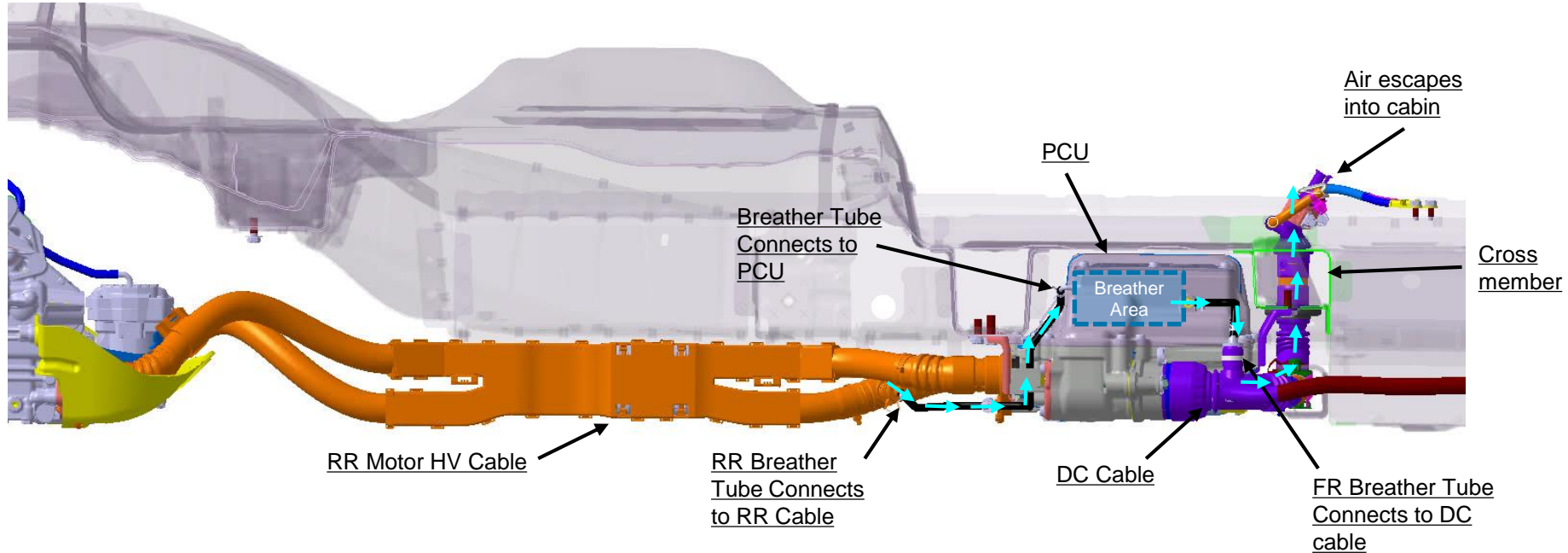
# PCU Structure

iMMD 2 motor PCU  
(Engine Room setting)



Maximum output [kVA]	270.2
Maximum voltage [V]	260
Front motor maximum current [Arms]	200
Rear motor maximum current [Arms]	200(x2)
Main components	3-in-1 inverter Motor control ECU 12V DC-DC converter
Weight [kg]	20.2
Total volume [L]	25

# Underfloor IPU Breathing Structure



## 1. Background

1.1. Honda Sport Hybrid Lineup

1.2. Overall configuration

## 2. Operation of SH-AWD

2.1. Drive modes

2.2. Integrated Dynamics System (IDS) mode

2.3. Torque vectoring

## 3. Configuration of IPU and PCU

3.1. Body commonality and crash concept

3.2. IPU mounting and cooling concept

3.3. Underfloor PCU concept

**3.4. HEV component ground protection concept**

## 4. Conclusion

# Ground Clearance Protection Concept



## 1. Background

1.1. Honda Sport Hybrid Lineup

1.2. Overall configuration

## 2. Operation of SH-AWD

2.1. Drive modes

2.2. Integrated Dynamics System (IDS) mode

2.3. Torque vectoring

## 3. Configuration of IPU and PCU

3.1. Body commonality and crash concept

3.2. IPU mounting and cooling concept

3.3. Underfloor PCU concept

3.4. HEV component ground protection concept

## 4. Conclusion

# Conclusion

- Achieved a “No Compromise Cabin” by setting the IPU and PCU under the floor.
- A downsizing of the IPU and PCU using new technologies and methods allowed for packaging the units under the car.
- New cooling and protection concepts had to be considered due the placement of the IPU/PCU and new user scenarios of SUV vs. Sedan.



**MDX**  
*Sport Hybrid* **SH-AWD**

<b>Fuel economy</b>	City	<b>26</b> mpg
	Highway	<b>27</b> mpg
	Combined	<b>27</b> mpg