Introduction to GAS HEAT PUMPS technology

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GAS HEAT PUMPS Technology

ONE SYSTEM – MANY ADVANTAGES

GAS HEAT PUMP

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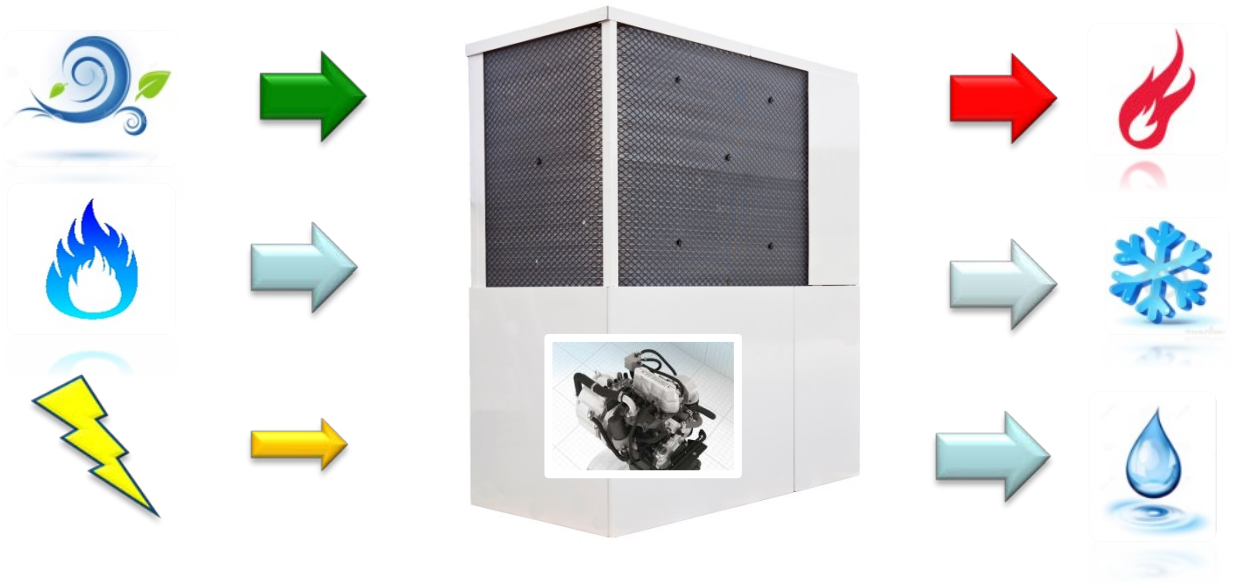
AISIN GAS HEAT PUMP

How it works

The Gas Heat Pump (GHP) is a compression heat pump driven by a gas combustion engine

GHP uses the renewable energy of air + primary energy (NG or LPG gas) to provide heating, cooling and domestic hot water.

INPUT



OUTPUT

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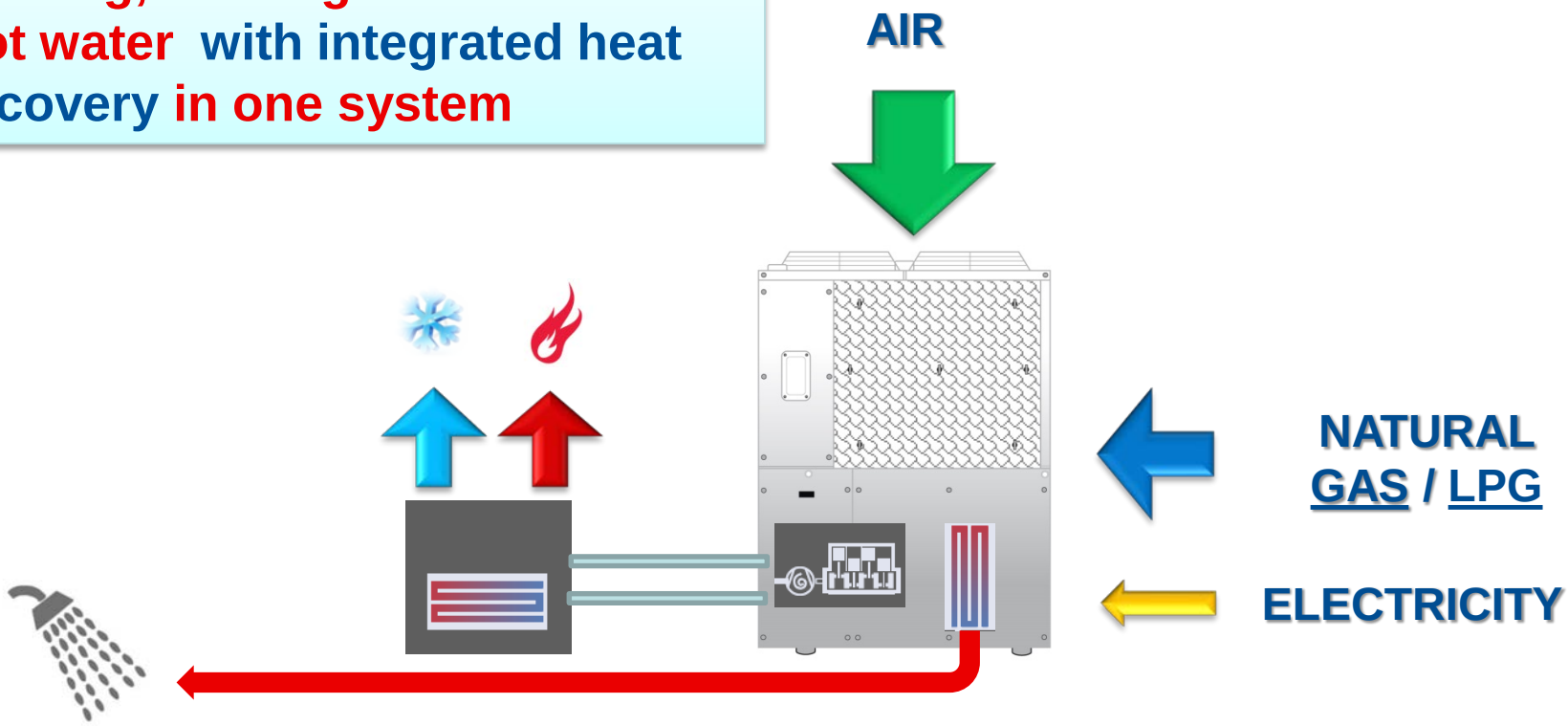
GAS HEAT PUMP
Integrated solution

Heating, Cooling and domestic hot water with integrated heat recovery in one system



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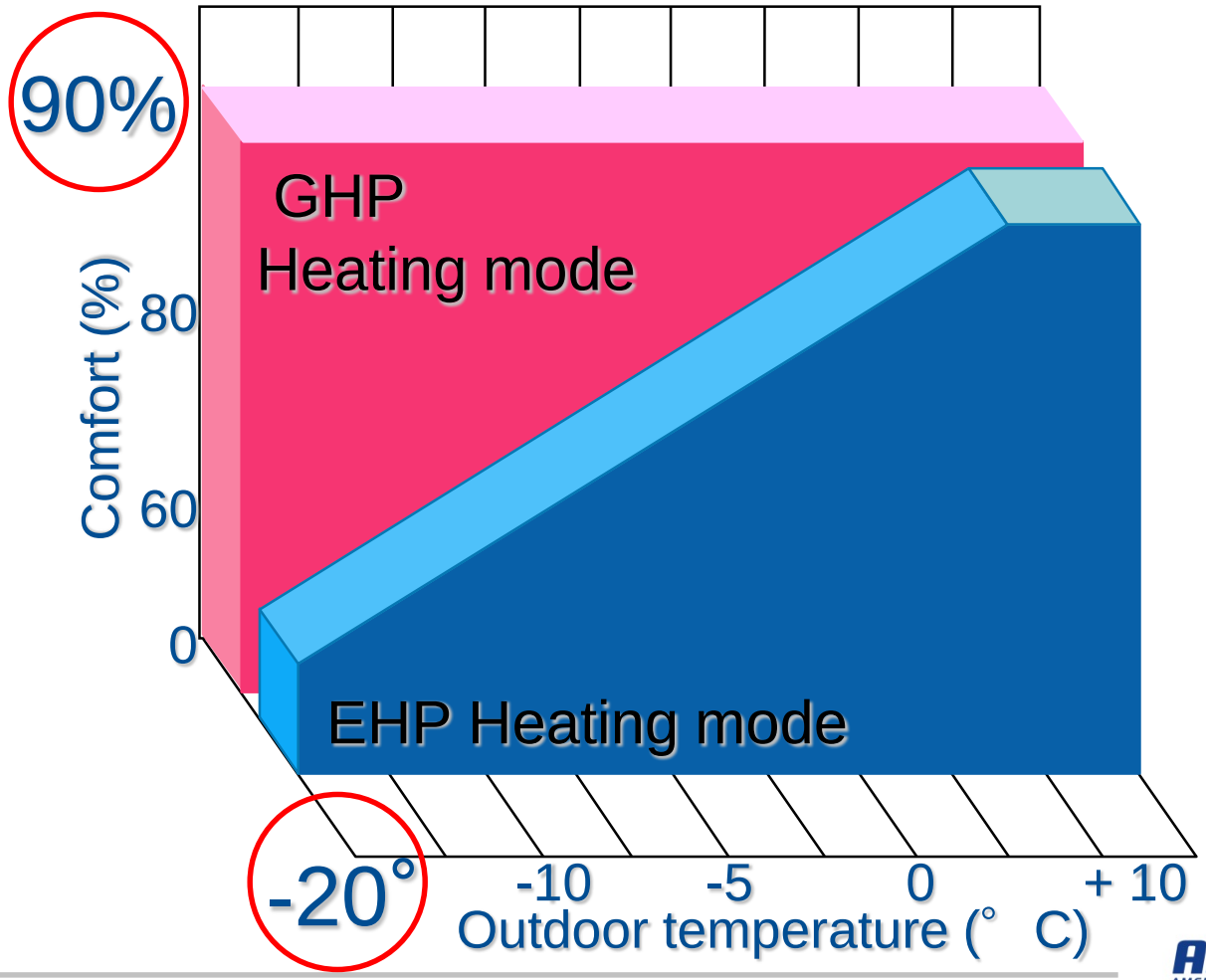
GAS HEAT PUMPS

Heat recovery

CONSTANT HEATING CAPACITY AT LOW TEMPERATURES



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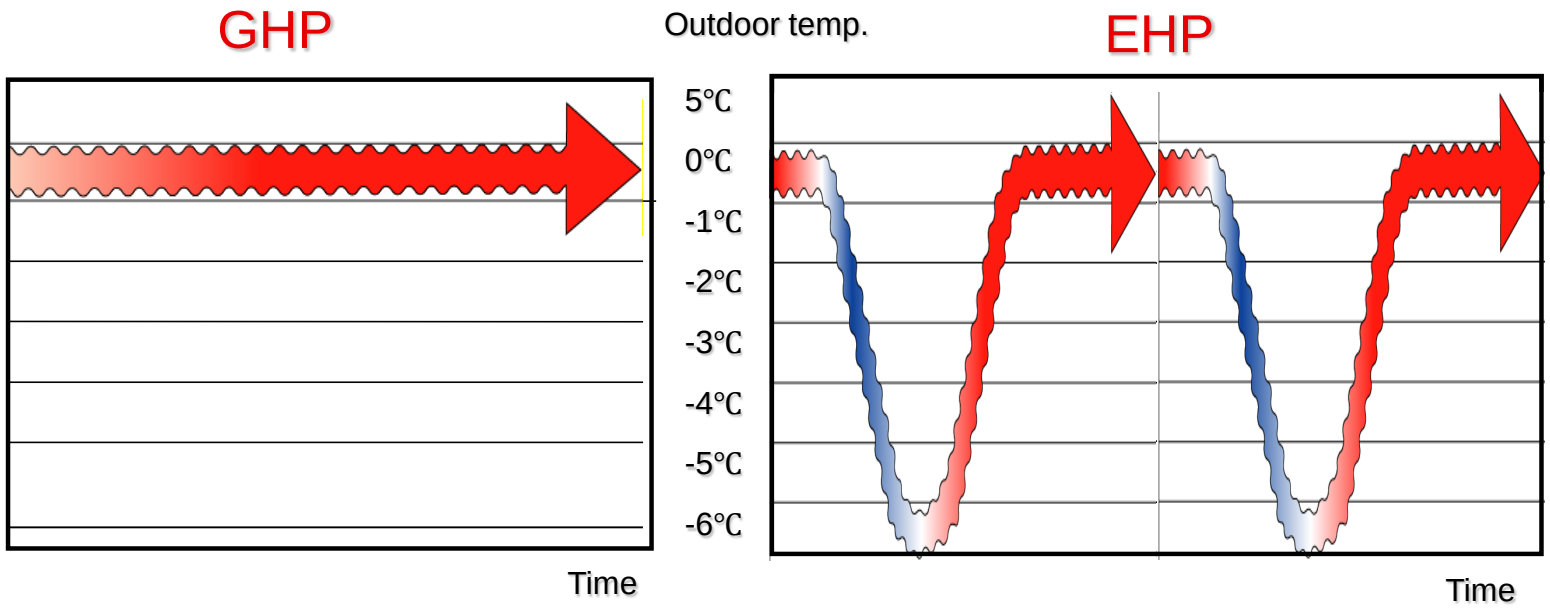
GAS HEAT PUMPS

Heat recovery

REDUCED NUMBER OF DEFROST CYCLES



Defrost may occur in case of strong humidity area

Reduced comfort because of the cycle inversion

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Product line up

6,5-8-10TON

8-10-13 HP

12-15-20TON

16-20-25 HP

22,4-28-35,5kW cooling

45-63-71 kW cooling
Combination Multi: up to 160 kW

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Small sizes - performances

	6,5 TON	8TON	10TON
Cooling capacity	22,4 kW	28 kW	35,5 kW
Heating capacity	25 kW	31,5 kW	40 kW
Fuel consumption	15 – 15,9 kW (1,59 – 1,68 m³/h)	19,2 – 20,3 kW (2,03 – 2,15 m3/h)	26,4 – 27 kW (2,79 – 2,86 m³/h)
GUE cooling*	1,49	1,46	1,34
GUE heating*	1,57	1,55	1,48
W-kit recovery	8 kW	10 kW	13,5 kW
GUE cool. + W-Kit*	1,99	1,96	1,84
GUE heat. + W-Kit*	1,82	1,80	1,73

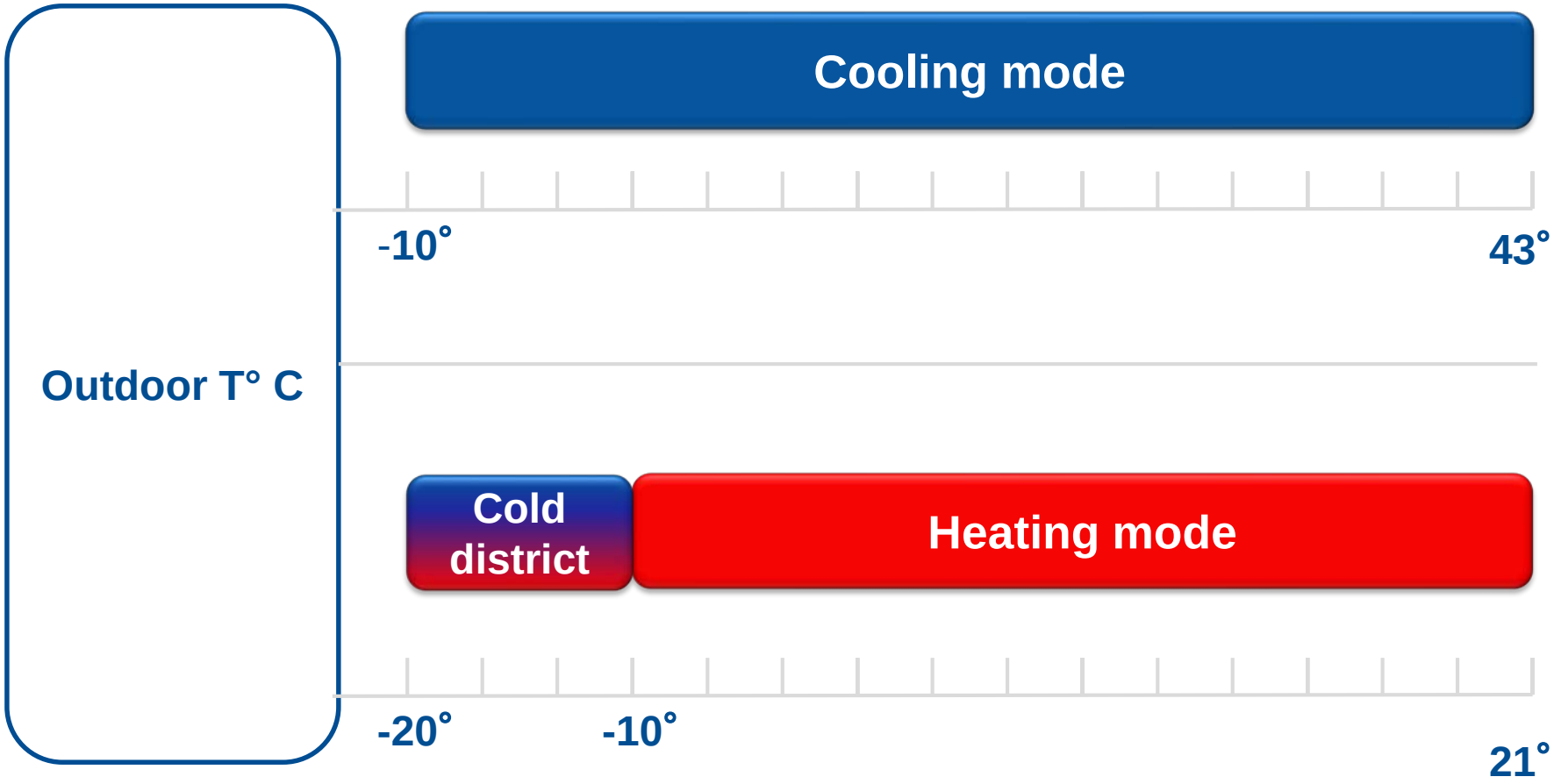
GHP

Big sizes - performances

	12TON	15TON	20TON
Cooling capacity	45 kW	56 kW	71 kW
Heating capacity	50 kW	63 kW	80 kW
Fuel consumption	31 – 31,7 kW (3,28 – 3,35 m3/h)	40,7 – 42 kW (4,31 – 4,44 m3/h)	55,1 – 53,6 kW (5,83 – 5,67 m3/h)
GUE cooling*	1,45	1,38	1,29
GUE heating*	1,58	1,50	1,49
W-kit recovery	16,5 kW	20 kW	25 kW
GUE cool. + W-Kit*	1,95	1,88	1,79
GUE heat. + W-Kit*	1,83	1,75	1,74

GHP

Outdoor temperature operation range



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Direct expansion layout

LAYOUT EXAMPLE

VRV/VRF system type

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Indoor units line up

4-way cassette
60 x 60

4-way round flow cassette

Ceiling suspended

Slim concealed ceiling unit

2-way cassette

1-way cassette

Wall mounted

Standard duct type

Floor standing

VAM

VKM

Hotel duct type

High static pressure duct type

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Controllers

Standard wired controller

Infrared wireless controller

I-Touch Manager

Wall built-in controller

Wall built-in simplified controller

Standard central controller

I-Touch Controller

Central ON/OFF controller

Weekly Timer

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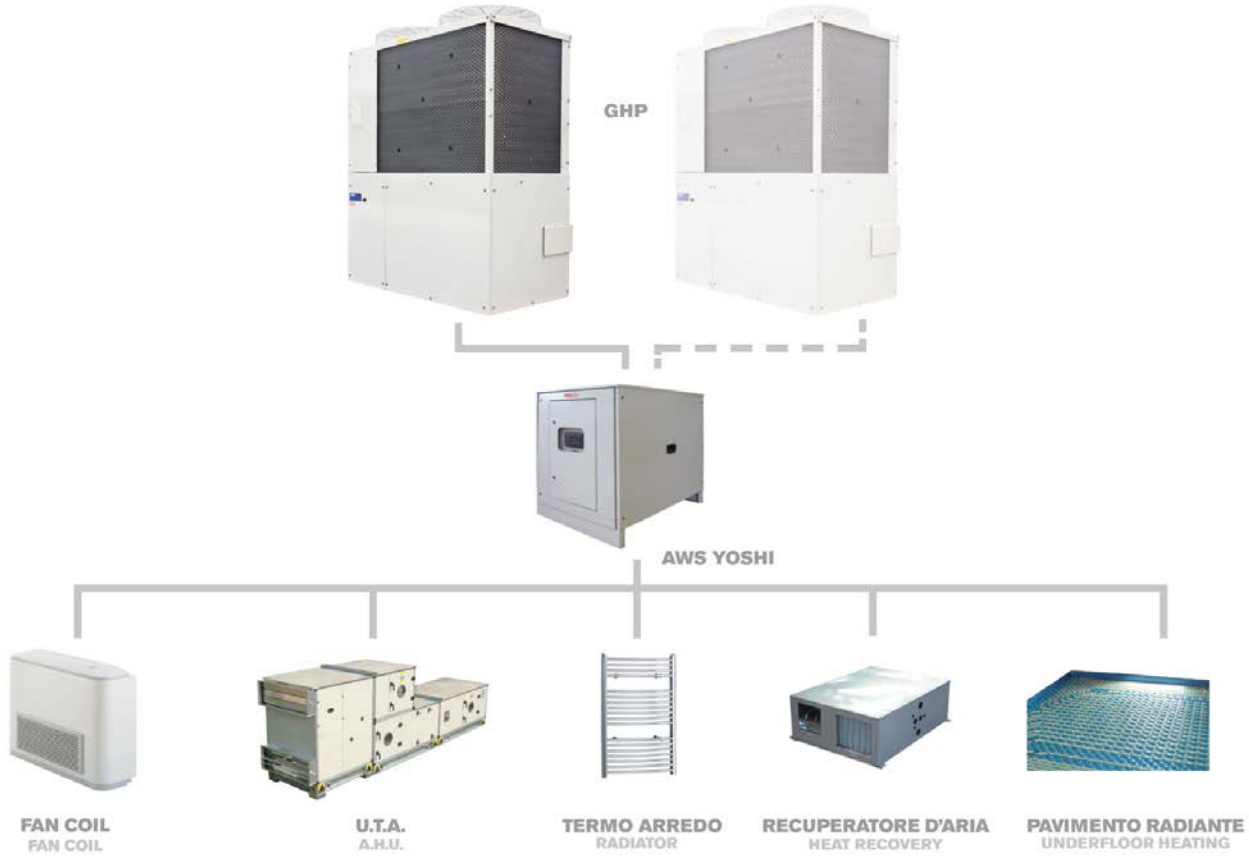
Air to water layout: Yoshi AWS features



LAYOUT EXAMPLE

Air-to-Water distribution

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Air to water layout: Yoshi AWS features

AWS is a sofisticated heat exchanger AIR to WATER:

- Modulating refrigerant capacity according to building demand through the return water T° on the primary circuit.
- Built-in pump control (only for single AWS)
- Built-in antifreeze protection, flow and pressure switches
- Built-in timer
- Electronic expansion valve

CONSTANT WATER FLOW RATE

AWS TWIN:

- Same single AWS settings and dimensions
- One device can provide up to 150 kW heating - 126 kW cooling
- Reduced installation spaces and costs
- Only for GHP big sizes combi (16-20-25hp)

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Air to water layout: Yoshi AWS features

DIGITAL INPUTS:

- GHP ON-OFF mode setting
- HEATING/COOLING mode setting

ANALOGUE INPUTS:

- setpoint T° regulation with 4-20mA signal
- capacity management with 4-20mA signal

DIGITAL OUTPUTS:

- alarms/errors status

COMMUNICATION PROTOCOL:

- ModBus RTU

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ENERGY ANALYSIS

Heat pumps comparison

$\eta_{EU} = 40\%$

If $f_{Prim,EL} = 2,5$ (EU)

$$GUE = \frac{COP}{f_{Prim,EL}}$$

η_{EU} = EU Power Plant average efficiency

f = EU Primary energy facror

- After converting the heat pump consumption into primary energy, you can proceed to the calculation of heat pump energy performance.

  Ex. VRF COP = 3,5 → $\frac{3,5}{2,5}$ = 1,4 VRF GUE

- At this point we can compare two heat pumps run on different sources (natural gas, electricity, etc ...)

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SYSTEMS COMPARISON

Aisin GHP performances table - AWS

conditions
external T°C = 35°C DB (dry bulb)
water T°C = 7°C WB

	AWGP450E1				
	Cooling mode				
	Capacity (kW) E	Consumption (kW) E	GUE E	W-kit (kW)	GUE E Total
30%	14,1	9,9	1,43	4,94	1,93
50%	20,7	15,1	1,37	7,55	1,87
70%	28,9	21,7	1,33	10,85	1,83
100%	41,5	32,0	1,30	16,00	1,80

W-kit contributes to enhance GHP performances

conditions
external T°C = 27°C DB (dry bulb)
water T°C = 7°C WB

	AWGP450E1				
	Cooling mode				
	Capacity (kW) E	Consumption (kW) E	GUE E	W-kit (kW)	GUE E Total
30%	14,7	7,2	2,04	3,60	2,54
50%	21,9	11,9	1,84	5,95	2,34
70%	31,0	18,2	1,70	9,10	2,20
100%	44,0	27,2	1,62	13,60	2,12

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GAS HEAT PUMP
GUE vs COP

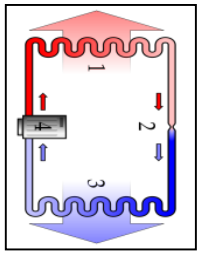
POWER STATION

GRID NETWORK

VRF/VRV

Gas 100

COP 3.5



GUE = 1,40

LOSSES 60

AVAILABLE 40

GHP/EHP +25%

GHP

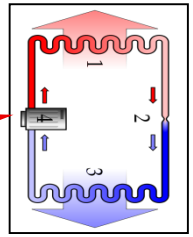
Gas 100

AVAILABLE 100

32 torque

53 heating recovery

15 losses



GUE_{TOT} = 1,80

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SYSTEMS COMPARISON
EU regulations and technical standard

conditions
external T°C = 35°C DB (dry bulb)
water T°C = 7°C WB

conditions
external T°C = 27°C DB (dry bulb)
water T°C = 7°C WB

Outdoor T°C: +35°C, +27°C and Water T°: +7°C
Are conditions set by the following **European Regulations**:

- Ecolabel 811/2013

Commission Regulation (EU) No. 811/2013 of the Commission of February 18, 2013 as far as labeling is concern of energy equipment for space heaters and combination heaters, sets of equipment for space heating, devices for temperature control and solar devices and sets of combination heaters, devices for temperature control and solar devices that define the energy class of the appliance.

- Ecodesign 813/2013

Commission Regulation (EU) No. 813/2013 of the Commission of 2 August 2013, laying down rules for the implementation of Directive 2009/125 / EC of the European Parliament and of the Council on the specific eco-design requirement of space heaters and combination heaters.

EU technical standard for GHP: EN 16905

In the GHP total energy efficiency calculations, the technical standard considers also the engine thermal recovery.

This recovery contributes to increase GHP energy efficiency and it's available during year round in different percentages.

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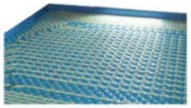
W-kit: free Domestic Hot Water

GHP



PAVIMENTO RADIANTE
UNDERFLOOR HEATING

U.T.A.
A.H.U.

WKIT ensures high performances at different loads

The heat is fully recovered (only for gas engine driven heat pumps)

The recovered heat can be used for:

Free domestic hot water

Buildings heating

Air Handling Unit post-heating

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Hot sanitary water production (lt/min)

	IN/OUT (T°C)				
	55/60	50/60	40/60	30/60	20/60
WKIT - 8HP	23,0	11,5	5,7	3,8	2,9
WKIT - 10HP	28,7	14,4	7,2	4,8	3,6
WKIT - 13HP	37,4	18,7	9,3	6,2	4,7
WKIT - 16HP	46,0	23,0	11,5	7,7	5,7
WKIT - 20HP	57,5	28,7	14,4	9,6	7,2
WKIT - 25HP	71,8	35,9	18,0	12,0	9,0

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GHP strong points

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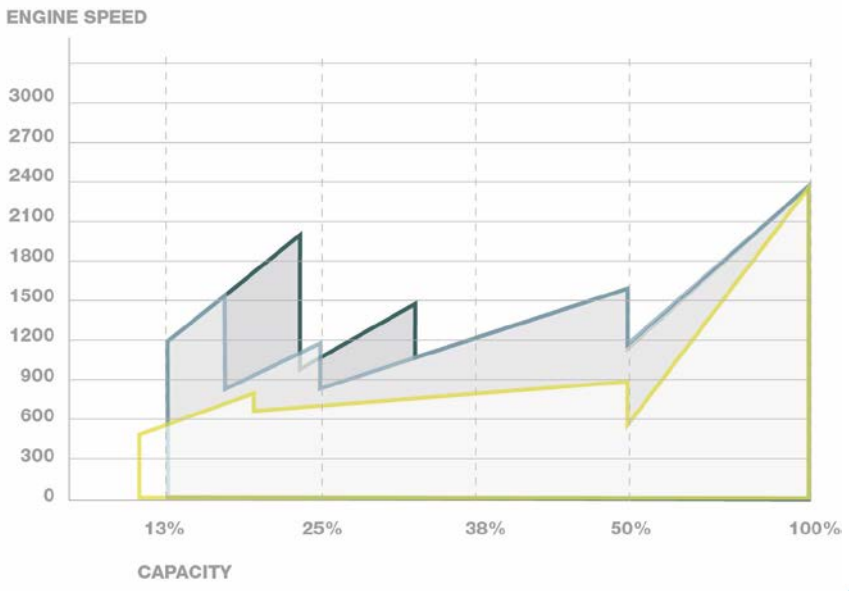
GHP
High Seasonal Performances

- Variable capacity scroll compressors
- Wide engine modulation range (2800 down to 600 rpm)
- Higher performances at partial loads
- Total energy recovery

High Seasonal GUE



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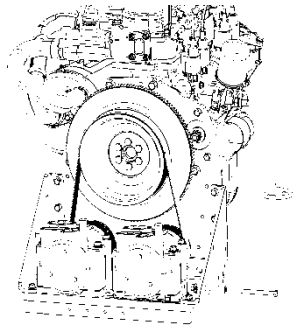
GHP Total energy recovery

AIR = Renewable energy

NG / LPG = natural energy



32%

Torque available for compressors

53%

Energy available for refrigerant circuit

Heat recovery for free domestic hot water

15%

Losses (frictions, not recovered heat)

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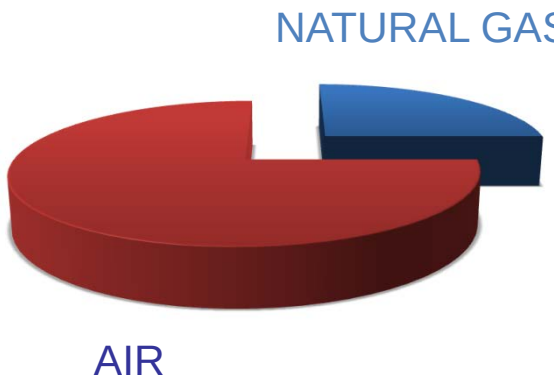
Use of air as renewable source of energy

EU DIRECTIVE 2009/28/CE declares that

aerothermal energy is a renewable source of energy

Aisin GHP uses aerothermal energy



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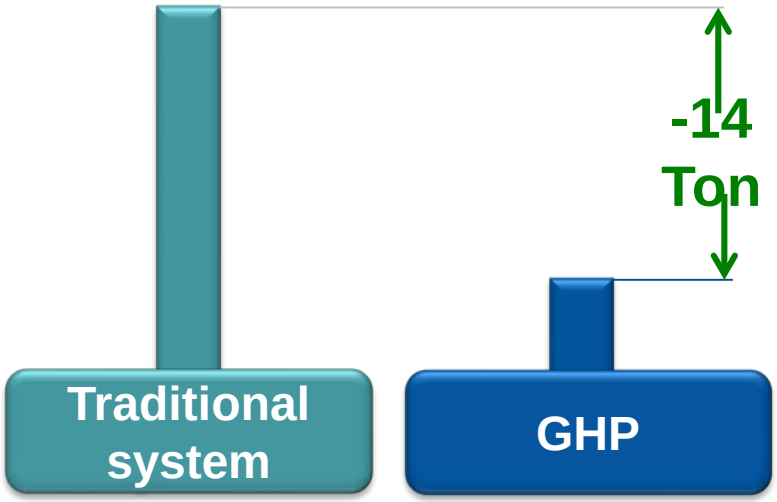
GHP
Reduction in CO_2 emissions

- GHP reduces CO_2 emissions up to 40% when compared to traditional systems
- 1 year = up to 17 Ton of CO_2 savings
- AISIN GHPs running in Europe = more than 68.000 Ton of CO2 savings/year



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GHP
Higher building efficiency rating

- **Higher seasonal performances**
- **Possible use of aerothermal energy as renewable quota**
  (according to local standards)
- **Reduced defrost cycles**
- **Free production of domestic hot water (heat recovery)**
- **Very low electric consumptions (1/10 compared to electric VRV)**

Low primary energy consumption

Low running costs

GHP allows you to improve buildings energy class → increased building value on real estate market

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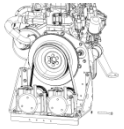
GHP

Low running costs

LOW RUNNING COSTS DUE TO

Use of aerothermal energy

Low primary energy consumption



Refrigerant flow management through variable engine speed and variable compressors capacity

No need of expensive power sub-station installation

Engine cooling and exhausts heat recovery

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EASY and LOW COST MAINTENANCE

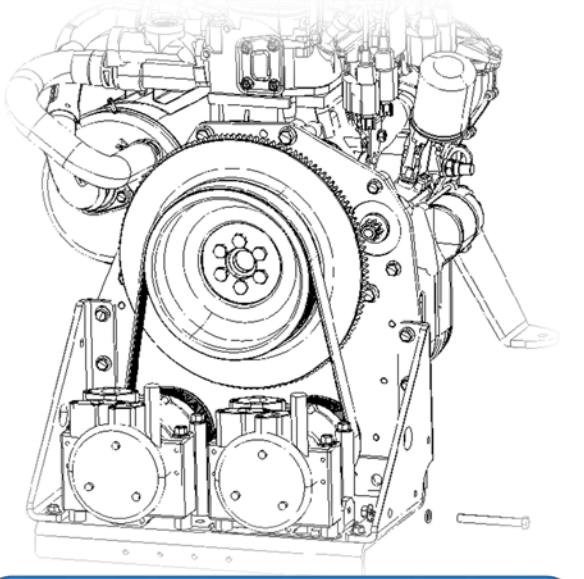
GUARANTY TECHNICAL SUPORT 24/7

EASY MAINTENANCE!

30,000 hours: oil change

MARKET LEADER!

Air filter



Spark plugs

Oil filter

Compressors belt

10,000 hours: oil top-up

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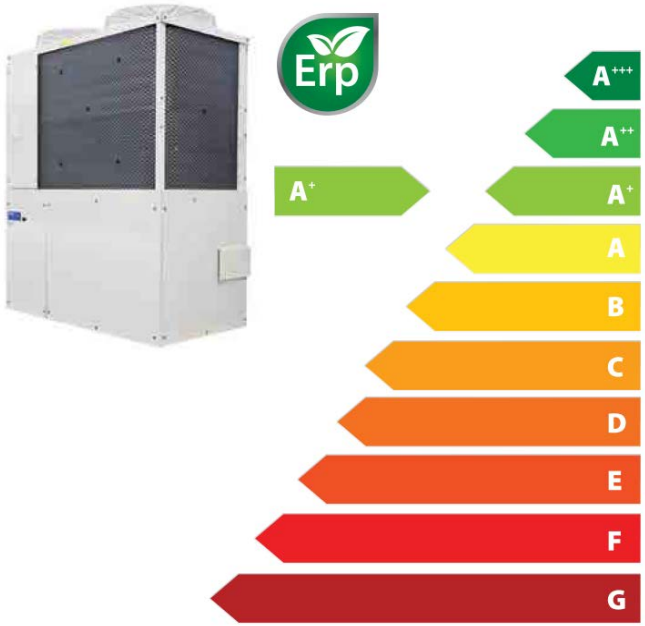
Eco Label and Eco Design

EU dir. 811/2013 and 813/2013

Aisin Air-to-Water line up are in compliance with European Directives standards.



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Return On Investment
80 TON GHP

Annual electricity fixed costs			€ -	€ -	€ -	€ -	€ -	€ -	€ -	€ -	
Annual maintenace costs			€ 1.445,4	€ 317,3	€ -	€ 1.762,7	WRITE BELOW	WRITE BELOW	WRITE BELOW	€ -	
Fill in manually maintenance costs							€ 2.000,00	€ 500,00		€ 2.500,0	
Cost of electricity consumption:											
Total cost electr. consumption	2.568	1.165				1.786,8				24.516,3	
Cost of gas consumption:											
Total costs of gas consumption	2.568	1.165				13.493,2				5.108,0	
TOT. ANNUAL WORKING HOURS	3.733										
TOT. ANNUAL RUNNING COSTS						€ 17.042,7				32.124,4	
ANNUAL CO2 PRODUCTION (fuel+electrical) in Tn						91,0				126,1	

- Payback -

Initial cost difference	€		45.300,00
CO2 SAVINGS / YEAR	Tn		-35
CO_2 savings/year compared to competitor's system	%		-28%
Payback in €	€		15.082
	%		47%
Payback time	Years		3,00
Primary Energy Savings	kWh		181.309
CO2 SAVINGS / YEAR	Ton.		-71
Tot. energy recovery/year	kWht		167.989
Economic savings [€] /year with W-KIT	€		20.878
	%		55%
Payback time with W-KIT	Years		2,17
Primary Energy Savings	kWh		363.906

Software deveolped by

TECNOCASA CLIMATIZZAZIONE

Sole European Distributor AISIN
Gas Heat Pump (GHP) / Microcogenerator (MCHP)

Version 2.09 S EN

28/04/17

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SYSTEMS COMPARISON

Alternative solutions?

BOILER + CHILLER

- Low energy efficiency
- High electric demand and high primary energy consumption
- Boiler room necessary
- Only air-to-water layouts

ELECTRIC HEAT PUMP

- High primary energy consumption
- Performances losses (up to 35%)
- System oversizing to ensure building demand
- High electricity demand
- Frequent defrost cycles

ABSORBTION HEAT PUMP

- Energy performances in cooling mode dramatically drop off
- No reliable system
- High noise levels
- Unit stops for seasonal switch mode (heating to cooling and vice-versa)
- Huge installation spaces needed, evaporative tower

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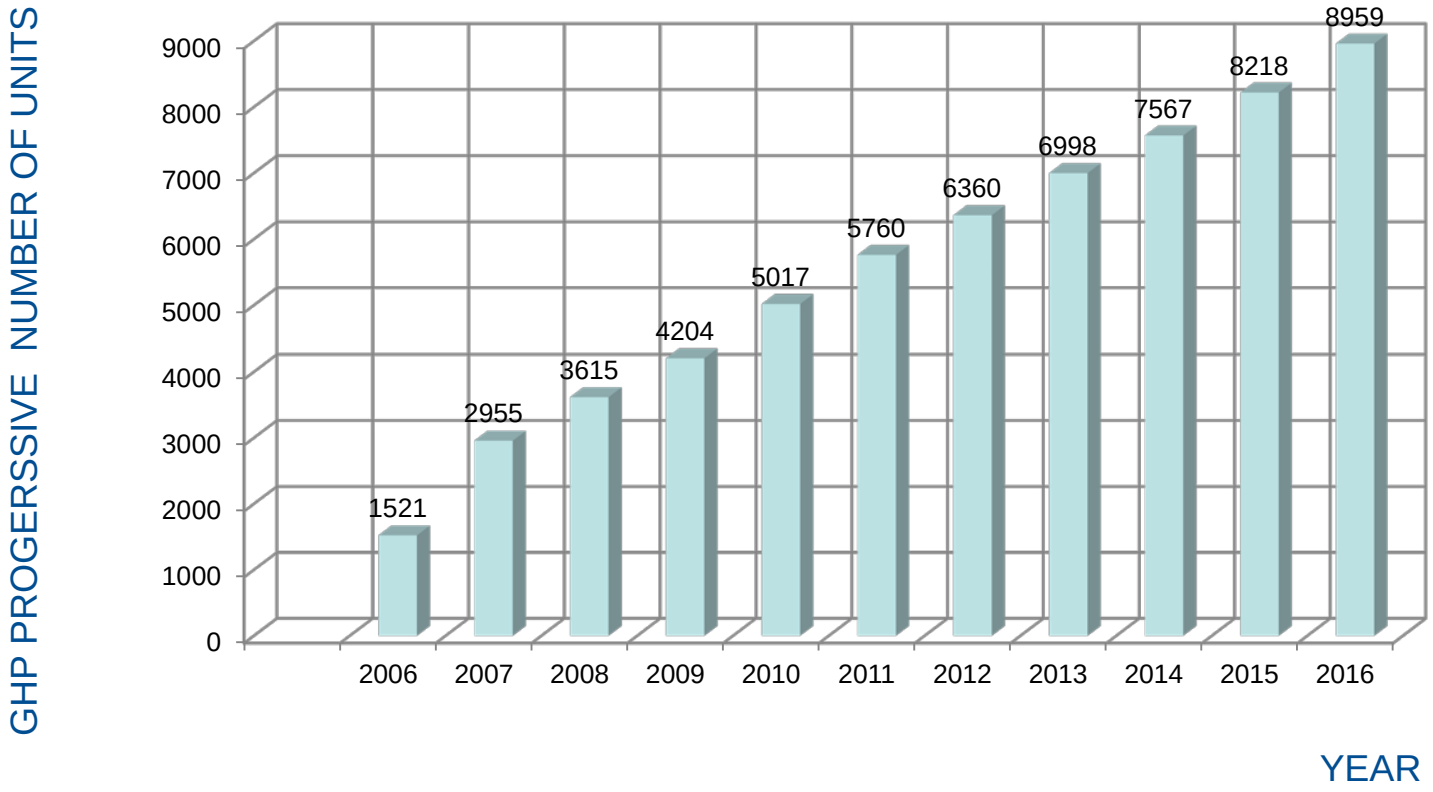
EUROPEAN GHP MARKET

Sales q.ty 2006-2016



Source: GHP Japanese consortium
4 GHP manufactures declared export quantities in Europe

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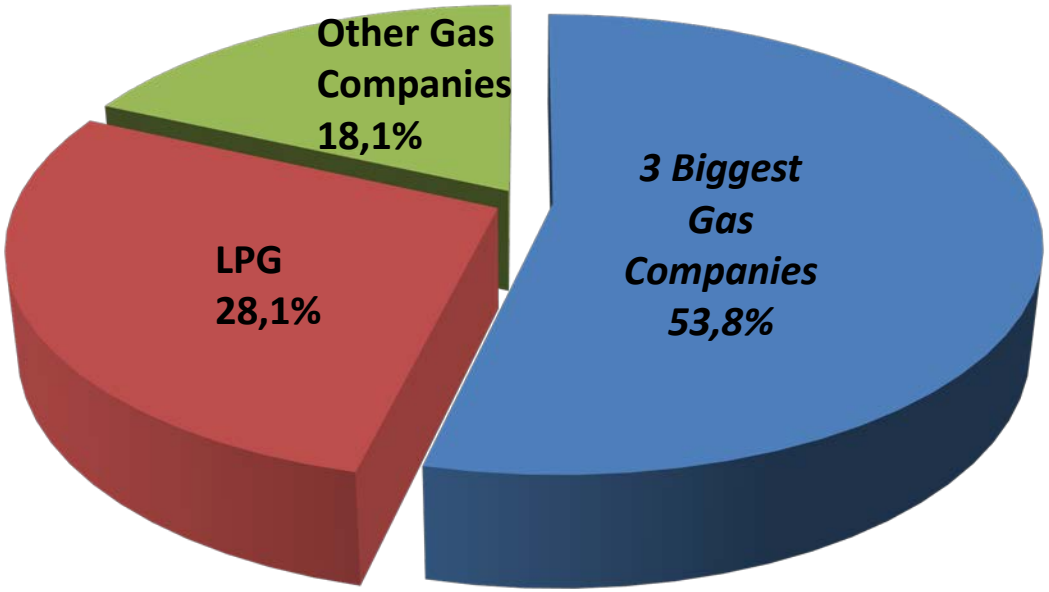
JAPANESE GHP MARKET

Sales q.ty 2002-2016



Around 406,472 UNITS SOLD

Main sales channels in Japan
are **NATURAL GAS and LPG Companies**

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APPLICATIONS

HOTELS, SPA, RESTAURANTS

COMPANIES (offices, factories, warehouses)

HOSPITALS / NURSING HOME

FLATS

GYMS, SWIMMING POOLS

PUBLIC AUTHORITIES

BANKS

OTHER (Churches, schools,

GHP REFERENCES WORLDWIDE

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AISIN GHP REFERENCES

GERMANY – AMAZON Logistic Center: 1,7 MW (27 GHP)
540 TON

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AISIN GHP REFERENCES

GERMANY – AMAZON Logistic Center: 1,7 MW (27 GHP)

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AISIN GHP REFERENCES

UK: London Langdon Park School: 71 kW + AWS(20TON)

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AISIN GHP REFERENCES

BELGIUM – Showroom : 35,5kW + Dx (10 TON)

Single GHP
Small size

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AISIN GHP REFERENCES

BELGIUM - Supermarket : 56kW+ Dx (15TN)

Single GHP
Big size

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AISIN GHP REFERENCES

GERMANY – Showroom: 224kW + Dx (64 TON)

GHP combination multi Direct expansion layout (DX)

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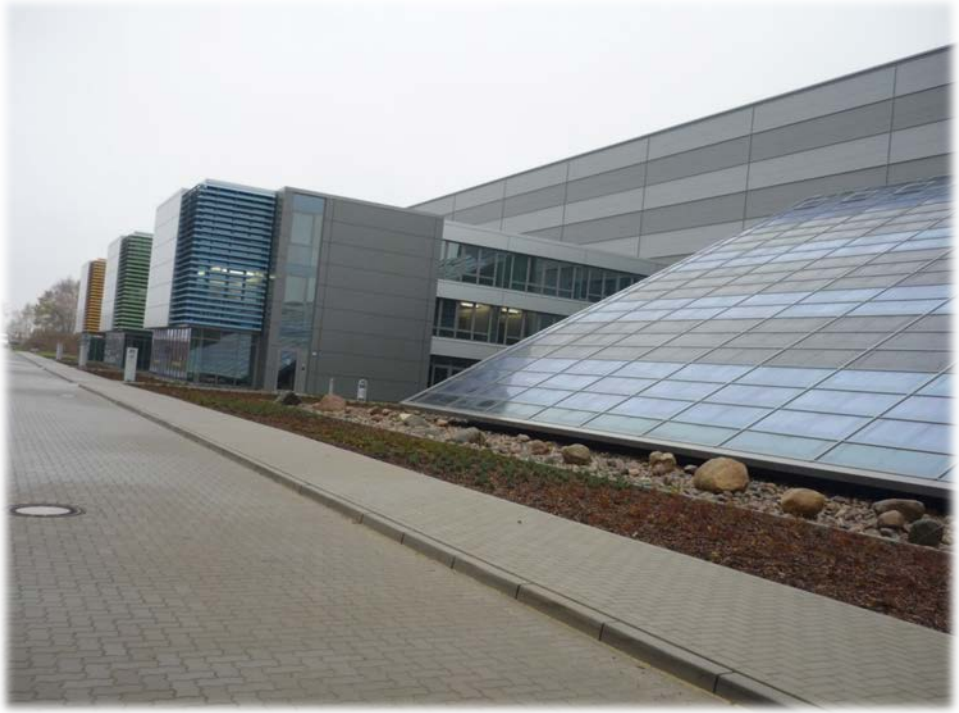
AISIN GHP REFERENCES

GERMANY – Industry: 710kW + AWS -200 TON



GHP combination multi Air-to-water layout (AWS)

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AISIN GHP REFERENCES

GERMANY – Gas Company: 56 kW + Dx (15TON)

GHP life-span record:
80,000 hours

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AISIN GHP REFERENCES

GREECE – Hotel: 560 kW + AWS (150TON)

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AISIN GHP REFERENCES

SWITZERLAND - Gas company: 28kW + AWS(8 TON)

Swiss gas company followed German example

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AISIN GHP REFERENCES

BELGIUM – Offices: 112 kW + Dx (30TON)

Preservation of buildings aesthetics

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POLAND – Church: 56 kW + Dx (15 TON)

Key account

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AISIN GHP REFERENCES

BELGUIM – Industry: 112 kW + Dx (30 TON)

Systems-combined applications

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AISIN GHP REFERENCES

POLAND – Business Center: 71 kW + AWS(20TON)

Live show events for professionals

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POLAND – Industry: 168 kW – Dx (50TON)

Aisin GHP for Toyota industries

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AISIN GHP REFERENCES

HUNGARY – Industry: 504 kW + AWS (135TON)

Non-stop operating A/C

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AISIN GHP REFERENCES

BULGARIA – Hospital: 112 kW + Dx (30TON)

GHP avoided power sub-station installation

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AISIN GHP REFERENCES

SLOVAKIA – MTF University: 1207kW + AWS(345 TON)

EU community project

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AISIN GHP REFERENCES

SLOVENIA – Lifeclass Hotels: 426 kW + AWS (120 TON)

Energy efficiency upgrade
Hotel & Wellness

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AISIN GHP REFERENCES

ITALY - Toyota car dealer: 112 kW + AWS(30 TON)

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AISIN GHP REFERENCES

ITALY - Nursing home: 336 kW + AWS(96 TON)

Low noise levels

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AISIN GHP REFERENCES
Italy

Country houses
Wine cellars

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AISIN GHP REFERENCES

Italy

Banks
Warehouses

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AISIN GHP REFERENCES

ITALY – Business Center: 710 kW + AWS (200TON)

Mixed-use buildings

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AISIN GHP REFERENCES

MALEYSIA – Hotel: 1.420kW + AWS (405 TON)

Aisin Japan + TC project

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AISIN NEW HQ

JAPAN – Kariya City (Nagoya): 7.074kW+ Dx (2.021TON)

129 GHPs

GHP inside building

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AISIN GHP REFERENCES

JAPAN – Tokyo Kenzai University: 900kW+ Dx(257TON)

Standard layout type

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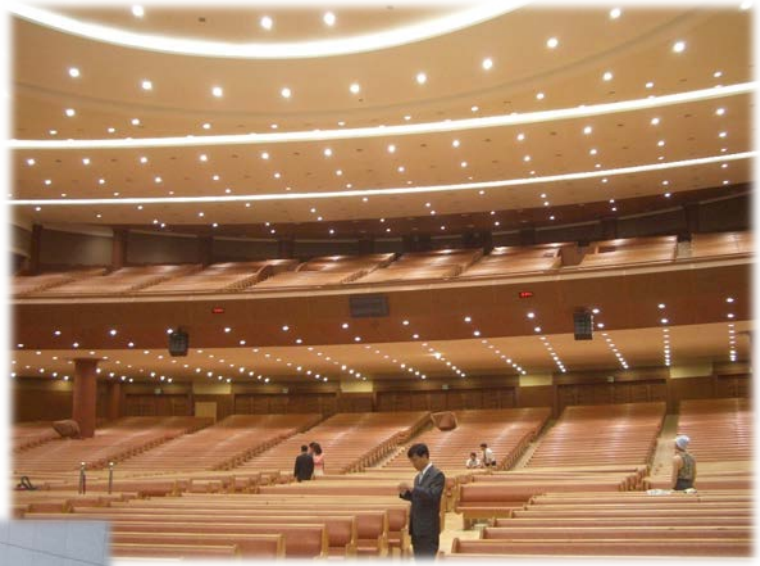
AISIN GHP REFERENCES

KOREA – Church: 4.480kW + Dx (1.280TON)

80 GHPs



Cascade system

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תודה לך על תשומת הלב

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