By fusion of two or more types of energy sources

Complex heat source (air + water) hybrid heat pump with waste heat recovery

without outdoor unit

KCH(KOREAN COOLING & HEATING)

We provide practical value by converging energy and the environment through constant change and innovation.
INVESTOR RELATIONS 2023

Outline

"If you use K-cooling and heating,

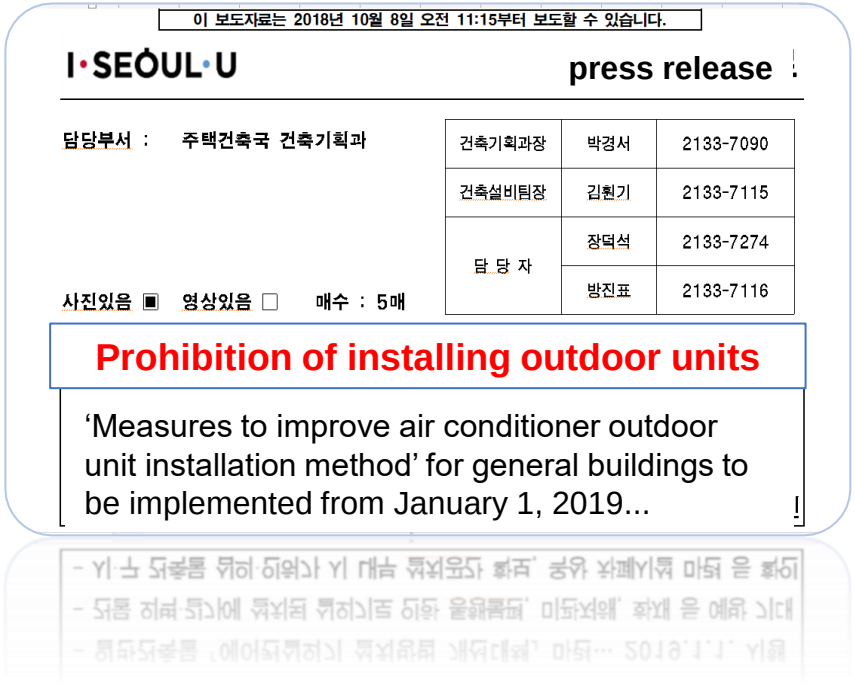
Outdoor units, boilers, and LNG pipes disappear.

Cooling and heating energy costs and carbon emissions are reduced at the same time."

Social Problems

October 6, 2018/Seoul City

‘From 2019, air conditioner outdoor units cannot be placed on the exterior walls of new buildings in Seoul.



이 보도자료는 2018년 10월 8일 오전 11:15부터 보도할 수 있습니다.

I·SEOUL·U press release

담당부서 : 주택건축국 건축기획과			
	건축기획과장	박경서	2133-7090
	건축설비팀장	김환기	2133-7115
	담 당 자	장덕석	2133-7274
		방진표	2133-7116

사진있음 ▣ 영상있음 ☐ 매수 : 5매

Prohibition of installing outdoor units

‘Measures to improve air conditioner outdoor unit installation method’ for general buildings to be implemented from January 1, 2019...

-건물 외벽에 설치된 에어컨 실외기 Heat exhaustion noise pollution 상당하며, condensate dripping 외기 주변을 걷는 보행자들이 불편을 겪어 왔다.

-또 실외기가 햇빛에 많이 노출되거나 먼지가 쌓이면 fire risk 커지고, 지지대가 부실할 falling accident 하기도 한다.

-**류훈 서울시 주택건축국장은** “에어컨 실외기 건물 내 설치가 의무화되면 에어컨 실외기로 인해 발생한 통행불편, 도시미관 저해, 낙하사고 등 많은 문제가 해결될 것”이라면서 “아울러 에어컨 실외기가 태양에 직접 노출되지 않아 에어컨 냉방능력이 향상 Energy saving effect 것으로 보인다”고 말했다.

Seoul Metropolitan Government Housing and Construction Bureau Director

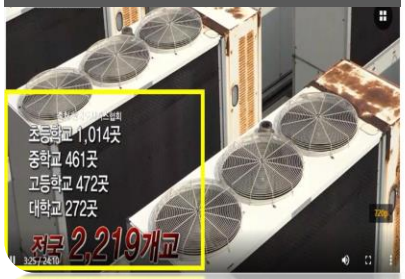
In July 2018, of the 189 fires that occurred in air conditioners, 65% (121 cases) were fires that occurred in the ‘outdoor unit’ of the air conditioner.

Social Problems

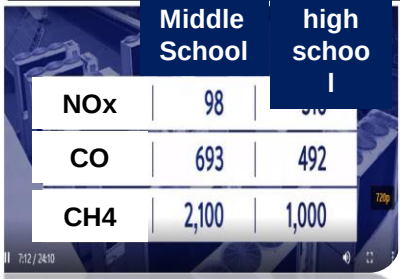
October 9, 2020/SBS

Over 15,000 locations nationwide,
Gas air conditioners emit hazardous substances...
schools are dangerous (SBS, October 9, 2020)

Up to 100 times more environmental pollution than automobile exhaust gases



Use of gas engine heat pump for heating and cooling



	Middle School	high school
NOx	98	
CO	693	492
CH4	2,100	1,000

-**Gas heat pumps (GHPs)** installed in over 5,000 locations across the country, on the rooftops of schools and public institutions, are causing fatal damage to people's health by emitting environmental pollutants (**Nox, CH4, Co**) about '**100 times more**' than automobile exhaust gases

[Source]: 2020. 10. 9. SBS Broadcasting News Story

Social Problems

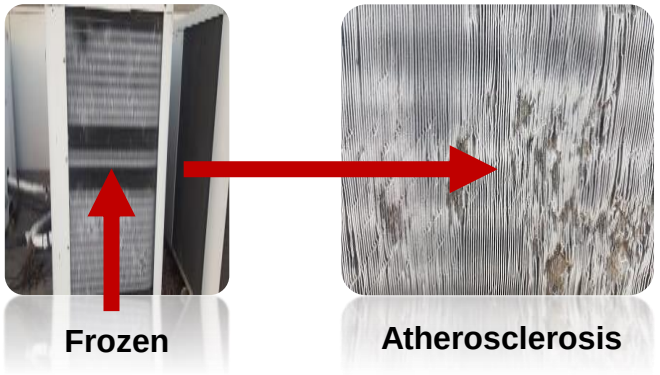
March 1, 2024/MBC broadcast

The Paris Olympics, which aims to hold an eco-friendly Olympics by reducing carbon emissions, has no air conditioning in the 'eco-friendly' athletes' village.

Social Problems

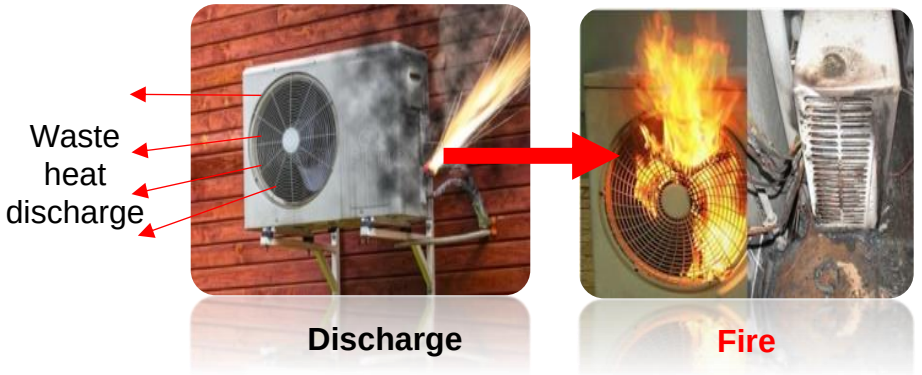
The main cause of energy and environmental problems

Frost on outdoor unit
during winter heating season



Energy efficiency issues

Summer cooling season
- outdoor unit overheats, fire occurs



Environmental and safety issues

- A total of 1,234 air conditioner fires occurred in the past 5 years (2018-22)
- The fire resulted in 86 casualties (11 dead, 75 injured).casualties
- The fire resulted in 86 casualties (11 dead, 75 injured).casualties

[source] National Emergency Management Agency

Solution

Solving Energy and Environmental problem
By applying outdoor unit removal technology

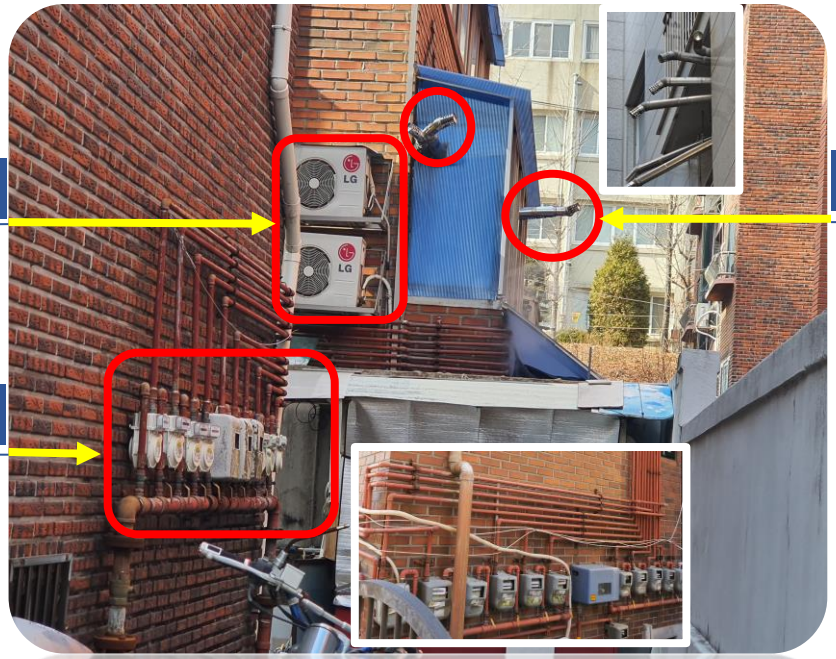
So We removed the outdoor unit.

[Source:] Chosun Ilbo, October 8, 2018

Solution

Everything disappears (boiler (room), outdoor unit (room), LNG piping, GHP)

normal house



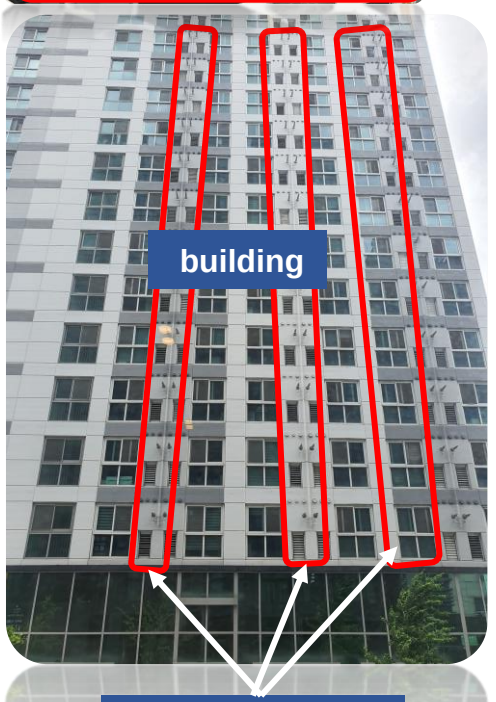
① Out Door unit

② Boiler

③ LNG Pipe

④ GHP (gas heat pump)

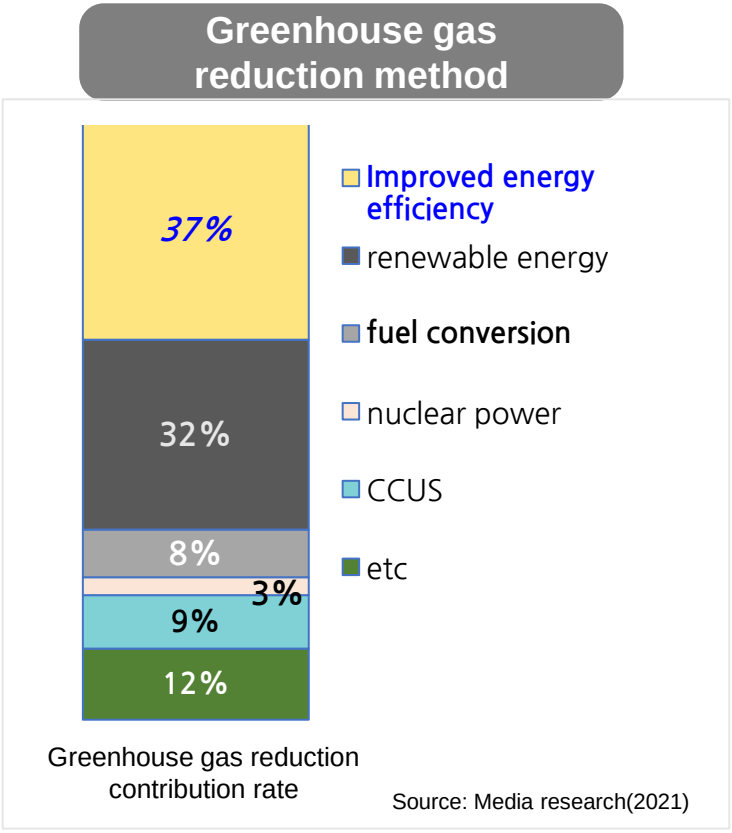
Roof-top



Solution

Among greenhouse gas reduction methods, the first is
– improving energy efficiency (37%)

Due to global greenhouse gas emissions,The severity of climate change is increasing, with the average global temperature expected to rise by 1.5 degrees by 1940, and ‘improving energy efficiency’ is being emphasized as a solution to reducing greenhouse gas emissions.



Greenhouse gas reduction contribution rate

Source: Media research(2021)

- As a result of the IEA World Energy Outlook (’19) analysis, energy efficiency improvement was analyzed as the most contributing means to reducing greenhouse gases.

Solution

Comparison of energy efficiency and carbon emissions

69%(K-Cooling and heating hybrid systems account for 69% of greenhouse gas reduction methods. **)**

To generate 1 kWh of energy from gas, 0.202 kg of carbon is emitted.
To generate 1 kWh of energy with electricity, more than 0.4 kg of carbon is emitted.

(32%) Renewable Energy

(37%) Improved Energy Efficiency

	K-Combined heat source heat pump	General heat pump	Gas boiler	Condensing boiler	electric boiler
(Heat Source)	**air+water (electric)**	air (electric)	LNG gas	electric	electric
Efficiency (%)	**COP3.3.7 (*) (370%)**	COP3.0 (300%)	COP0.95 (95%)	COP0. 92(92%)	COP0.8 (80%)
Heat production per 1kWh of energy	**3.7kWh**	3KWh (-15℃-->1kWh)	0.95kWh	0.92kWh	0.8kWh
Carbon Emissions (When supplying 1,000 kWh to the building)	**114.5kg**	141.3kg (-15℃→412kg)	212.6kg	460.8kg	530kg

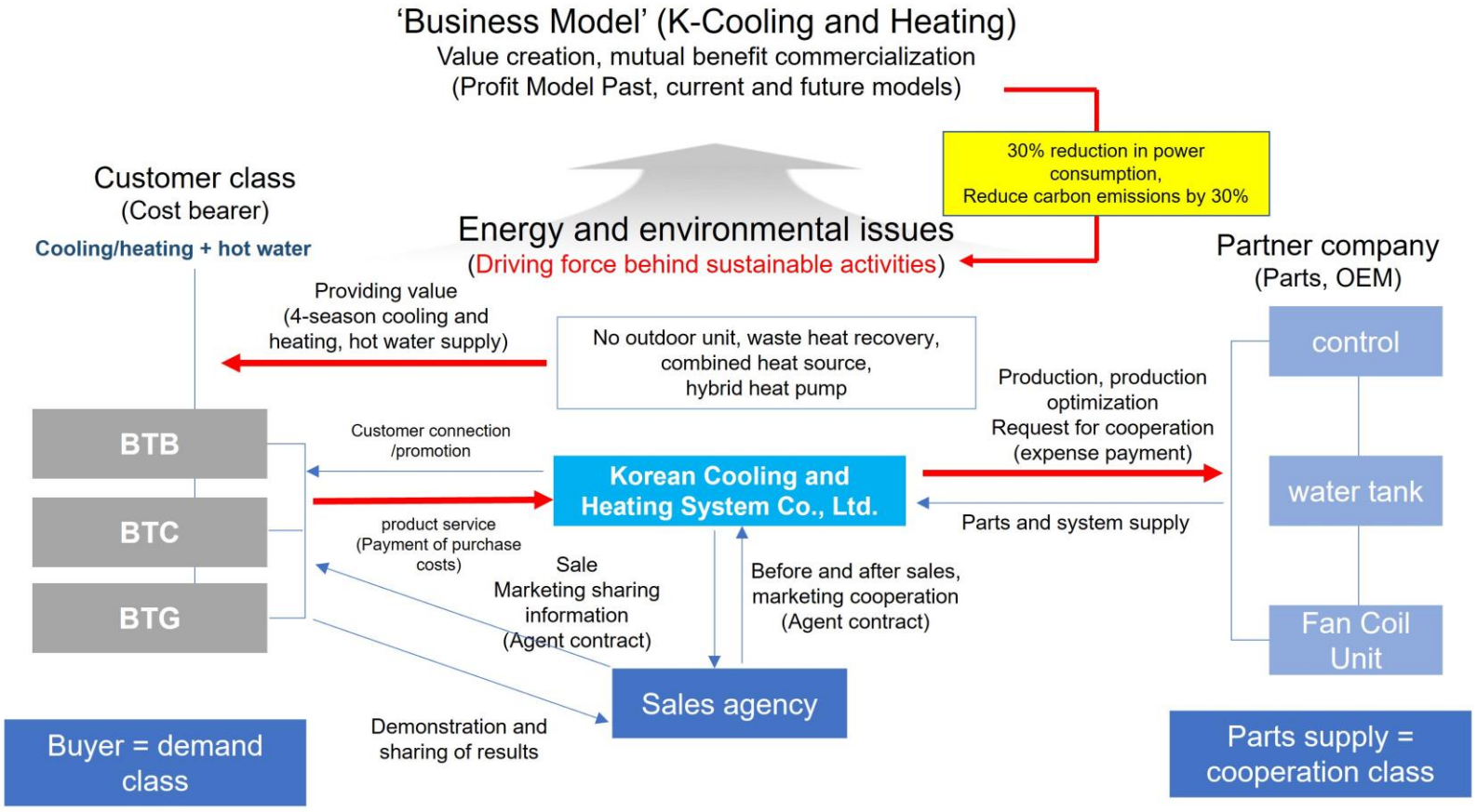
[source] “Boiler that protects the Earth”, to be phased out overseas in 2025, September 21, 2022, Hankook Ilbo

*Based on supply of 1,000 kWh of heat energy

(*): Official test results - Korea Institute of Industrial Technology (2018)

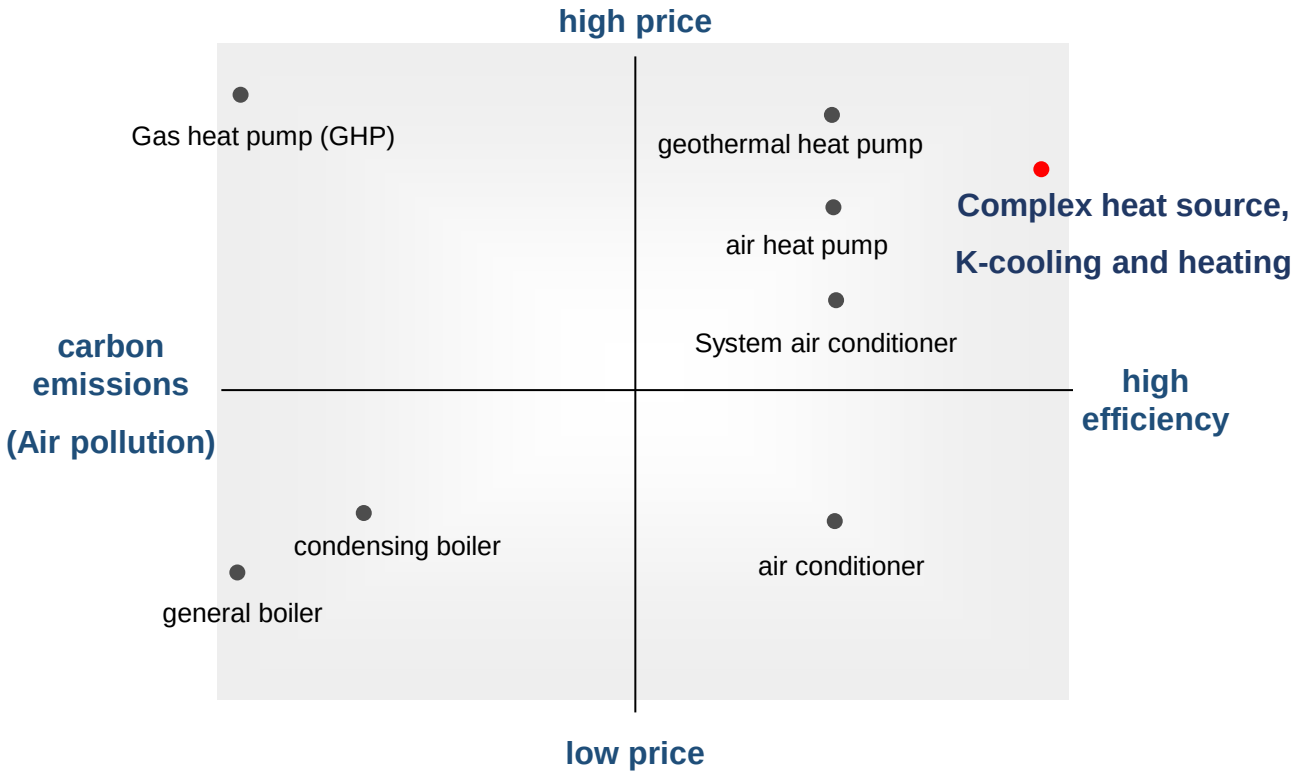
BM(Business Model)

K-Cooling and Heating, 'The Ecosystem(E2 SOLUTION)'



Relationship with competing products

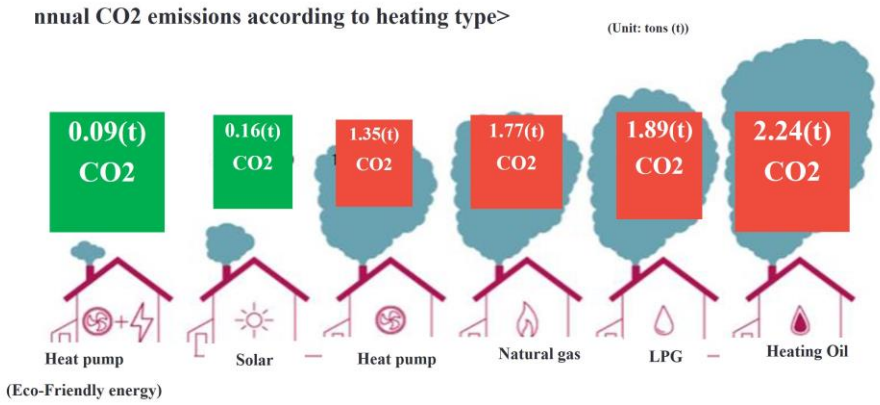
Positioning MAP



Differentiation

Reduce carbon emissions
and improve energy efficiency

carbon emissions 1/25 level



① Air source heat pump

② Water source heat pump

③ Geothermal source heat pump

K- COOLING & HEATING, Heat pump

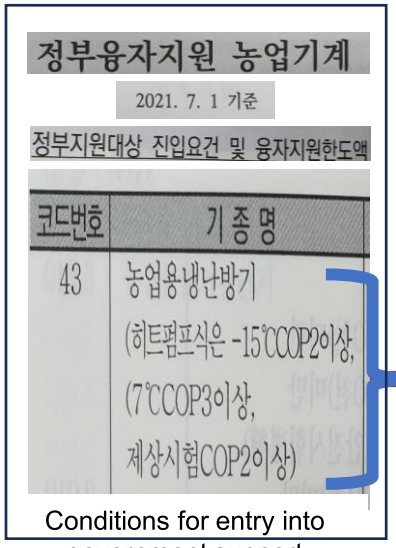
Complex heat source, Multi Heat Pump

K-Cooling and Heating, Hybrid Heat Pump is the first technology that uses all available energy as a heat source

Action plan, prototype

K-Cooling and heating, official test and self-test results (feasibility, implementation ability)

Government, agricultural machinery entry conditions


정부융자지원 농업기계

2021. 7. 1 기준

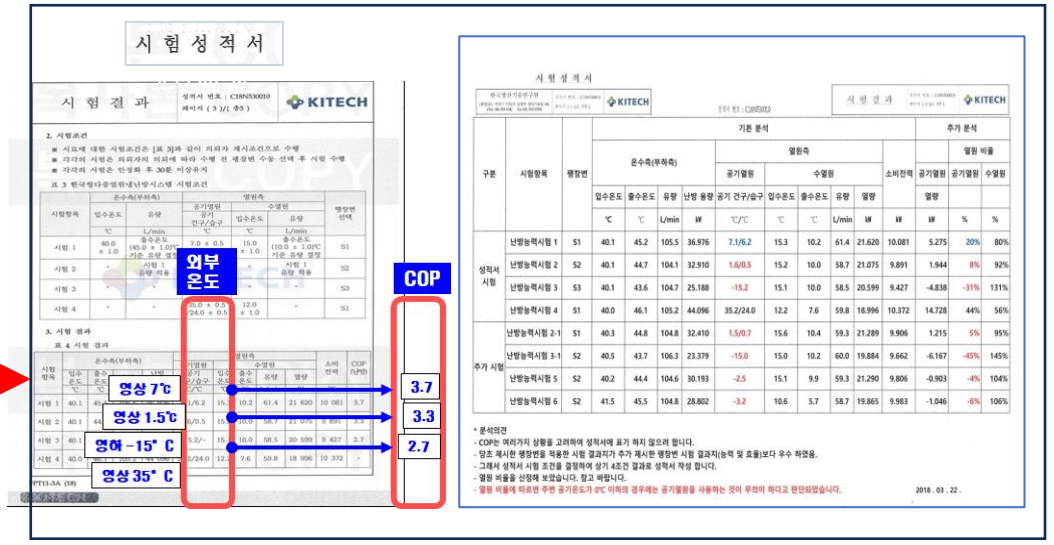
정부지원대상 진입요건 및 융자지원한도액

코드번호	기종명
43	농업용냉난방기 (히트펌프식은 -15℃COP2이상, (7℃COP3이상, 제상시험COP2이상)

Conditions for entry into government support

COP 2.0

Official test results (March 22, 2018)



COP 3.3

[Check feasibility and implementation ability]

- ●Proving the ability to implement a composite heat source (air + water) compared to a single air heat source
- ●Proving the feasibility of a combined heat source by not being able to operate at an external temperature of 1.5℃ or lower
- ●1.5℃-->Air heat source (8%): Water heat source (92%)
- ●-15℃-->Air heat source (-31%) : Water heat source (131%)
- ●In the case of general heat pumps, they cannot be operated in sub-zero temperatures or cause a surge in power consumption.

Prototype self-test results (January 31, 2018)


KCH- 100 AWT(10마력 100평형) 난방 성적 (C.O.P.)-2017년 난방

온수 평균 용량 : 1,000ℓ / 1 kw = 860 kcal

일 시	가동 시간	최초 온수 온도	최종 온수 온도	온수 변화량 △t	최초 전력량	최종 전력량	전력 변화량 △kw	C.O.P. △t×1000 / △kw×860	비 고
11 / 8	8:52 ~ 9:35	27 ℃	50 ℃	23 ℃	428 kw	435 kw	7 kw	23,000 / 6,020 = 3.82	
	10:52 ~ 11:20	34 ℃	50 ℃	16 ℃	435 kw	440 kw	5 kw	16,000 / 4,300 = 3.72	
	13:27 ~ 13:52	35 ℃	50 ℃	15 ℃	441 kw	446 kw	5 kw	15,000 / 4,300 = 3.49	
11 / 10	8:47 ~ 9:30	29 ℃	51 ℃	22 ℃	454 kw	461 kw	7 kw	22,000 / 6,020 = 3.65	
11 / 11	8:22 ~ 9:09	27 ℃	50 ℃	23 ℃	461 kw	469 kw	8 kw	23,000 / 6,880 = 3.34	
11 / 14	8:52 ~ 9:51	21 ℃	50 ℃	29 ℃	470 kw	479 kw	9 kw	29,000 / 7,740 = 3.75	
1 / 30	14:12 ~ 14:35	32 ℃	41 ℃	9 ℃	541 kw	544 kw	3 kw	9,000 / 2,580 = 3.49	
1 / 31	10:52 ~ 11:15	30 ℃	39 ℃	9 ℃	553 kw	556 kw	3 kw	9,000 / 2,580 = 3.49	
	13:17 ~ 13:41	32 ℃	42 ℃	10 ℃	557 kw	560 kw	3 kw	10,000 / 2,580 = 3.88	
2 / 1	13:38 ~ 14:00	30 ℃	39 ℃	9 ℃	573 kw	576 kw	3 kw	9,000 / 2,580 = 3.49	

상기 데이터는 2017년도 겨울 난방 전력사용량을 측정하기 위하여 일일단위로 운전하여 실제 한국전력의 전력사용량에 따른 전력비 지출을 근거하여 거짓없이 작성된 내용임을 확인합니다.

㈜한국형냉난방시스템 대표이사

㈜한국형냉난방시스템

Highest COP3.88

Core competencies (technology) differentiation, innovation, creativity

E² solution Energy & Environment

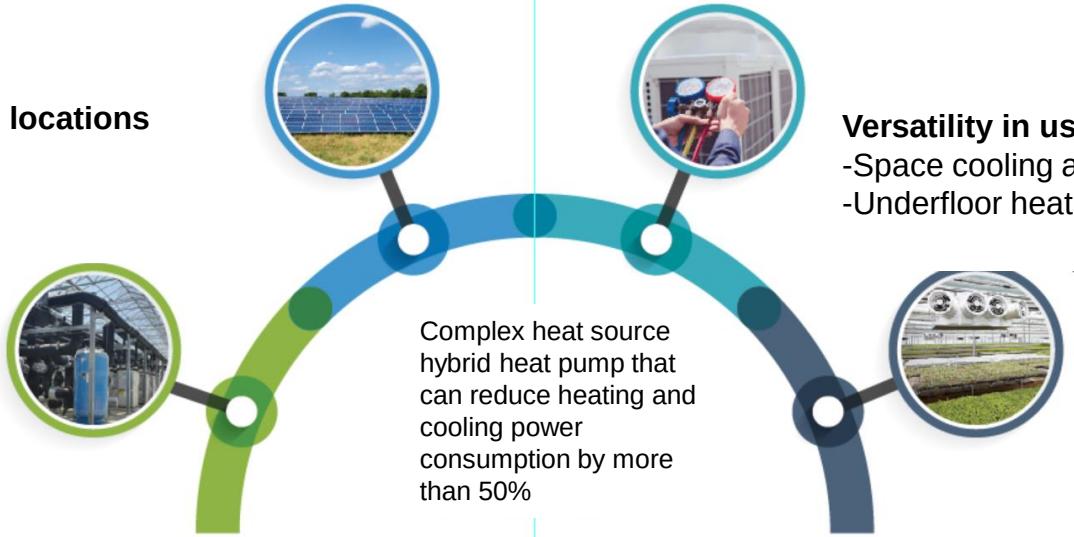
K-Cooling and heating, ① Diversity of installation locations, ② Diversity of heat sources, ③ Functional quality, ④ Diversity of use

01. Reduction of carbon emissions 02. Background for reducing power consumption by more than 50%

Diversity of heat sources
-Use all heat sources including air, water, and sunlight
-Use each heat source individually or simultaneously

Functional diversity (all possible in one device)
-Air conditioner (cooling)
-Boiler (heating, hot water)
-Chiller (cold and hot water)
-Cooling/heating + ventilation

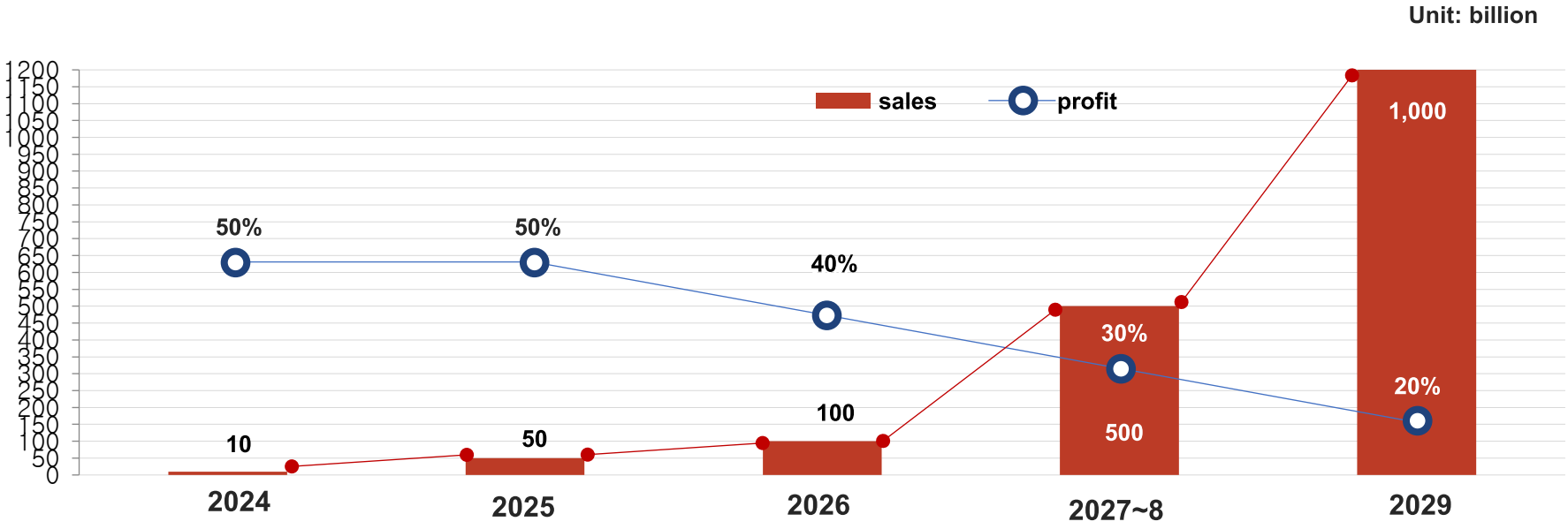
Diversity of installation locations
-rooftop
-ground
-underground



Complex heat source hybrid heat pump that can reduce heating and cooling power consumption by more than 50%

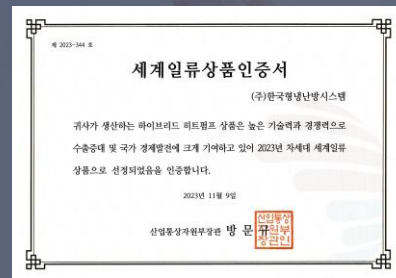
Versatility in use (all possible in one device)
-Space cooling and heating
-Underfloor heating

Roadmap (estimated finances, funding)



Q&A

감사합니다



제 2023-344 호

세계일류상품인증서

(주)한국형냉난방시스템

귀사가 생산하는 하이브리드 히트펌프 상품은 높은 기술력과 경쟁력으로 수출증대 및 국가 경제발전에 크게 기여하고 있어 2023년 차세대 세계일류상품으로 선정되었음을 인증합니다.

2023년 11월 9일

산업통상자원부장관 방 문 규

NO. 2023-344

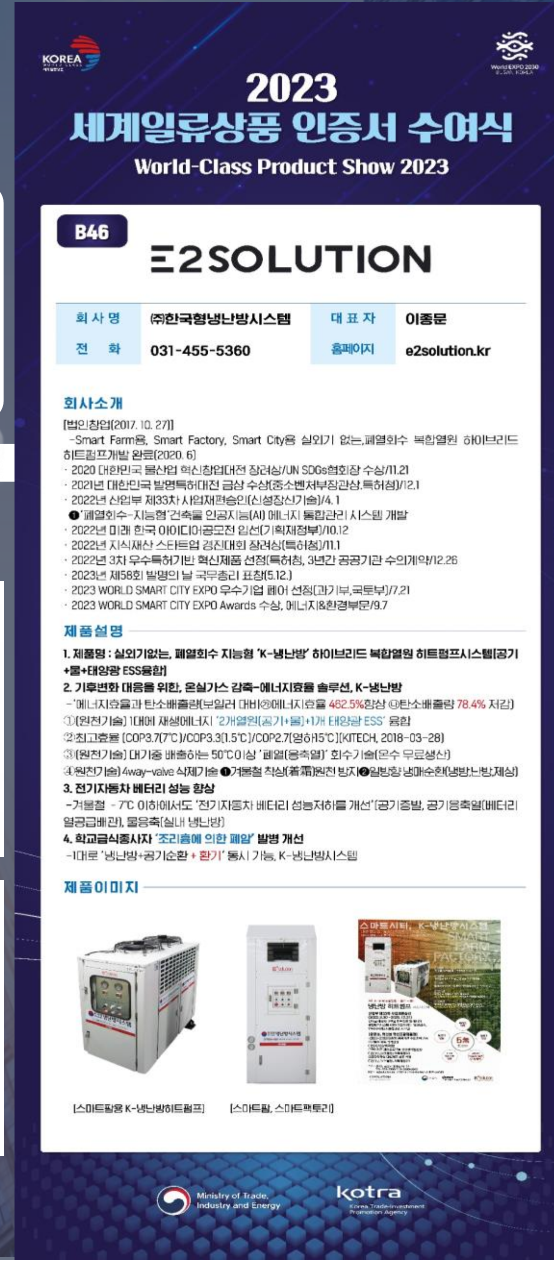
World-class Product of Korea 2023

KCH(Korean Cooling & Heating) SYSTEMS

In recognition of your company's contributions to the future development of 'Hybrid Heat Pump' and in honor of your dedicated commitment to Korea's high technology exports and national competitiveness.

November 9, 2023

Bang, Moon Kyu
Minister of Trade, Industry & Energy
Republic of Korea



2023
세계일류상품 인증서 수여식
World-Class Product Show 2023

B46

E2SOLUTION

회 사 명	㈜한국형냉난방시스템	대 표 자	이종문
전 화	031-455-5360	홈페이지	e2solution.kr

회사소개

[법인창업(2017. 10. 27)]
-Smart Farm용, Smart Factory, Smart City용 실외기 없는,폐열회수 복합열원 하이브리드 히트펌프개발 완료(2020. 6)
· 2020 대한민국 물산업 혁신창업대전 장려상/UN SDGs협회장 수상/11.21
· 2021년 대한민국 발명특허대전 금상 수상(중소벤처부장관상,특허청)/12.1
· 2022년 산업부 제33차 사업재편승인(신성장신기술)/4.1
❶'폐열회수-지능형'건축물 인공지능(AI) 에너지 통합관리 시스템 개발
· 2022년 미래 한국 아이디어공모전 입선(기획재정부)/10.12
· 2022년 지식재산 스타트업 경진대회 장려상(특허청)/11.1
· 2022년 3차 우수특허기반 혁신제품 선정(특허청, 3년간 공공기관 수의계약/12.26
· 2023년 제58회 발명의 날 국무총리 표창(5.12.)
· 2023 WORLD SMART CITY EXPO 우수기업 페어 선정(과기부,국토부)/7.21
· 2023 WORLD SMART CITY EXPO Awards 수상, 에너지&환경부문/9.7

제품설명

1. 제품명 : 실외기없는, 폐열회수 지능형 'K-냉난방' 하이브리드 복합열원 히트펌프시스템[공기+물+태양광 ESS융합]
2. 기후변화 대응을 위한, 온실가스 감축-에너지효율 솔루션, K-냉난방
-'에너지효율과 탄소배출량(보일러 대비)㉮에너지효율 462.5%향상 ㉯탄소배출량 78.4% 저감)
①(원천기술) 1대에 재생에너지 '2개열원(공기+물)+1개 태양광 ESS' 융합
②최고효율 (COP3.7(7℃)/COP3.3(1.5℃)/COP2.7(영하15℃)(KITECH, 2018-03-28)
③(원천기술) 대기중 배출하는 50℃이상 '폐열(응축열)' 회수기술(온수 무료생산)
④원천기술) 4way-valve 삭제기술 ❶겨울철 착상(着霜)원천 방지❷일방향 냉매순환(냉방,난방,제상)
3. 전기자동차 베터리 성능 향상
-겨울철 -7℃ 이하에서도 '전기자동차 베터리 성능저하를 개선'(공기증발, 공기응축열(베터리 열공급배관), 물응축(실내 냉난방)
4. 학교급식종사자 '조리흄에 의한 폐암' 발병 개선
-1대로 '냉난방+공기순환 + 환기' 동시 가능, K-냉난방시스템

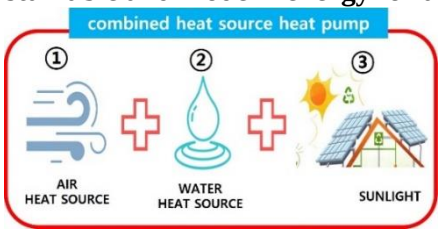
제품이미지

[스마트팜용 K-냉난방히트펌프] [스마트팜, 스마트팩토리]

Ministry of Trade, Industry and Energy
kotra

㈜한국형냉난방시스템

7. Ensure access to affordable, reliable, sustainable and modern energy for all



13. Emergency response to combat climate change and its impacts

Greenhouse Gas Reduction
-Energy Efficiency Improvement(37%), Solution

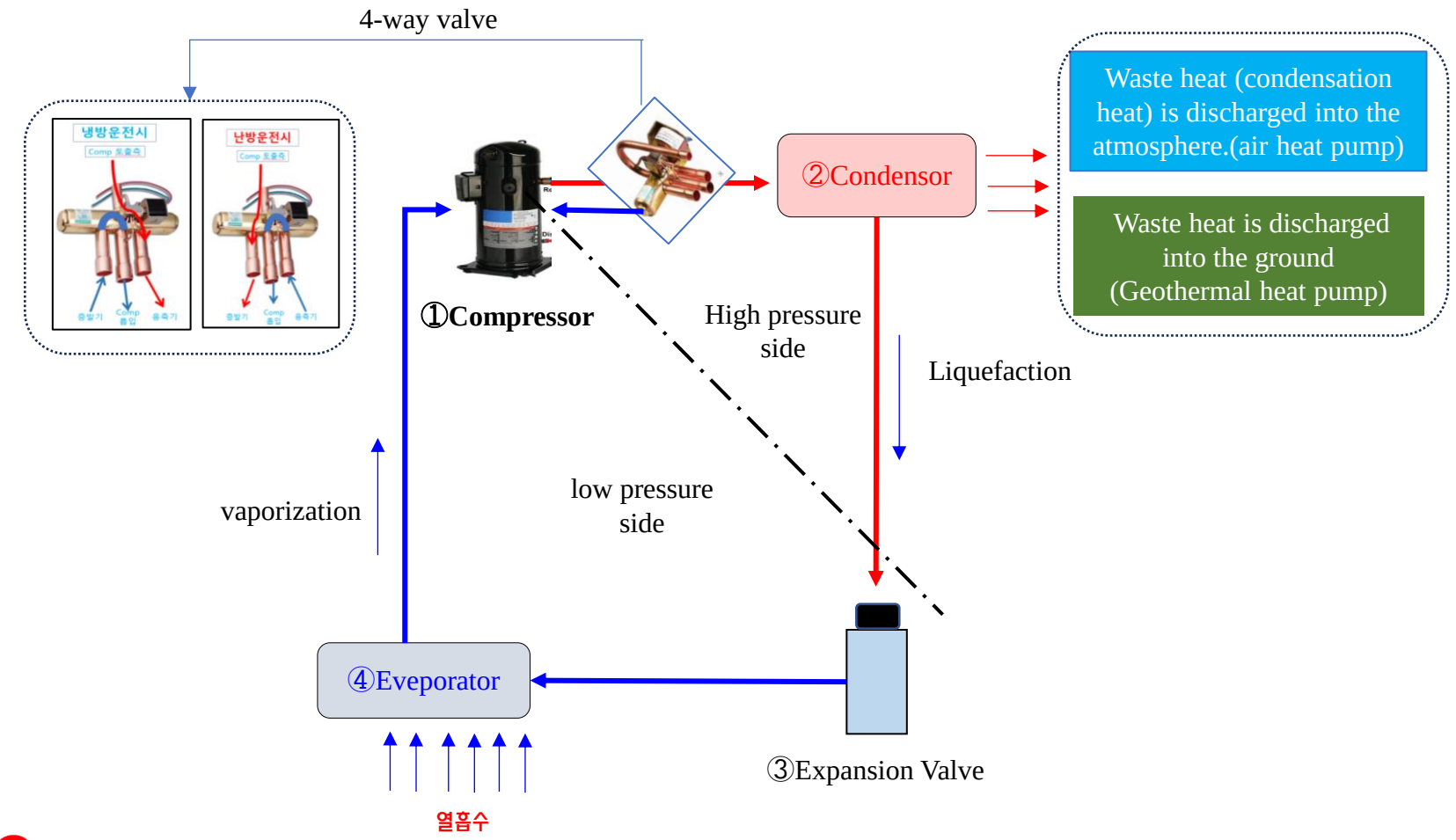
Contribution to greenhouse gas reduction

17 goals announced by the United Nations in 2015 for sustainable development

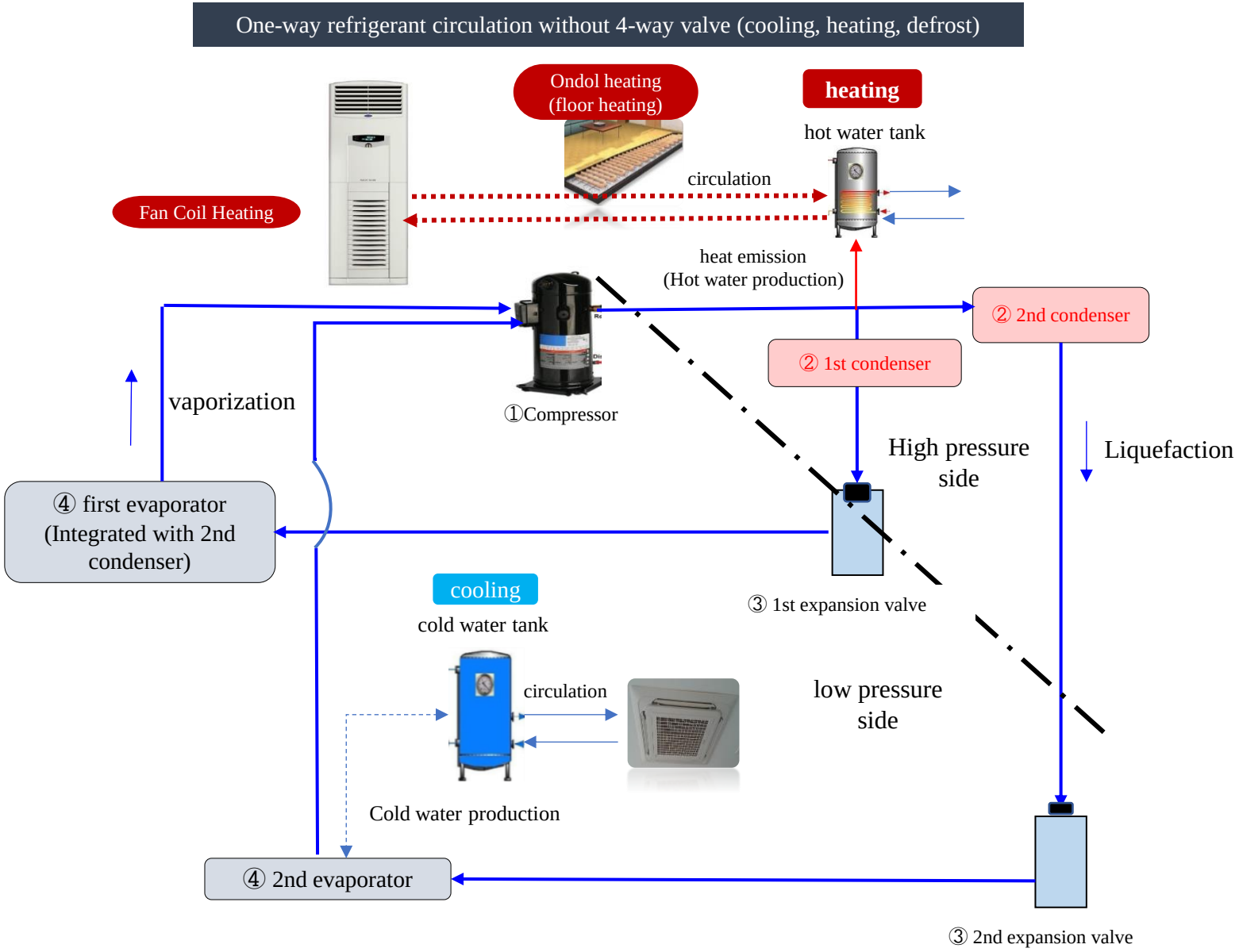
Solution(Existing refrigeration cycle)

Single heat source heat pump cycle (air source heat pump)

4-Way Valve (Reversing Valve) - Cause of increased power consumption



K-cooling/heating hybrid composite heat source heat pump system configuration diagram

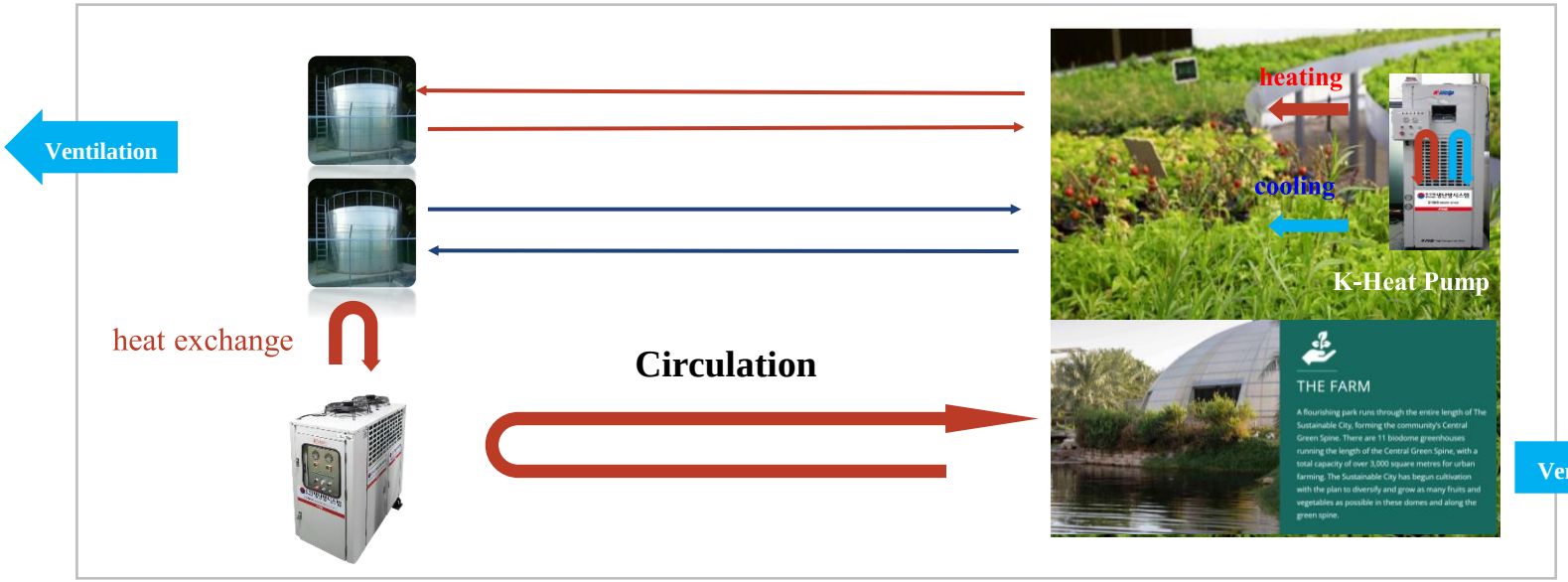


㈜한국형냉난방시스템

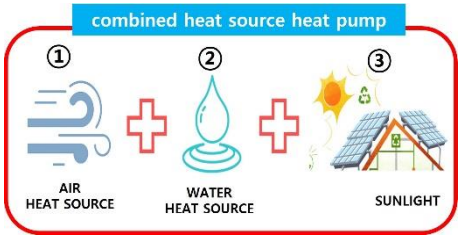
- Complex heat source: energy production (evaporation) from (air + water)
- Hybrid: obtain energy from air or water simultaneously or separately

Multi-heat source cooling/heating system applied to SMART Farm [Air heat source 50% + Water heat source 50%]

There are 11 biodome greenhouses running the length of the Central Green Spine, with a total capacity of over 3,000 square metres for urban farming.



Division	'K-cooling and heating' heat pump system
Heat source	• 100 % (water source 50% + air source 50%)
Heat source supply type	• (cold/hot water + cold/warm air) + air circulation + ventilation
Breakdown	• replace immediately

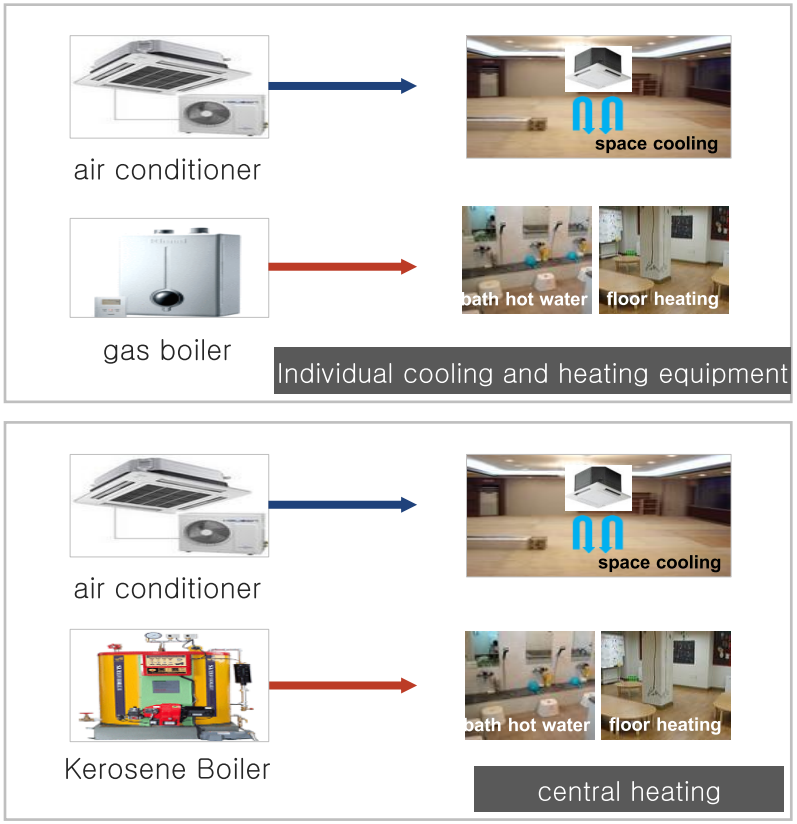


There are design differences depending on the region and space.

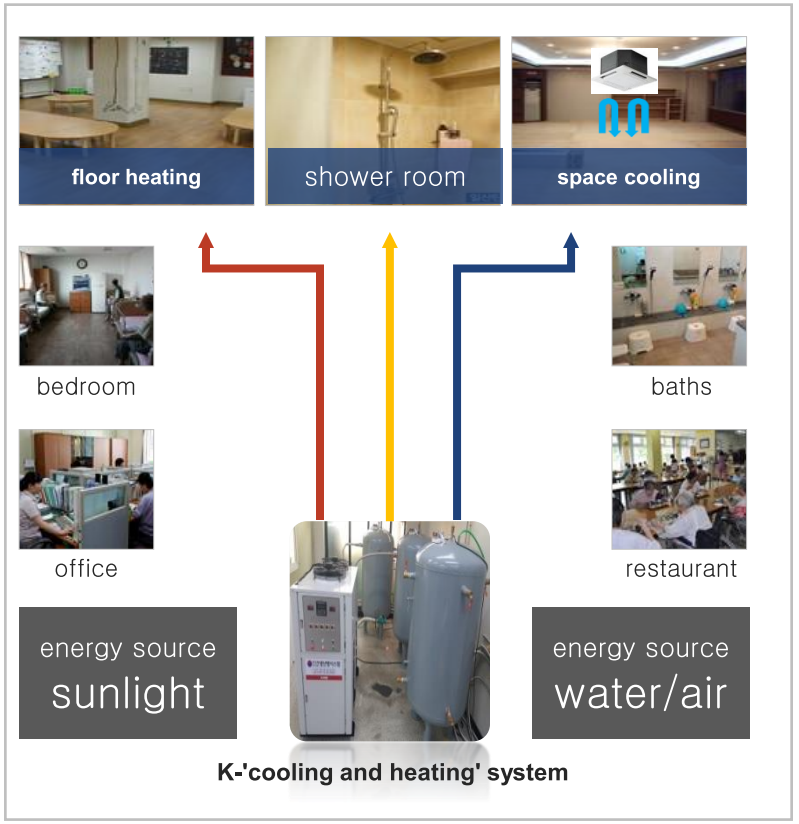
Cooling and heating, proposal 4

- Nursing home and welfare center, public building, SANAD AUTISM VILLAGE

Existing cooling/heating(in korea)



K-cooling & heating Air source 50% + Water source 50%

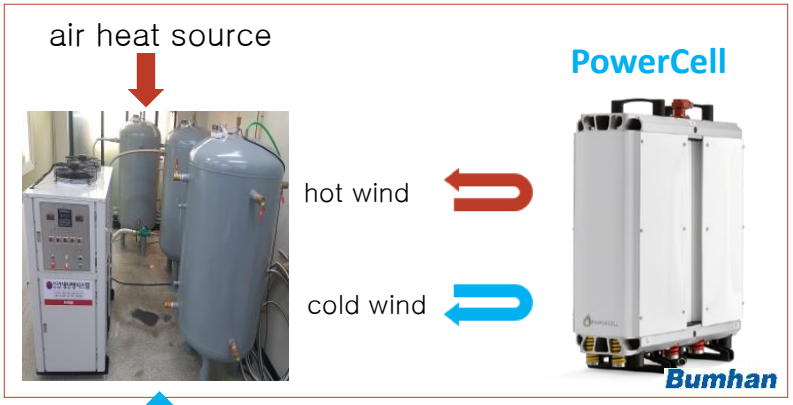


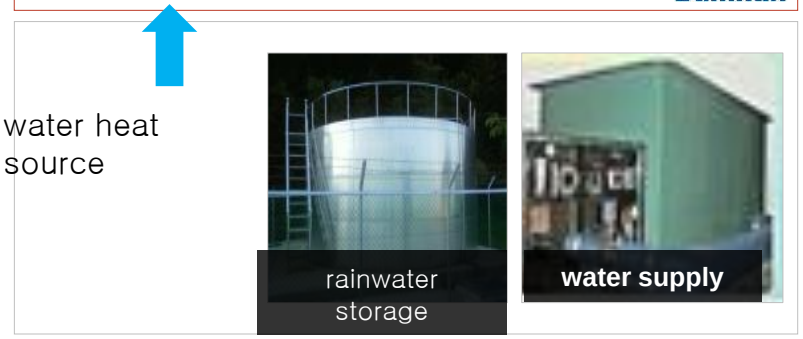
1. No need for gas (oil) boilers and air conditioners
2. Eco-friendly house
3. Reduce nuclear power by using renewable energy
4. No need for gas (LNG) piping by using electricity for cooking

K-Cooling and heating, proposal 5

-school, DIAMOND INNOVATION CENTRE, FAIRGREEN INTERNATIONAL SCHOOL(green living)

Air source 50% + Water source 50%





1. 100% renewable energy (solar power generation, fuel cell power generation)

① Air heat source + Water heat source

② Decreased fossil fuel and gas imports

③ CO_2 emission reduction → environmental protection

④ ZERO (zero) energy → Solar ESS, late-night electricity ESS

2. Energy saving

① Efficiency over 462.5% of general boilers (compared to boilers) ② Cooling in summer → Recovery of waste heat (condensation heat) from the outdoor unit

③ Heating in winter → Prevention of frost (prevention of the cause of rapid increase in power consumption)

→ Free production of hot water (shower, etc.)

→ One-way refrigerant circulation method (remarkable energy saving)

3. Pleasant educational environment

① Eco-friendly because there is no outdoor unit

② Provide floor heating for sleeping quarters, etc.

③ Ondol heating for lower grade classrooms

④ Parents' economic activities are convenient by installing preschools and kindergartens in schools

⑤ Prevention of lung cancer in school food workers

→ Cooking room, heating/cooling + ventilation function

→ Kitchen, free hot water supply

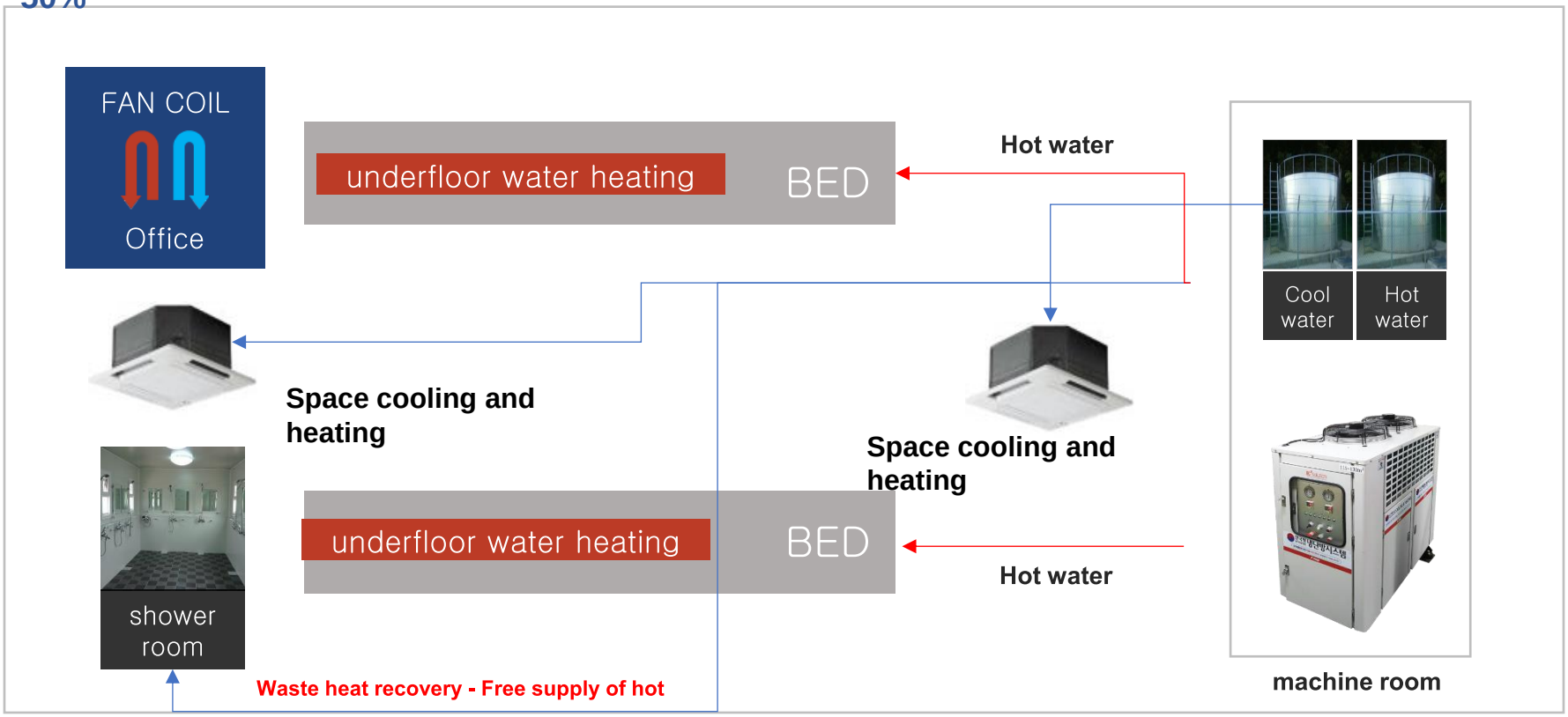
4. Dramatic reduction in carbon emissions

① 78.2% reduction in carbon emissions (compared to boilers)

K-Cooling and heating, proposal 6

- Army

Air heat source 50% + Water heat source 50%

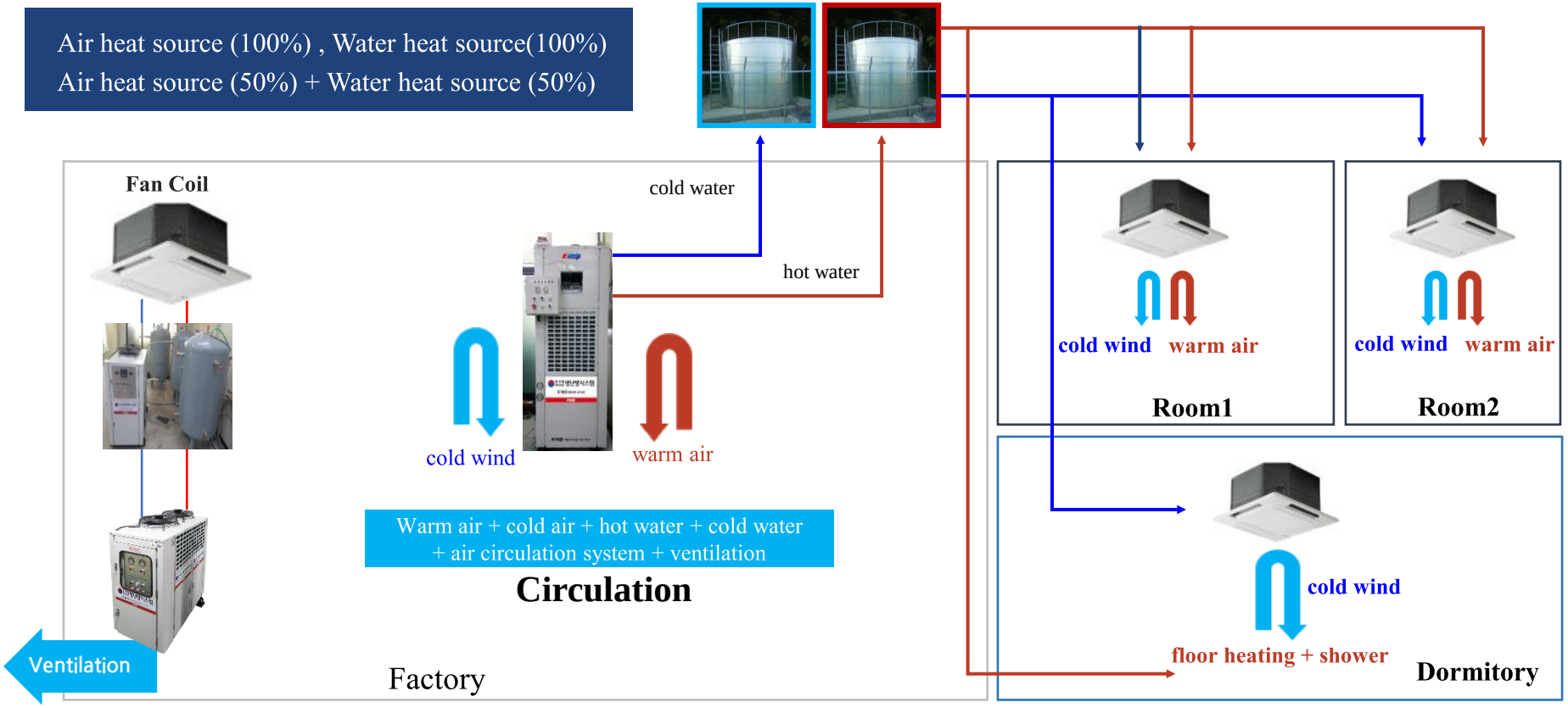


1. Bed: Floor heating (coil installed)
2. Office: FAN COIL space cooling and heating
3. Shower room, bath: hot water supply (free hot water supply during cooling)4. Energy saving
   ① Efficiency over 462.5% compared to general boilers
   ② Cooling in summer → Saving electricity by using waste heat (condensation heat) from the outdoor unit
   ③ Heating in winter → Frost protection (prevention of increased power consumption)

K-Cooling and heating, proposal 3

- Smart factory, industrial [factory] (combined heat source heat pump)

E2SOLUTION



[Production site + 2 offices + dormitory]

- Simultaneous cooling and heating system without outdoor unit

- Cooling and heating at production sites + cooling and heating in dormitories
- During the cooling season in summer, hot water (shower, laundry) production energy is free without a boiler / automatic ventilation function in the production plant
- Simultaneous heating and cooling of factories and offices

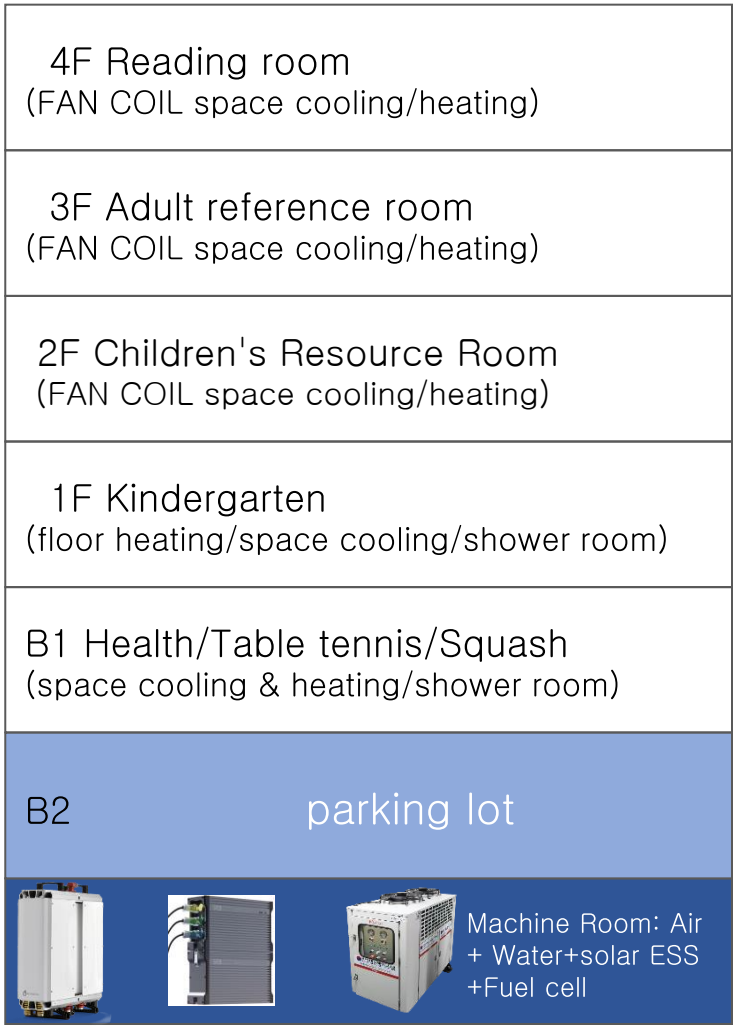
K-Cooling and heating, proposal 7

- Library/Kindergarten/Gym

Air heat source 50% + Water heat source 50%

Library/Kindergarten

1. Install the system in the underground machine room (noise prevention)
2. Ground and rooftop environment improvement (no air conditioner outdoor unit)
3. Hot water production using waste heat from air conditioners (free supply of shower water to B1 gym, etc.)
4. Renewable energy facilities
   ① Solar power – used as K-cooling and heating power
   ② Solar ESS – Used for K-cooling and heating assistance
   ③ Fuel cell– Used as K-cooling and heating power

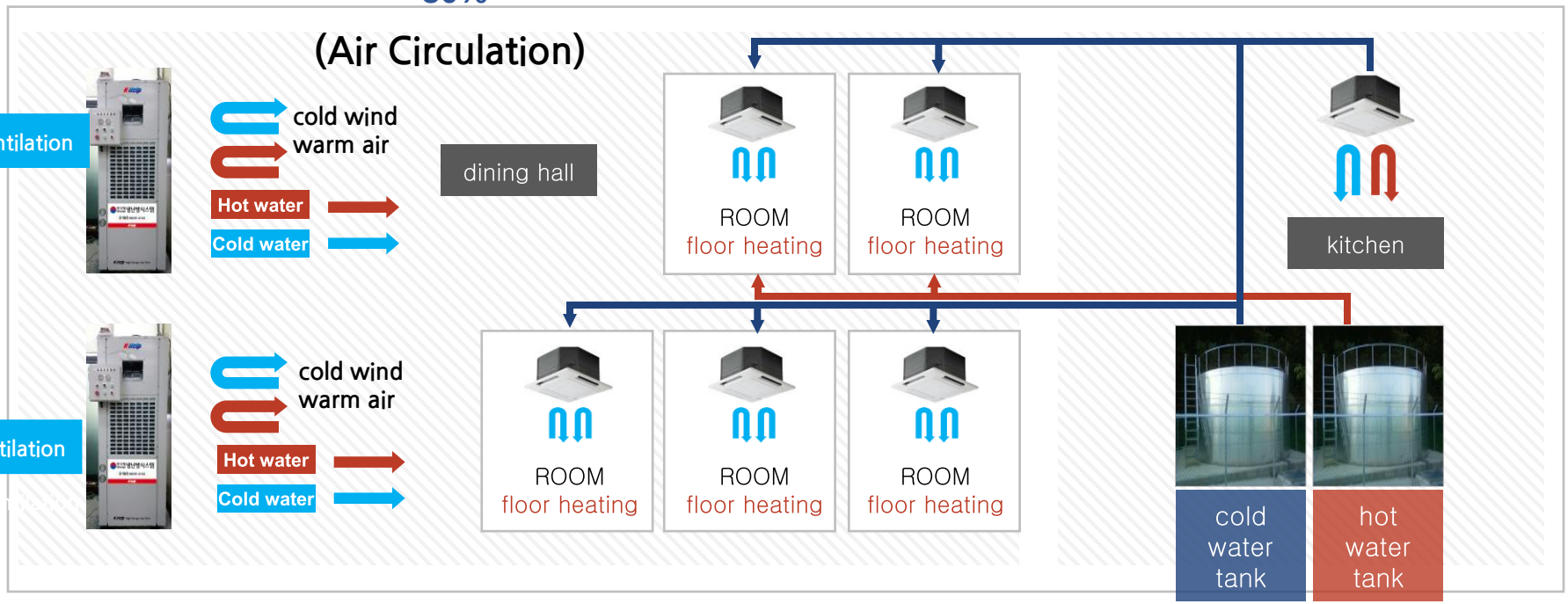


K-Cooling and heating, proposal 8

- Restaurants

Air heat source 100%

Air heat source 50% + Water heat source 50%



1. Installation of 2 K-heat pump systems 5 HP: Installed in the restaurant hall

2. Installation of hot water tank and cold water tank of 2 tons each: kitchen/outdoor installation

3. Restaurant hall: Space cooling/heating + air circulation

4. Restaurant ROOM ① Floor heating (heating coil installation) ② FAN COIL cooling

5. Restaurant kitchen ① FAN COIL space cooling/heating ② Kitchen hot water

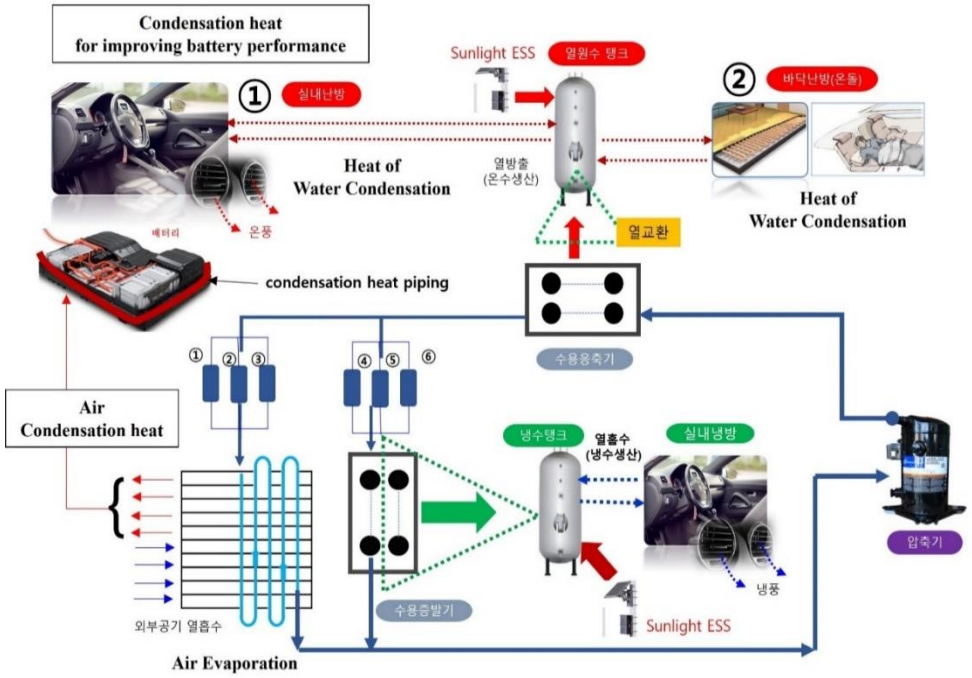
6. Ventilation function: The heat pump itself also functions as a ventilation function, so there is no need for a separate ventilation device.

There are design differences depending on the region and space.

K-Cooling and heating, proposal 5

- Proposal for Improving Electric Vehicle Battery Performance

Electric Vehicle, Heating&Cooling + Ondol System Configuration Diagram



This is a basic system proposal, and there may be differences in design depending on the region and space.

[Electric car fire]

- 12 cases in 2020
- 15 cases in 2021
- 33 cases in 2022
- 34 cases in 2023, total cumulative 94 cases

[Number of newly registered electric vehicles in Korea]

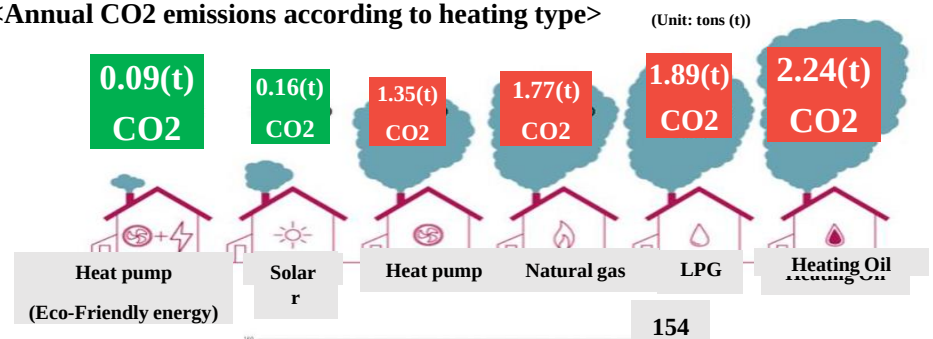
- 46,623 units in 2020
- 100,355 units in 20211
- 64,324 units in 2022

- 16 cases (17%) are accessories installed in vehicles, such as black boxes, auxiliary batteries, and portable chargers.
- Of the 78 cases, 51 (54.3%) fires occurred in ‘high-voltage batteries’.More than half of all electric vehicle fires are caused by batteries

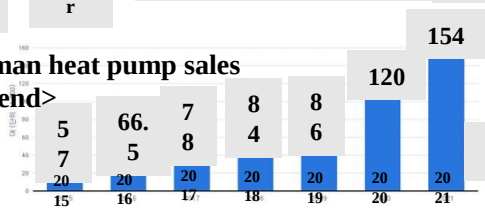
Current status of Germany's heat pump market

<Annual CO2 emissions according to heating type>

(Unit: tons (t))



<2015~2021 German heat pump sales trend>



(Unit: 1000 units)

*Note: 4-person household and 200m² multi-family home

[Data]: Statista, German Heat Pump Association

<2021 German heat pump sales and scale>

	Air/water heat pump	Geothermal heat pump
Sales	127,000 Units	27,000Units
Share rate	82%	18%
Growth rate	33%	10%

154,000Units

K- COOLING & HEATING, Heat pump

- ① Air source heat pump
- ② Water source heat pump
- ③ Geothermal source heat pump

→ Complex heat source, Multi Heat Pump

K-Cooling and Heating, Hybrid Heat Pump is the first technology that uses all available energy as a heat source

㈜한국형냉난방시스템

[Source: German Federal Environment Agency (Umweltbundesamt), dein-heizungsbauer.de]

[Data]: Statista, German Heat Pump Association kotra

Korean Cooling and Heating system product group

Korean cooling and Heating System has a product line of heat pumps for apartment/industrial and rural areas, and can achieve cold and hot water temperatures from a minimum of 8 degrees to a maximum of 55 degrees.

	For home use/pension/return to rural areas	For apartments/buildings			For industry/agriculture/fish farms	
						
contents	Fan coil heating/cooling, hot water supply, floor heating	Fan coil heating/cooling, hot water supply, floor heating	Fan coil heating/cooling, hot water supply, floor heating	Fan coil heating/cooling, hot water supply, floor heating	cold wind, warm wind, Ventilation	cold wind, warm wind, Ventilation
Heating capacity	18,500 W	37,000 W	55,500 W	83,250 W	18,500 W	37,000 W
Cooling capacity	16,850 W + 22,000 W(hot water)	33,700 W + 44,000 W(hot water)	50,550 W + 66,000 W(hot water)	75,825 W + 99,000 W(hot water)	16,850 W	33,700 W
Cold/hot water temperature	8°C / 55°C	8°C / 55°C	8°C / 55°C	8°C / 45°C	10°C / 45°C	8°C / 55°C
Power Consumption	5Kw/h (165m^2)	10Kw/h (330m^2)	15Kw/h (495m^2)	20Kw/h (660m^2)	5Kw/h (165m^2)	10Kw/h (330m^2)

(주)*

Test results (accredited)

성적서 번호 : C18N530010

페이지 (3)/(총5)

KITECH

시험항목	온수측(부하측)				열원측					Power Consumption
					Air heat source	Water heat source				
	입수 온도	출수 온도	유량	난방 용량	공기 건구/습구	입수 온도	출수 온도	유량	열량	national standard 21Kw/h
	℃	℃	L/min	W	℃/℃	℃	℃	L/min	W	
난방능력시험 1	40.1	45.2	105.5	36 976	▶7℃	15.3	10.2	61.4	21 620	▶10Kw/h
난방능력시험 2	40.1	44.7	104.1	32 910	▶1.5℃	15.2	10.0	58.7	21 075	▶9.8Kw/h
난방능력시험 3	40.1	43.6	104.7	25 188	▶-15℃	15.1	10.0	58.5	20 599	▶9.4Kw/h
난방능력시험 4	40.0	46.1	105.2	44 096	▶35℃	12.2	7.6	59.8	18 996	▶10.3Kw/h

Based on 660(M2) power consumption

[참고자료]

[참고]히트펌프(냉난방기기)등의 냉난방효율에 관한 선정시 참고사항

시 험 성 적 서

한국생산기술연구원 KITECH

성적서 번호 : C18N530010

시 험 결 과 KITECH

Air heat source

Water heat source

구분	시험항목	팽창변	기본 분석									추가 분석		
			온수측(부하측)								소비전력		열원 비율	
			입수온도	출수온도	유량	난방 용량	공기 건구/습구	입수온도	출수온도	유량	열량		Air	water
			℃	℃	L/min	kW	℃/℃	℃	℃	L/min	kW	kW	kW	%	%
성적서 시험	난방능력시험 1	S1	40.1	45.2	105.5	36.976	7.1/6.2	15.3	10.2	61.4	21.620	10.081	5.275	20%	80%
	난방능력시험 2	S2	40.1	44.7	104.1	32.910	1.6/0.5	15.2	10.0	58.7	21.075	9.891	1.944	8%	92%
	난방능력시험 3	S3	40.1	43.6	104.7	25.188	-15.2	15.1	10.0	58.5	20.599	9.427	-4.838	-31%	131%
	난방능력시험 4	S1	40.0	46.1	105.2	44.096	35.2/24.0	12.2	7.6	59.8	18.996	10.372	14.728	44%	56%
추가 시험	난방능력시험 2-1	S1	40.3	44.8	104.8	32.410	1.5/0.7	15.6	10.4	59.3	21.289	9.906	1.215	5%	95%
	난방능력시험 3-1	S2	40.5	43.7	106.3	23.379	-15.0	15.0	10.2	60.0	19.884	9.662	-6.167	-45%	145%
	난방능력시험 5	S2	40.2	44.4	104.6	30.193	-2.5	15.1	9.9	59.3	21.290	9.806	-0.903	-4%	104%
	난방능력시험 6	S2	41.5	45.5	104.8	28.802	-3.2	10.6	5.7	58.7	19.865	9.983	-1.046	-6%	106%

외부공기 온도(℃)

▸Cause of rapid increase in power consumption when outdoor air temperature is below freezing

▸The heat pump loses its ability to secure heat source in sub-zero outside air temperatures.

* 분석의견
- COP는 여러가지 상황을 고려하여 성적서에 표기 하지 않으려 합니다.
- 당초 제시한 팽창변을 적용한 시험 결과치가 추가 제시한 팽창변 시험 결과치(능력 및 효율)보다 우수 하였음.
- 그래서 성적서 시험 조건을 결정하여 상기 4조건 결과로 성적서 작성 합니다.
- 열원 비율을 산정해 보았습니다. 참고 바랍니다.
- 열원 비율에 따르면 주변 공기온도가 0℃ 이하의 경우에는 공기열원을 사용하는 것이 무의미 하다고 판단되었습니다.

2018 . 03 . 22 .

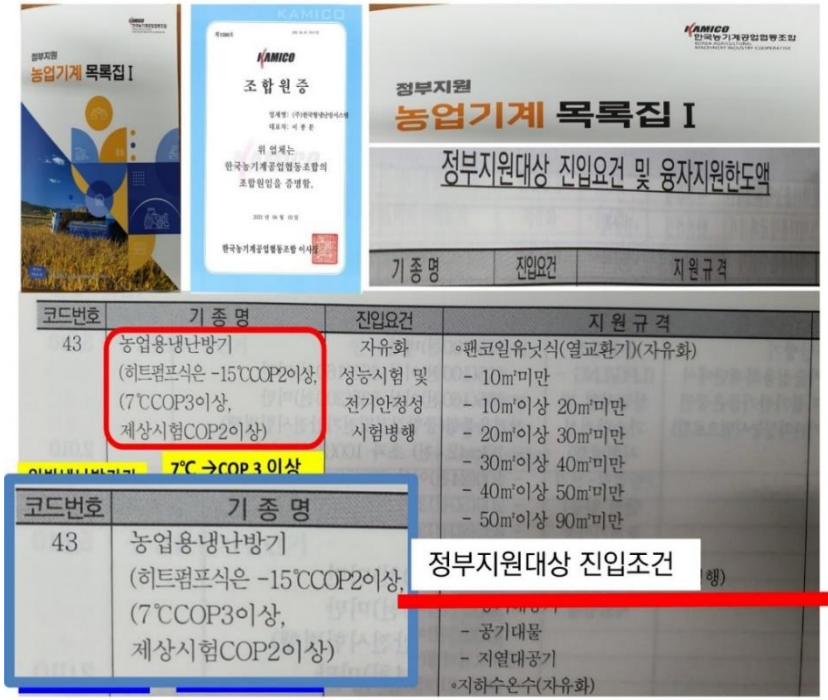
[참고자료]

[참고]히트펌프(냉난방기기)등의 냉난방효율에 관한 선정시 참고사항

정부 농기계진입조건 대비 경제성 분석

정부지원대상 농업용 냉난방 농기계(히트펌프) 진입조건 대비 50% 이상 COP 효율(사업성 확인)

(7℃ →23% 향상 / 1.5℃→65% 향상 / 영하15℃→ 35% 향상)



효율(표준난방, 제상난방, 저온난방, 냉방조건)

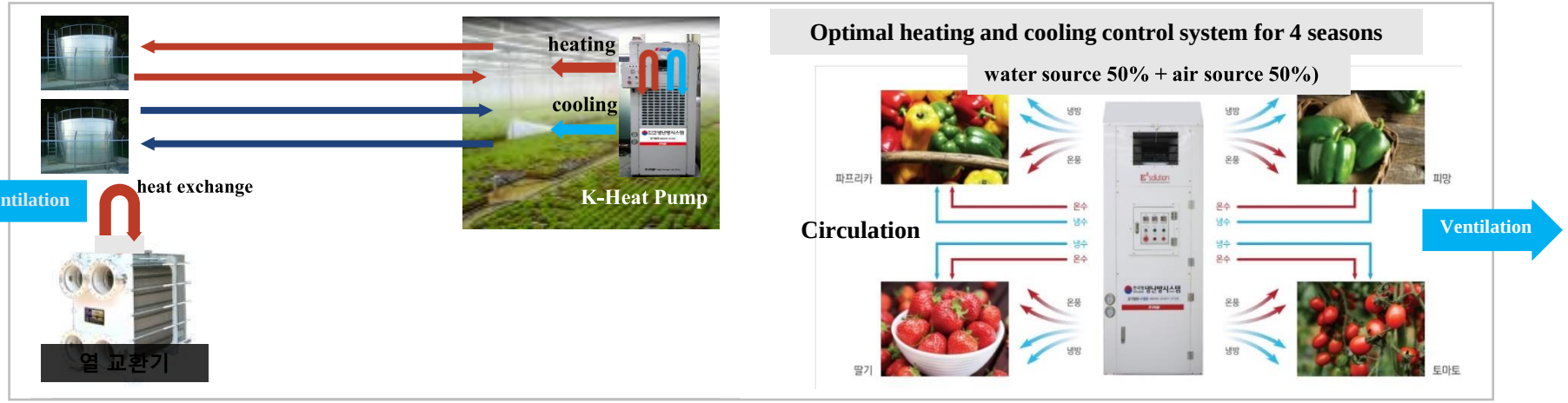
출처 : 정부지원 농업기계 목록집(2021. 7. 1, 한국농기계공업협동조합) *COP:Coefficient Of Performance(효율)

출처 : 공인인증 시험결과(2018. 2, 한국생산기술연구원 천안본원)

K-Cooling and heating, proposal 2

-Smart Farm, Four-Season Farming (Improvement of Agricultural Management Performance by Reducing Fuel Costs)

Multi-heat source cooling/heating system applied to SMART Farm
[Air heat source 50% + Water heat source 50%]



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