Atıksu Kaynaklı Isı Pompası ve Uygulamaları

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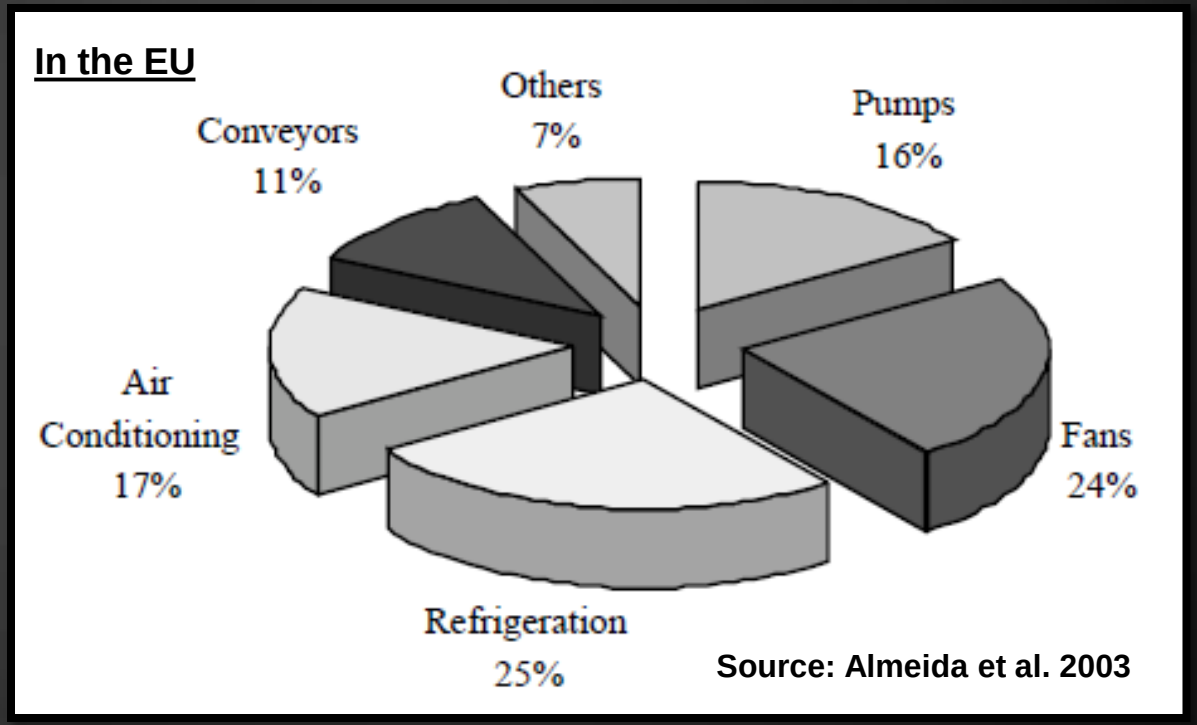
Atık Su ile Isıtma ve Soğutma Fırsatları Kolokyumu
Yaşar Üniversitesi-2 Aralık 2015

Outline

- Introduction
- WWHP utilization
- Applications
  - Worldwide
  - Turkey
- Conclusion

Heating and cooling of the buildings occupy the largest portion of overall energy consumption in domestic use (more than 40% in the EU)



We need to reduce this amount (40%) for the sustainable world. We can save energy by using more efficient heating/cooling systems.

Solution(?)

Efficient Heat Pump (HP) can be one of the solutions.

- Using efficient thermal sources
- Using variable speed compressor
- Renewable energy powered HP

HP is not new\ but using WW is more efficient than others.

Thermal Source	Source Temperature Range (°C)	
	Winter	Summer
Air (ambient)	-10 /15	26/45
Ground Water	4/15	6/18
Lake Water	0/15	10/20
River Water	0/15	8/18
Sea Water	4/15	10/25
Ground	0/15	10/20
Wastewater(WW)	9/14	26/29

Why wastewater; because we are wasting energy through wastewater

- **Daily fresh water utilization per person 217 liter/day**
- **Daily wastewater production per person 182 liter/day (%84 of fresh w.)**
- **In Izmir daily total wastewater ≅600.000 m^3/day**
- **For ∆T= 1℃ about Q ≅ 700 MWh/day**
- **Wastewater temperatures in Izmir (typical Mediterranean climate)**

  Winter 9-14^oC

  Summer 26-29^oC

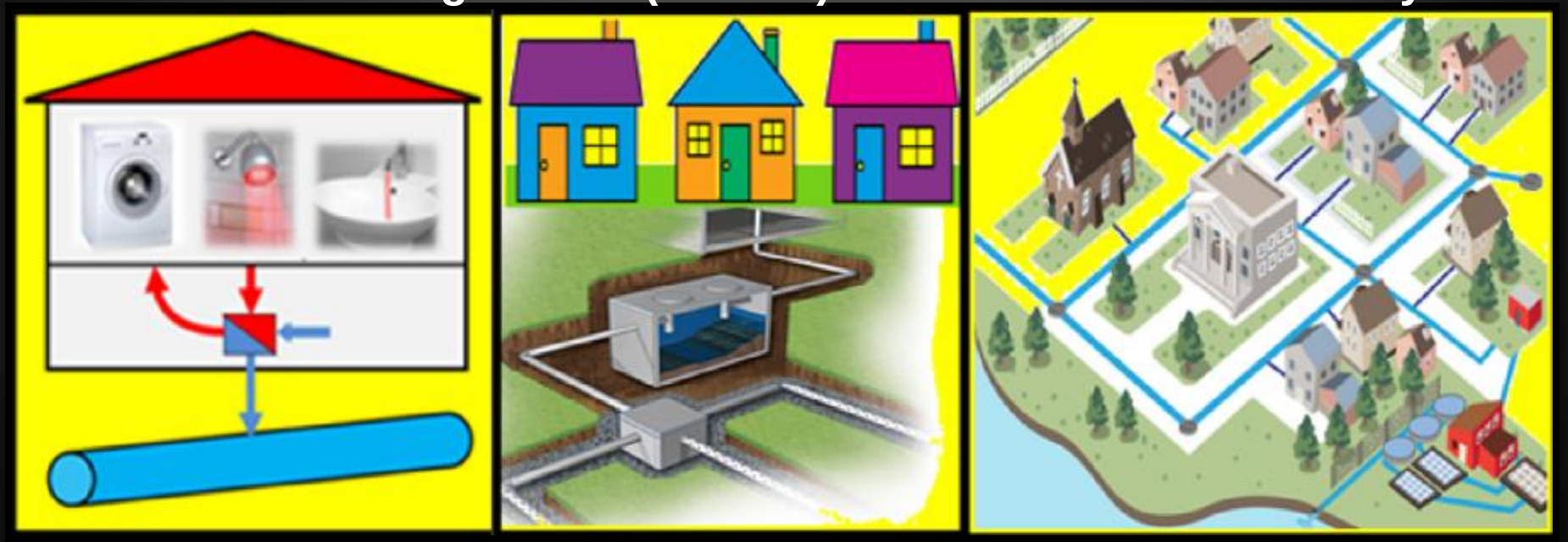
- **WW temperature changes depending on the amount of WW, region, WW source and season, etc.**

Utilization of wastewater for HP;

Inside the building

Outside the building (We use)

Outside the city



Under the tap

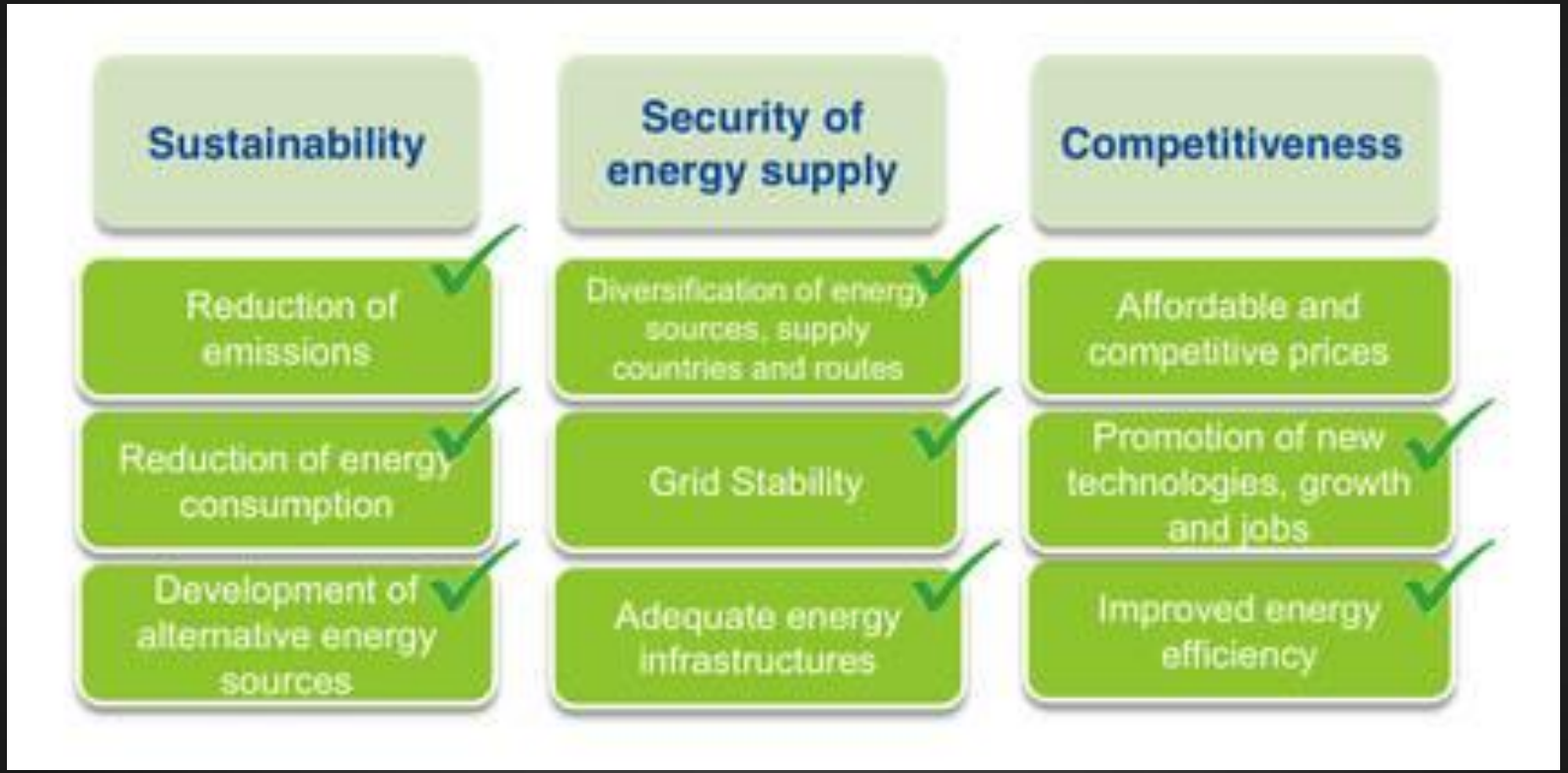
In WW pipe line

In WW treatment plant

Europe heat pump utilization scenario until 2020 (Source: EHPA)

- Installed capacity: 35,6 GW_{th}
- Energy provided: 191,62 TWh_{th}
- RES integrated: 131,1 TWh
- GHG emission saved: 34,4 Mt
- Primary energy save: 80,2 TWh

Europe heat pump utilization 2030 targets:

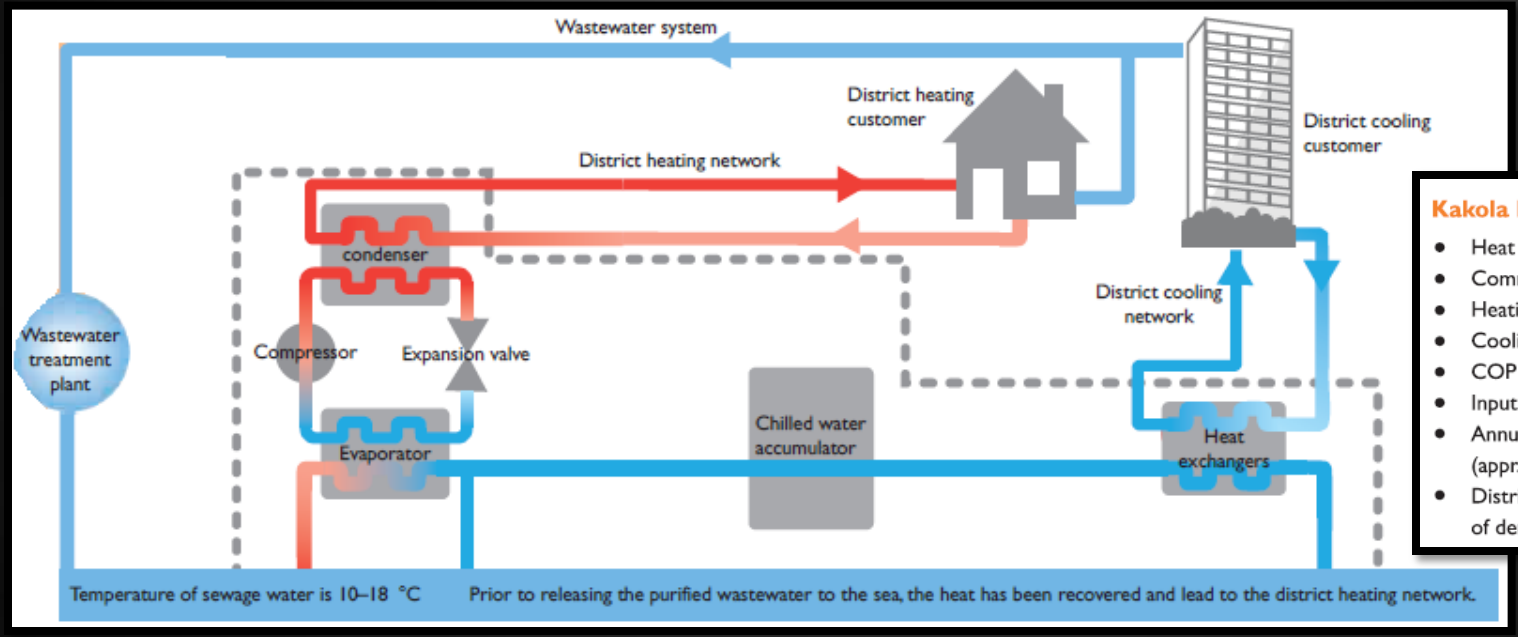


Source: EHPA-http://www.ehpa.org/projects/heat-pump-panel/

Worldwide Applications of Wastewater Heat Pump(WWHP) systems

1-) Kakola WWHP Plant:

Located in Turku-Finland. District heating and district cooling from treated wastewater.



Kakola Heat Pump Plant

- Heat pump plant utilizing treated wastewater
- Commissioned 2009
- Heating power 21 MW
- Cooling power 14.5 MW
- COP 3.3
- Input power (electricity) 6.5 MW
- Annual district heating production 160 GWh (appr. 8 % of Turku demand)
- District cooling production 90 % of demand

CO_2 reduction is 50.000 ton yearly

2-) Chicago Water Reclamation HP Plant:

Heating&cooling in the reclamation building. Collaboration with University of Illinois Chemical Eng. Dept.
Average temp. of water 55 ^{o}F (12.7 ^{o}C)

3-) Amstetten WWHP Plant:

Located in Austria, established in 2012, about 400 single-family homes can be heated and cooled.

- **WW from city channel for heat pump (heating and cooling)**
- **210 m district heating pipe (from channel to building)**
- **1 heat pump of 230 kW**
- **COP 5.6**
- **Annual CO_2 reduction: 55 tons (72%)**
- **85% more energy-saving than gas boilers**

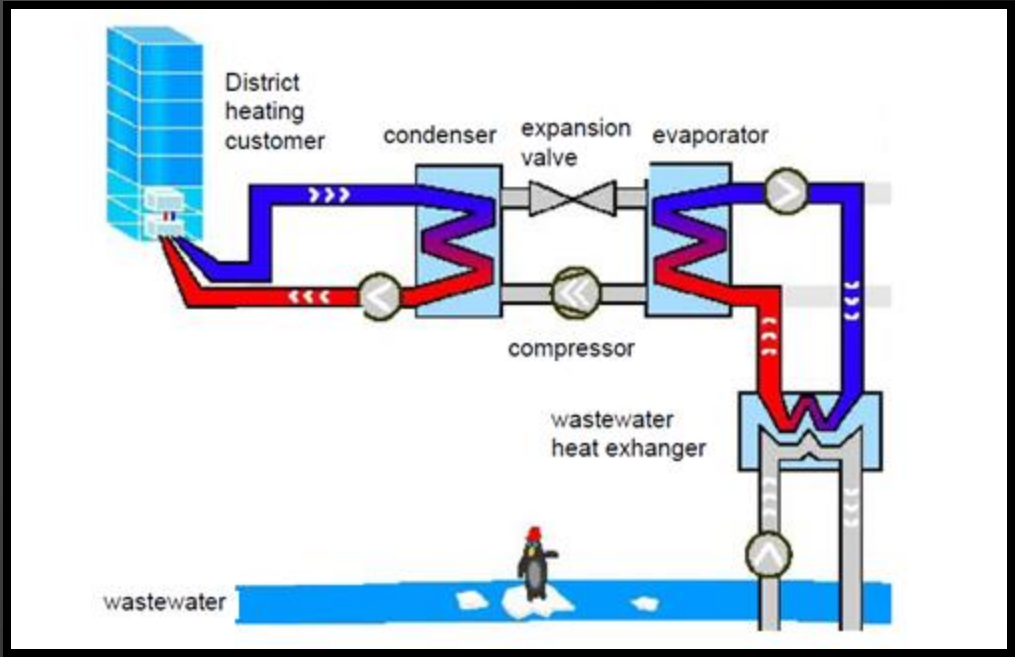
4-) Katri Vala WWHP Plant:

Located in Helsinki-Finland. District heating and cooling from <u>treated</u> wastewater. Connected population 800 000 person and wastewater flow 260 000 m^3/h

- **Heating power 5x18 MW (45-88 ^oC)**
- **Cooling power 5x12 MW (20-4 ^oC)**
- **Electrical motor cap. 6500 kW/10 kV**
- **Refrigerant R134a**

<u>Waste water heat exchangers</u>

- **Capacity 24 MW**
- **Temperature (wastewater) 12-6 ^oC**
- **Temperature (cooling) 4-10 ^oC**



5-) Located in Bochum Germany. Pool heating. 200 m away from the WW line.

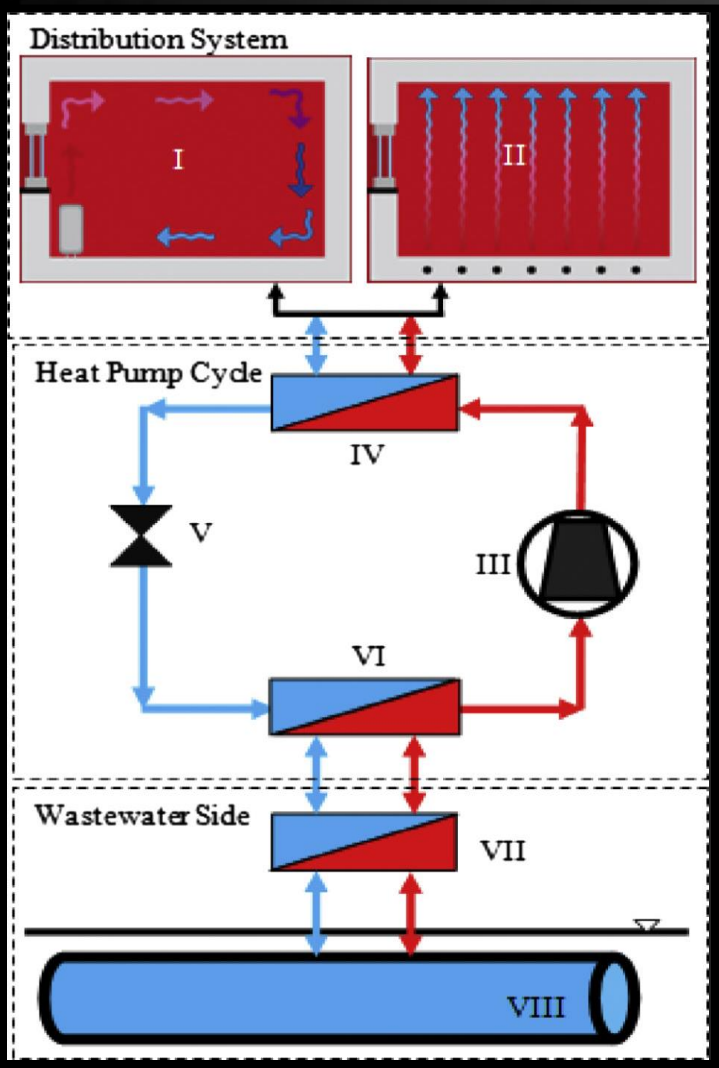
- **Average 12 ^{o}C wastewater**
- **Heating to 50-55 ^{o}C**
- **Gas for heating decreased from 2952 MWh/a to 1,857 MWh/a by using WW**
- **CO_2 emissions reduced by 220 tons (37%)**

WWHP System in the market;

Model			IWM-12B-34	IWM-12B-38	IWM-12B-51	IWM-12B-67
Performance		KW	117.79	133.6	180.47	235.7
		Kcal/h	101,300	114,900	155,200	202,700
		USRT	33.5	38	51.32	67.03
Power Consumption		KW	32	38	50	58
Power Supply			3Phase x 380V x 60Hz			
Compressor Capacity		HP	30	36	48	56
Dimension	Length	mm	1,200			
	Height		1,940			
	Depth		760			
Compressor	Type		Scroll type			
	Quantity		2		4	
	Operation Method		Direct-on-line			
	Volume Control	%	0~100%			
	Refrigeration Ton	RT	10.7	12.36	16.48	19.68
Refrigerant	Type		R-22			
	Control Method		Thermostatic expansion valve			
Heat Exchanger at Load-side	Type		Brazed Plate type			
	Circulation Volume	LPM	52.76	59.84	80.83	105.57
	Piping(IN/OUT)	A	40		50	
Heat Exchanger at Heat source -side	Type		Spiral Tube Type			
	Piping(IN/OUT)	A	125			
Control	Temperature Control		Automatic inlet/outlet temperature control			
	Operation Control		PCB			
Weight		kg	450	500	600	680
Operational Condition			Supply side (entry) temp to be 28°C; discharge side (exit) temp to be 80°C; Waste water temp to be 25°C			

The above specification may vary depending on the site and temperature conditions.
The above specification may change without prior notice for further improvement.

Wastewater Source Heat Pump Systems in Turkey



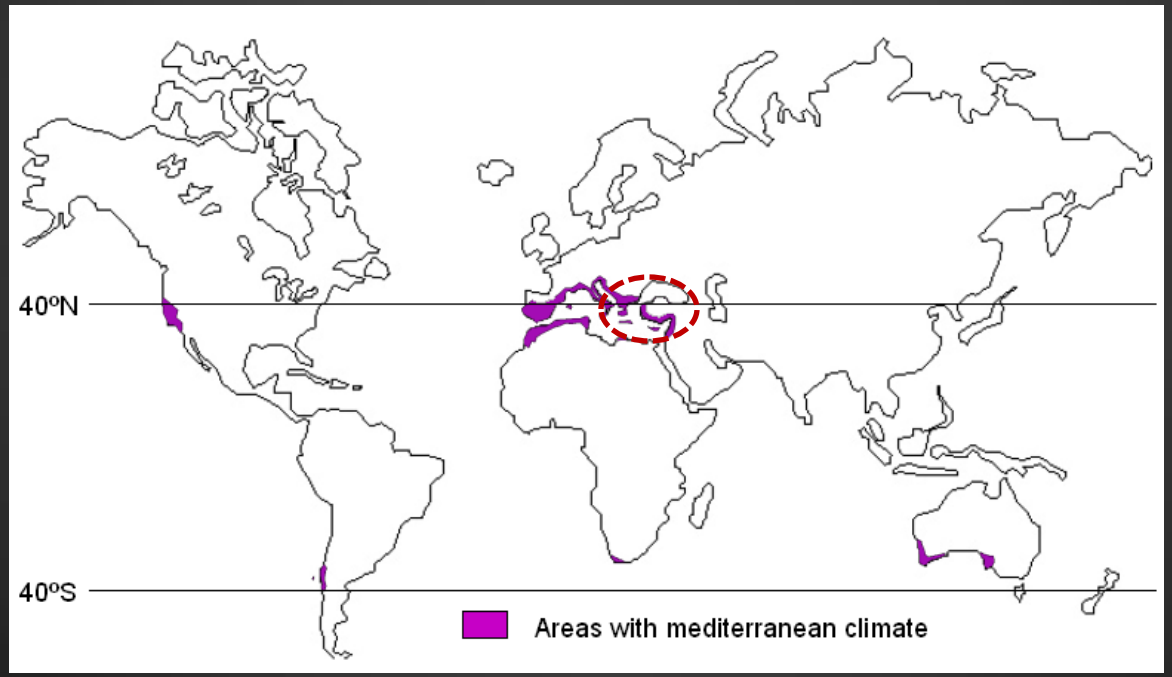
I- Fan-coil system, II- Air channel, III- Compressor, IV- Condenser/Evaporator, V- Expansion valve, VI- Evaporator/Condenser, VII- Wastewater HX, VIII- Wastewater line

In our WWHP System;

Air to Water HP	Specifications
Heating	~8 kW
Cooling	~5 kW
Air Side HX	Aluminum fin- copper pipe
Water HX	Plate type
PVT	5x190 W (electrical) and 460 W (thermal) •DC compressor of HP partially powered by PV •Auxiliary heating from PVT
WW HX	Special design

• This project was funded by the national research council of Turkey (TUBITAK) while it was the first application in Turkey.

• Our aim is to expand this application on a city scale in Izmir and also other cities in Turkey.



Energy Conversion and Management 88 (2014) 700–722

Contents lists available at ScienceDirect

Energy Conversion and Management

journal homepage: www.elsevier.com/locate/enconman

Review

A key review of wastewater source heat pump (WWSHP) systems

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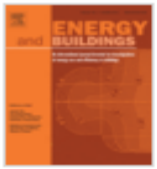
Energy and Buildings

Volume 104, 1 October 2015, Pages 215–232



Review

Heat exchanger applications in wastewater source heat pumps for buildings: A key review

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Received 16 March 2015, Revised 30 May 2015, Accepted 4 July 2015, Available online 8 July 2015

Thank you…

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