

CO₂ use in geothermal heat exchangers

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Monitoring

- Standardmonitoring
 - System information through measurement data and questionnaire
- Data bank
 - analysis of collected data
- Analysis
 - SPF
 - temperature trends
 - electrical Input, thermal Output
 - TEWI
 - emissions




Concept of monitoring

Questionnaire

- General Installation data
- Heat pump system
- Heat sink system
- Heat source system
- Domestic hot water preparation

Fragebogen für Referenzanlagen

Bitte beachten Sie, dass nur vollständig ausgefüllte Fragebögen zur Berichterstellung verwendet werden können.
Bei Fragen wenden Sie sich bitte an Tel.Nr.: 050550-6312



Ein Unternehmen der Austrian Research Centers.
Fax: +43 (0) 50550 - 6390

Anlagendokumentation

Installateur

Name _____

Adresse _____

Pltz _____

Ort _____

Telefon _____

Planer (falls Installateur nicht Planer ist)

Name _____

Adresse _____

Pltz _____

Ort _____

Telefon _____

Eigentümer

Name _____

Adresse _____

Pltz _____

Ort _____

Telefon _____

Nutzungszweck:

Einfamilienhaus	<input type="checkbox"/>	
Zweifamilienhaus	<input type="checkbox"/>	
Mehrfamilienhaus	<input type="checkbox"/>	
Büro	<input type="checkbox"/>	
Sonstige	<input type="checkbox"/>	_____

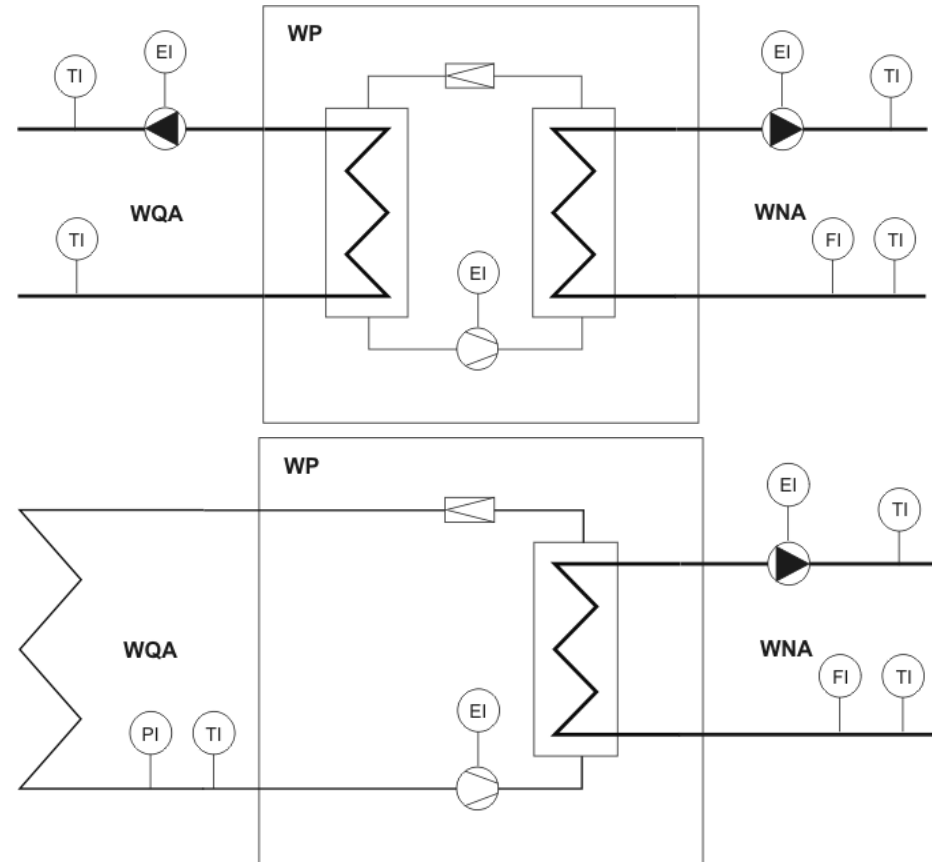
Die Anlagenauslegung lieferte folgende Werte:

Wärmebedarf lt. ÖNORM M 7500	_____	kW
Wärmebedarf lt. DIN 4701	_____	kW
Wärmebedarf lt. ÖNORM B 8135	_____	kW (alternativ)
maximale VL-Temperatur	_____	°C
Spreizung Heizung	_____	K
Spreizung Wärmequelle	_____	K
Beheizte Gesamtfläche	_____	m ²
Fußbodenheizung	_____	m ²
Wandheizung	_____	m ²
Radiatoren	_____	m ² (beheizte Fläche)
Andere Wärmeübertragung	_____	

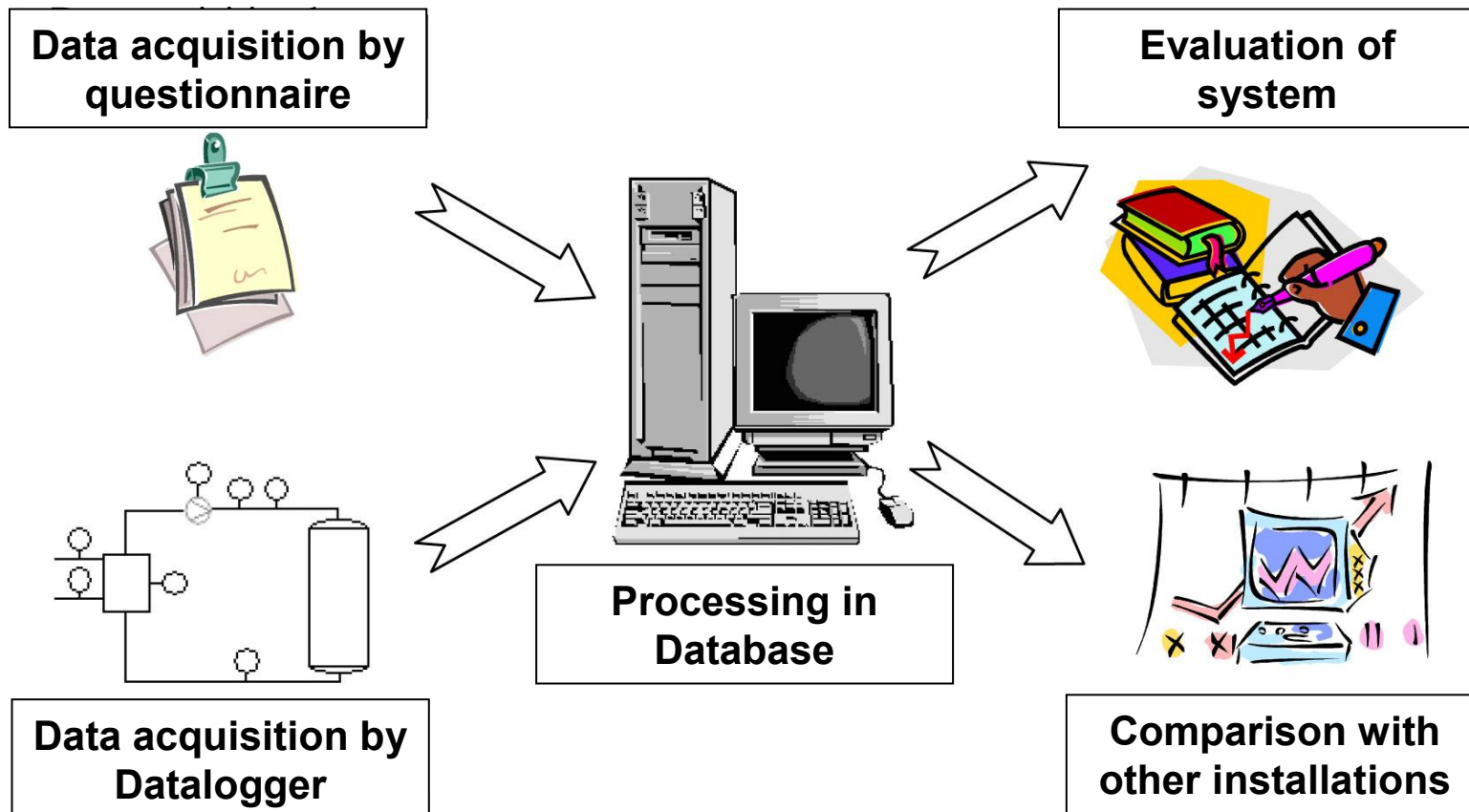
Concept of monitoring

Automatic data acquisition

- Data logger
- Data transmission by GSM-Modem
- Indoor and outdoor temperature
- ON/OFF-cycles of compressor
- Operational hours of heat pump

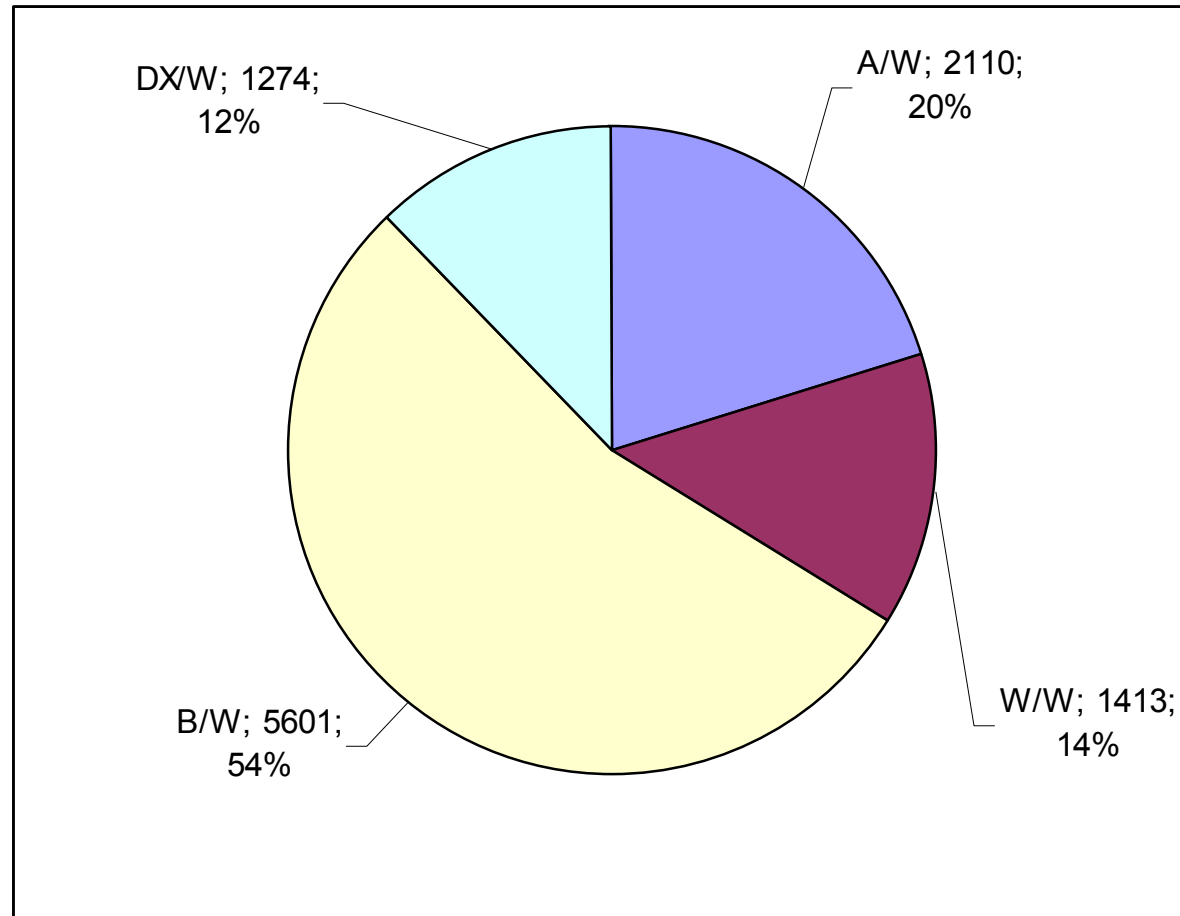


Concept of monitoring



Common Systems in Austria

- installed systems 2007 (10398)



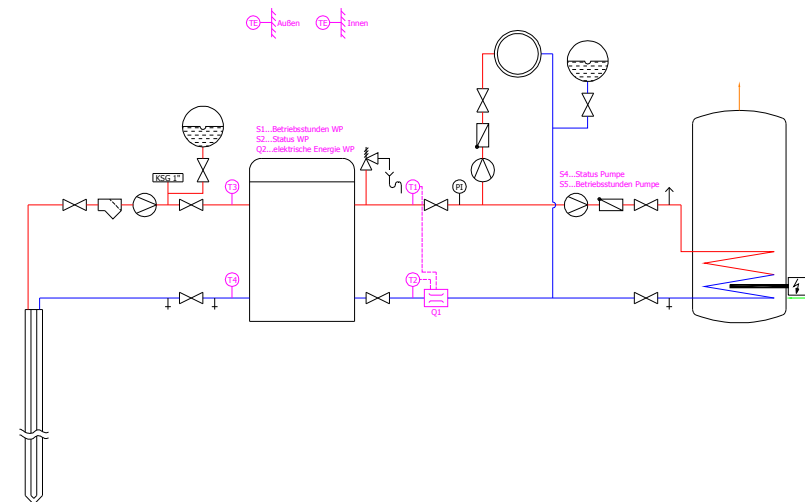
Monitoring Hohenems / Arnreit



- Hohenems / Vorarlberg / 430 m
- Arnreit / Upper Austria / 600 m

Monitoring Hohenems „standard system“

- monitoring 4.9.2006-4.9.2007
- Single family house - (Vorarlberg))
- Living space: 190m²
- System: brine / water
 - 1 vertical heat exchanger 32mm
 - length 116m
- Heating capacity: 6,3kW
- Domestic hot water
- heat pump 7,5 kW (B0/W35)
- Floor heating: 125m²
- Energy input: 3116kWh electricity
- energy output: 12460kWh thermal
- Domestic hot water: 3948kWh (31%)
- SPF: 4,1

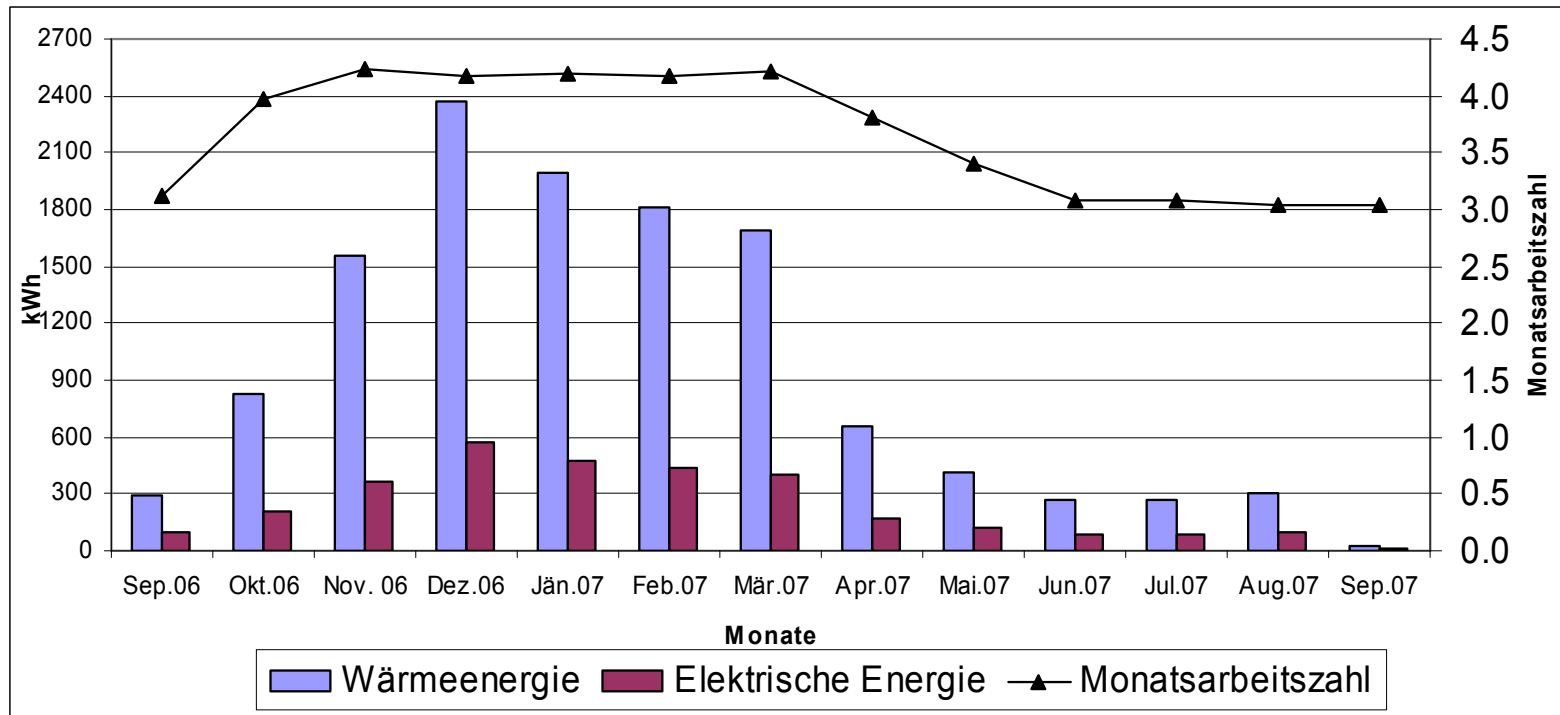


Monitoring Hohenems

monitoring results

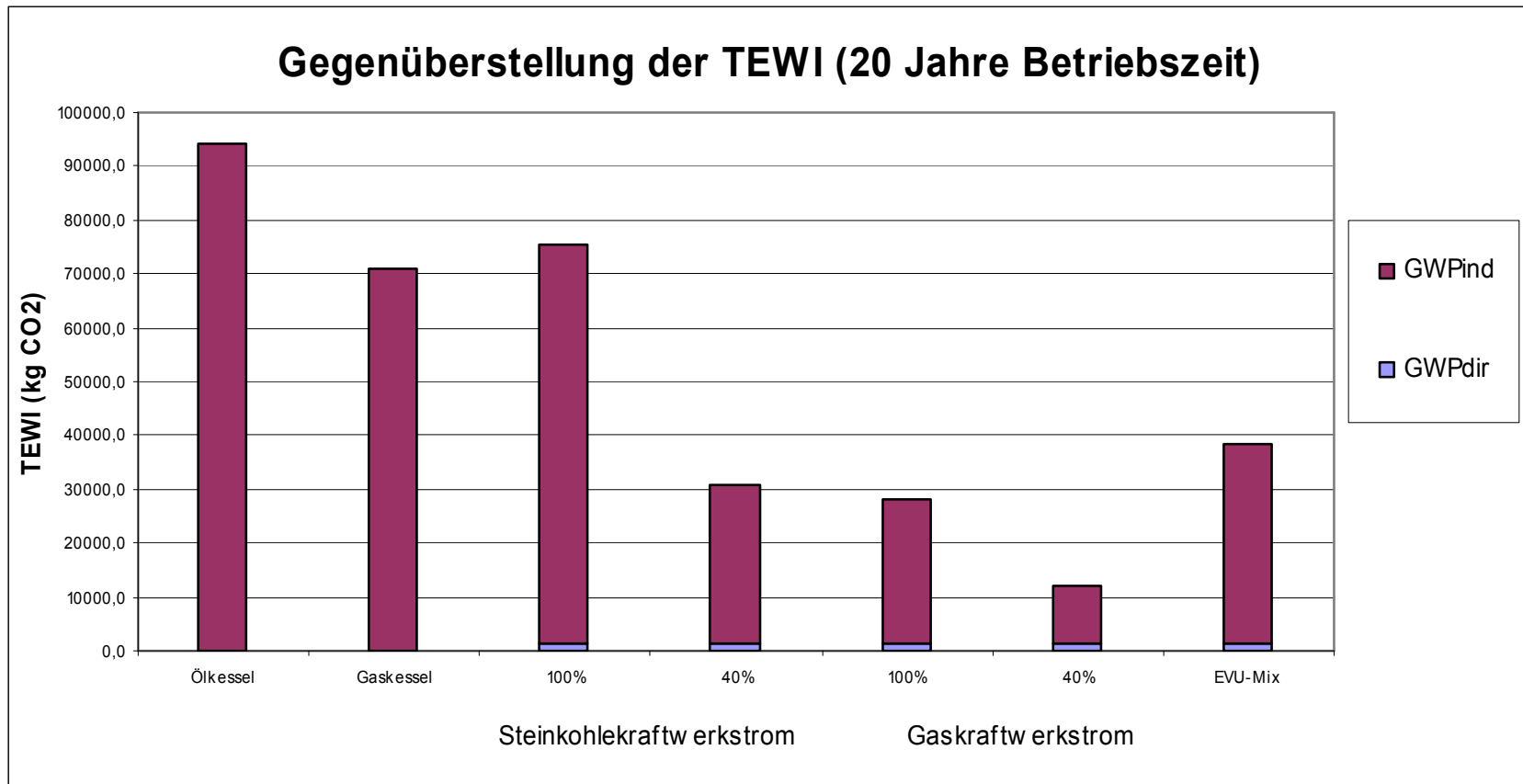
energy output	12460	kWh
-heating	8476	kWh
-domestic hot water	3948	kWh
energy input	3115,3	kWh
SPF	4	
operatin hours	1557,6	h
average heating capacity	8	kW
average electrical power input	2	kW
average daily operating time	4,3	h
on-off / 24 h	5,2	-
average supply temperature (during operation)	37,1	°C
average return temperature (during operation)	33,7	°C
average heat source supply temperature (during operation)	7,1	°C
average heat source return temperature (during operation)	3,2	°C
average indoor temperature	22,4	°C
average outdoor temperature	13,4	°C
average outdoor temperature (during heating season)	5,4	°C
heating degree days (HGD12/20)	2011	Kd
number of heating days (HD12)	152	d
nominal heating degree days (HGD12/20)	3632	Kd
nominale number of heating days (HD12)	223	d

Monitoring Hohenems



- Domestic hot water temperature 50°C
- Supply temperature space heating 37°C

Monitoring Hohenems

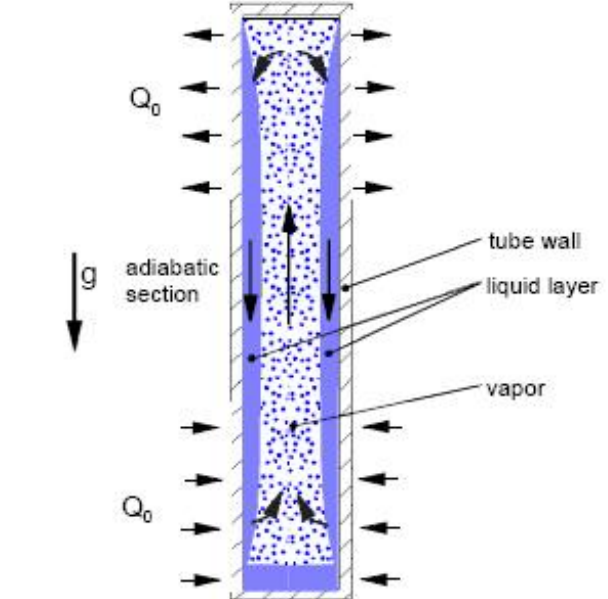
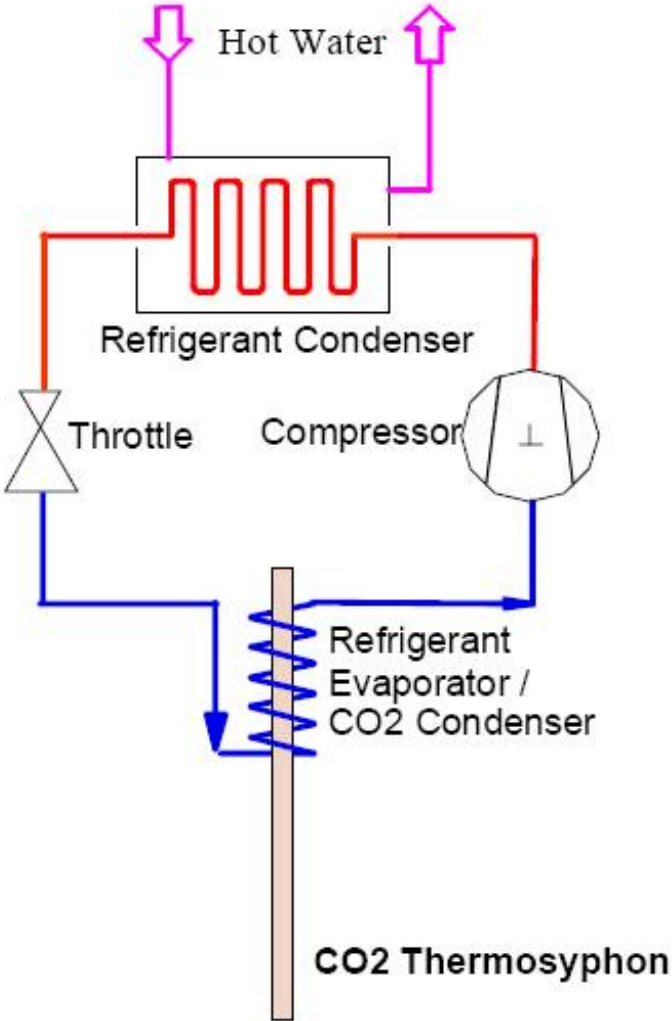


Monitoring Hohenems

parameters	unit	design	measured
abstraction capacity	W/m	50	51
Energy demand	kWh/(m ² a)	45	66
Specific heating capacity	W/m ²	33	42
Heat source inlet	°C	0	7,1
Heat source outlet	°C	-3	3,2
Supply temperature	°C	37	37,1
Return temperature	°C	32	33,7
Indoor temperature	°C	22	22,4
Outdoor temperature	°C	-13	-1,8
Heating degree days (HGD _{12/20})	d	3632	2011
Number of heating days (HT ₁₂)	d	223	152
Operating hours	h	1800	1557

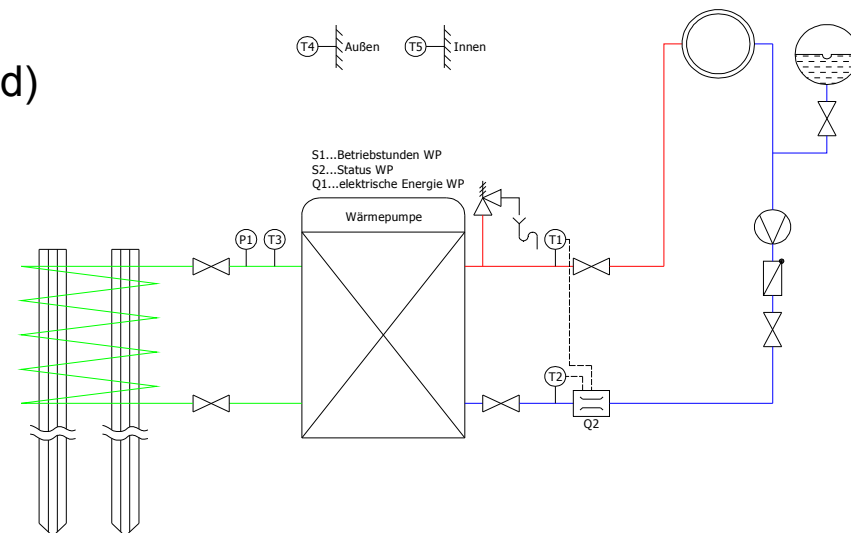
CO₂ vertical heat exchanger

Application – Two-phase Thermosyphon



Monitoring Arnreit „pilot plant“

- Monitoring 9.9.2006-9.9.2007
- Single family house - (OÖ)
- Living space: 224m²
- System: CO₂-vertical heat exchanger
 - 2 probes
 - length 75m
- Heating capacity: 10kW
- Heat pump 10,2 kW (frequency controlled) (B0/W35)
- Floor heating: 195m²
- Wall heating: 26m²
- Energy input: 1749kWh electricity
- Energy output: 11367kWh thermal
- No domestic hot water
- SPF:6,5

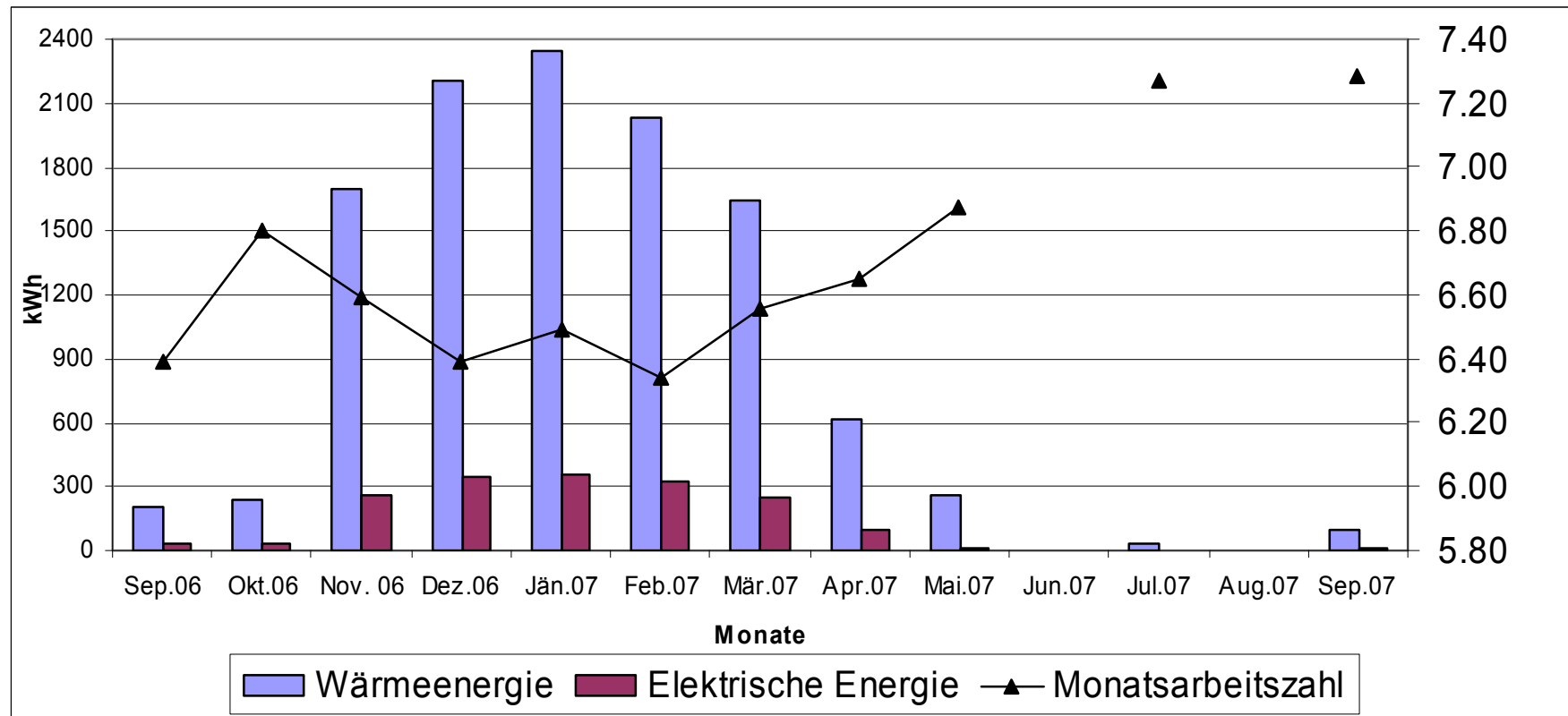


Monitoring Arnreit

monitoring results

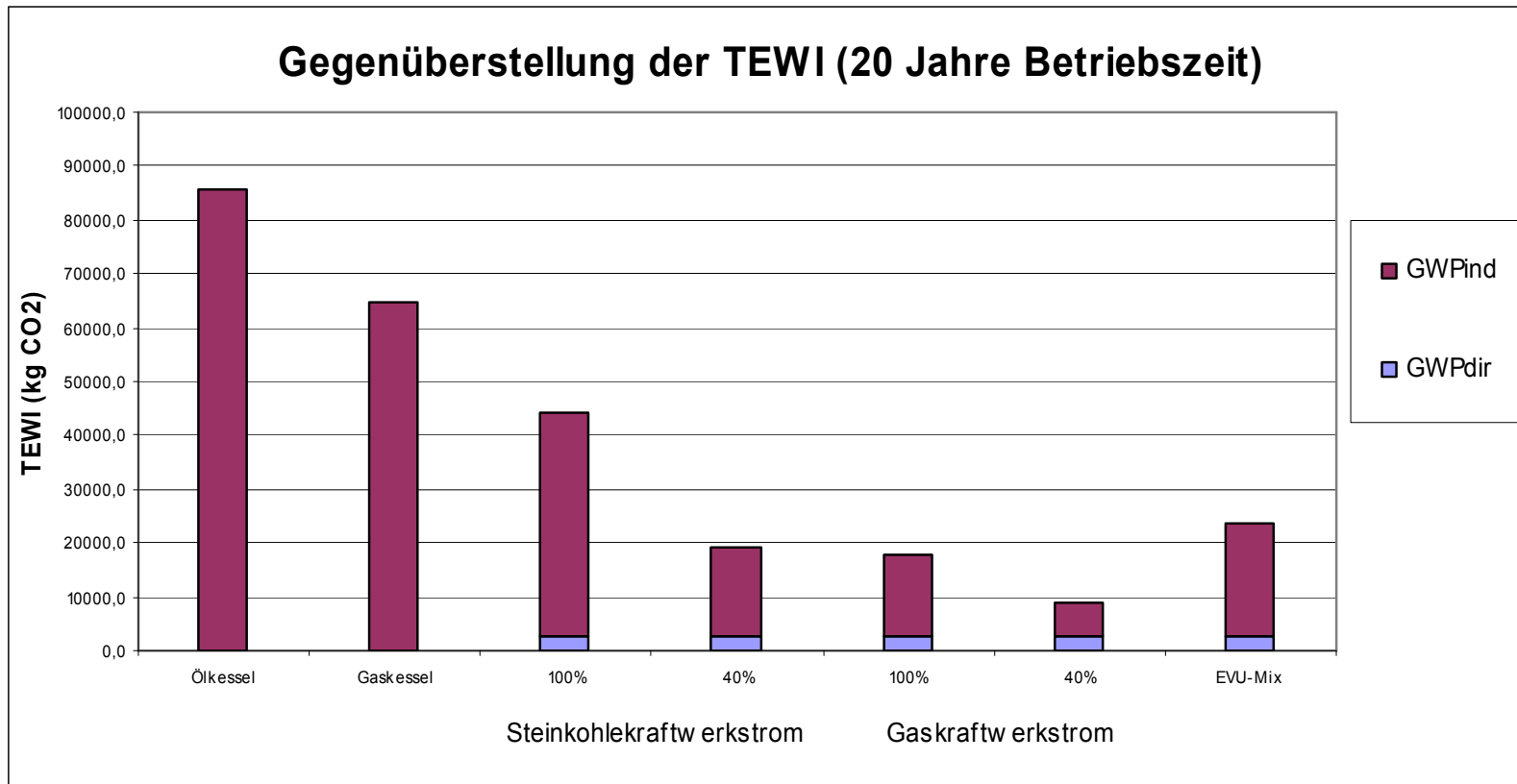
energy output	11367	kWh
energy input	1749,2	kWh
SPF	6,5	
operatin hours	1855,7	h
average heating capacity	6,1	kW
average electrical power input	0,9	kW
average daily operating time	5,1	h
on-off / 24 h	1	-
average supply temperature (during operation)	24,8	°C
average return temperature (during operation)	22,5	°C
average suction line temperature (during operation)	-1,1	°C
average evaporating temperature (during operation)	-4,9	°C
average indoor temperature	22,7	°C
average outdoor temperature	10,2	°C
average outdoor temperature (during heating season)	5	°C
heating degree days (HGD12/20)	3206	Kd
number of heating days (HD12)	211	d
nominal heating degree days (HGD12/20)	4162	Kd
nominale number of heating days (HD12)	240	d

Monitoring Anreize



- Average supply temperature: 24,8°C

Monitoring Anreize



Monitoring Arnreit

parameters	unit	design	measured
abstraction capacity	W/m	55 (B-5/W30)	34
Energy demand	kWh/(m ² a)	n.a	50,7
Specific heating capacity	W/m ²	44,6	27,1
Heat source inlet	°C	30	24,8
Heat source outlet	°C	26	22,5
Indoor temperature	°C	22	21,8
Outdoor temperature	°C	-15	-7,7
Heating degree days (HGD _{12/20})	d	4162	3206
Number of heating days (HT ₁₂)	d	240	211
Operating hours	h	1800	1856

comparison

monitoring results	Arnreit	Hohenems	
energy output	11367	12460	kWh
energy input	1749,2	3115,3	kWh
SPF	6,5	4	
domestic hot water	no	yes	-
frequency controlled compressor	yes	no	-
operatin hours	1855,7	1557,6	h
average heating capacity	6,1	8	kW
average electrical power input	0,9	2	kW
average daily operating time	5,1	4,3	h
on-off / 24 h	1	5,2	-
average supply temperature (during operation)	24,8	37,1	°C
average return temperature (during operation)	22,5	33,7	°C
average indoor temperature	22,7	22,4	°C
average outdoor temperature	10,2	13,4	°C
average outdoor temperature (during heating season)	5	5,4	°C
heating degree days (HGD12/20)	3206	2011	Kd
number of heating days (HD12)	211	152	d
nominal heating degree days (HGD12/20)	4162	3632	Kd
nominale number of heating days (HD12)	240	223	d

Thank you for your attention !!!

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