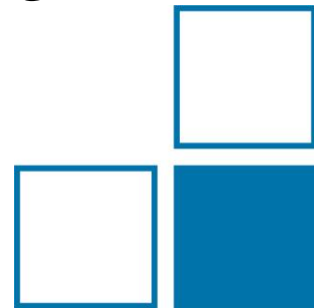


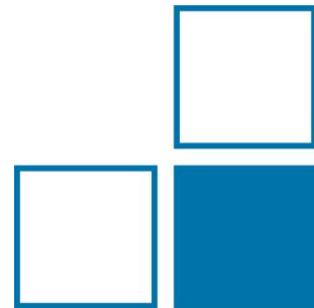
*English translation to be found
after the German part*



Metrologie schnellansprechender Messgeräte für thermische Energie

EMATEM-Sommerschule
23.09.2026

Markus Kühn, AG 7.52 Volumenstrom

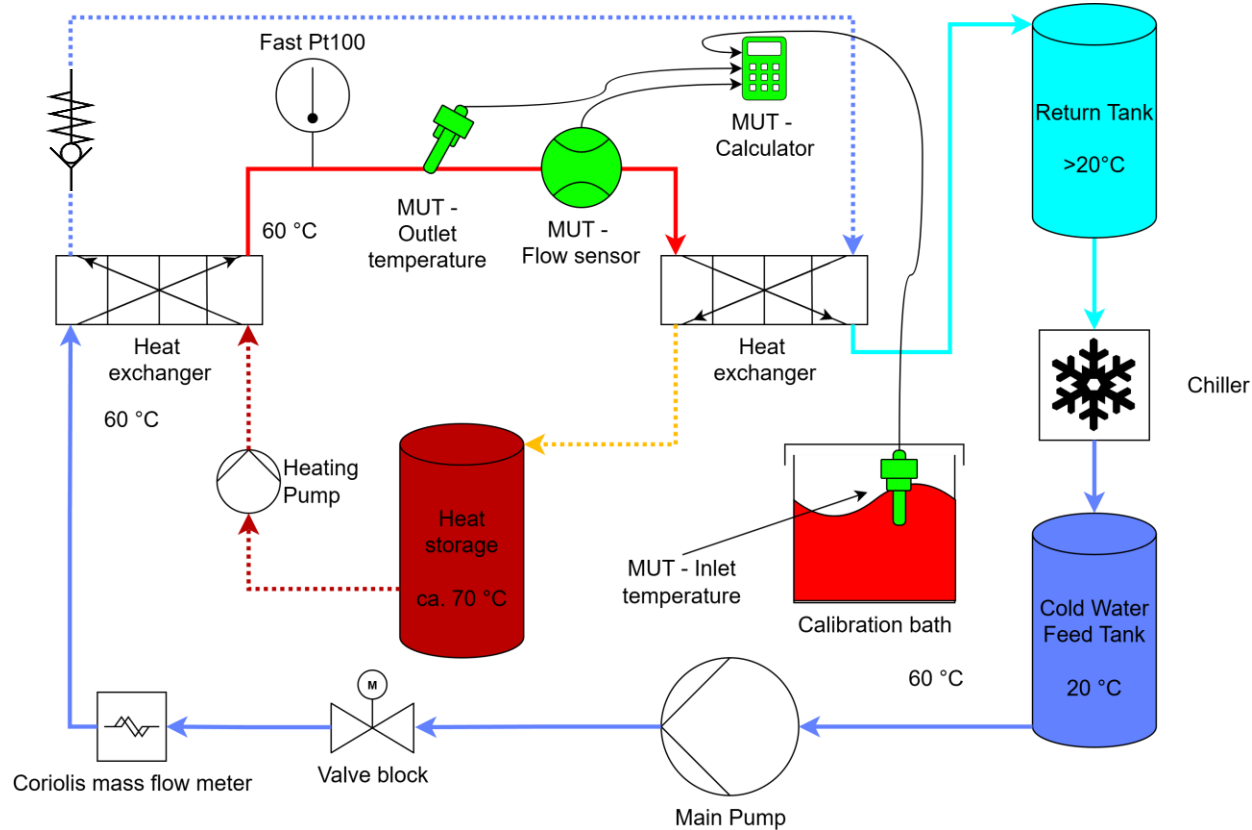


Stand der Dinge am Prüfstand

- Neuprogrammierung der Prüfstandssteuerung durch externe Firma leider extrem verzögert (Vereinbarte Zeit Stand heute um Faktor 4 überschritten...)
- Aber bereits lauffähiger Zustand in Betrieb genommen
- Erste Tests und Datenaufnahme der neuen Software mit einem Ultraschall-Wärmezähler durchgeführt



Anlagenschema





Sequenzeditor

PTB_SAW_Messplatz

File Edit View Project Operate Tools Window Help

Systemstatus

Übersicht | Diagramme | DuT | MBus | ReportViewer | Sequenzen | Parameter

Regelsequenz

Phase	Durchfluss [l/h]	Temperatur [°C]	Dauer [s]	Temperaturbedingung
1	1000	0	20	
2	0	0	15	
3	1000	0	20	
4	0	0	15	
5	1000	0	20	
6	0	0	15	
7	1000	0	20	
8	0	0	15	
9	1000	0	20	
10	0	0	15	
11	1000	0	20	
12	0	0	15	
13	1000	0	20	
14	0	0	15	
15	1000	0	20	
16	0	0	15	

Up
Remove
Down
Save
Open

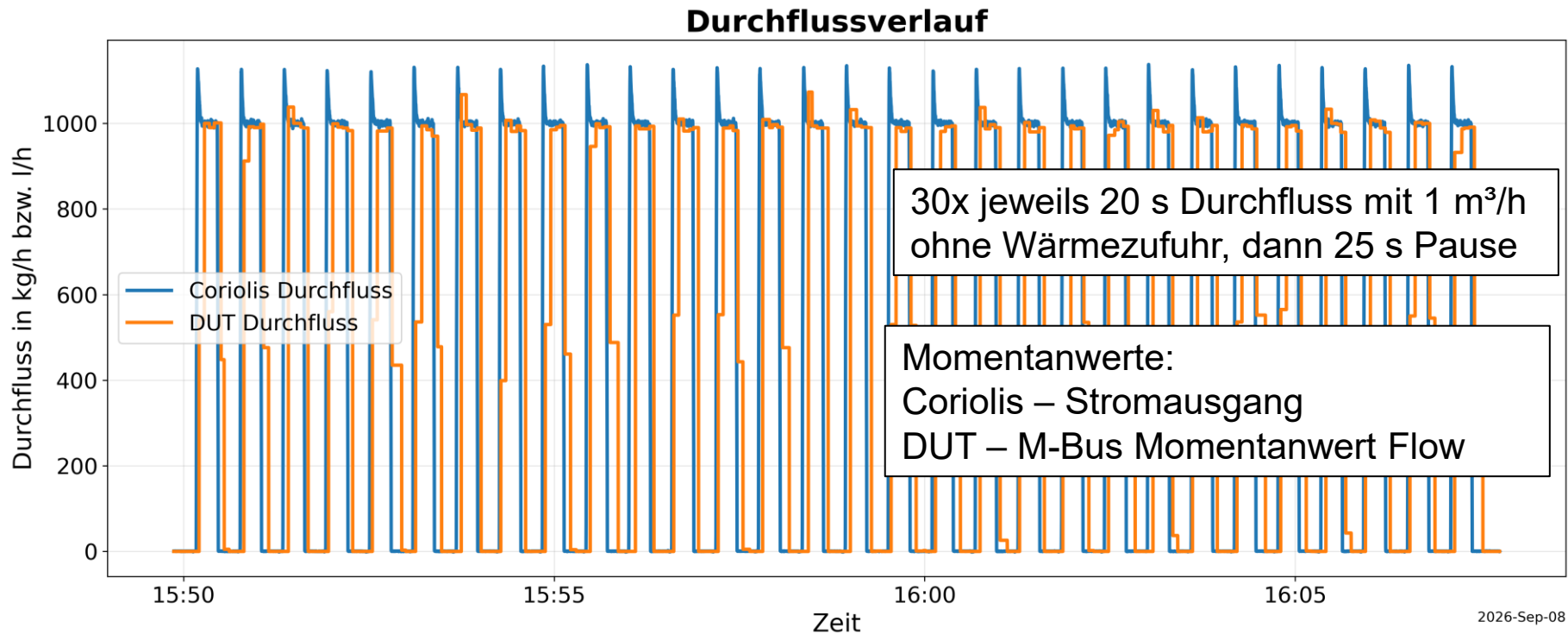
Steuersequenz

Schrittnummer	Dauer [s]	Regelventil 1 [%]	Regelventil 2 [%]	Ventil 1	Ventil 2	Ventil 3	Hauptpumpe [l/min]	Sekülpumpe [%]
1	61	100,0	100,0				2000	0,0
2	10	0,0	0,0				0	0,0
3	50	0,0	100,0				1200	100,0
4	10	0,0	0,0				0	0,0
5	61	100,0	100,0				2000	0,0
6	10	0,0	0,0				0	0,0
7	50	0,0	100,0				1200	80,0
8	10	0,0	0,0				0	0,0
9	61	100,0	100,0				2000	0,0
10	10	0,0	0,0				0	0,0
11	50	0,0	100,0				1200	40,0
12	10	0,0	0,0				0	0,0
13	61	100,0	100,0				2000	0,0
14	10	0,0	0,0				0	0,0
15	50	0,0	100,0				1200	40,0
16	10	0,0	0,0				0	0,0

Up
Remove
Down
Save
Open

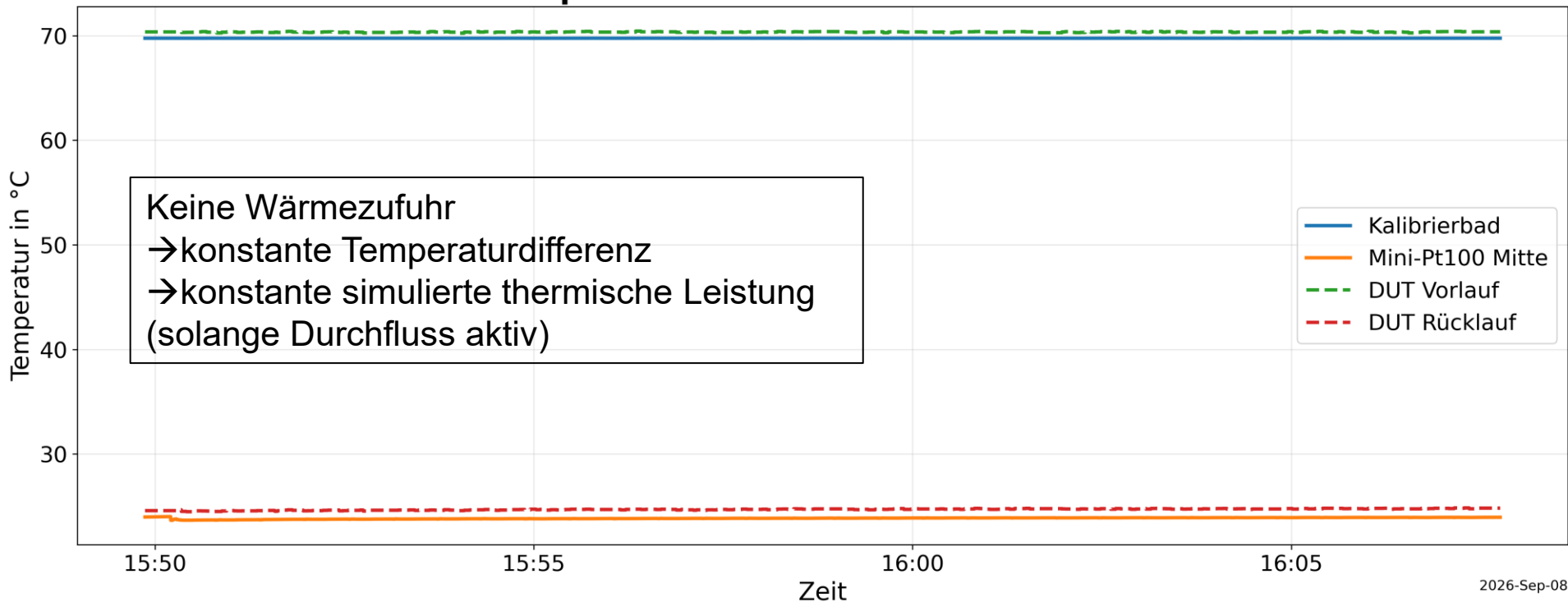
Regelsequenz starten
Steuersequenz starten
Daten Aufzeichnen
Automatik Betrieb
Manueller Betrieb
Beenden

Erste „Messdaten“



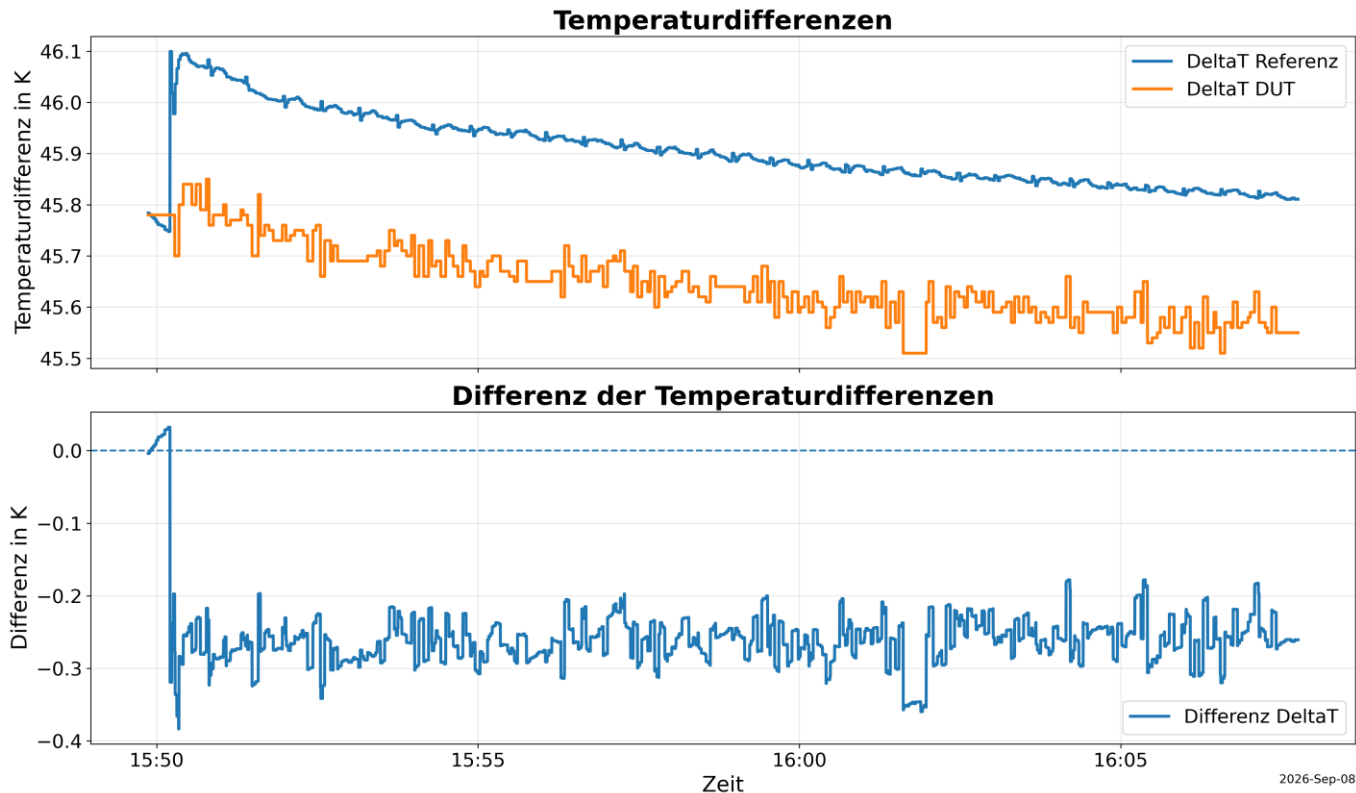
Erste „Messdaten“

Temperaturverlauf - Referenz und DUT



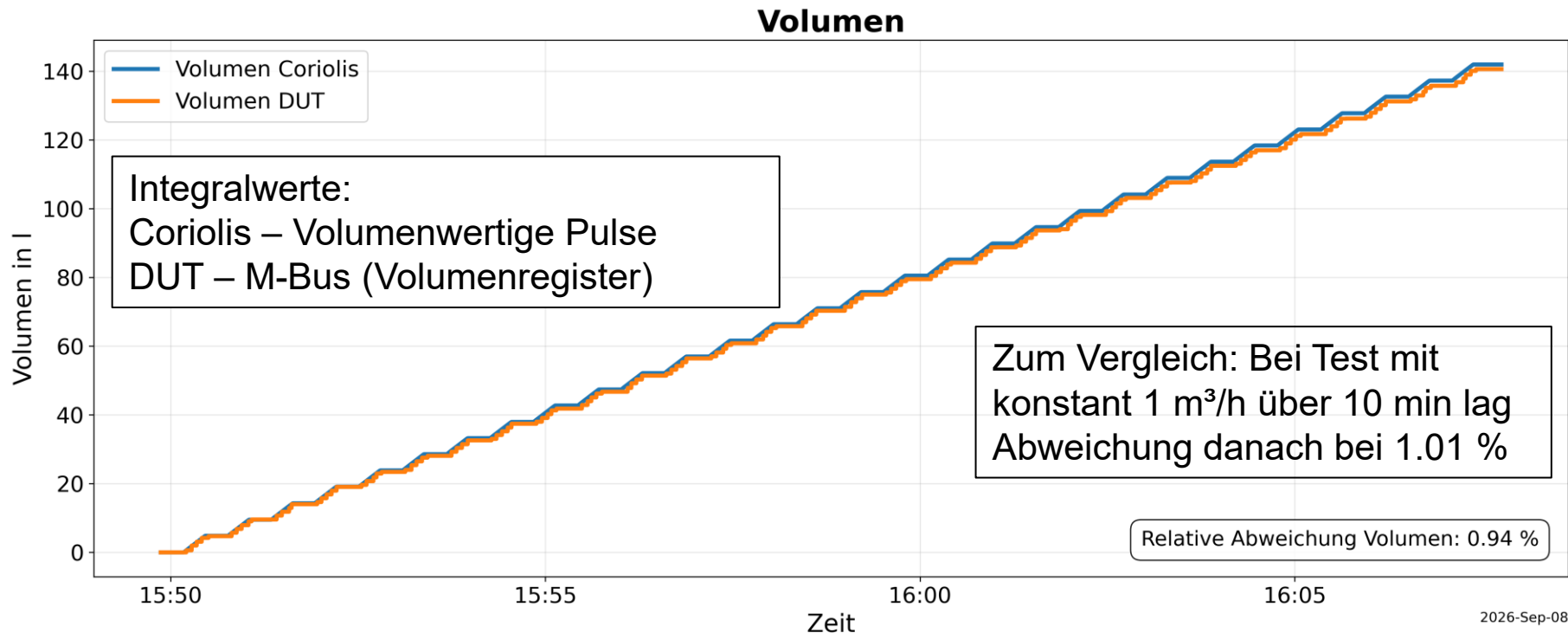
2026-Sep-08

Erste „Messdaten“



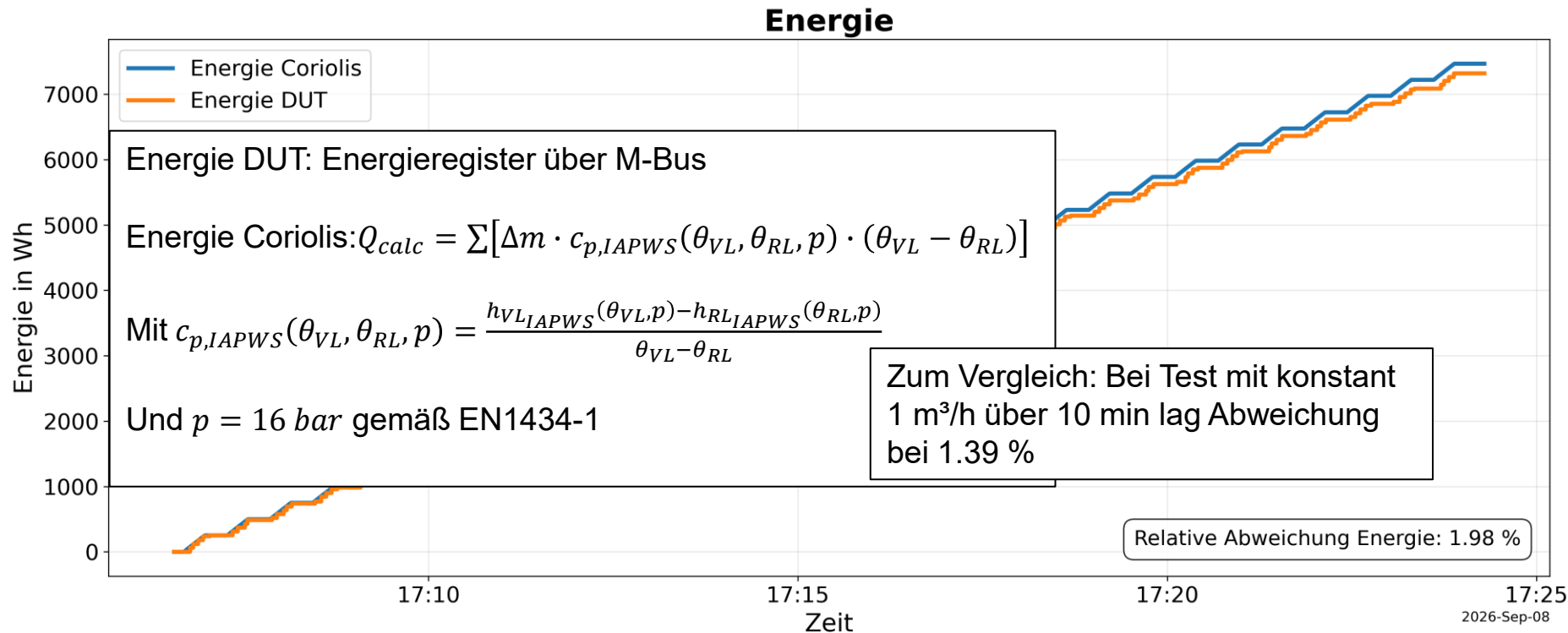
Ausgangsdatei: 2026-09-08 Volumentest 30x20s 1 m3h V-wertige Pulse

Erste „Messdaten“



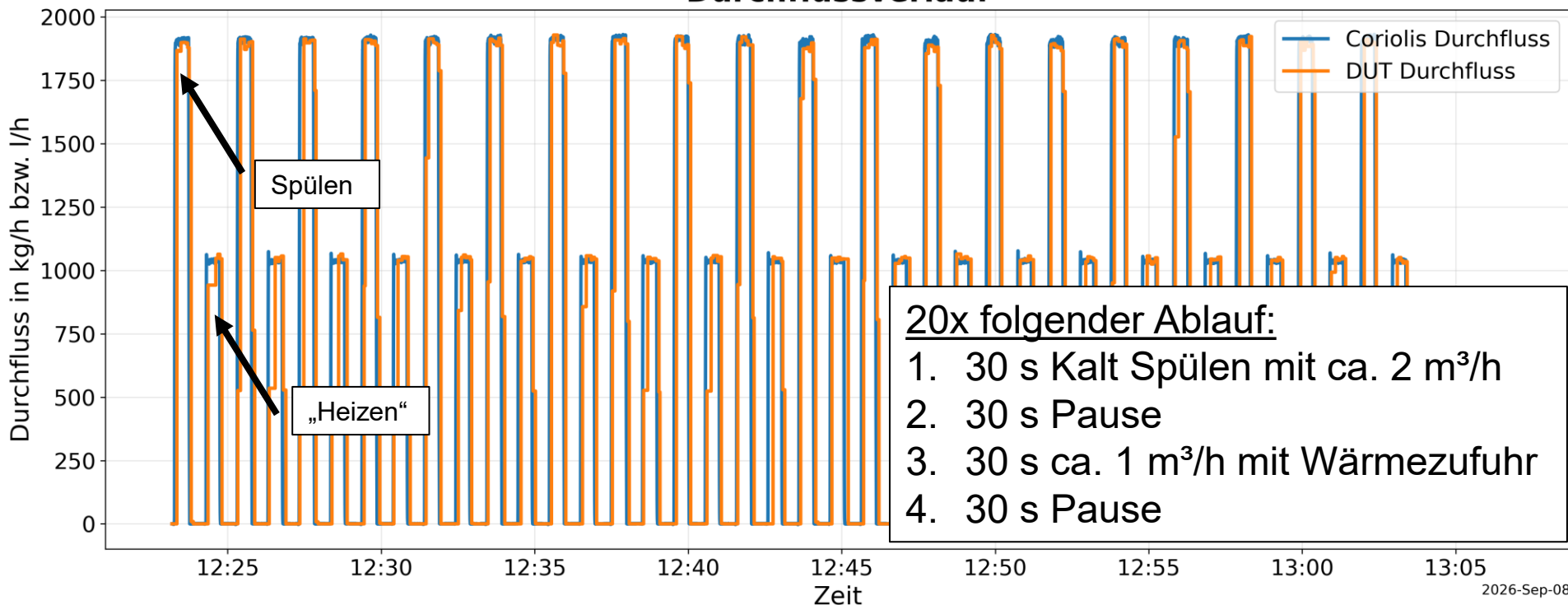
Ausgangsdatei: 2026-09-08 Volumentest 30x20s 1 m3h V-wertige Pulse

Erste „Messdaten“



Testprofil 2

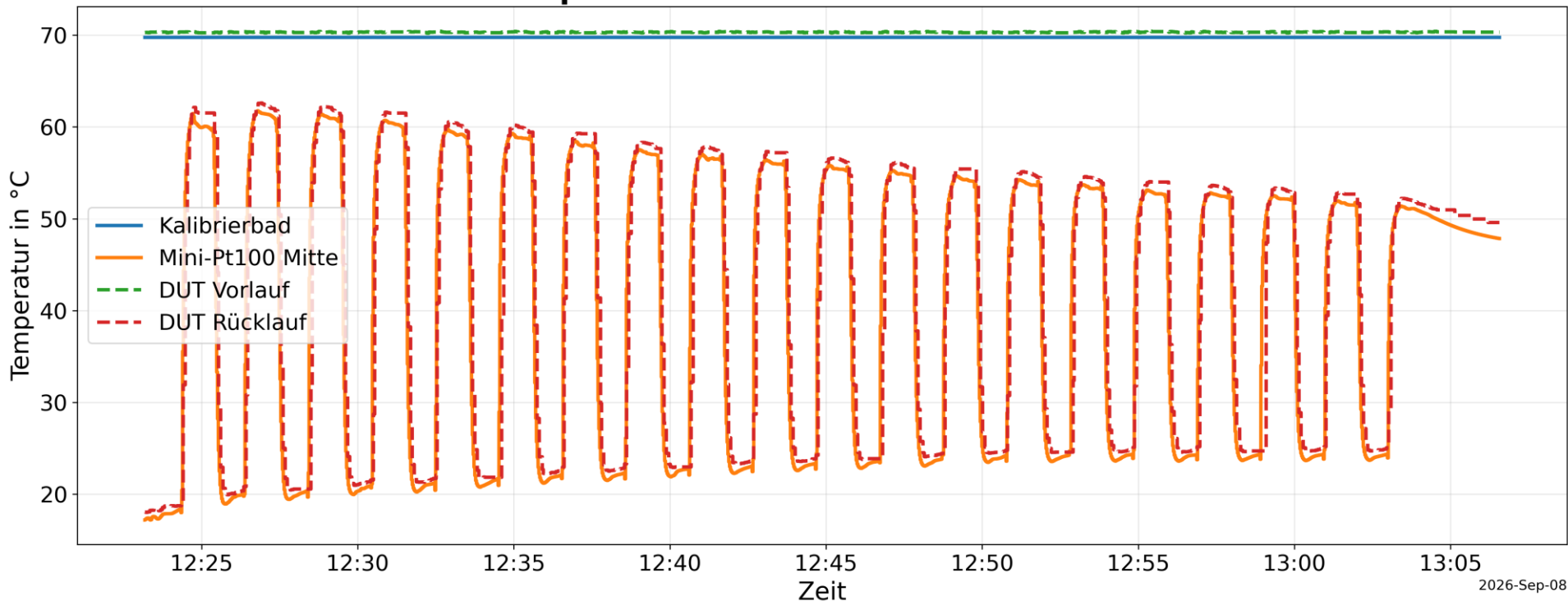
Durchflussverlauf



2026-Sep-08

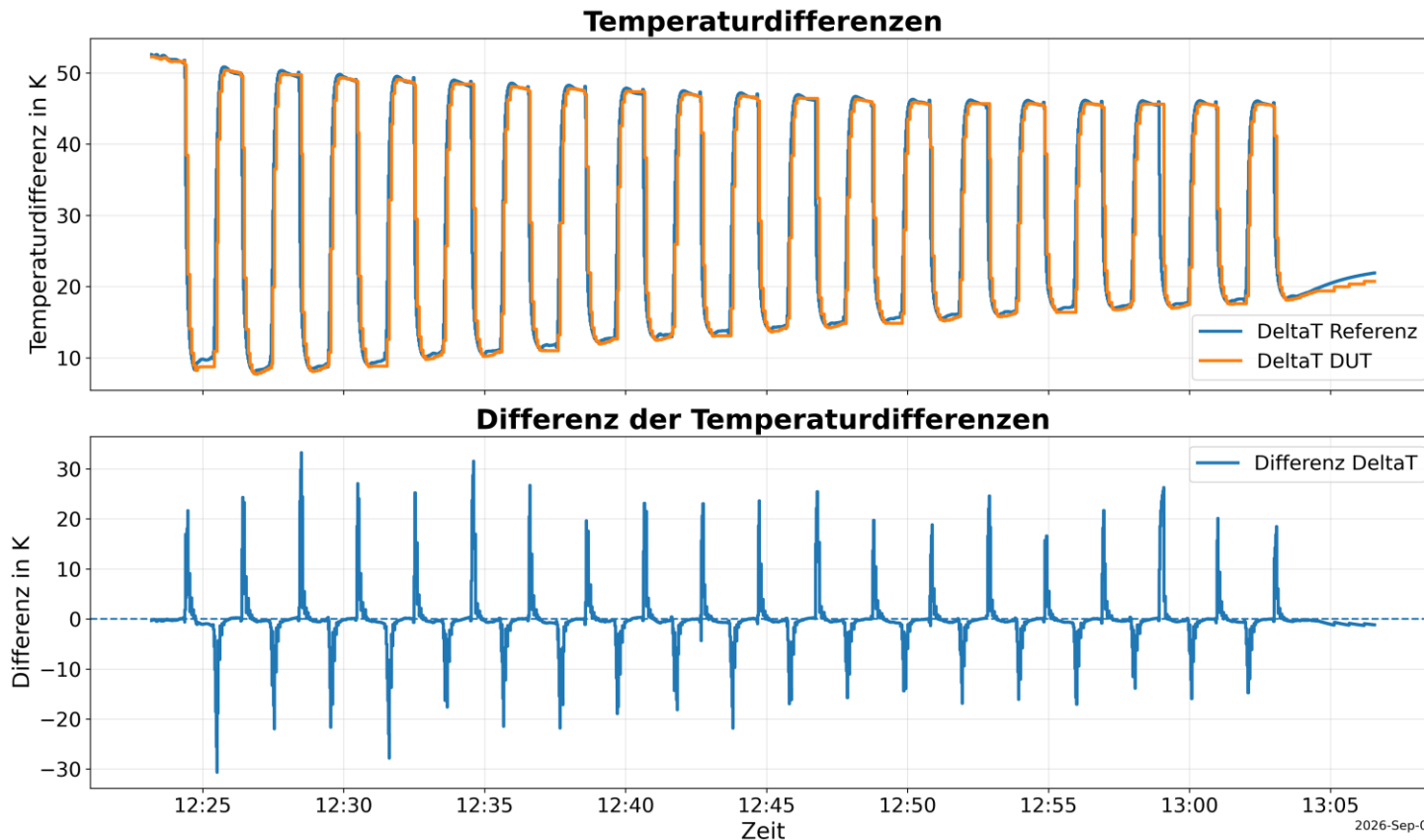
Testprofil 2

Temperaturverlauf - Referenz und DUT



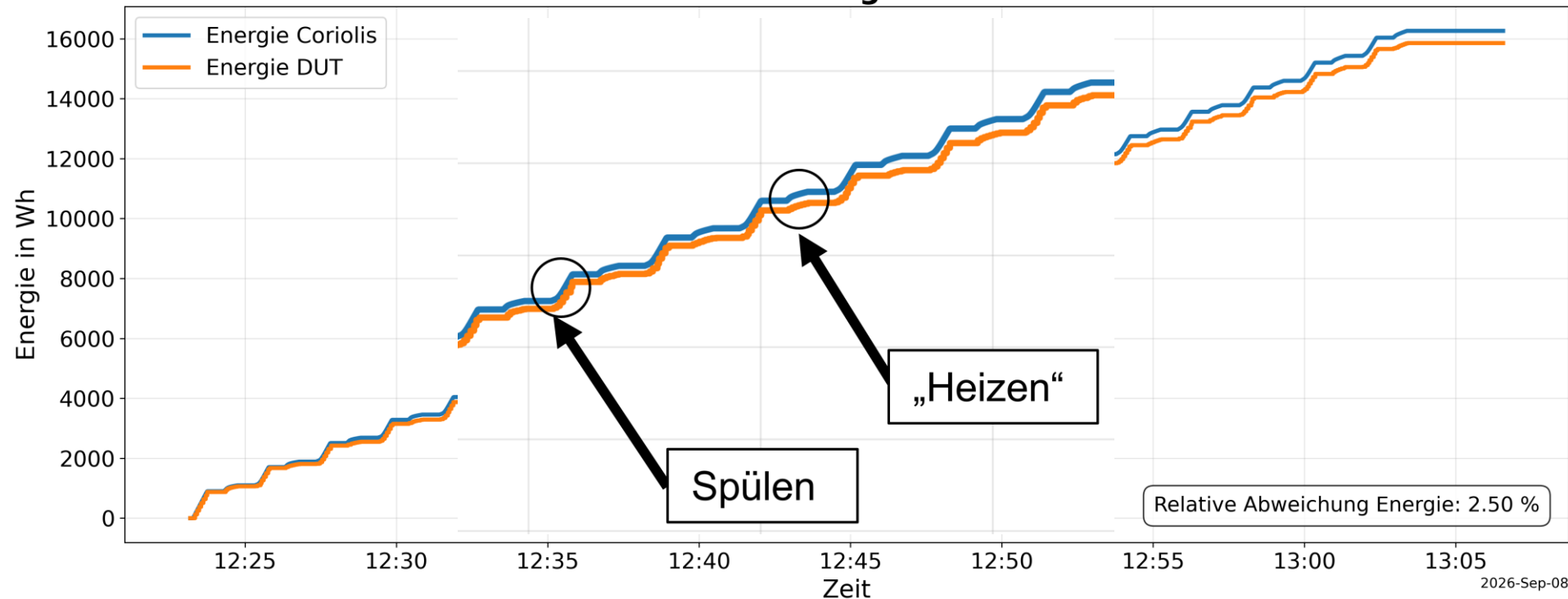
2026-Sep-08

Testprofil 2



Testprofil 2

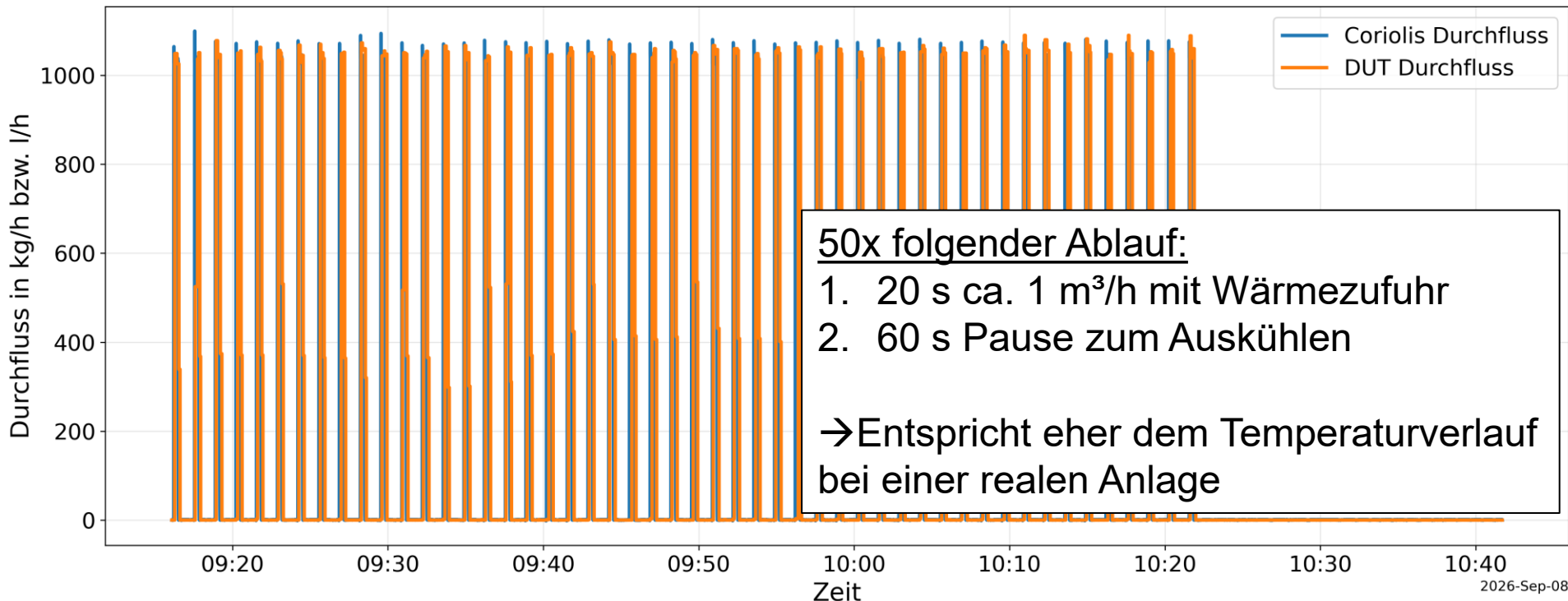
Energie



2026-Sep-08

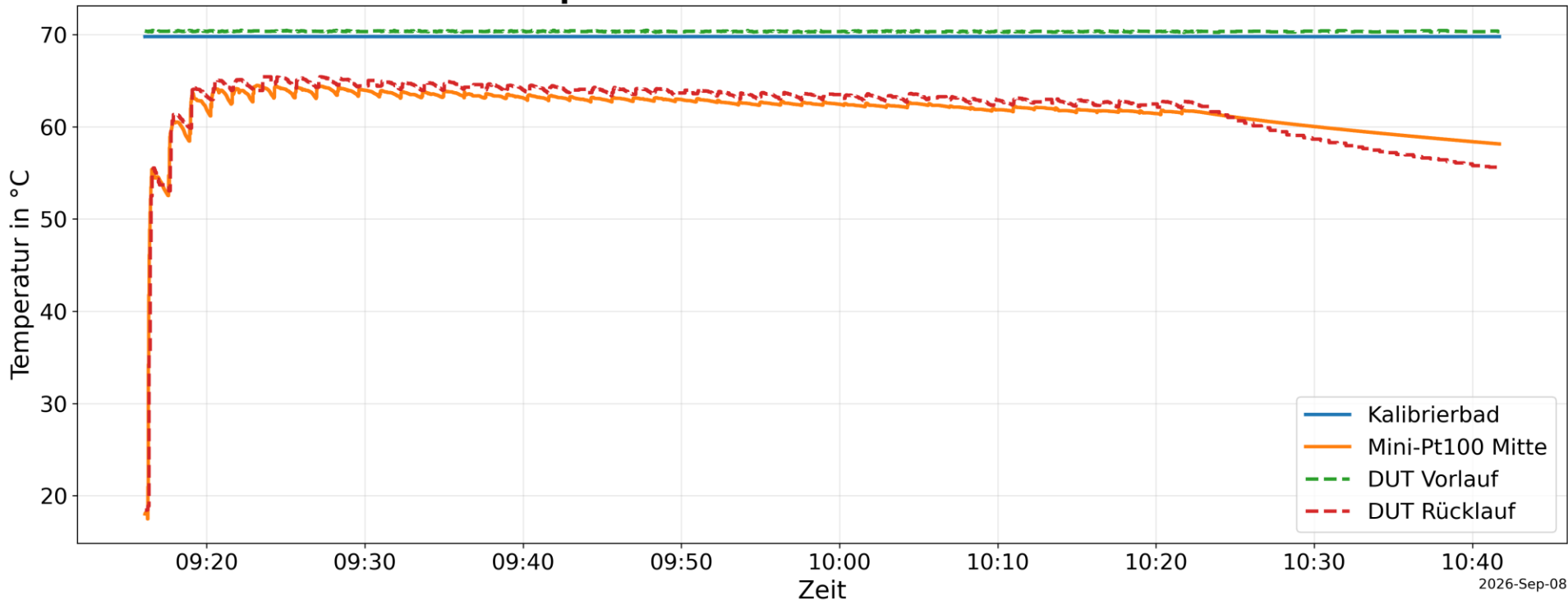
Testprofil 3

Durchflussverlauf



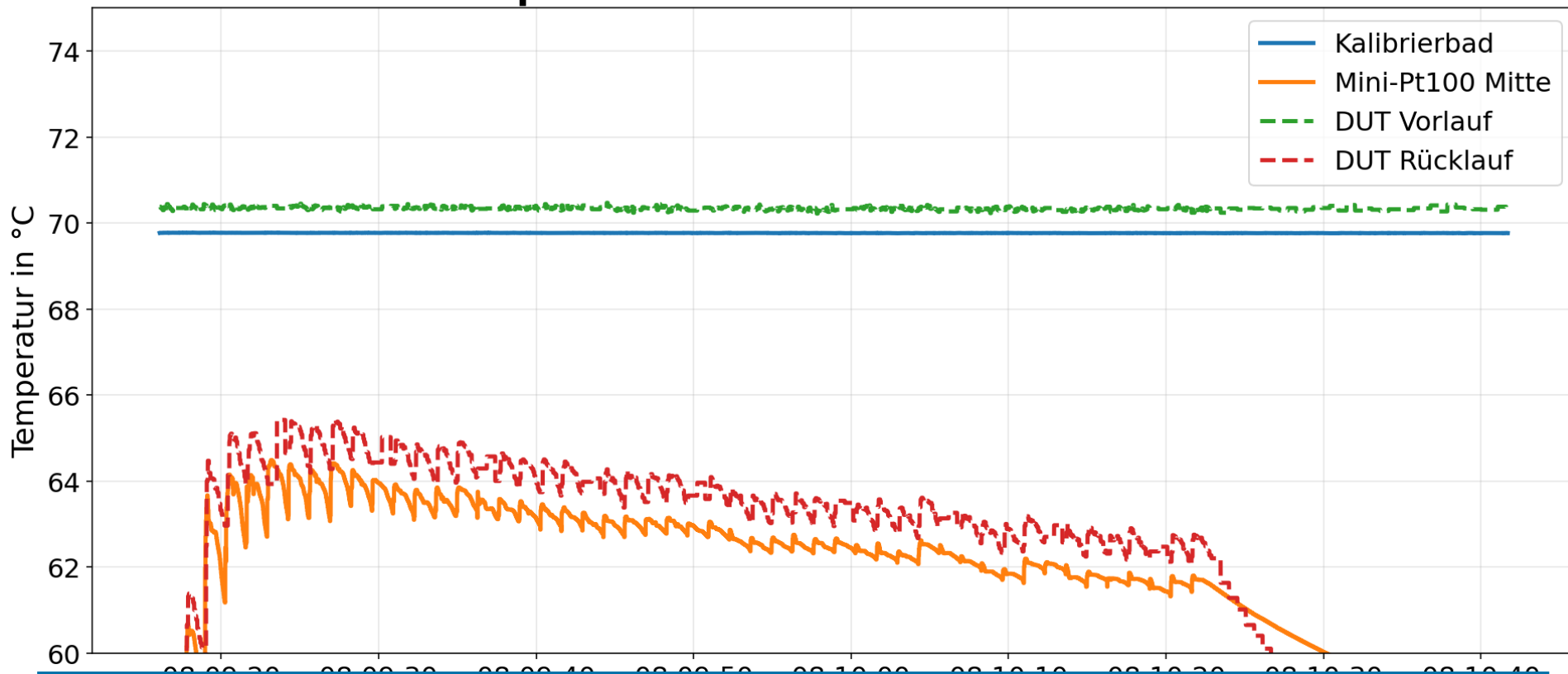
Testprofil 3

Temperaturverlauf - Referenz und DUT

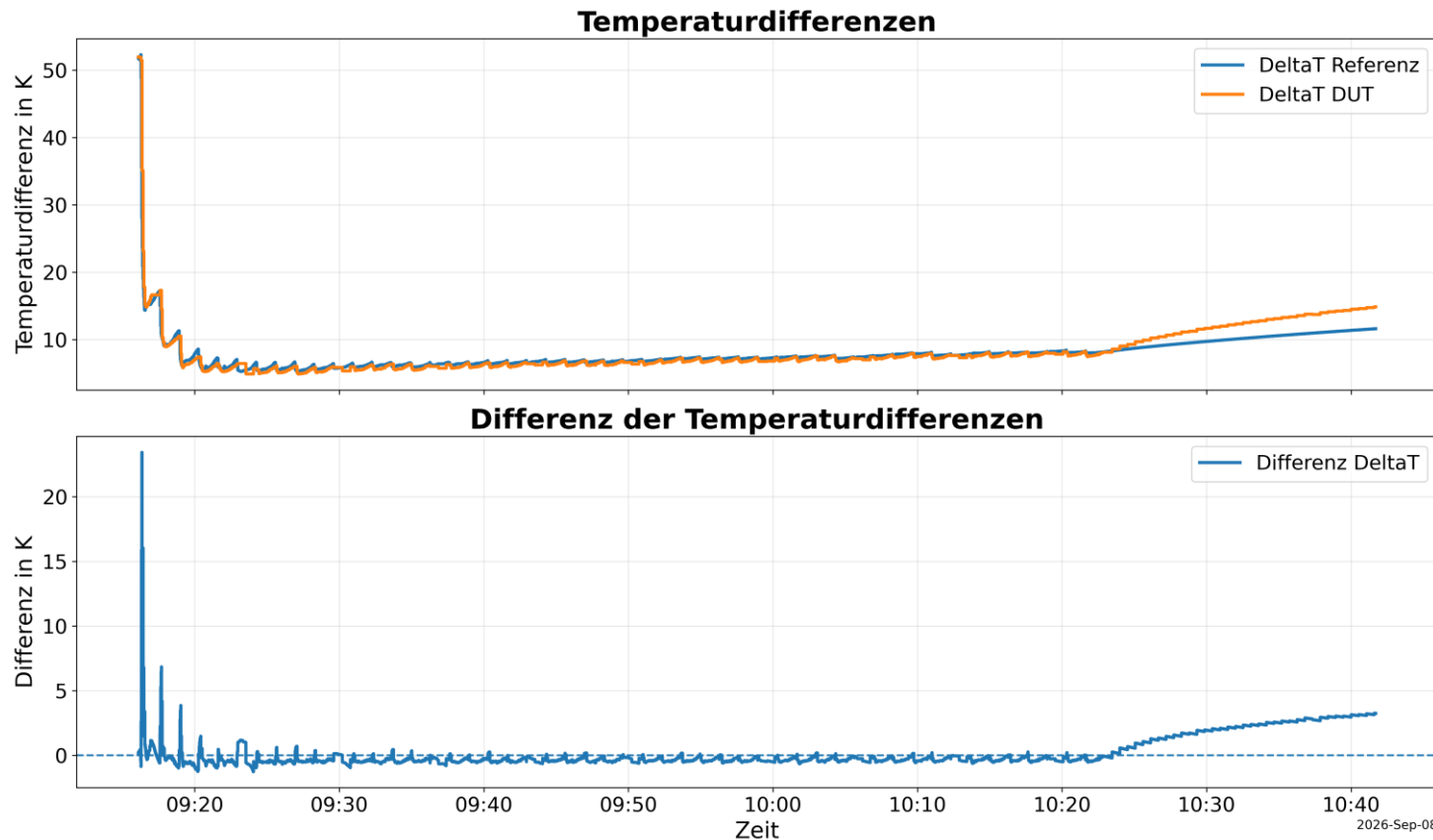


Testprofil 3

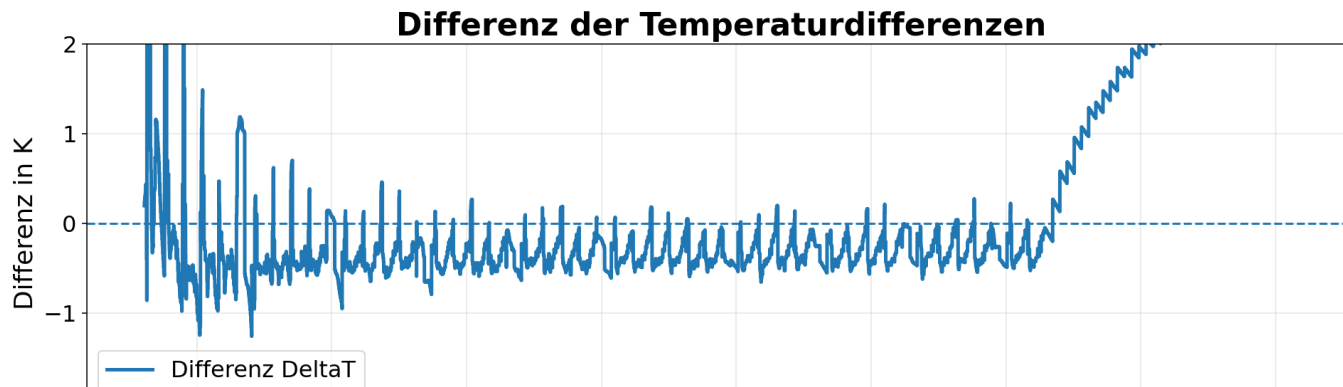
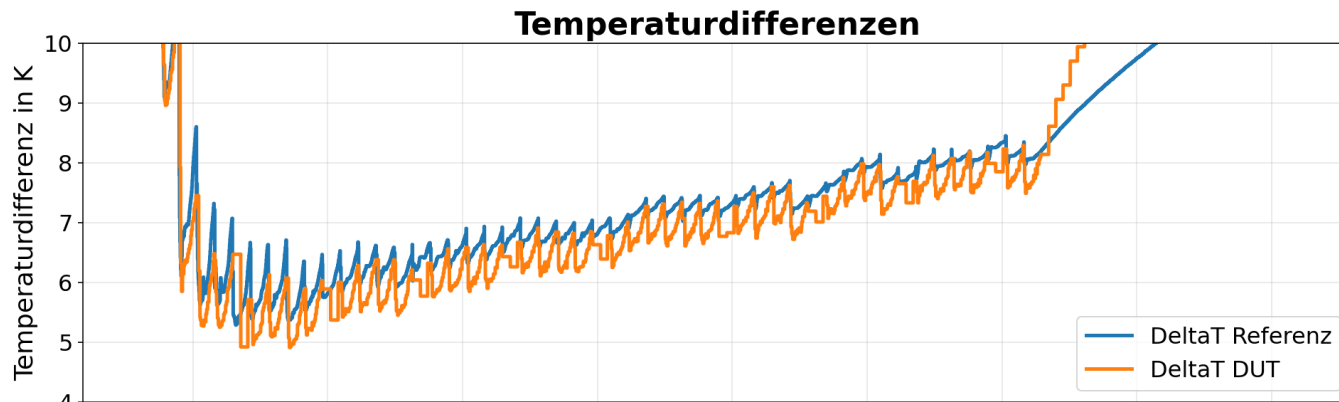
Temperaturverlauf - Referenz und DUT



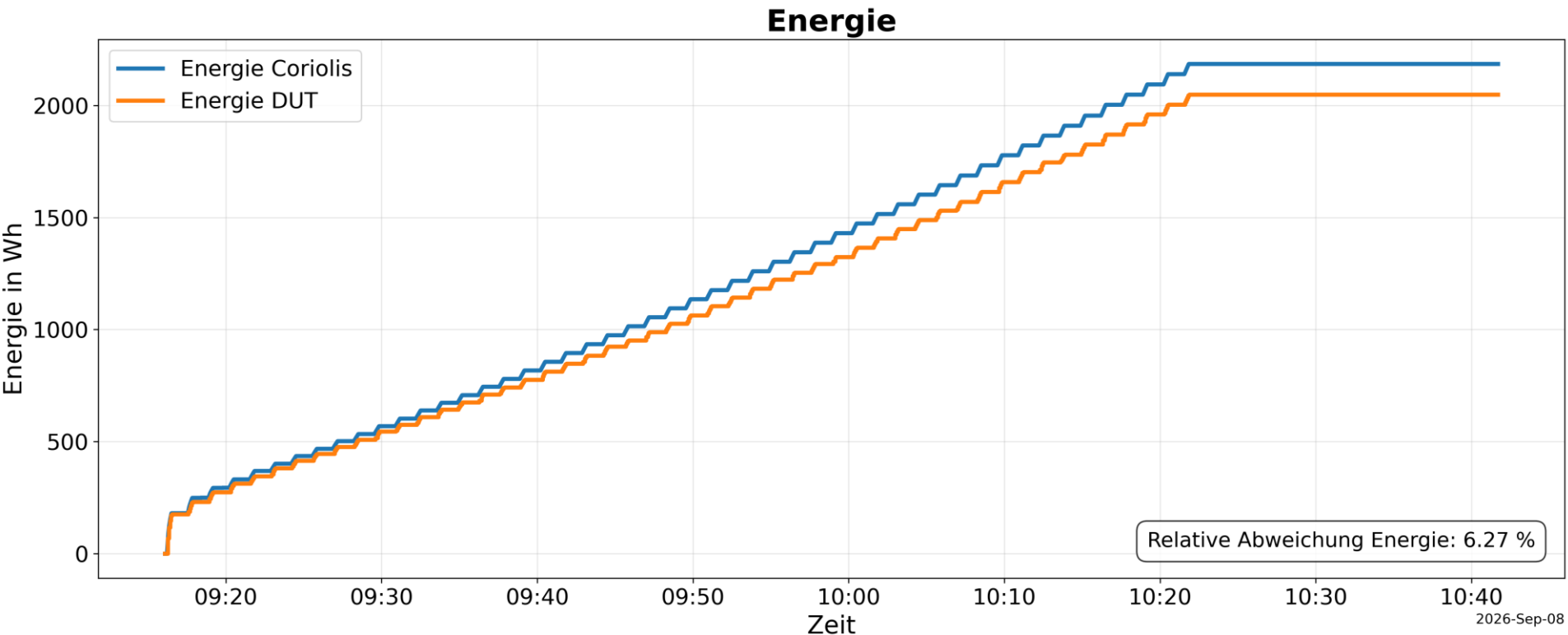
Testprofil 3



Testprofil 3



Testprofil 3



- Auf Grund des langen Verzugs des Dienstleisters ist Rekalibrierung der Messtechnik überfällig, aber würde deren Arbeiten behindern
- Alle Ergebnisse daher mit Vorsicht und als vorläufig zu betrachten
- Auftragnehmer muss Regelungstechnik noch vollumfänglich zum Laufen bringen und Reglerparametrierung durchführen
- Während der Tests war auch die schnelle Auswertung der Temperaturfühler softwareseitig fehlerhaft, weshalb Temperaturwerte des Prüfstands „nur“ mit 1 s abgetastet wurden



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E-Mail: markus.kuehn@ptb.de

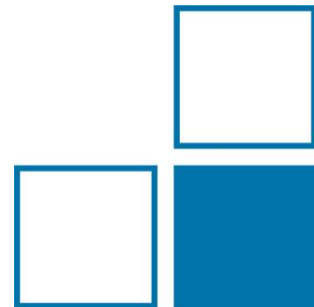
www.ptb.de



Fast response meters for thermal energy

EMATEM-Sommerschule
23.09.2026

Markus Kühn, AG 7.52 Volumenstrom

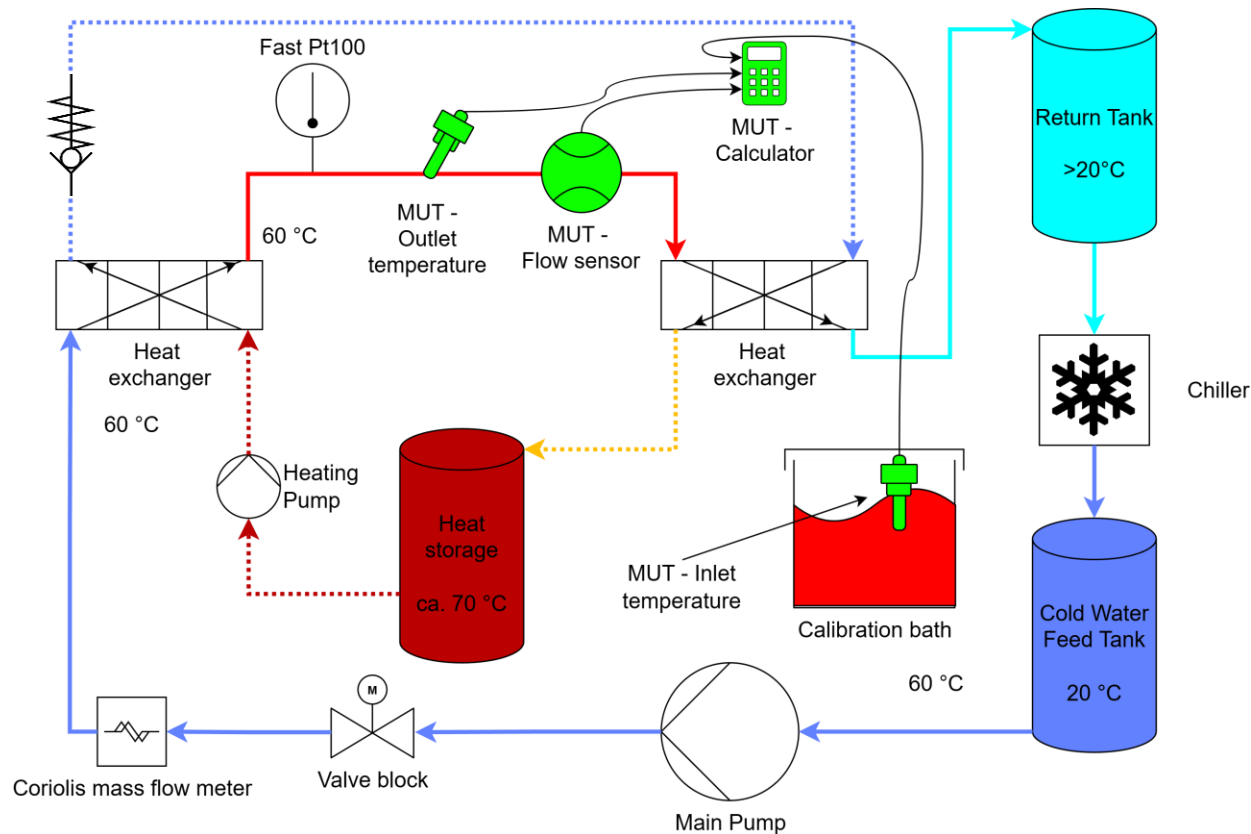


Status of test bench

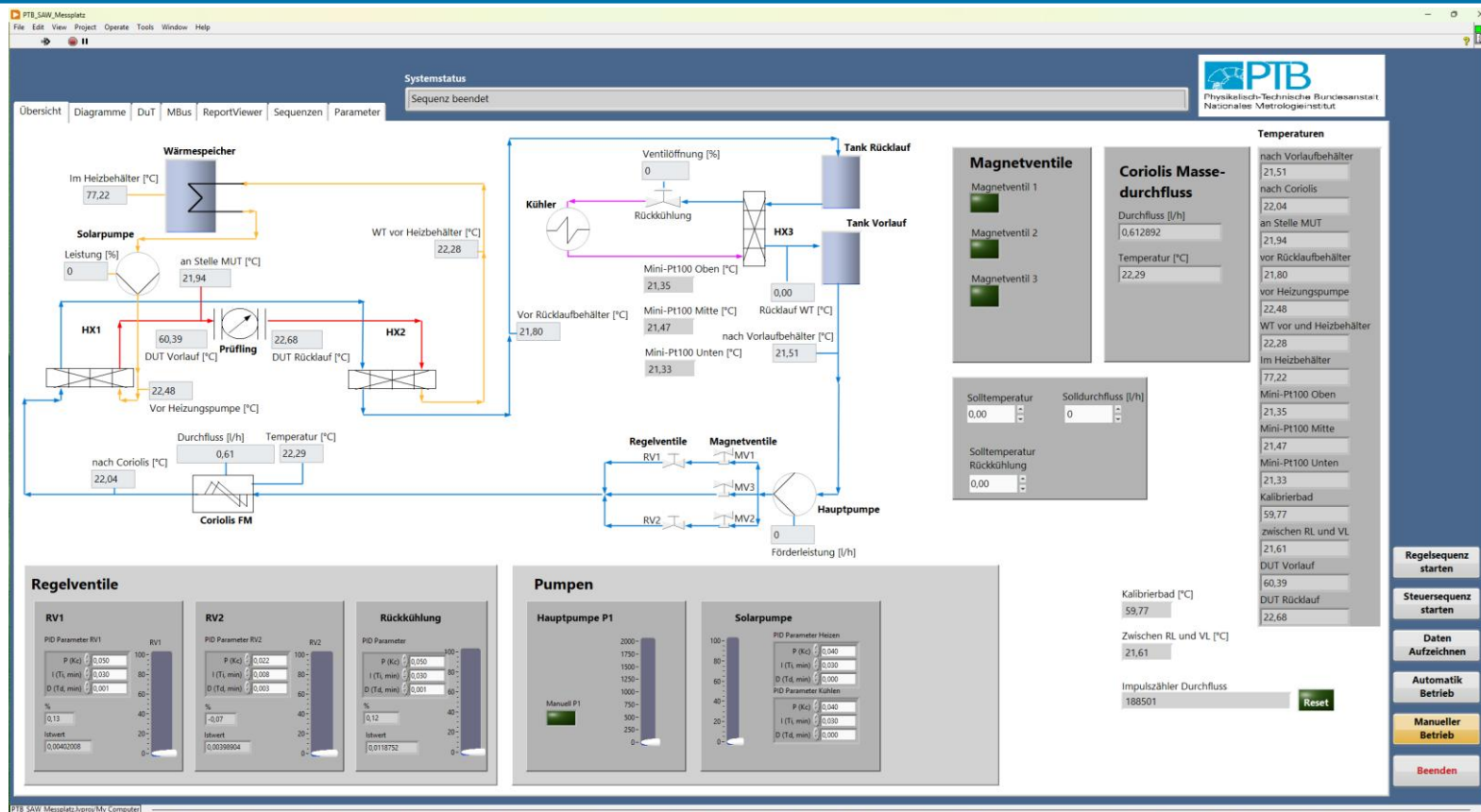
- reprogramming of test bench software by contractor has already taken way longer than agreed upon (Planned time frame has been exceeded by a factor of 4)
- Nevertheless, a working software version has been commissioned
- First tests and data acquisition with new software version and an ultrasonic heat meter



Flow schematic



User interface



Sequence editor

PTB_SAW_Messplatz

File Edit View Project Operate Tools Window Help

Systemstatus

Übersicht | Diagramme | DuT | MBus | ReportViewer | Sequenzen | Parameter

Regelsequenz

Phase	Durchfluss [l/h]	Temperatur [°C]	Dauer [s]	Temperaturbedingung
1	1000	0	20	
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3	1000	0	20	
4	0	0	15	
5	1000	0	20	
6	0	0	15	
7	1000	0	20	
8	0	0	15	
9	1000	0	20	
10	0	0	15	
11	1000	0	20	
12	0	0	15	
13	1000	0	20	
14	0	0	15	
15	1000	0	20	
16	0	0	15	

Up
Remove
Down
Save
Open

Steuersequenz

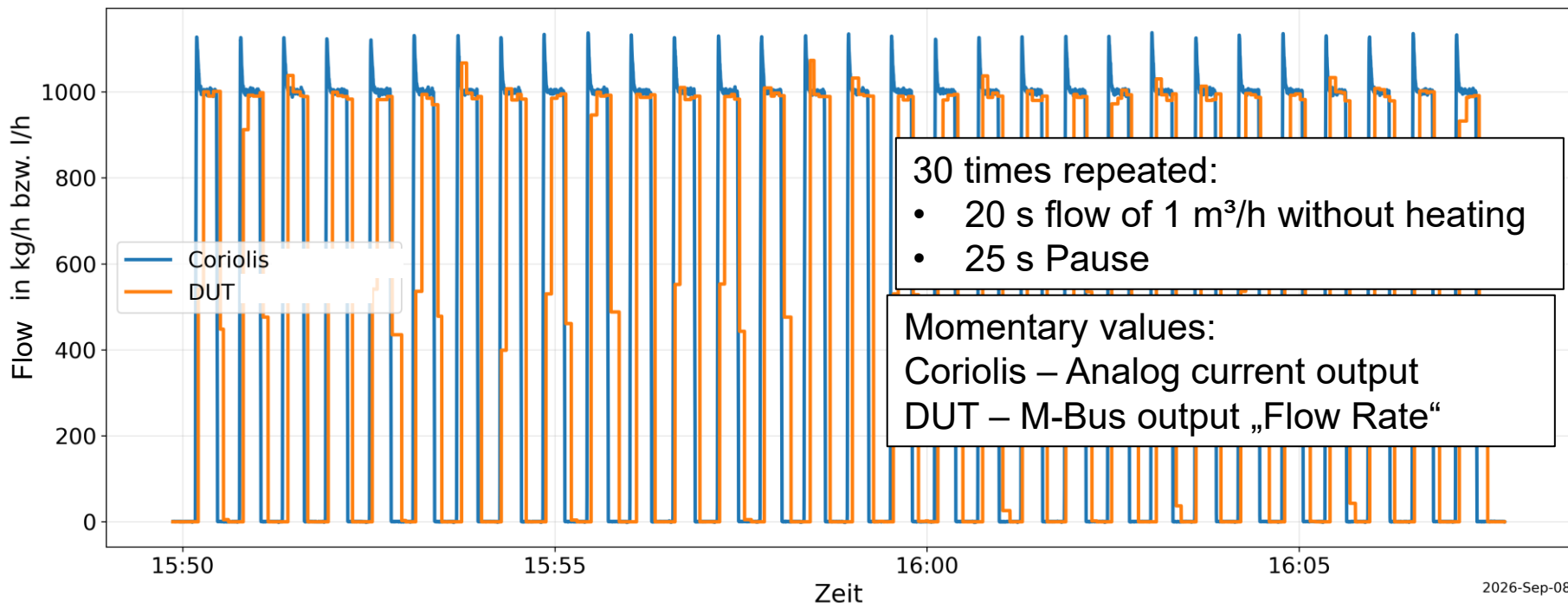
Schrittnummer	Dauer [s]	Regelventil 1 [%]	Regelventil 2 [%]	Ventil 1	Ventil 2	Ventil 3	Hauptpumpe [l/min]	Sekülpumpe [%]
1	61	100,0	100,0				2000	0,0
2	10	0,0	0,0				0	0,0
3	50	0,0	100,0				1200	100,0
4	10	0,0	0,0				0	0,0
5	61	100,0	100,0				2000	0,0
6	10	0,0	0,0				0	0,0
7	50	0,0	100,0				1200	80,0
8	10	0,0	0,0				0	0,0
9	61	100,0	100,0				2000	0,0
10	10	0,0	0,0				0	0,0
11	50	0,0	100,0				1200	40,0
12	10	0,0	0,0				0	0,0
13	61	100,0	100,0				2000	0,0
14	10	0,0	0,0				0	0,0
15	50	0,0	100,0				1200	40,0
16	10	0,0	0,0				0	0,0

Up
Remove
Down
Save
Open

Regelsequenz starten
Steuersequenz starten
Daten Aufzeichnen
Automatik Betrieb
Manueller Betrieb
Beenden

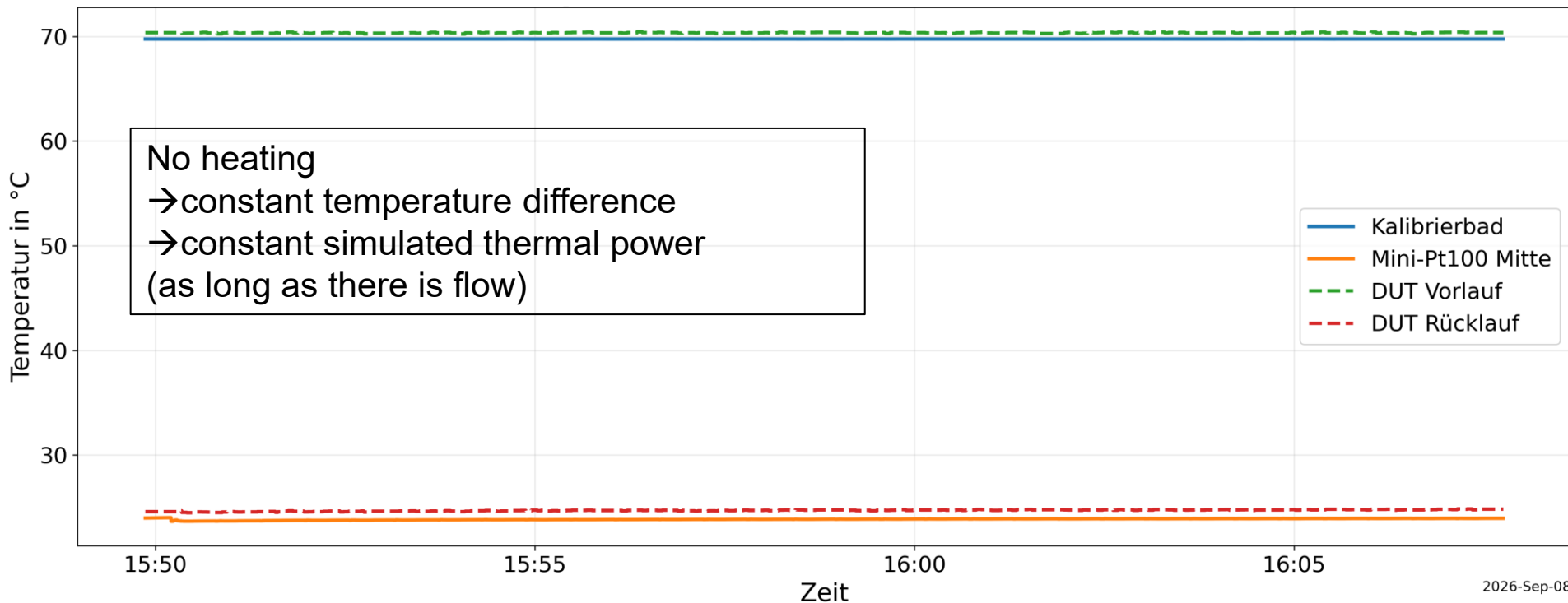
First „Measurements“

Flow rates



First „Measurements“

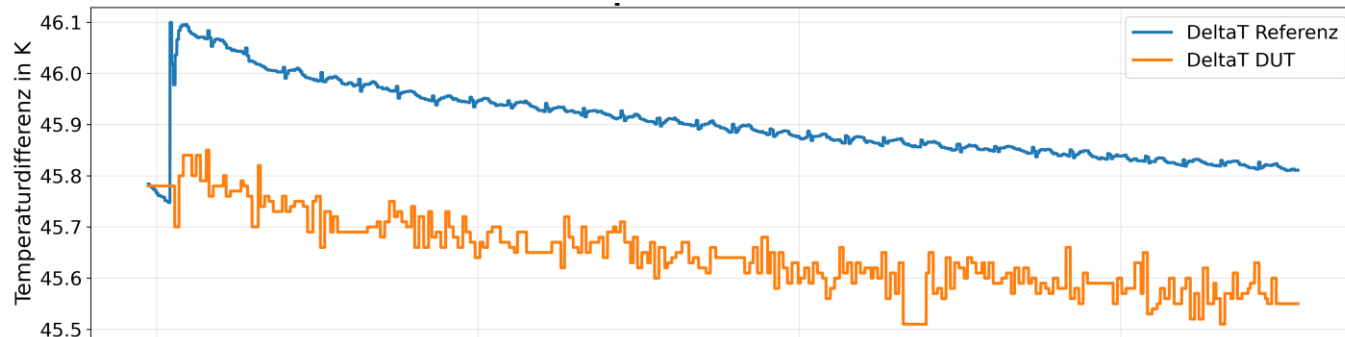
Temperatures



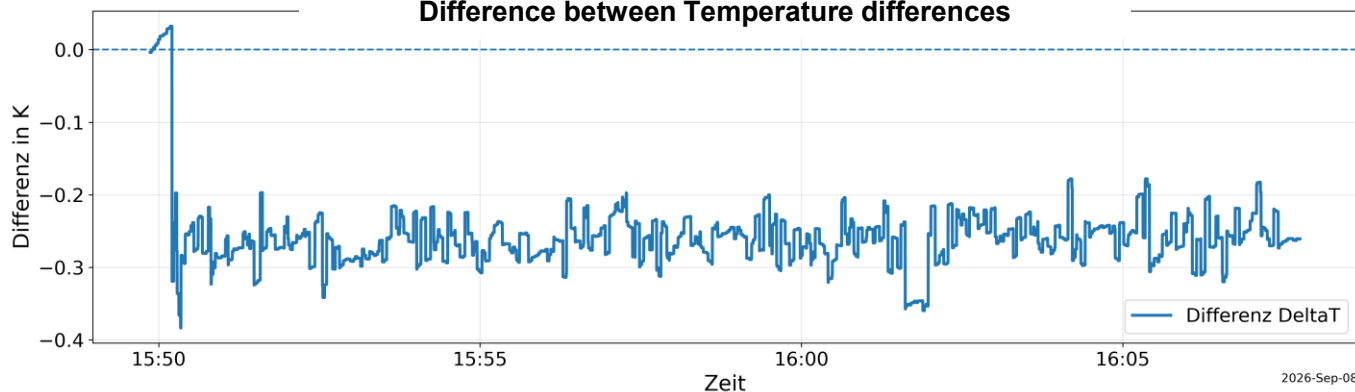
2026-Sep-08

First „Measurements“

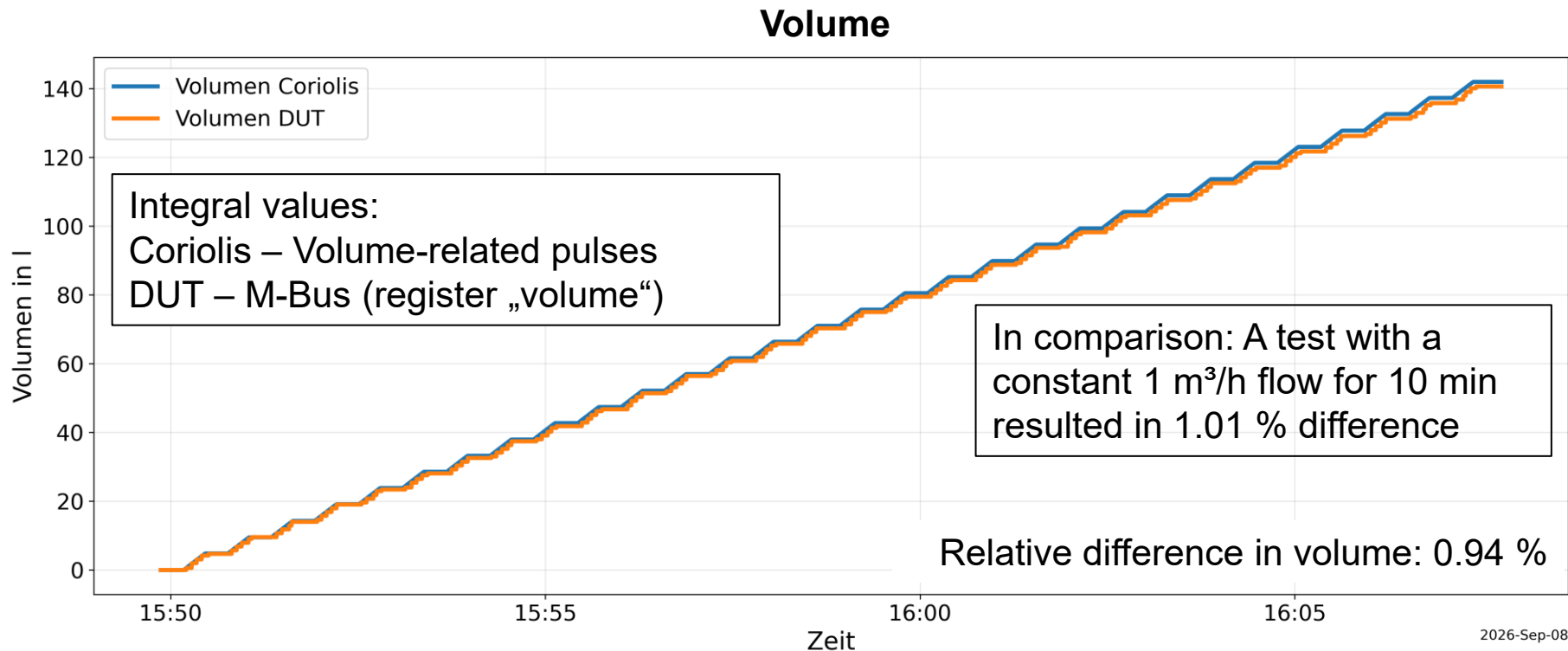
Temperature differences



Difference between Temperature differences

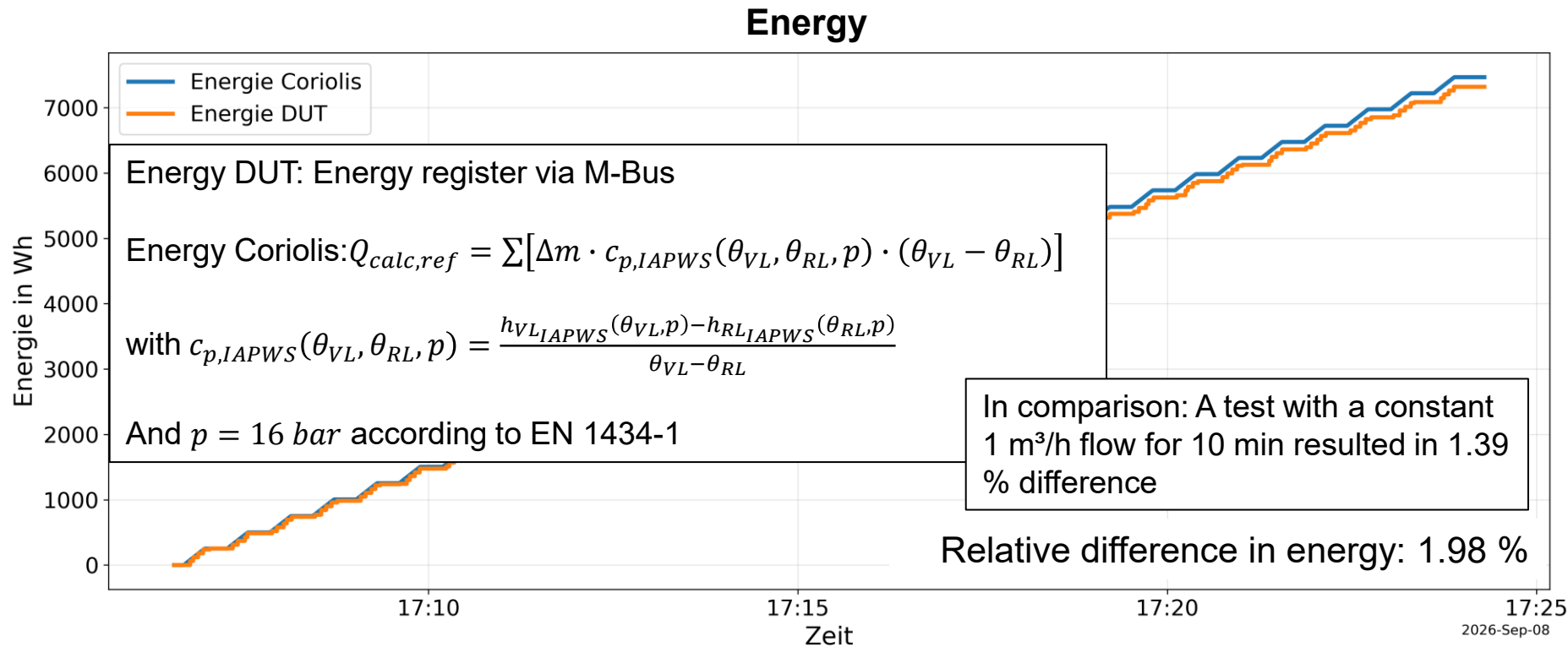


First „Measurements“

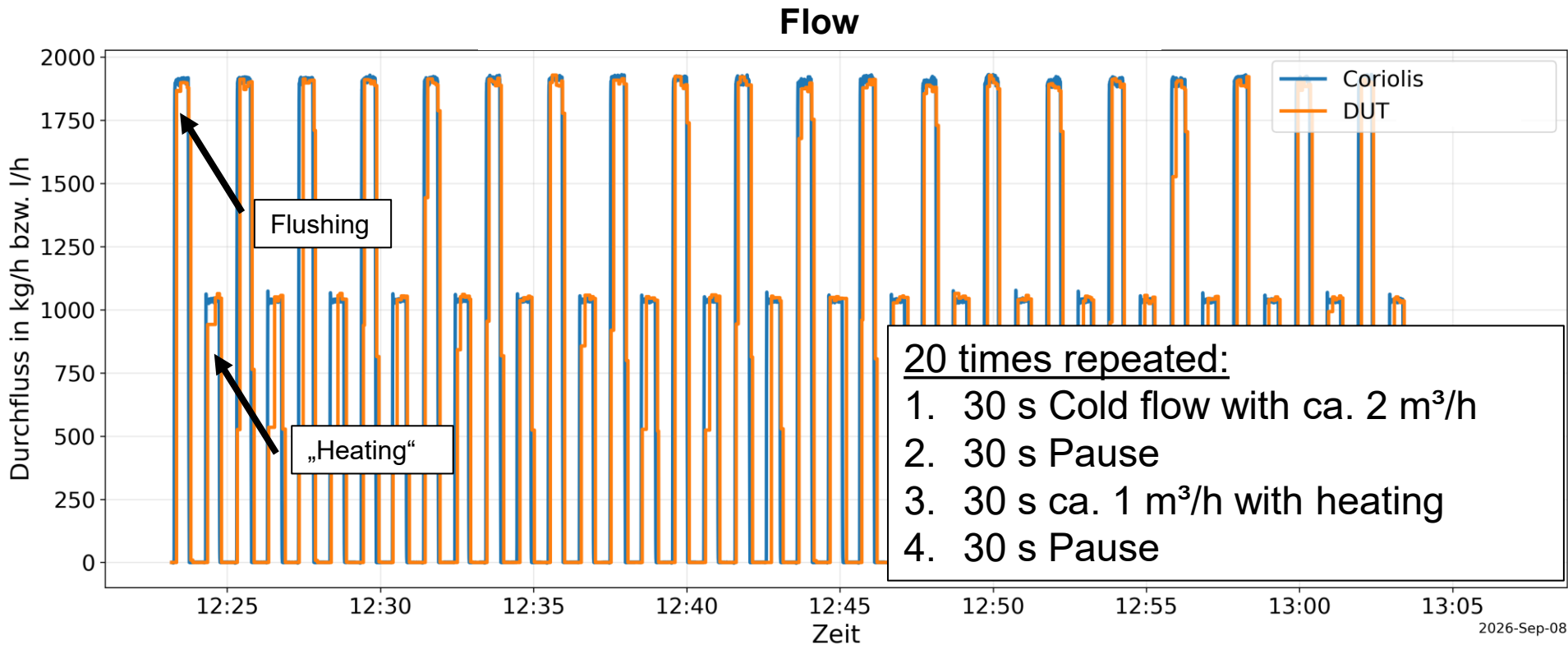


2026-Sep-08

First „Measurements“



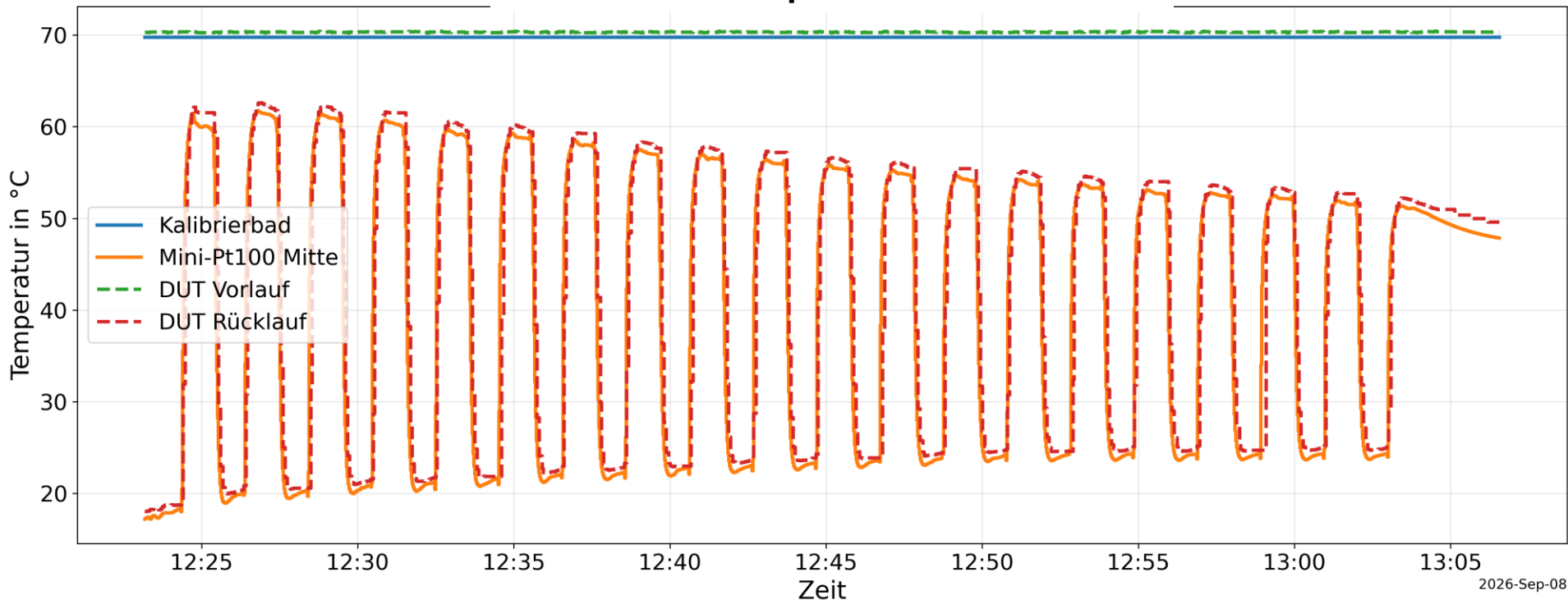
Test profile 2



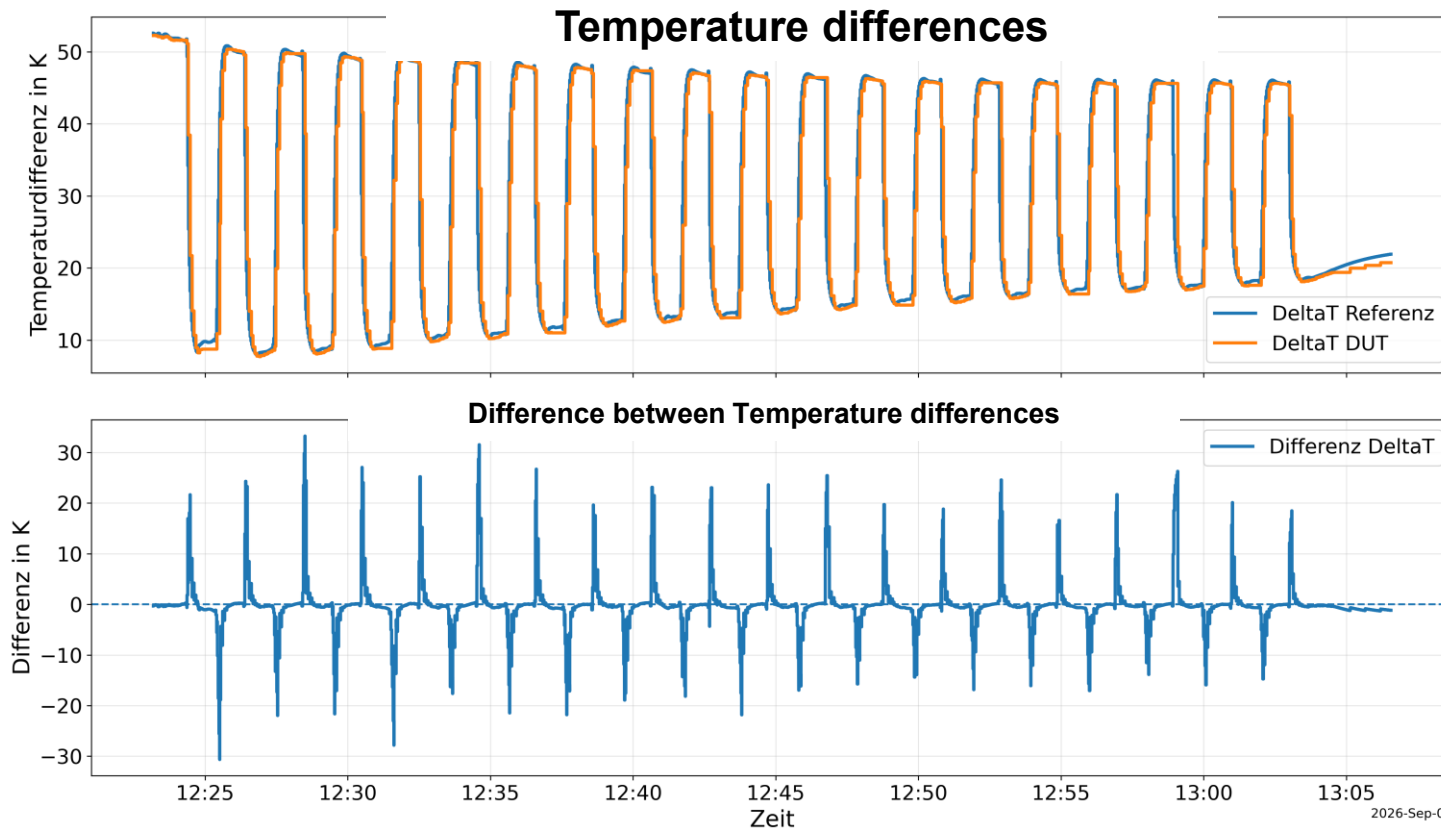
2026-Sep-08

Test profile 2

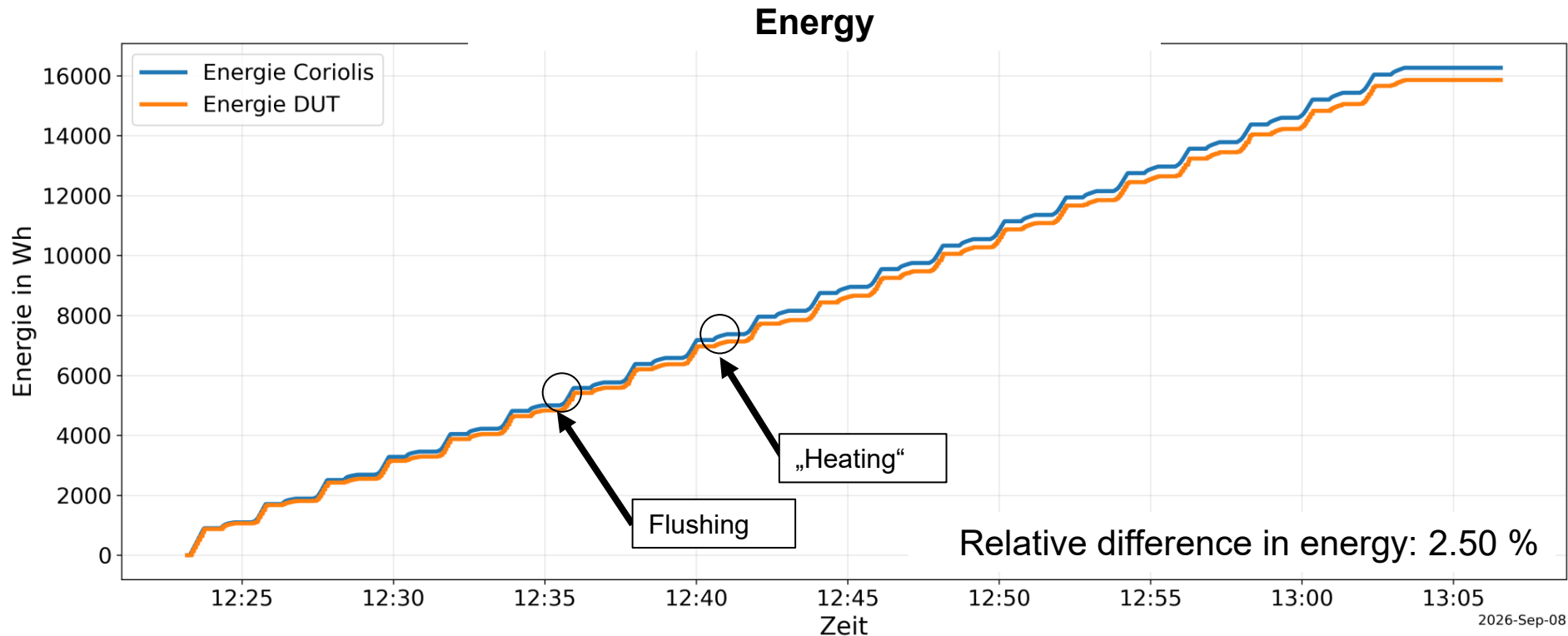
Temperatures



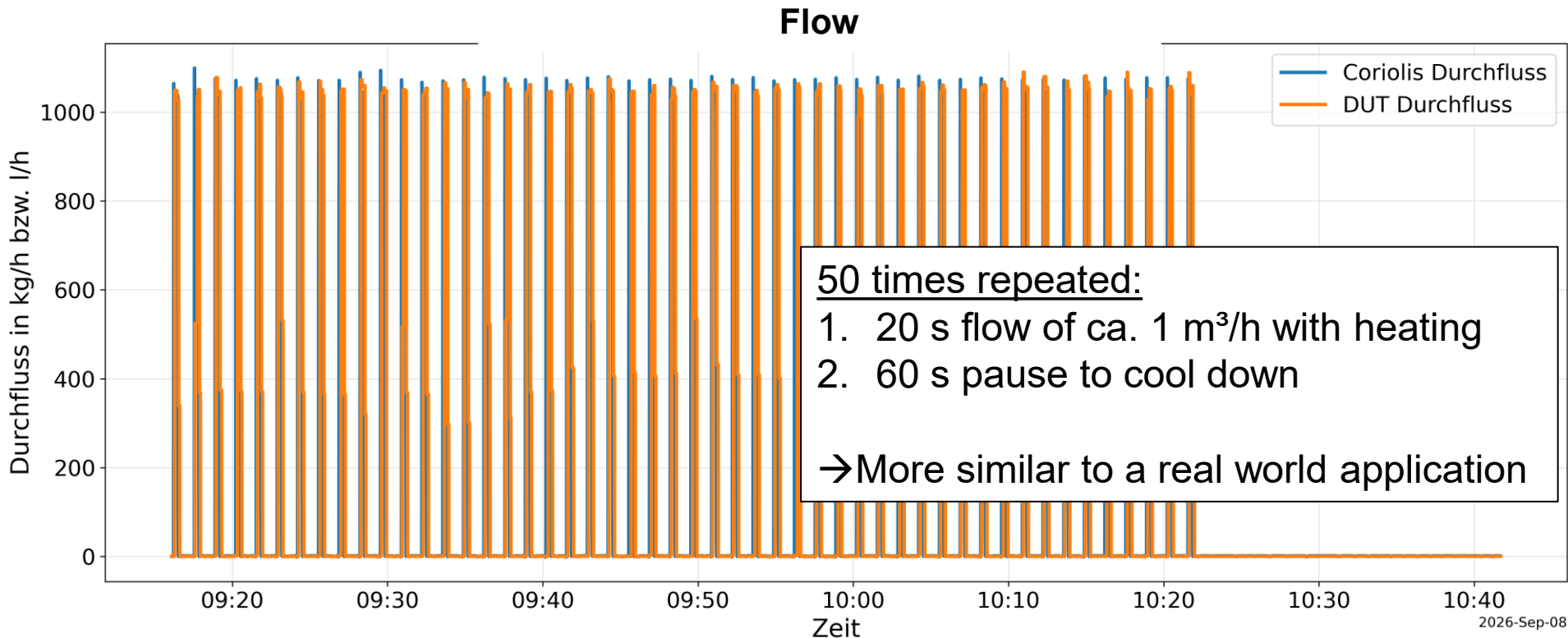
Test profile 2



Test profile 2

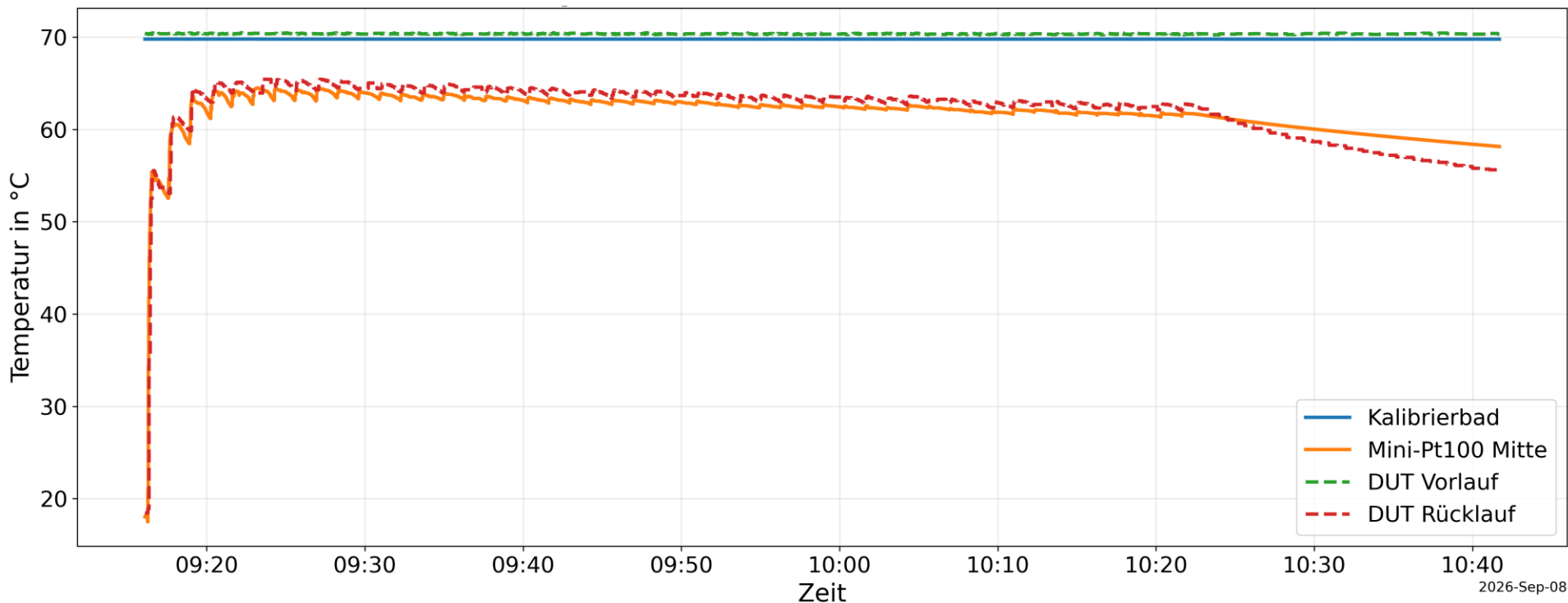


Test profile 3



Test profile 3

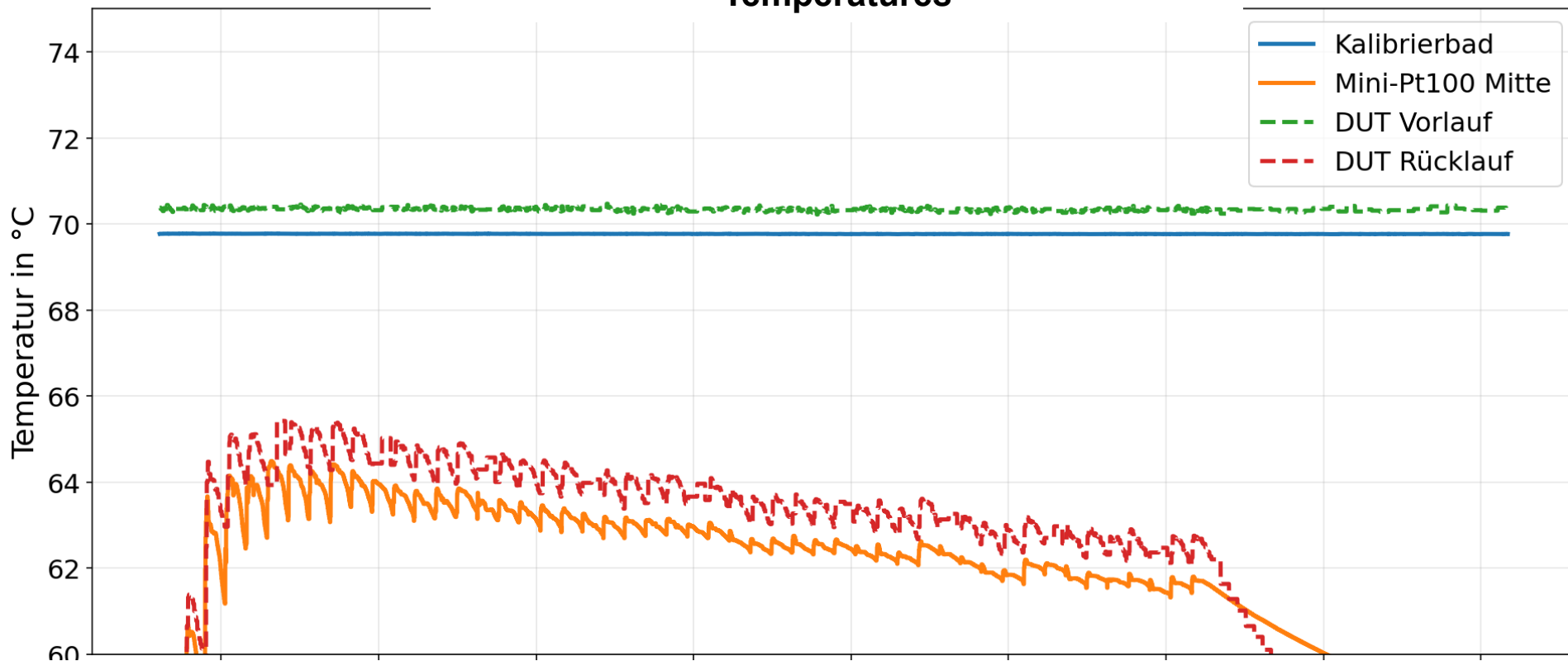
Temperatures



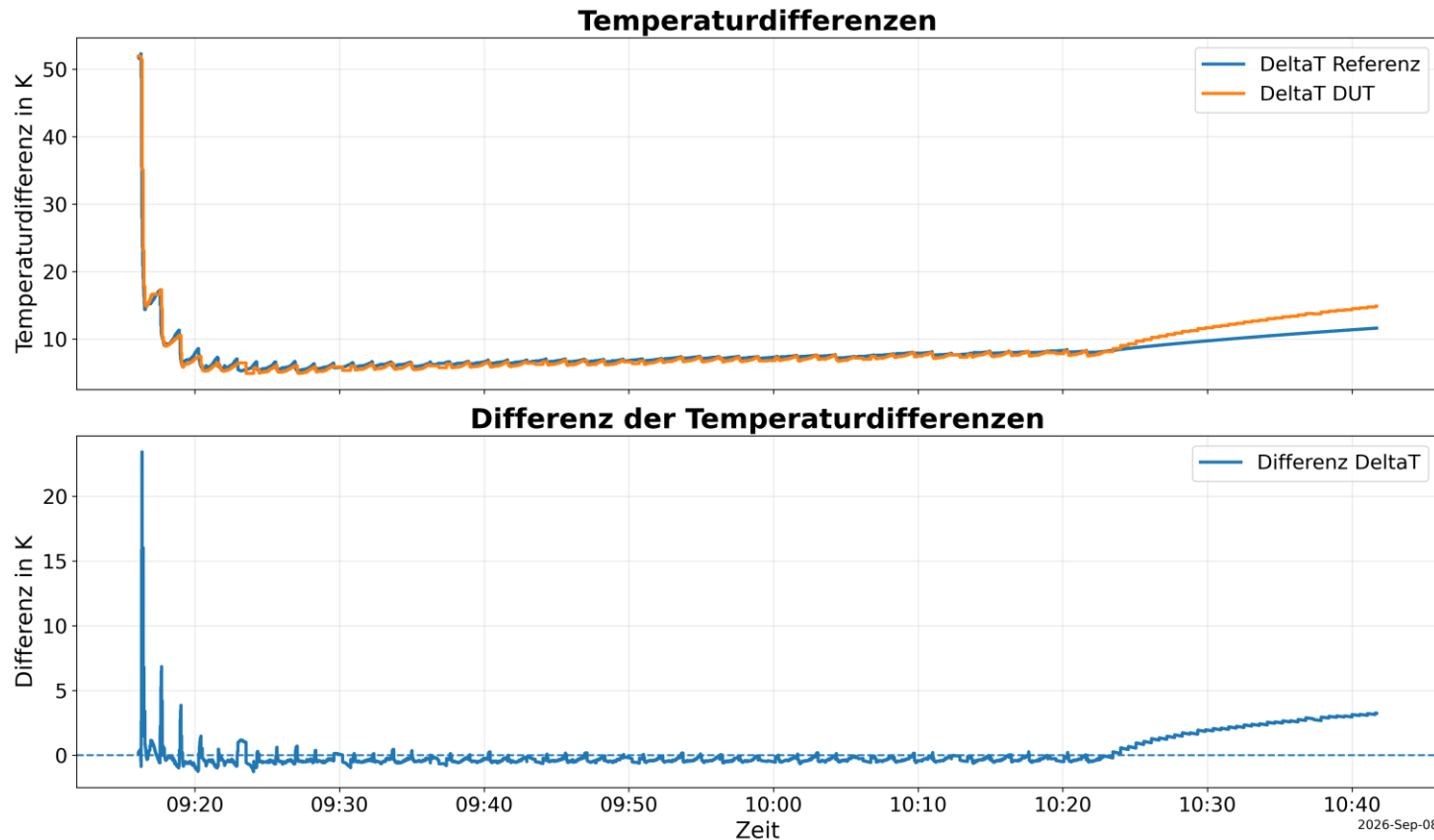
2026-Sep-08

Test profile 3

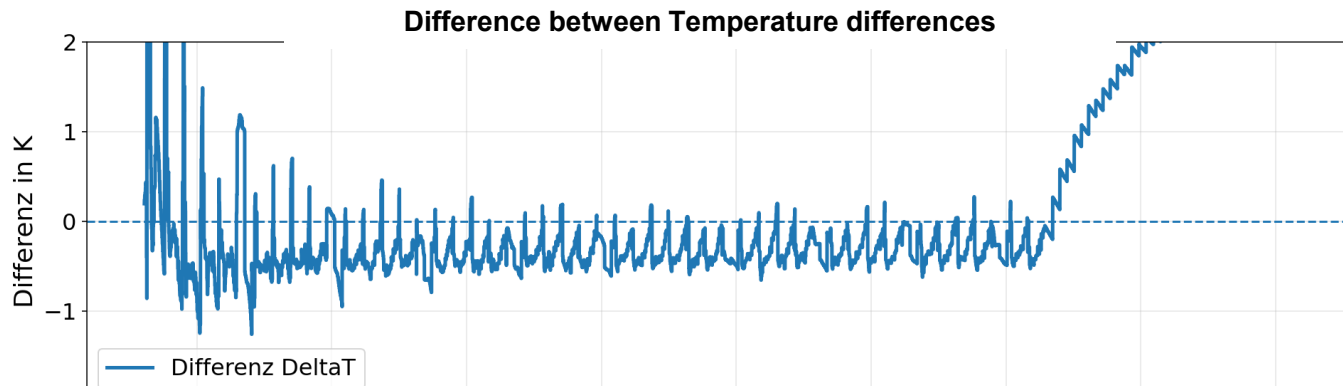
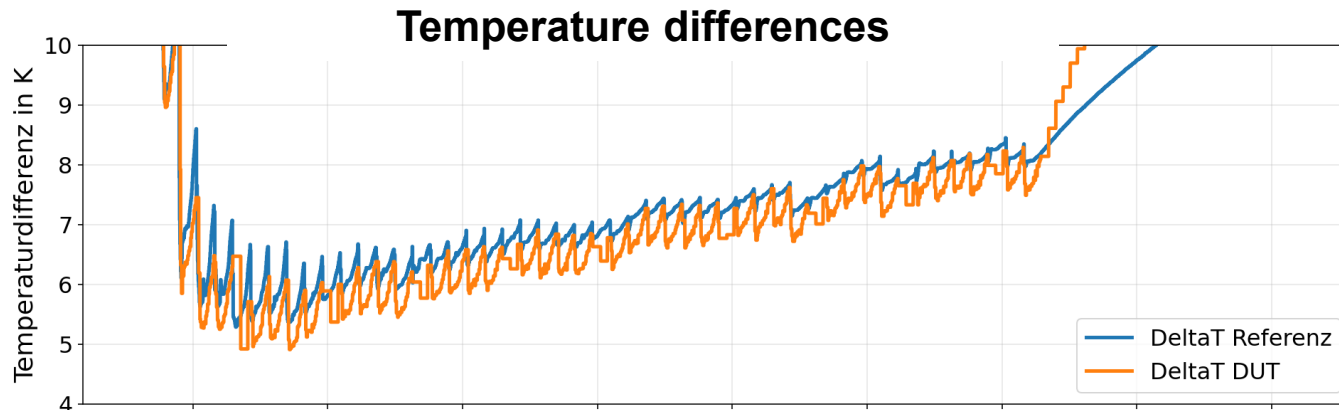
Temperatures



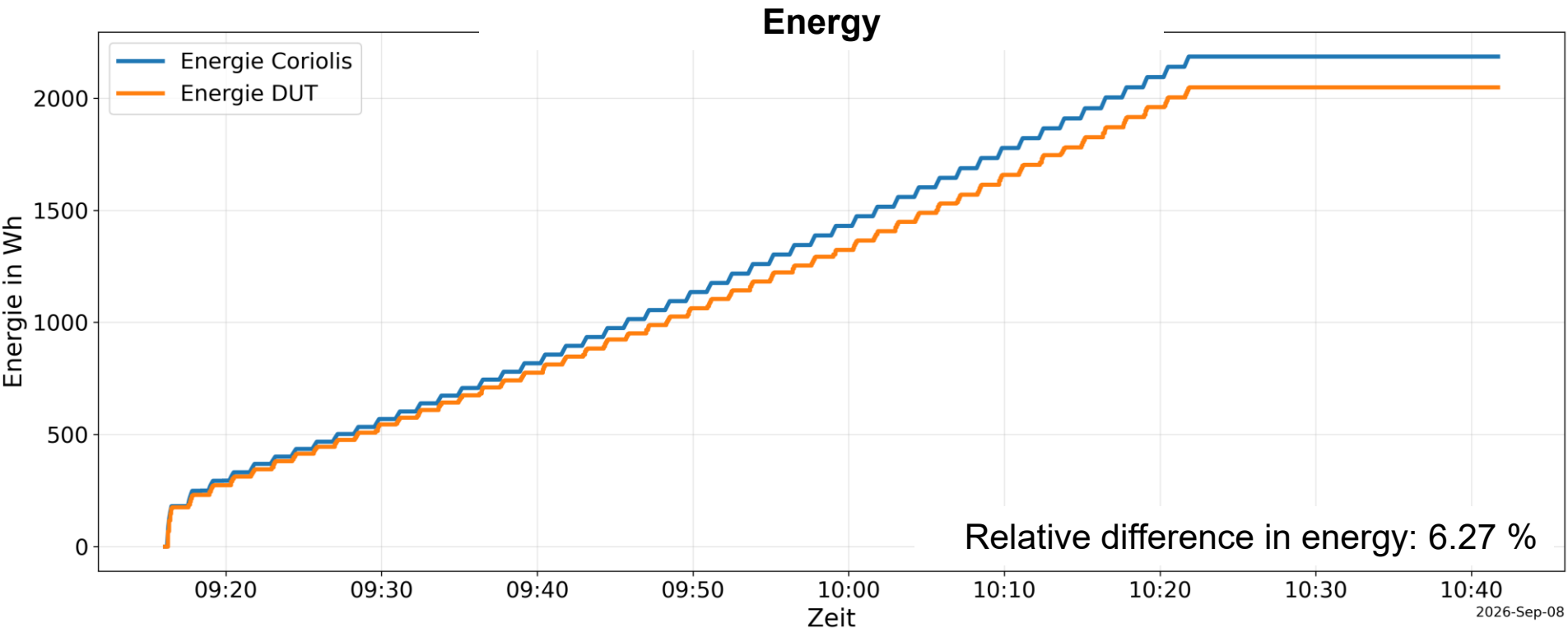
Test profile 3



Test profile 3



Test profile 3



- Because the reprogramming took way longer than expected, sensors of the test bench have to be re-calibrated as soon as contractor finishes
- All measurements and results are therefore to be regarded as preliminary and be taken with a grain of salt
- Contractor also needs to fully commission and tune control loops
- Due to a software bug, the temperature acquisition during the tests was limited to one value per second and channel, even if hardware and sensors are capable of way faster measurements



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