A. Illustration of dynamic heat exchanges in the sheep barn

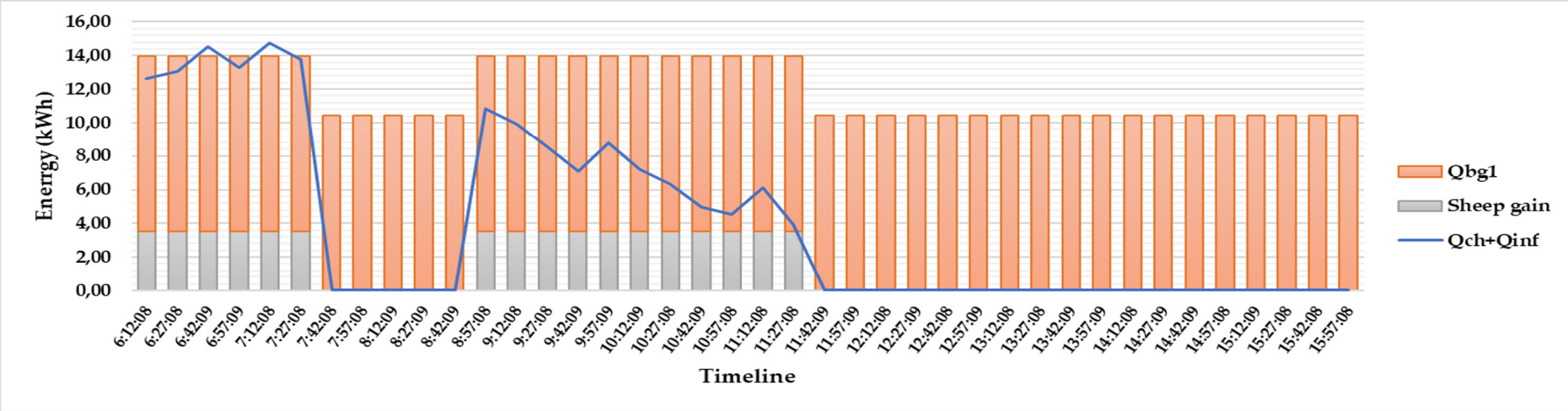

Figure S1. Energy exchanges for the Qbg1 scenario (23/01/2022)

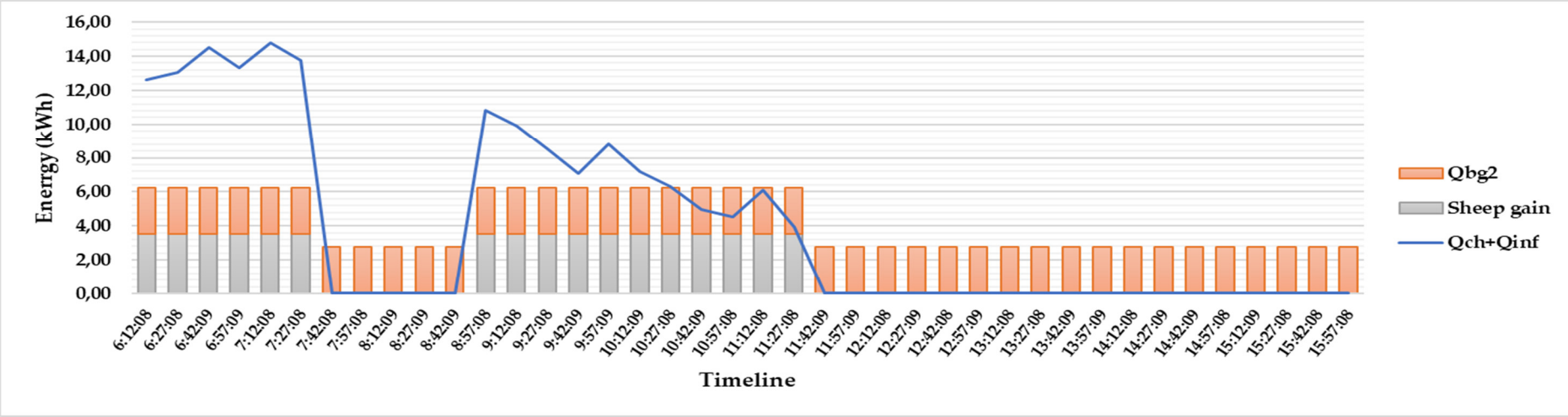

Figure S2. Energy exchanges for the Qbg2 scenario (23/01/2022)

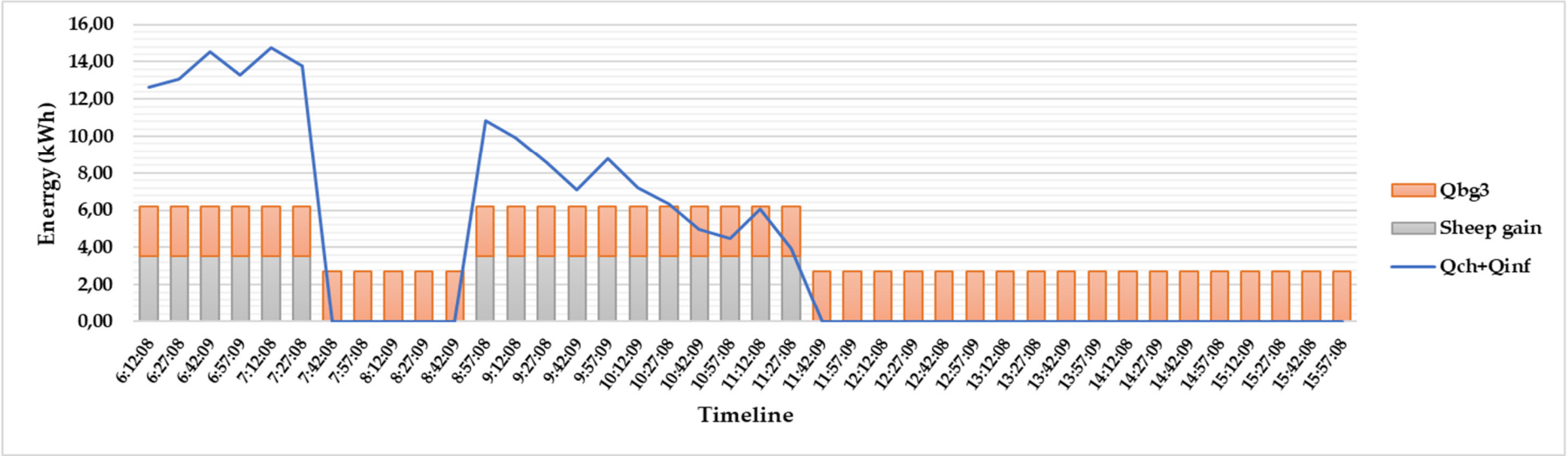

Figure S3. Energy exchanges for the Qbg3 scenario (23/01/2022)

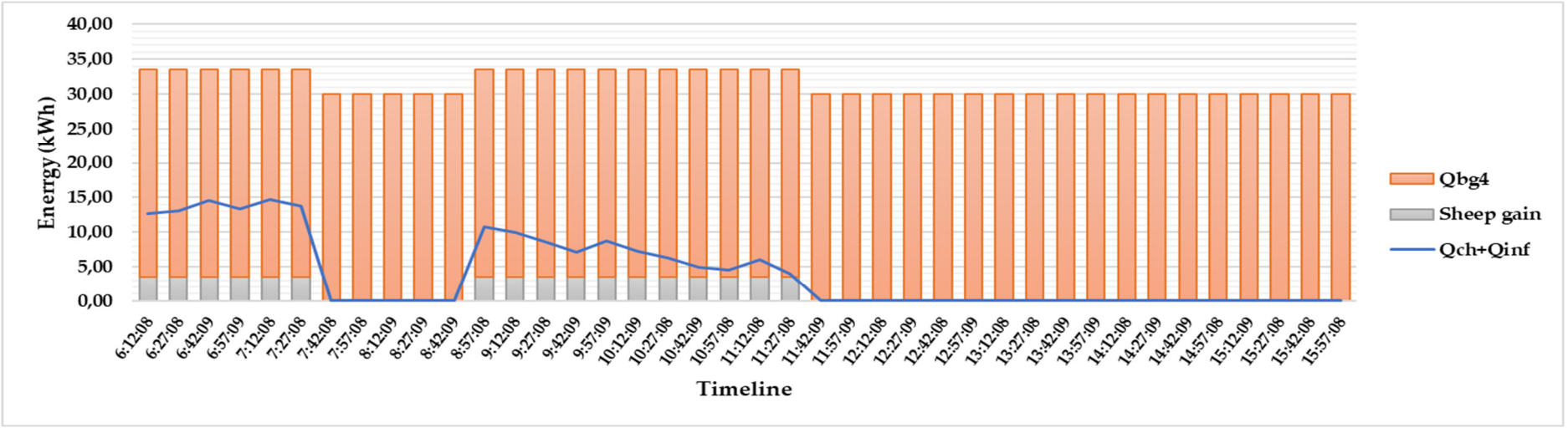

Figure S4. Energy exchanges for the Qbg4 scenario (23/01/2022)

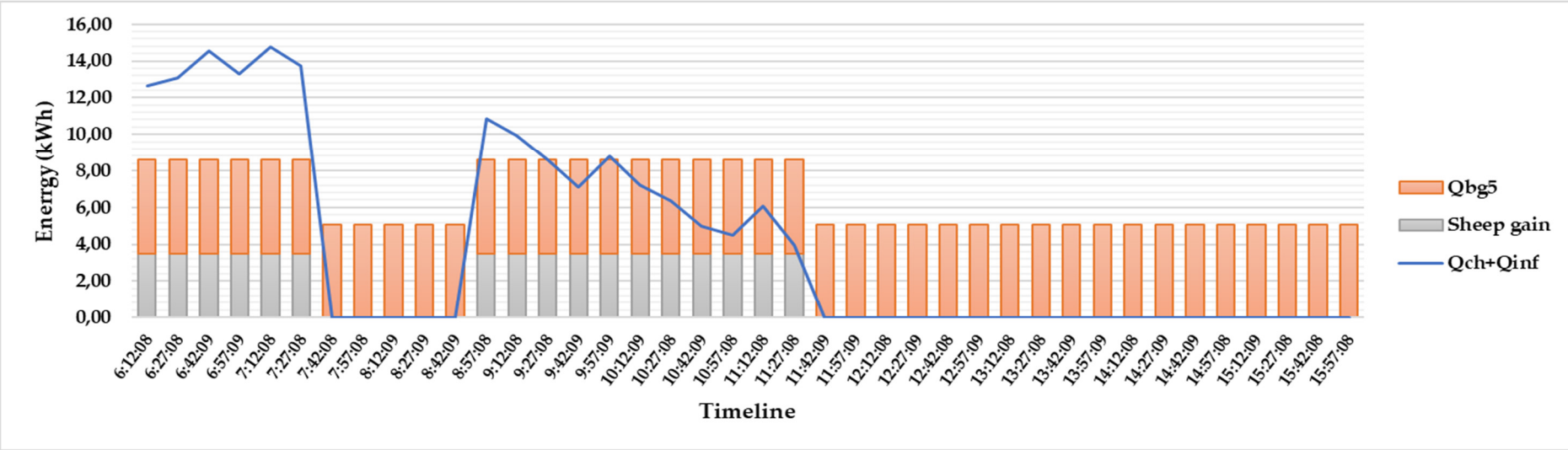

Figure S5. Energy exchanges for the Qbg5 scenario (23/01/2022)

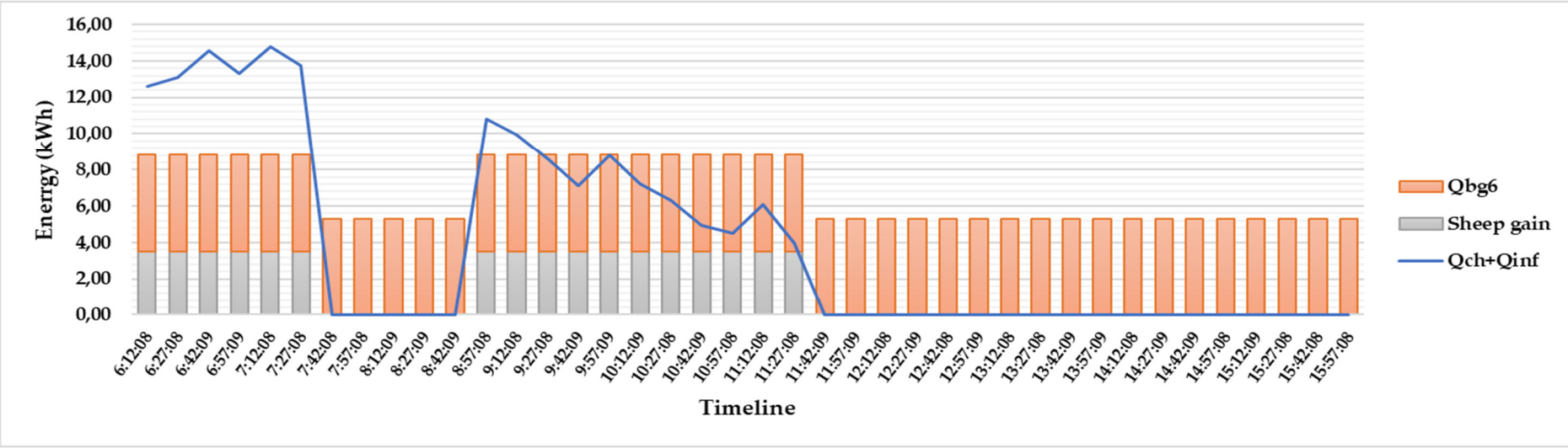

Figure S6. Energy exchanges for the Qbg6 scenario (23/01/2022)

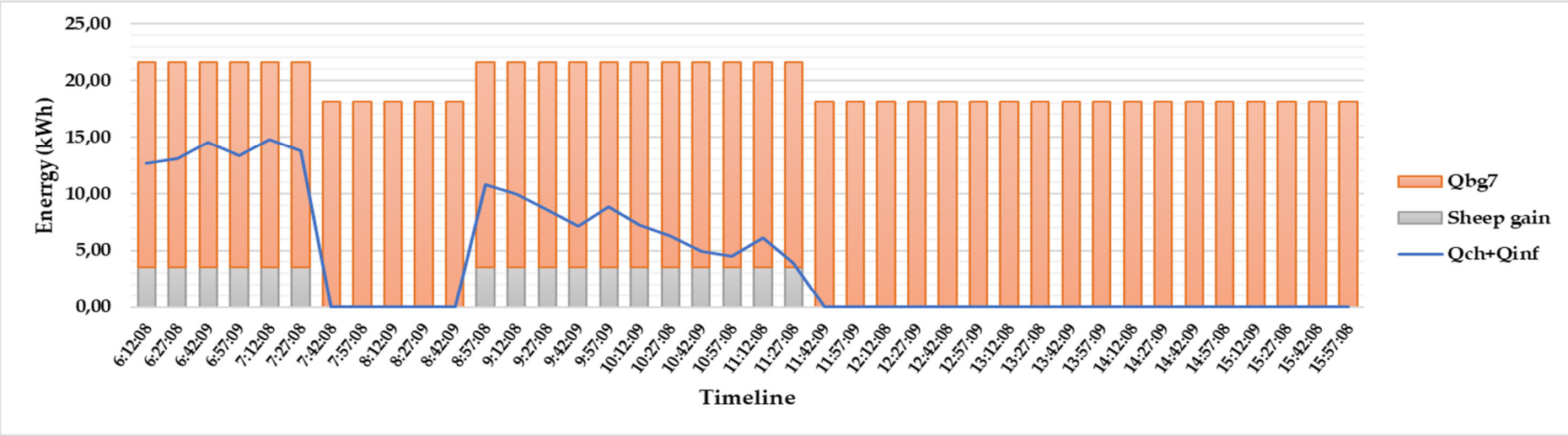

Figure S7. Energy exchanges for the Qbg7 scenario (23/01/2022)

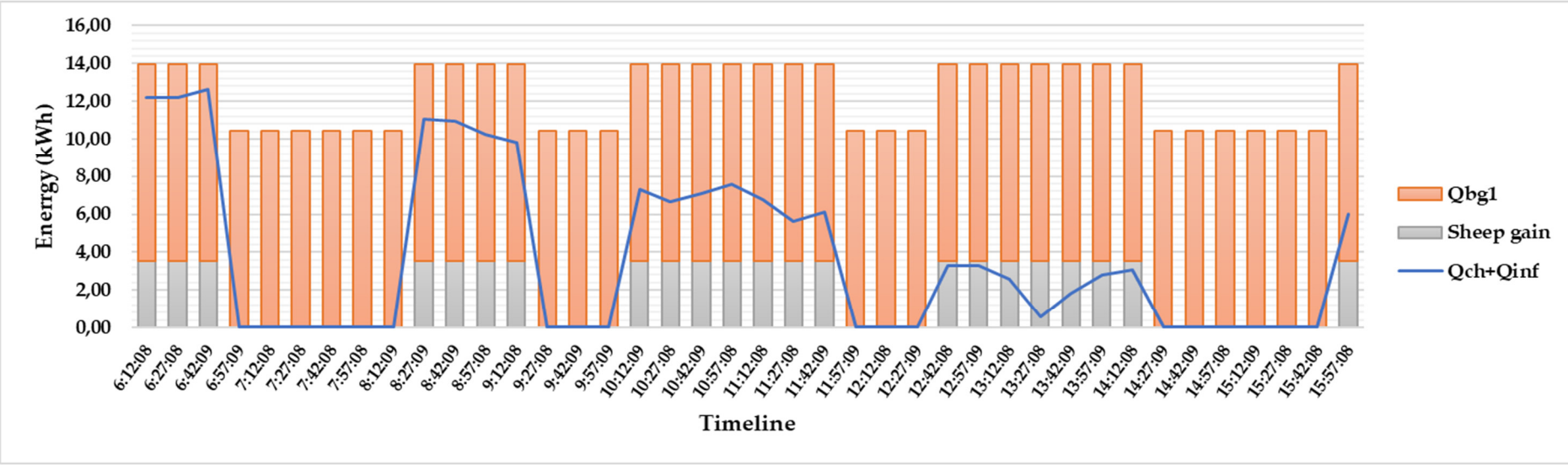

Figure S8. Energy exchanges for the Qbg1 scenario (24/01/2022)

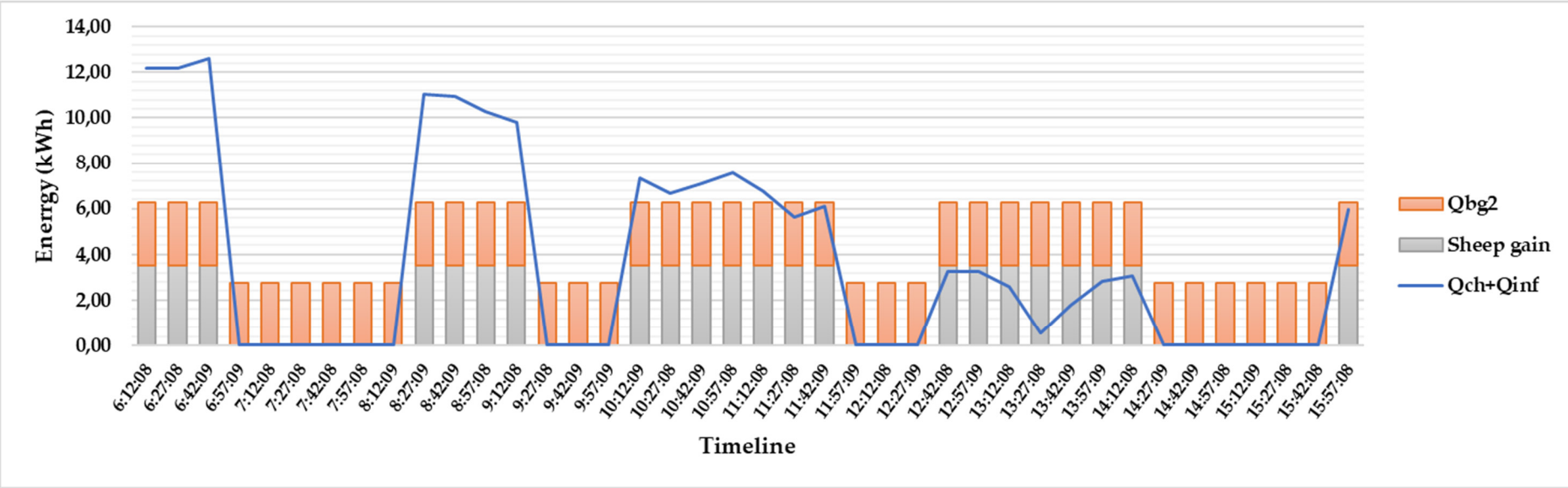

Figure S9. Energy exchanges for the Qbg2 scenario (24/01/2022)

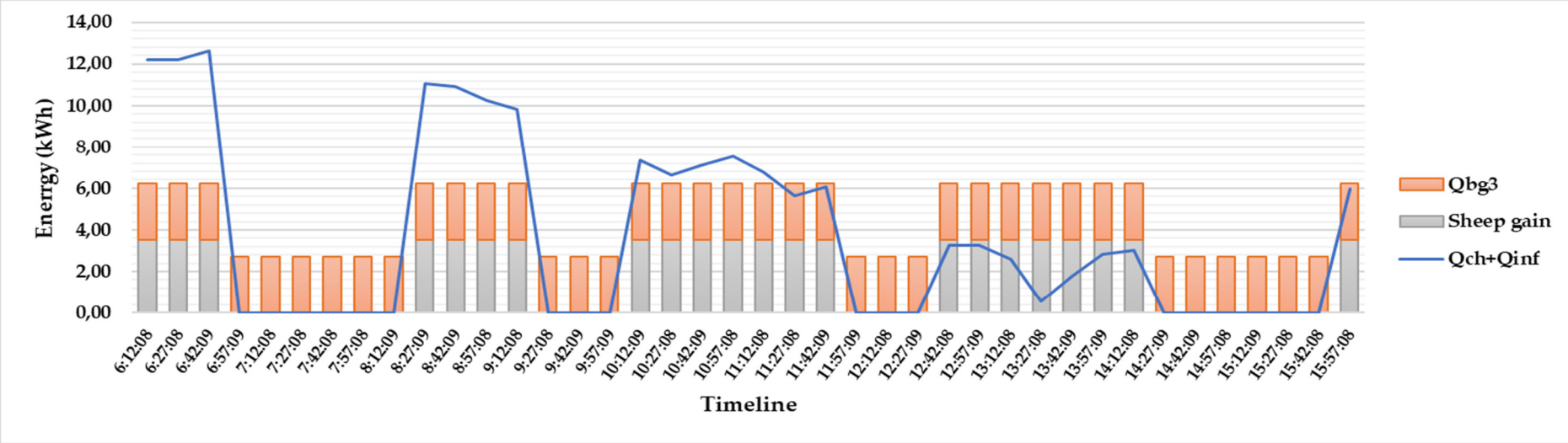

Figure S10. Energy exchanges for the Qbg3 scenario (24/01/2022)

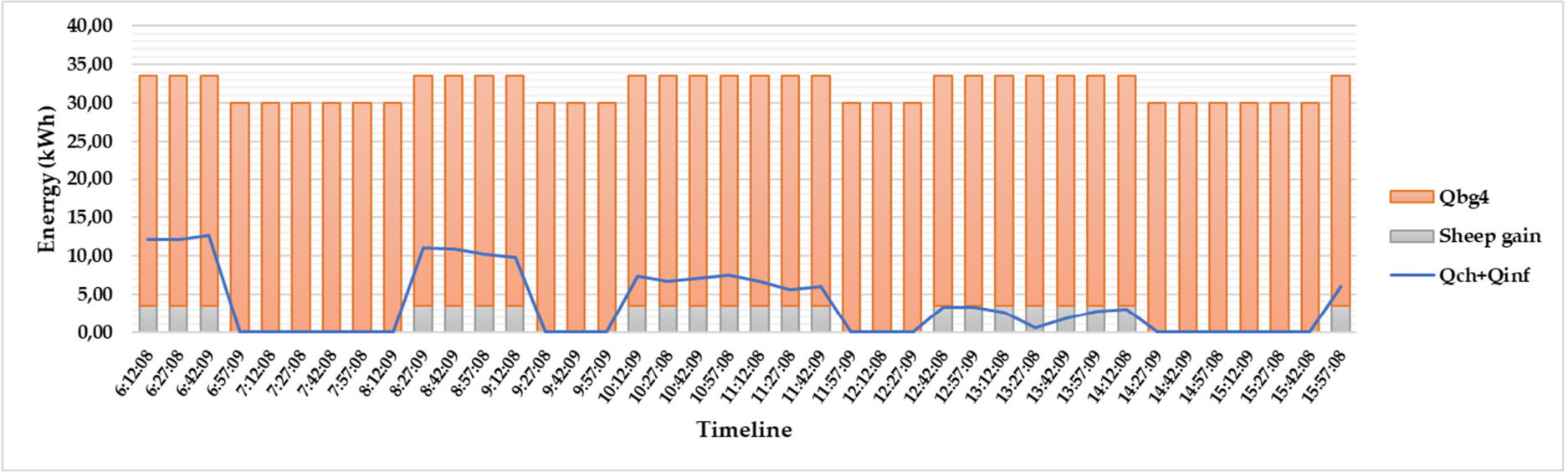

Figure S11. Energy exchanges for the Qbg4 scenario (24/01/2022)

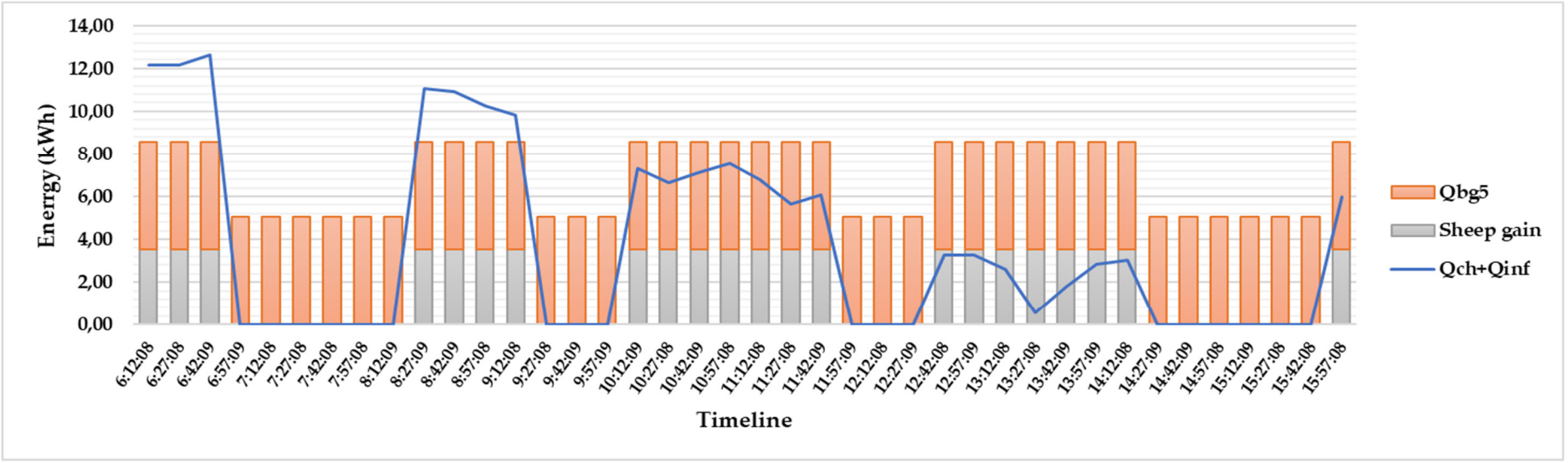

Figure S12. Energy exchanges for the Qbg5 scenario (24/01/2022)

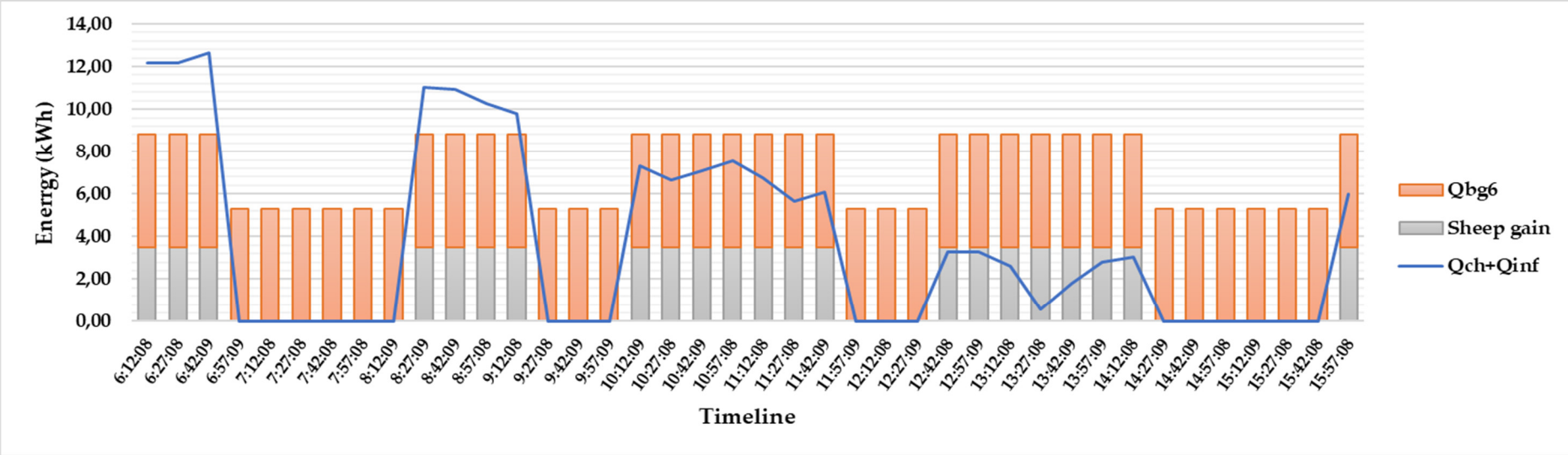

Figure S13. Energy exchanges for the Qbg6 scenario (24/01/2022)

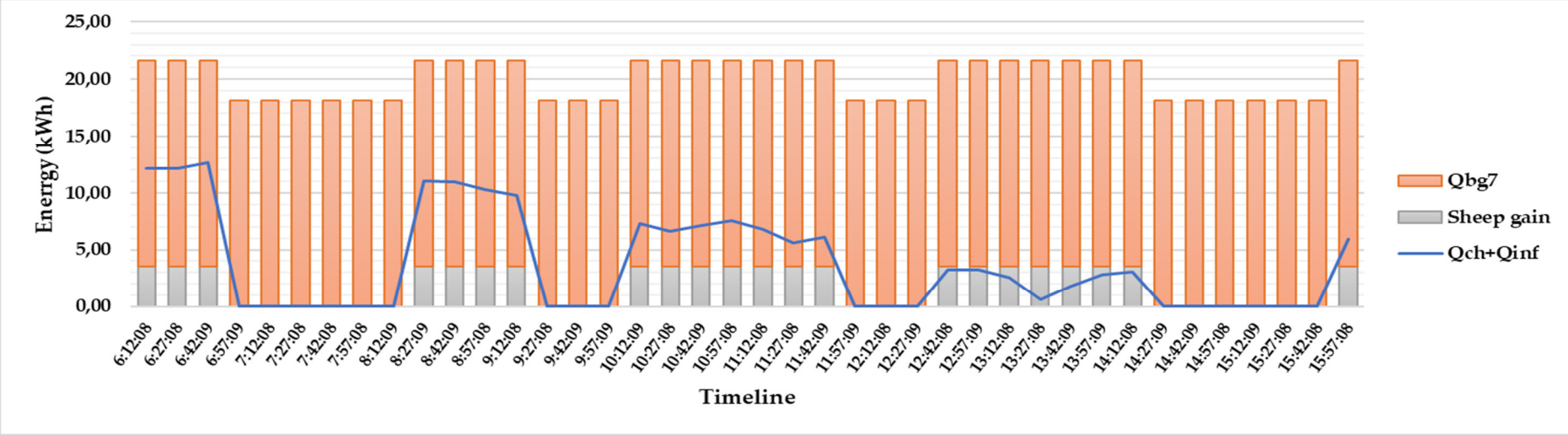

Figure S14. Energy exchanges for the Qbg7 scenario (24/01/2022)

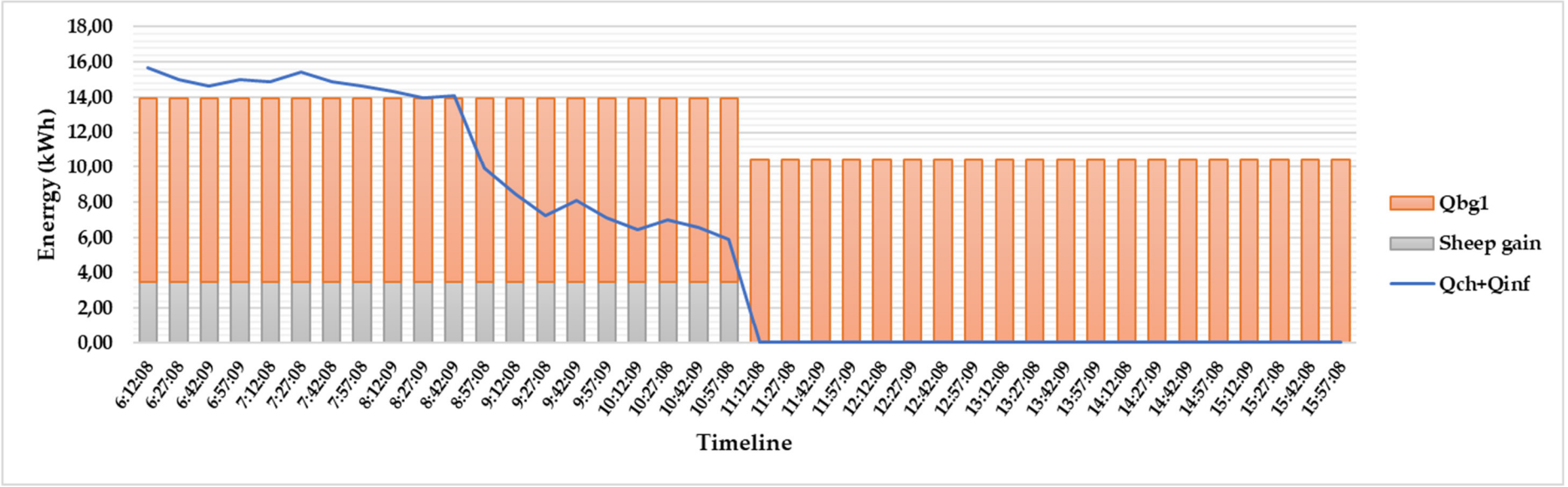

Figure S15. Energy exchanges for the Qbg1 scenario (25/01/2022)

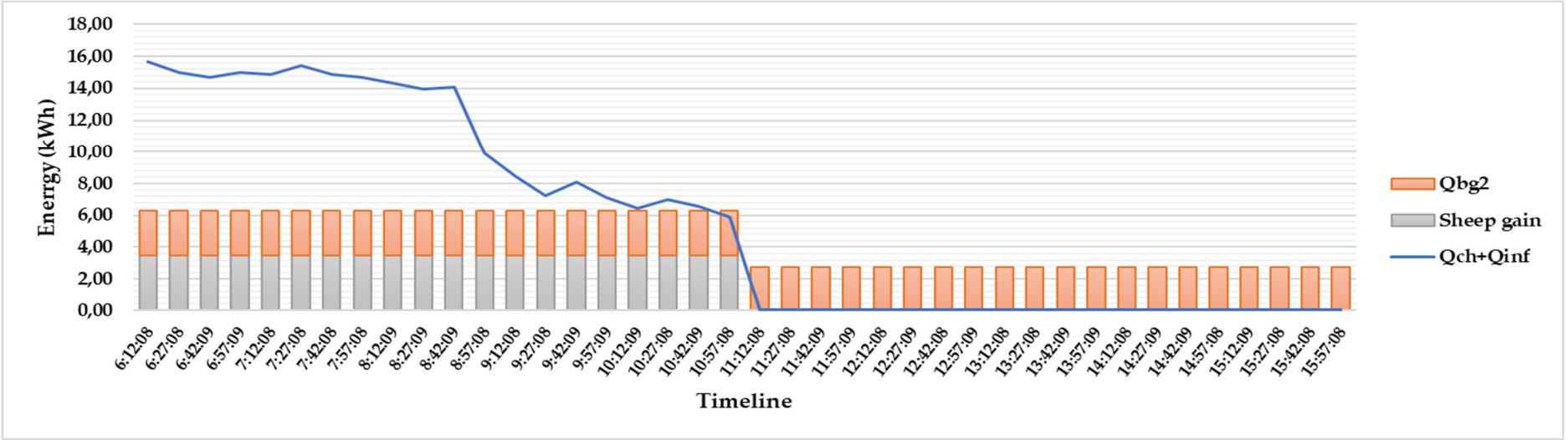

Figure S16. Energy exchanges for the Qbg2 scenario (25/01/2022)

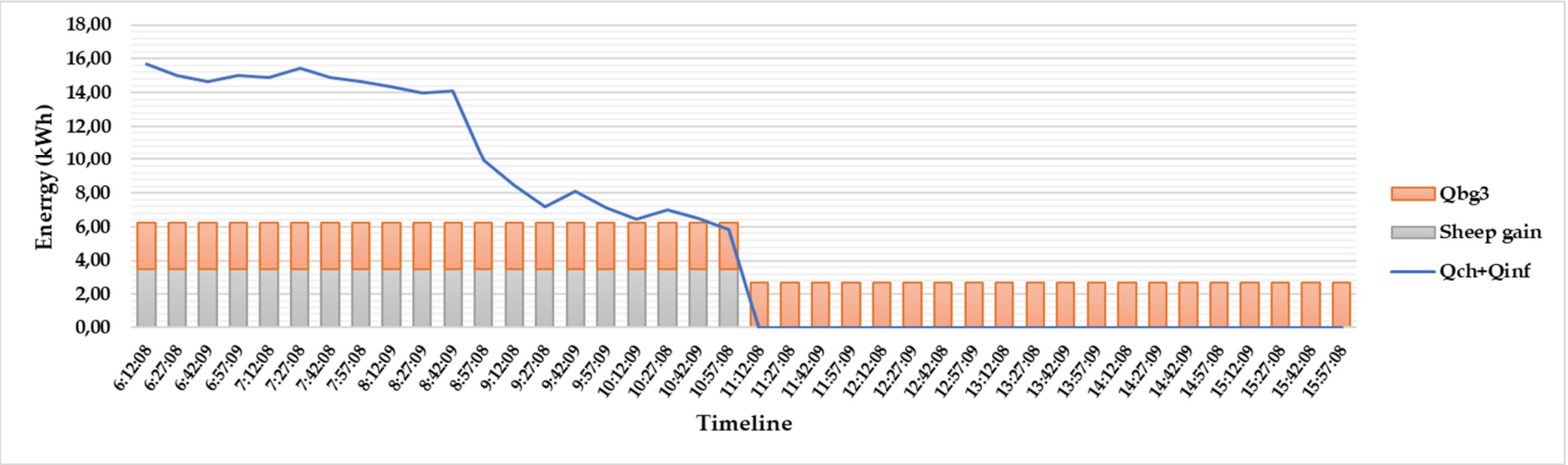

Figure S17. Energy exchanges for the Qbg3 scenario (25/01/2022)

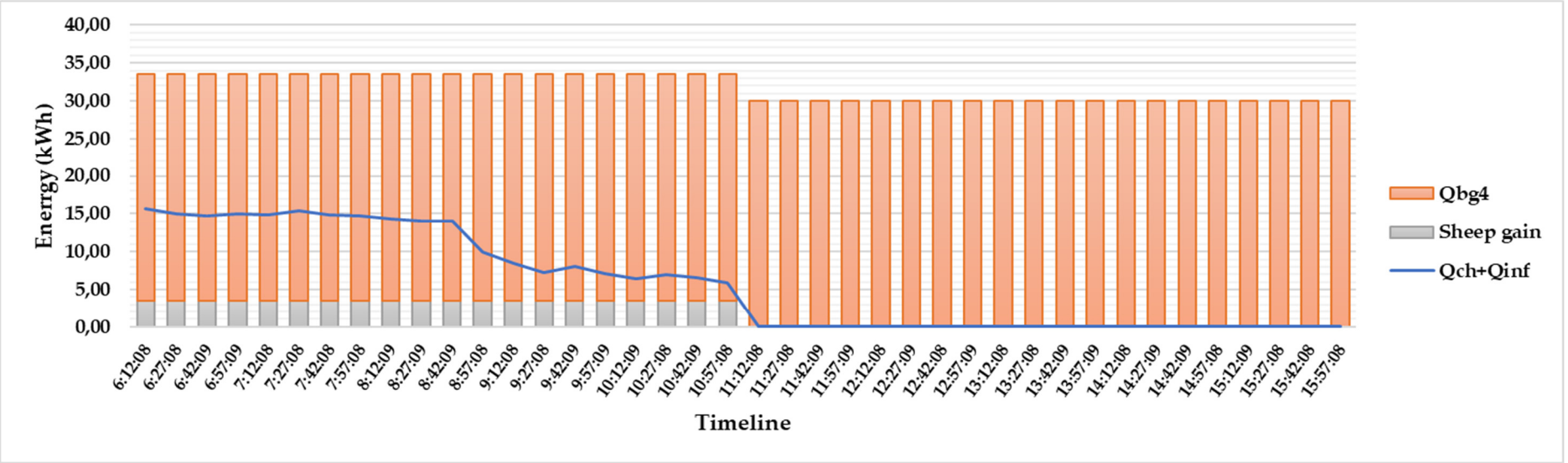

Figure S18. Energy exchanges for the Qbg4 scenario (25/01/2022)

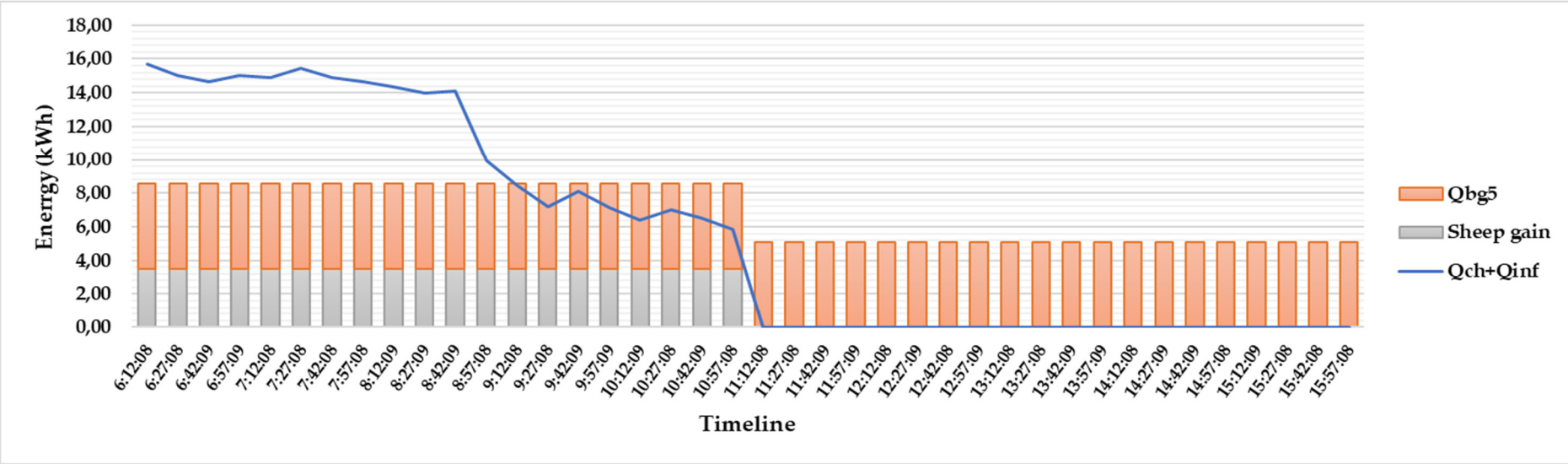

Figure S19. Energy exchanges for the Qbg5 scenario (25/01/2022)

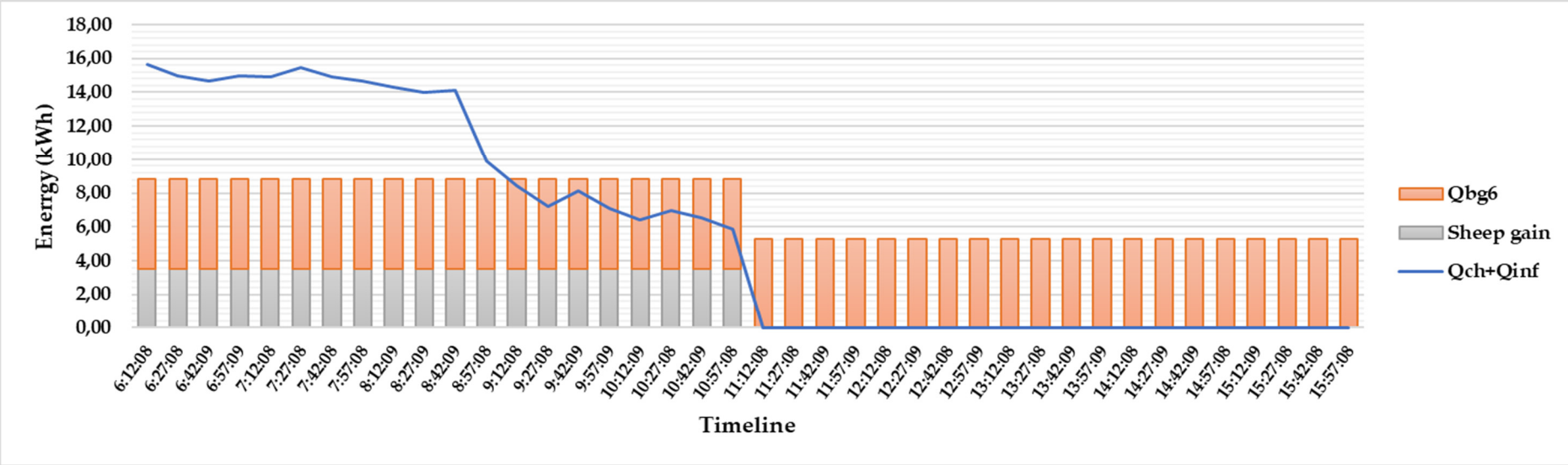

Figure S20. Energy exchanges for the Qbg6 scenario (25/01/2022)

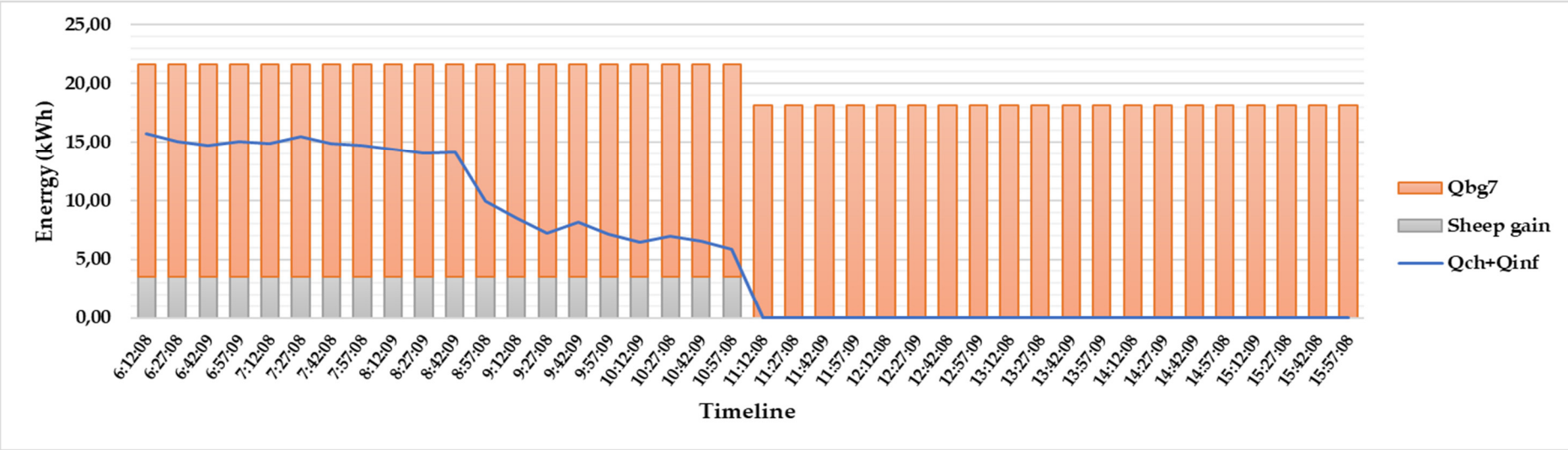

Figure S21. Energy exchanges for the Qbg7 scenario (25/01/2022)

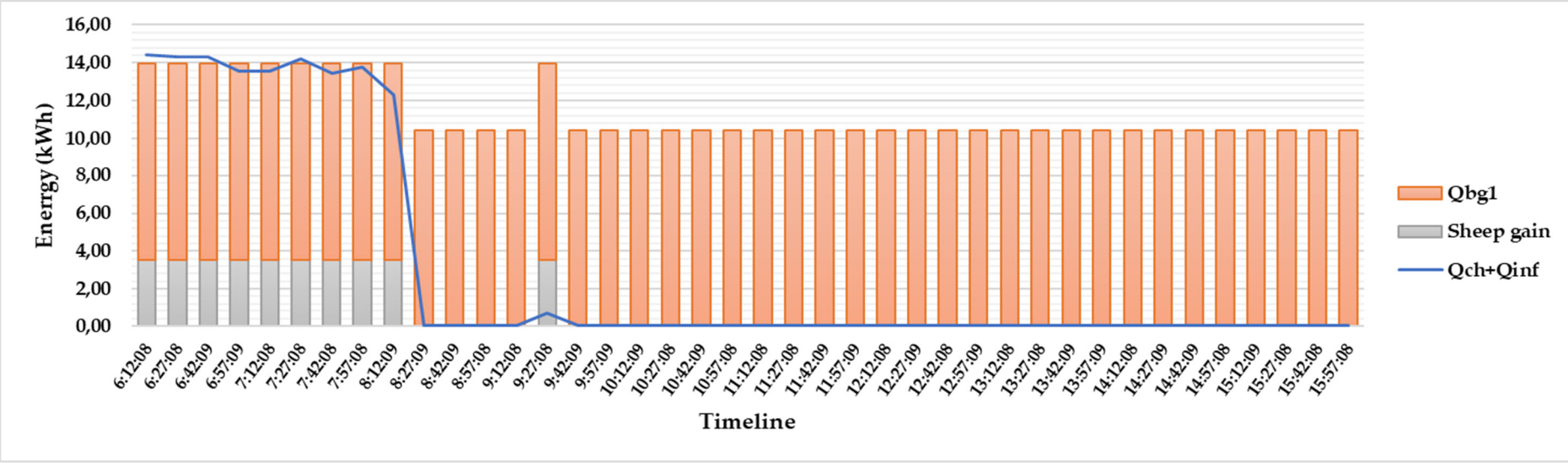

Figure S22. Energy exchanges for the Qbg1 scenario (26/01/2022)

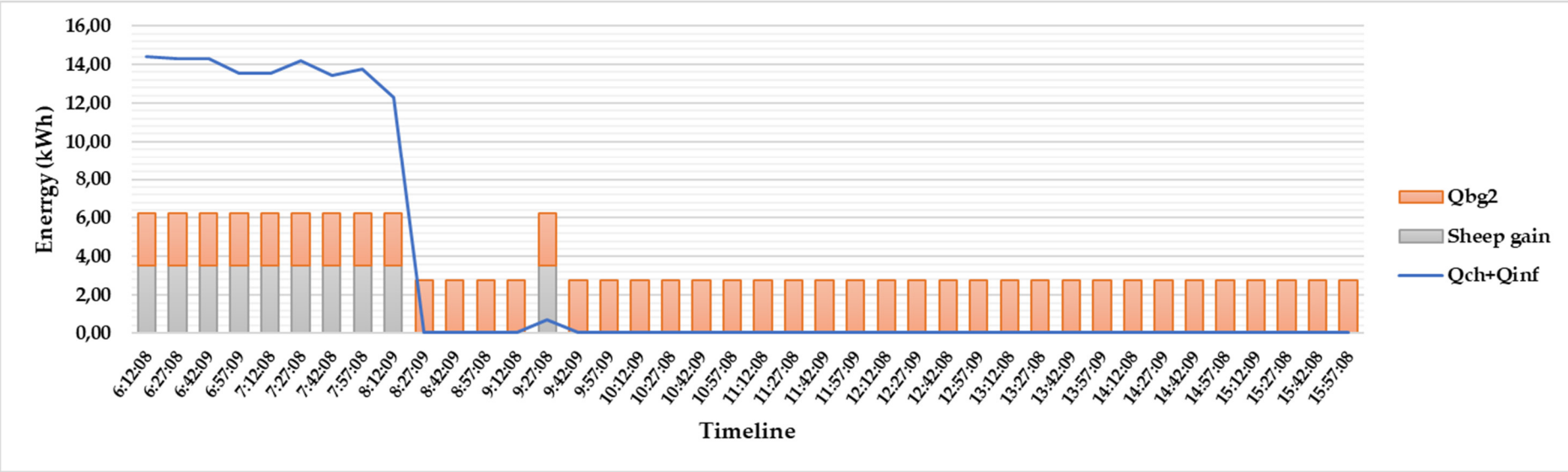

Figure S23. Energy exchanges for the Qbg2 scenario (26/01/2022)

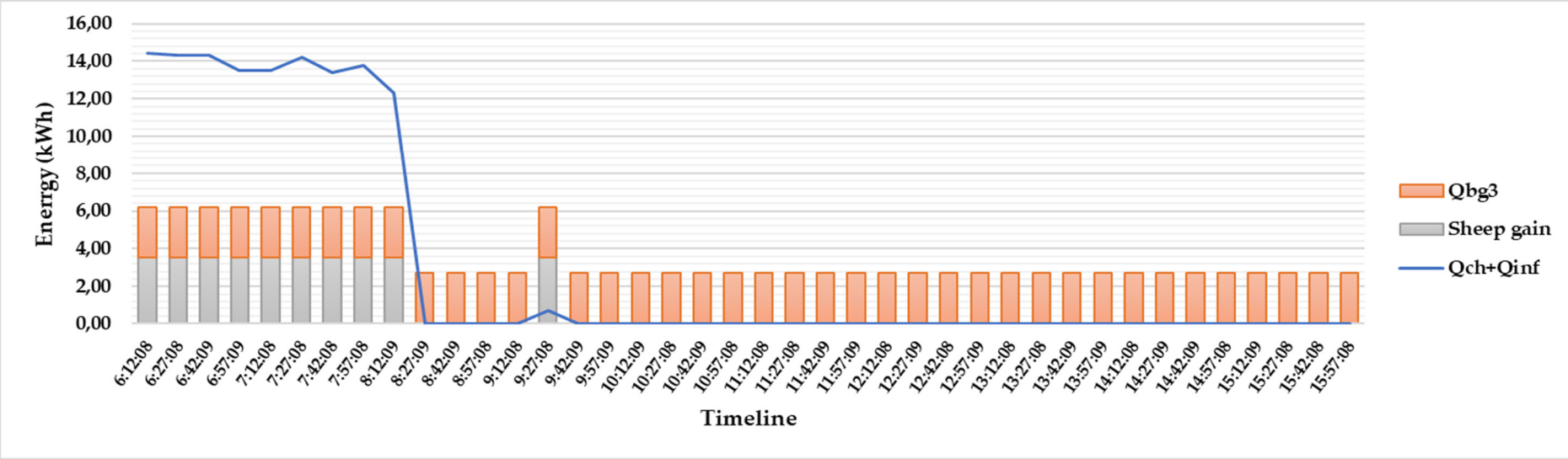

Figure S24. Energy exchanges for the Qbg3 scenario (26/01/2022)

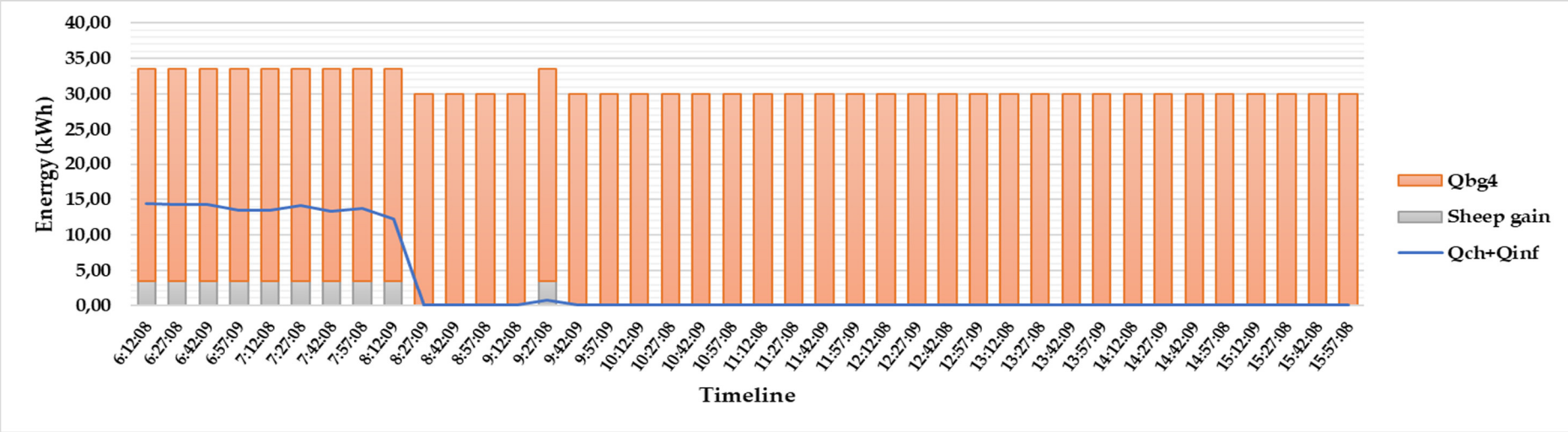

Figure S25. Energy exchanges for the Qbg4 scenario (26/01/2022)

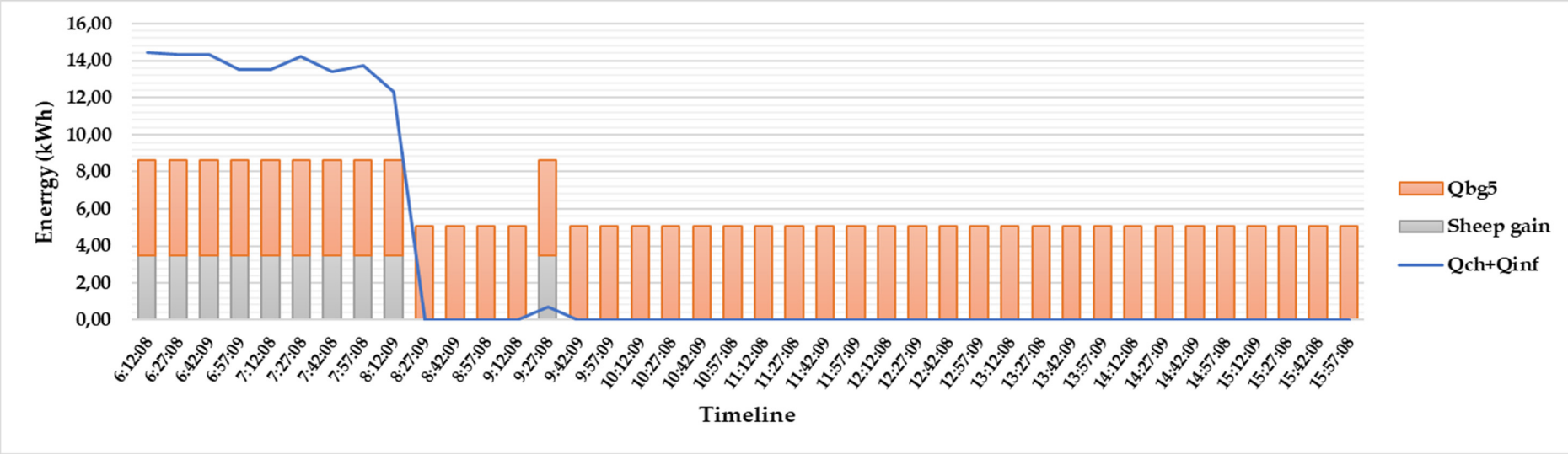

Figure S26. Energy exchanges for the Qbg5 scenario (26/01/2022)

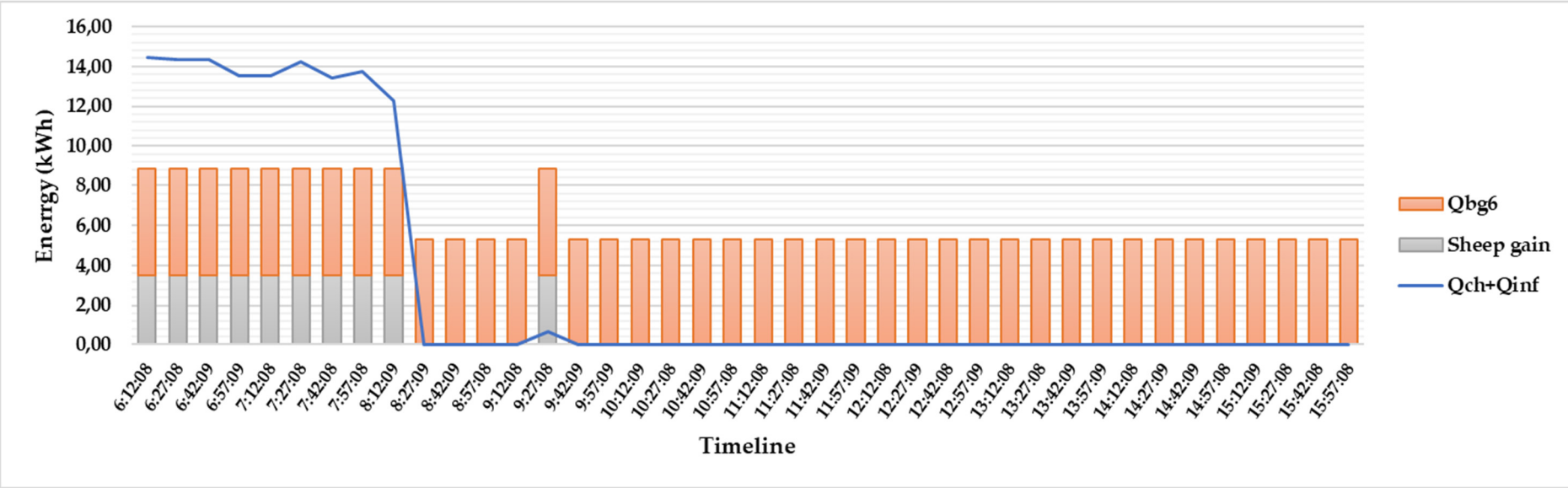

Figure S27. Energy exchanges for the Qbg6 scenario (26/01/2022)

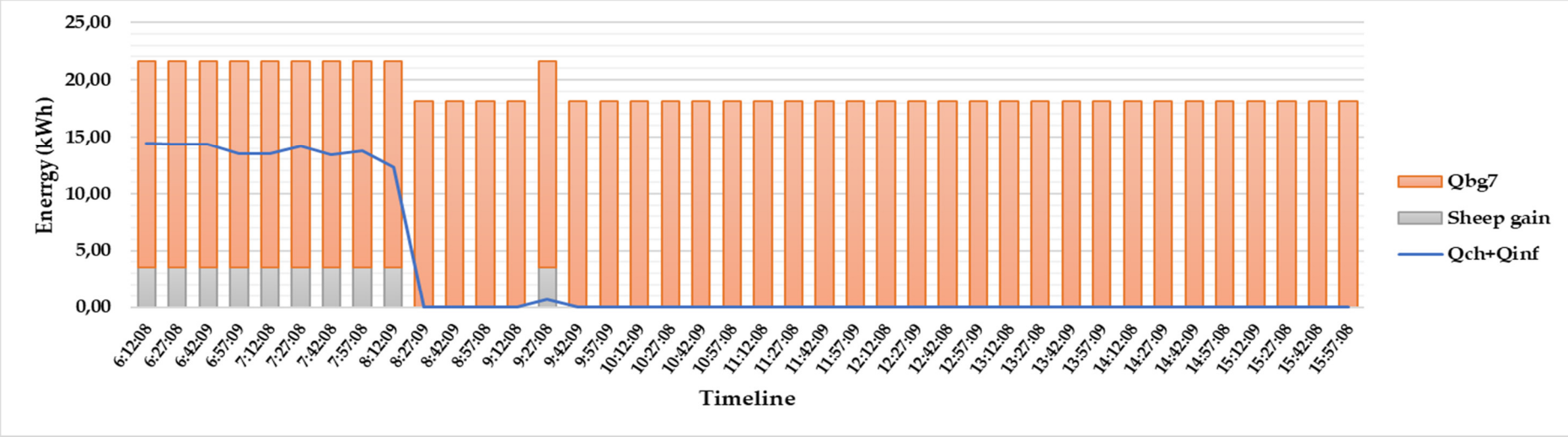

Figure S28. Energy exchanges for the Qbg7 scenario (26/01/2022)

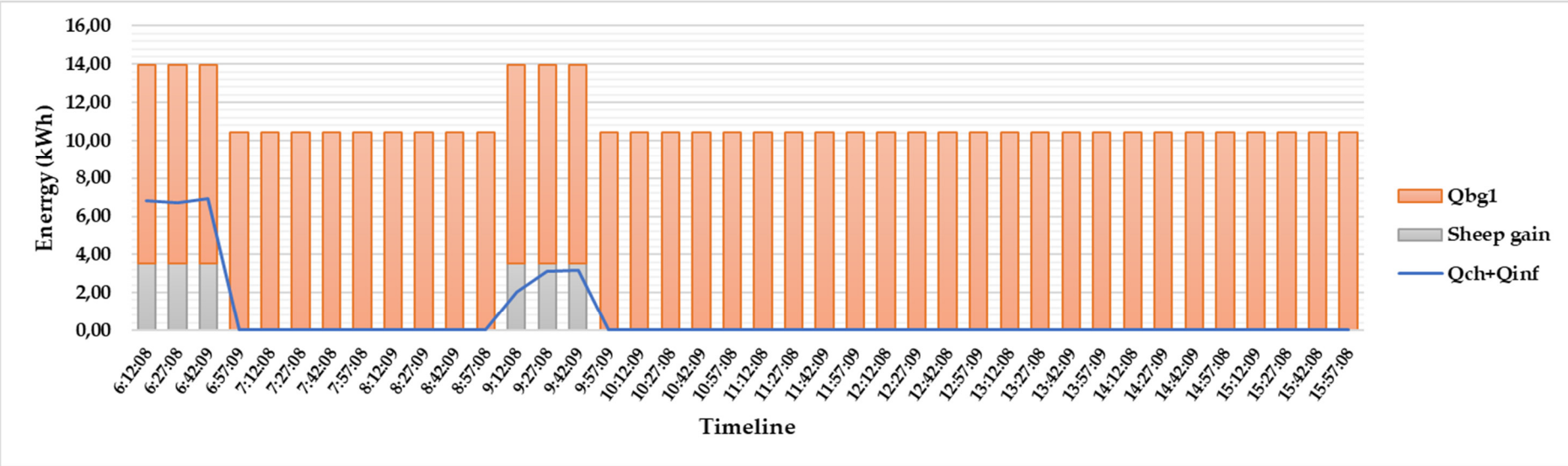

Figure S29. Energy exchanges for the Qbg1 scenario (27/01/2022)

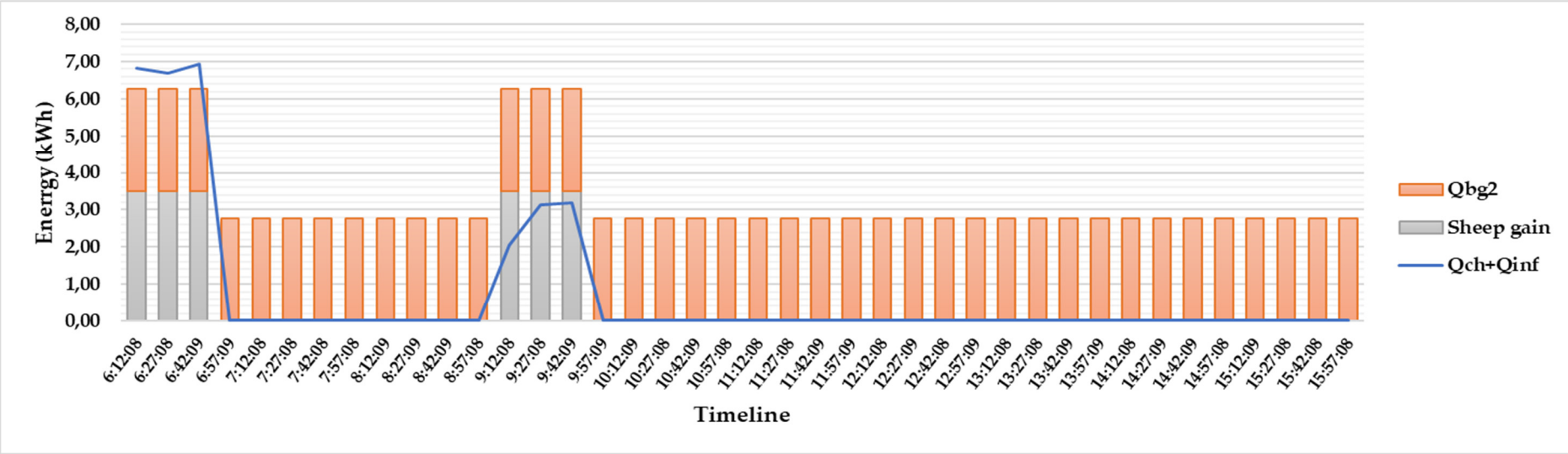

Figure S30. Energy exchanges for the Qbg2 scenario (27/01/2022)

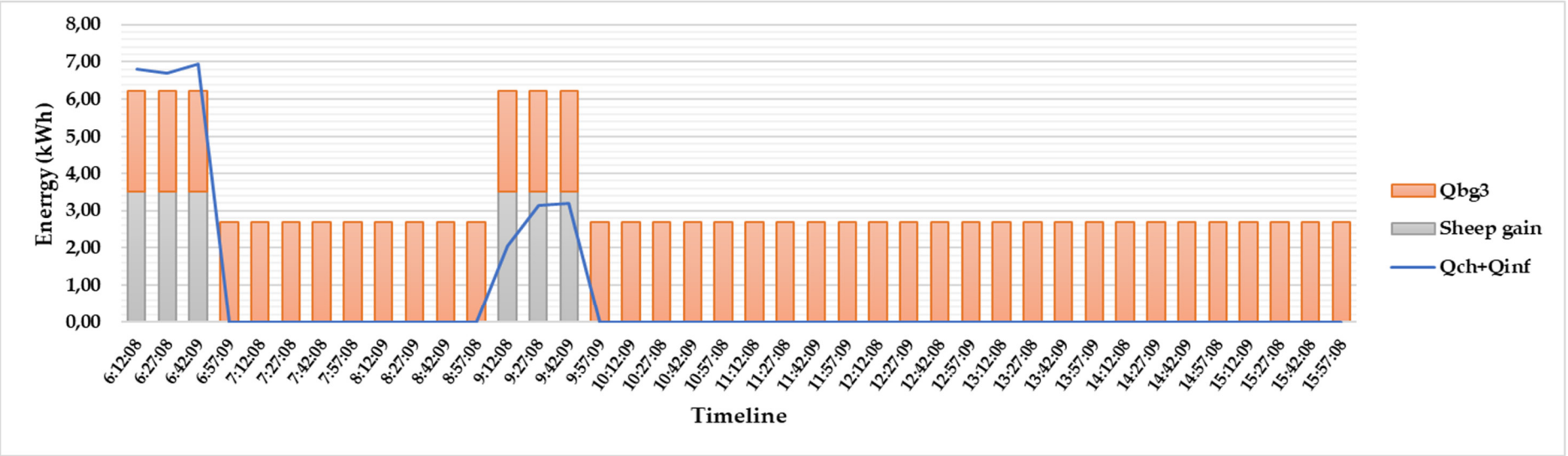

Figure S31. Energy exchanges for the Qbg3 scenario (27/01/2022)

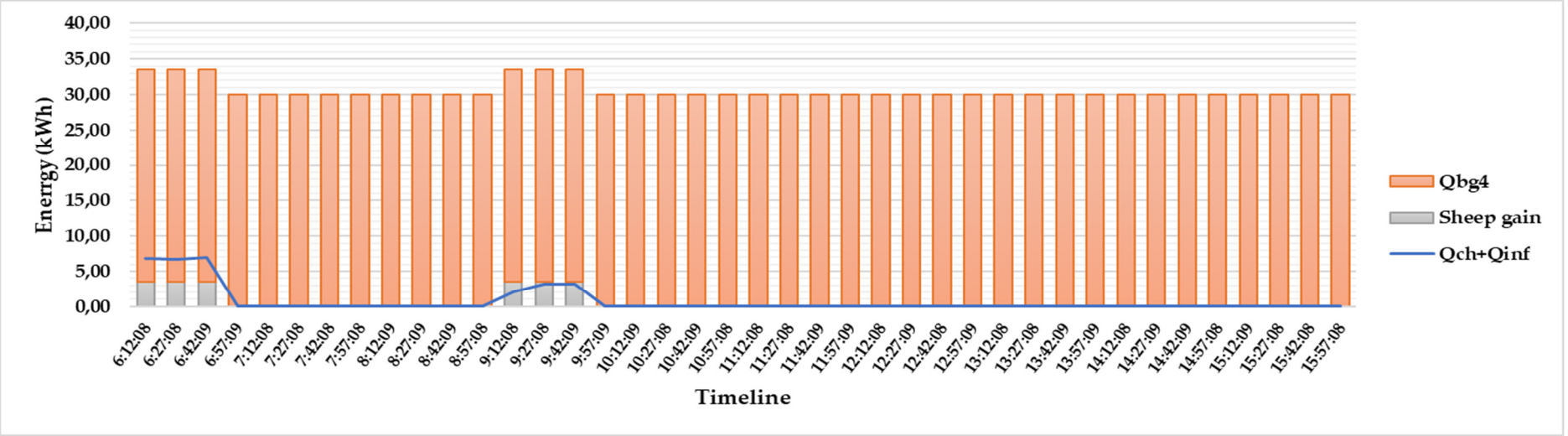

Figure S32. Energy exchanges for the Qbg4 scenario (27/01/2022)

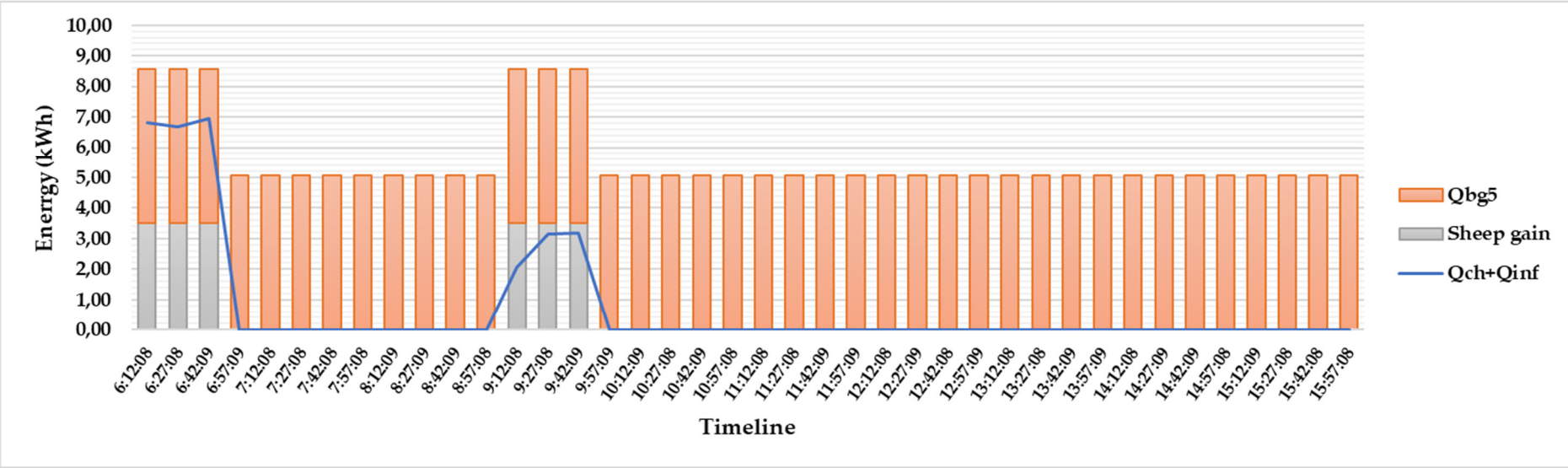

Figure S33. Energy exchanges for the Qbg5 scenario (27/01/2022)

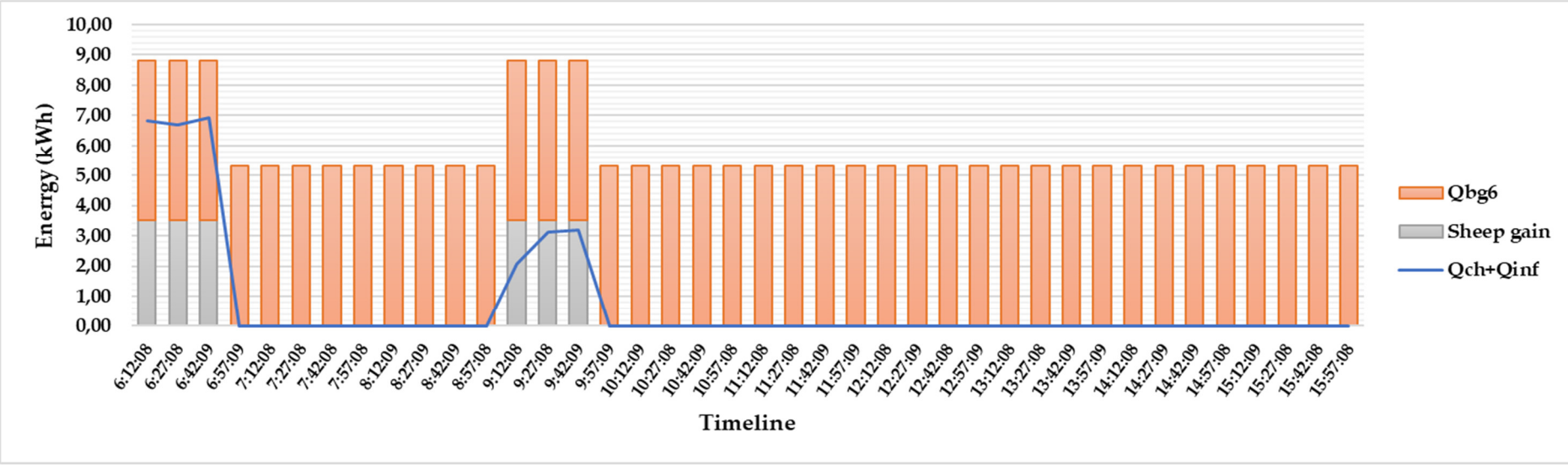

Figure S34. Energy exchanges for the Qbg6 scenario (27/01/2022)

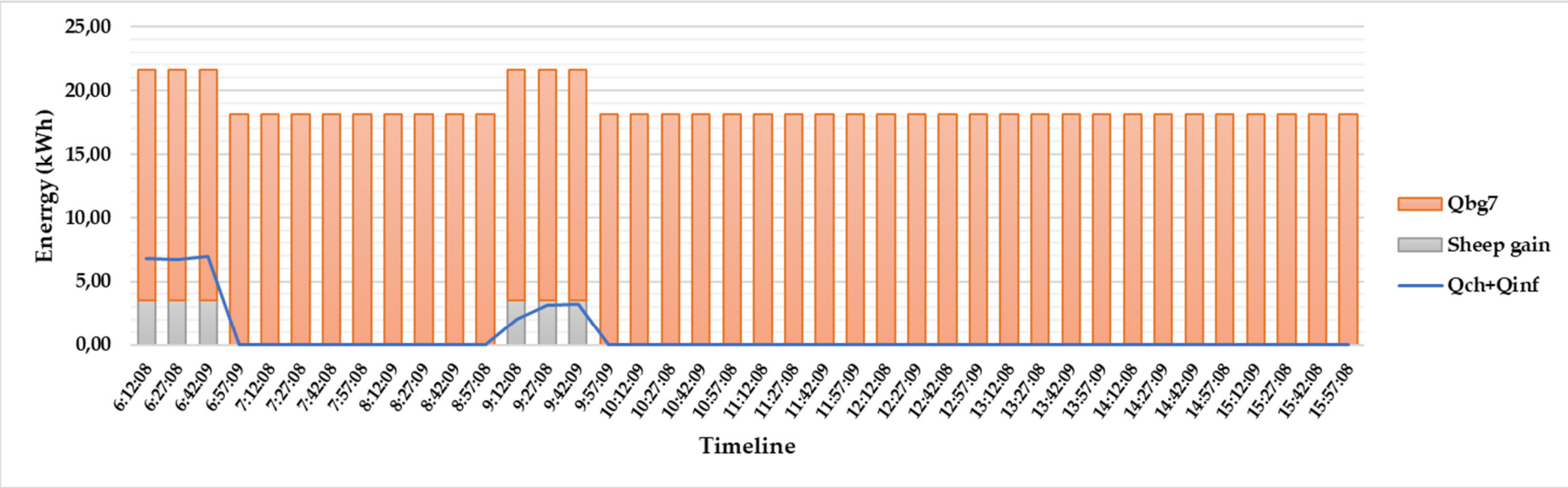

Figure S35. Energy exchanges for the Qbg7 scenario (27/01/2022)

B. Volatile Fatty Acids graphic illustration

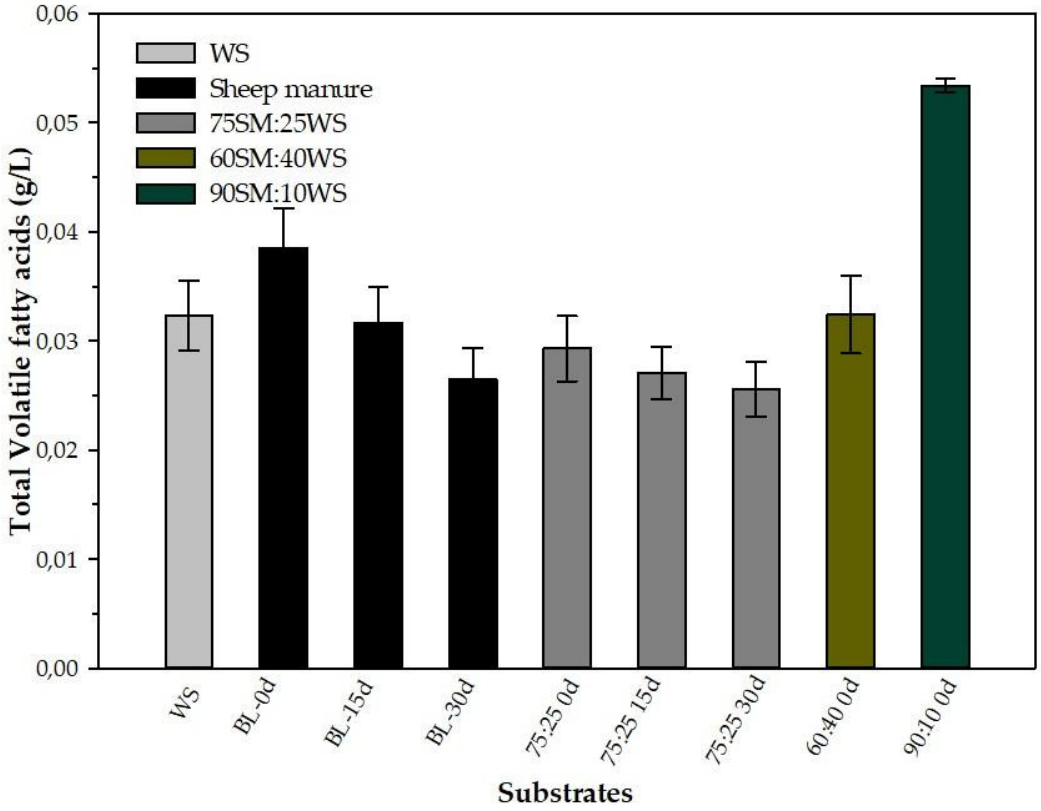

Figure S36. Total Volatile fatty acids at the end of the experiment from the anaerobic mono- and co-digestion of each substrate. The bars designate standard deviation.

C. Temperature and relative humidity graphs

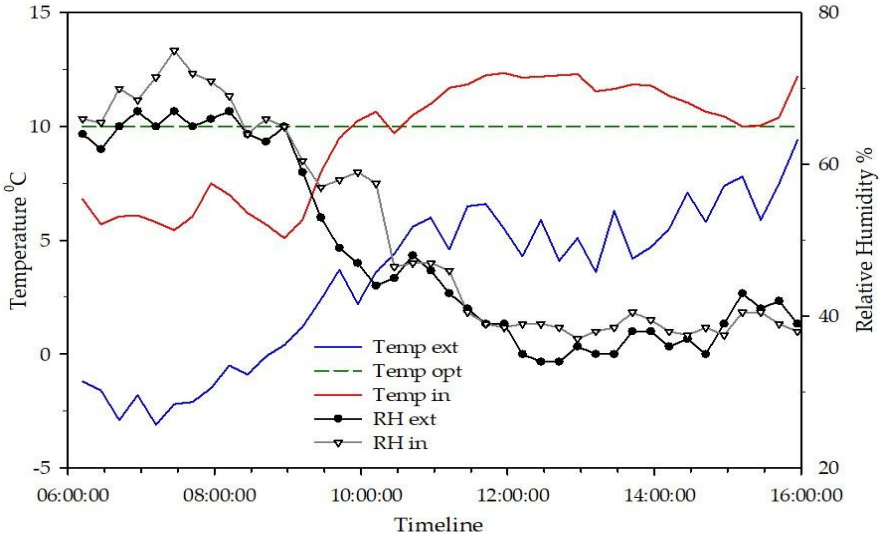

Figure S37. Temperature and relative humidity measurements (23/01/2022)

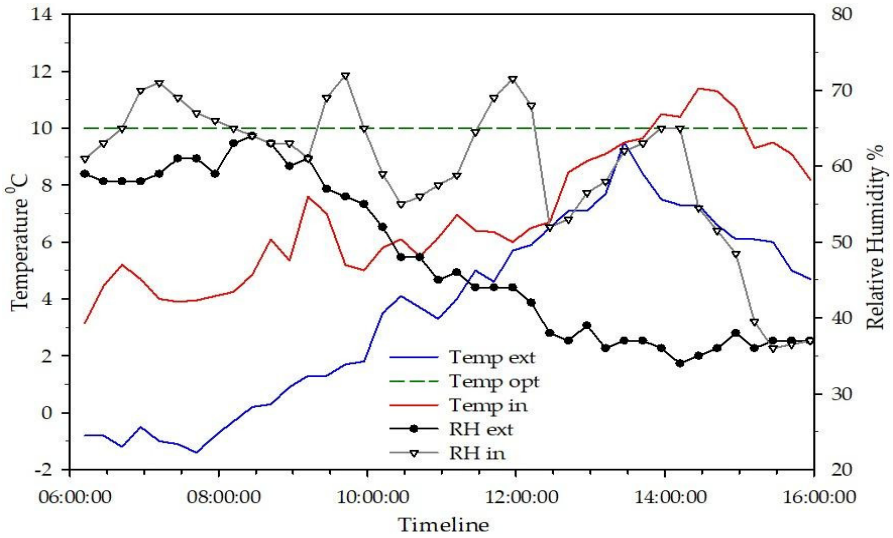

Figure S38. Temperature and relative humidity measurements (24/01/2022)

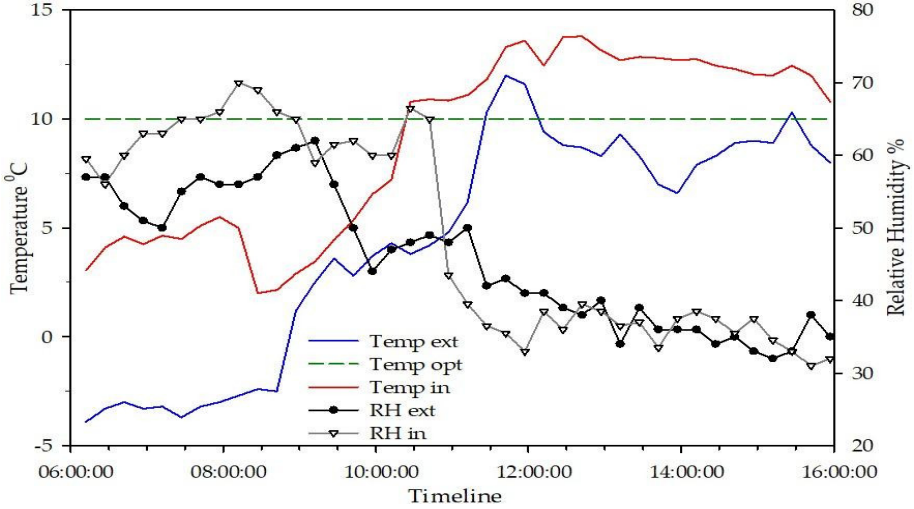

Figure S39. Temperature and relative humidity measurements (25/01/2022)

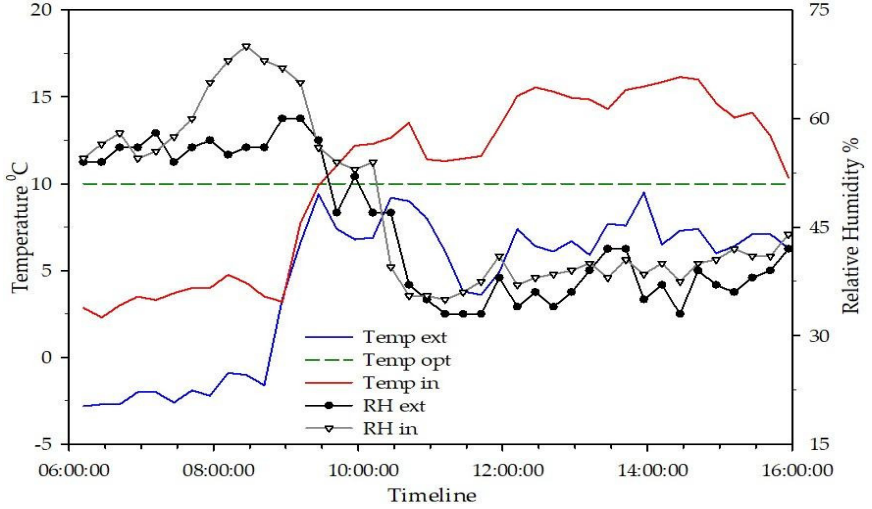

Figure S40. Temperature and relative humidity measurements (26/01/2022)

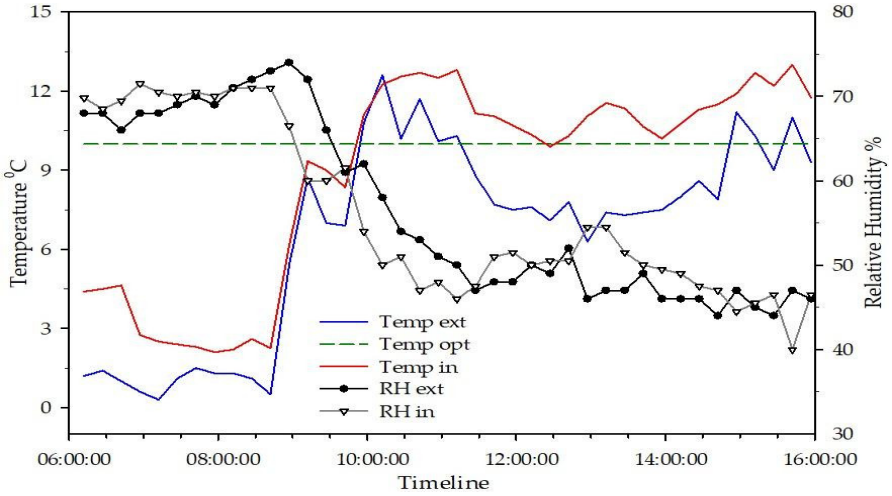

Figure S41. Temperature and relative humidity measurements (27/01/2022)

D. Internal air quality of the sheep barn

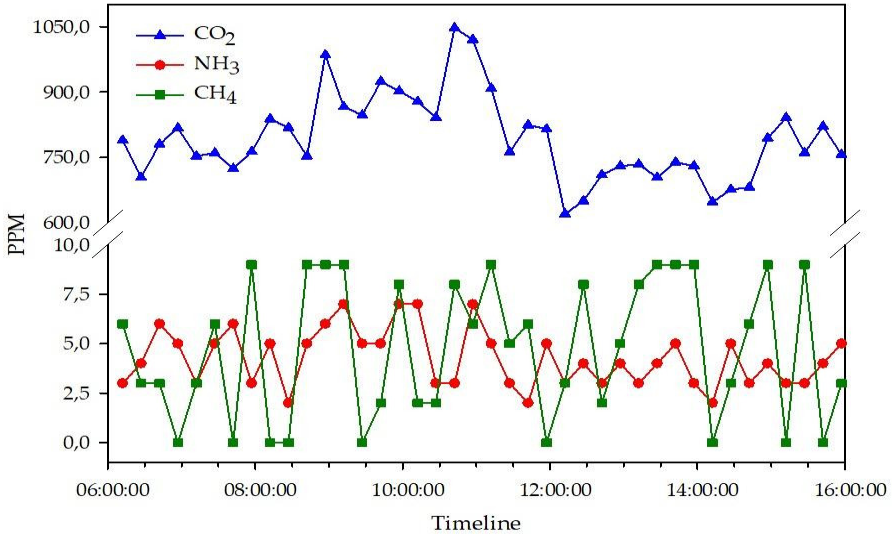

Figure S42. Gases measurements (23/01/2022)

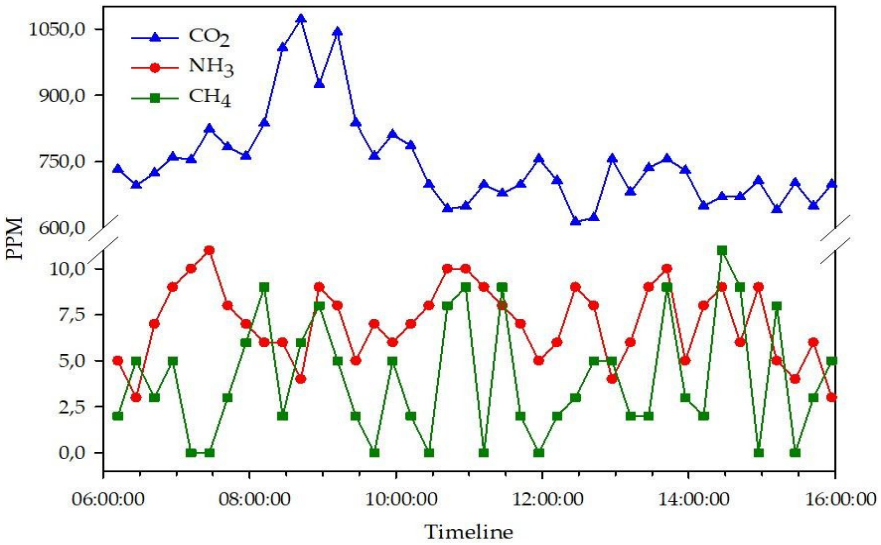

Figure S43. Gases measurements (24/01/2022)

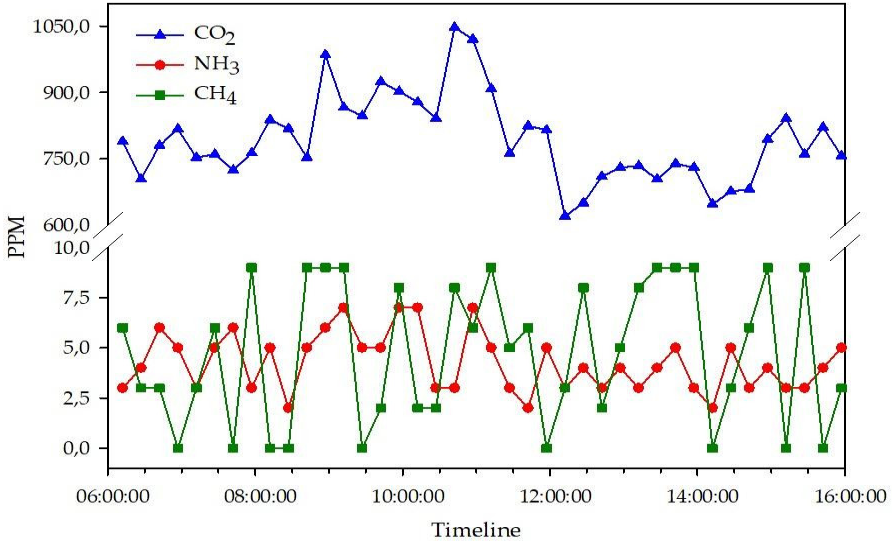

Figure S44. Gases measurements (25/01/2022)

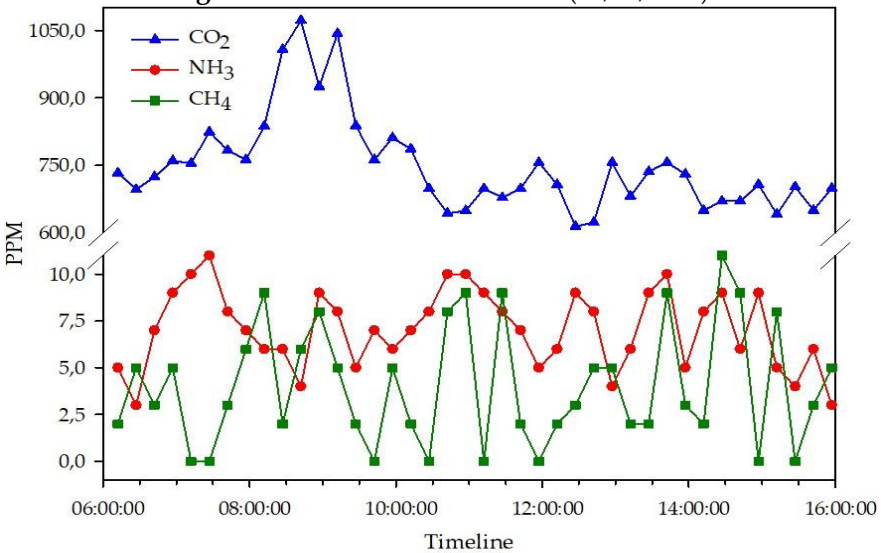

Figure S45. Gases measurements (26/01/2022)

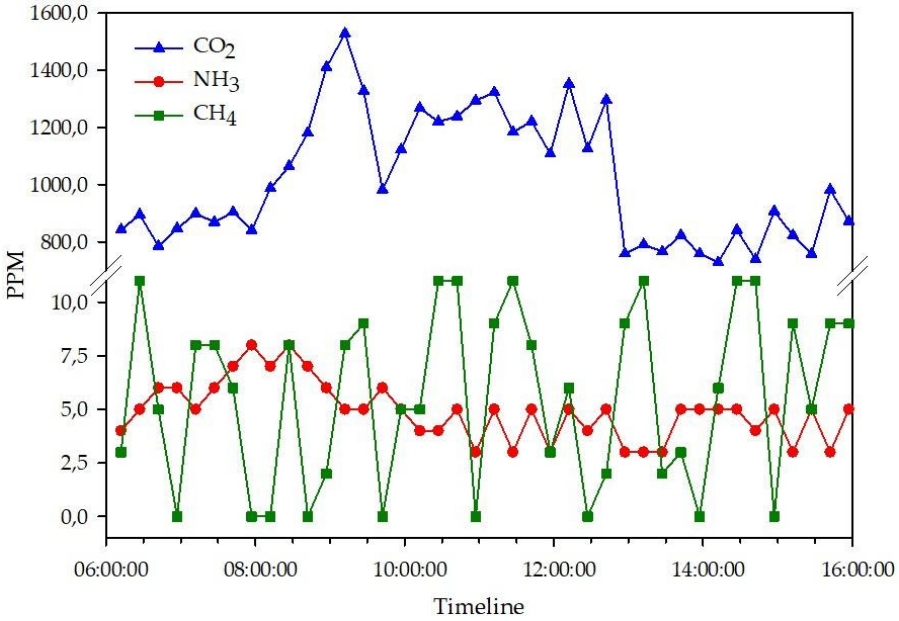

Figure S46. Gases measurements (27/01/2022)

E. Repairs and installation of equipment for the automation system for opening and closing side and the roof windows, as also the location of sensors for monitoring the internal air quality of the sheep barn.

Figure S47. Previous hand operation of the windows (left), installation of the electrical motor for automated operation (middle) and a view of the installed electrical motor

Figure S48. Repairment of the mechanical parts and restoration of the automated roof window mechanism

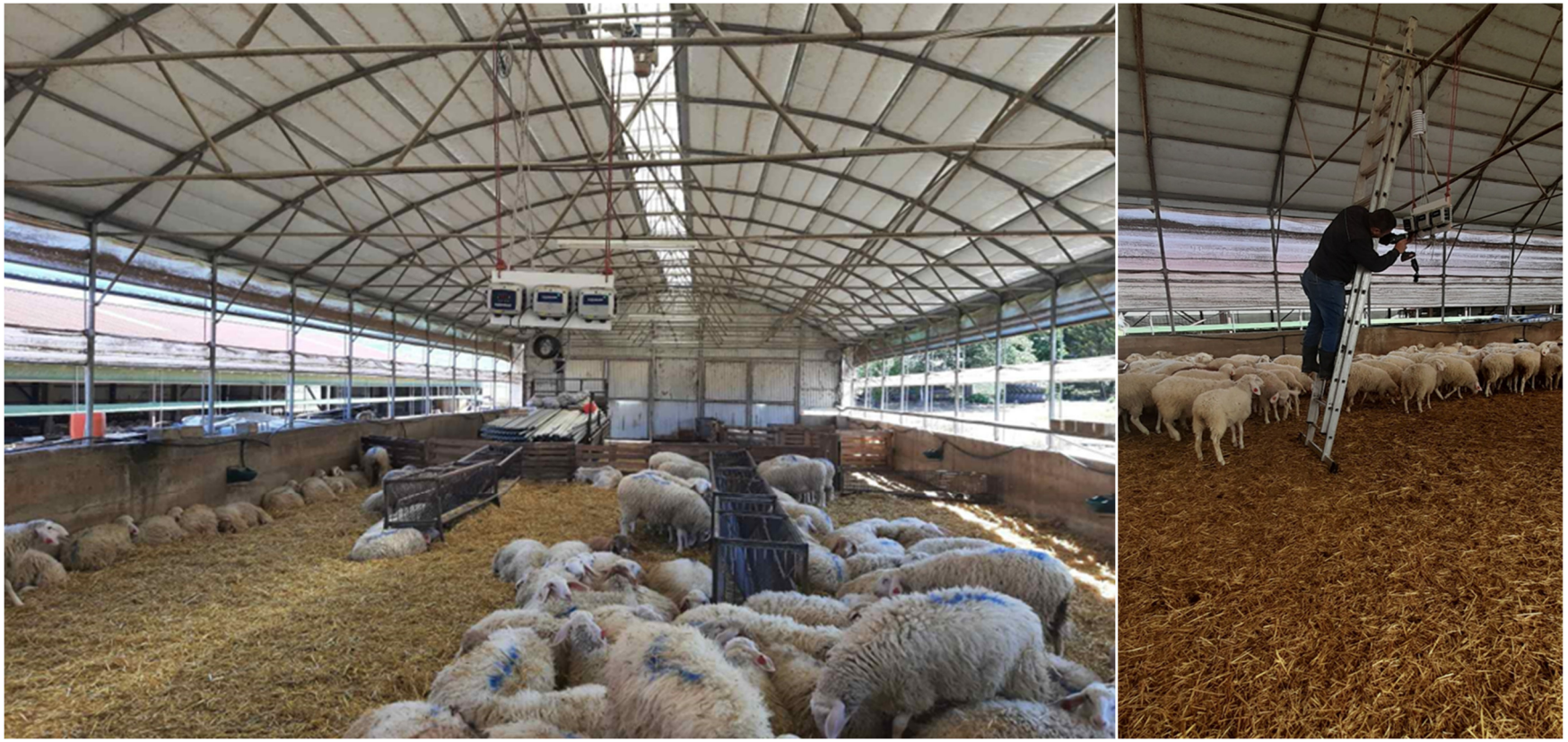

Figure S49. installation of the sensors at the appropriate location inside the sheep barn.

Figure 50. New electrical board equipped with a programmable logic controller (PLC)

F. U- value calculation

The U value calculation is done through Equations (1), (2) and (3) as mentioned in the literature [33] in the manuscript.

$$U = \frac{1}{R_{total}} \quad (1)$$

U: U-value ($W \cdot m^{-2} \cdot K^{-1}$)

R_{total}: Total thermal resistance ($m^2 \cdot K \cdot W^{-1}$)

$$R_{total} = ri + R1 + R2 + R3 + \cdots . + Rn + ro \quad (2)$$

$$Ri = \frac{l}{k} \quad (3)$$

l: thickness of the constructive element (m)

k: thermal conductivity of constructive material ($W \cdot m^{-1} K^{-1}$)

r_i: Thermal resistance of the internal side of the constructive element due to the interactions between the element and the internal air layer and it is received between 0.10 $m^2 \cdot K \cdot W^{-1}$ and 0.12 $m^2 \cdot K \cdot W^{-1}$ [33,34]

r_o: Thermal resistance of the external side of the constructive element due to the interactions between the element and the external air layer and it is received between 0.03 $m^2 \cdot K \cdot W^{-1}$ and 0.04 $m^2 \cdot K \cdot W^{-1}$ [33,34].

It must be noticed that in the cases where a commercial product is used the U-value can be taken as provided by the manufacturer of the material. In the case of the examined sheep barn the constructive element where the U-value was calculated or chosen was the concrete wall, the double windows, the roof and the front and back side of the structure. In Table 1-, the Rtotal and corresponding U-value for each construction element is shown as calculated or chosen by commercial providers.

Table S1. Concrete wall U-value calculation			
Material	l (m)	k ($W \cdot m^{-1} \cdot K^{-1}$)	R ($m^2 \cdot K^{-1} \cdot W^{-1}$)
Concrete (dense)	0.15	1.25 [35]	0.120
Thermal resistance of the internal side of the constructive element			0.105
Thermal resistance of the external side of the constructive element			0.032
R_{total}			0.257

U-value	**3.89 W · m^{-2} · K^{-1}**

Table S2. Corrugated metal sheet (steel) U-value calculation			
Material	l (m)	k ($W \cdot m^{-1} \cdot K^{-1}$)	R ($m^2 \cdot K^{-1} \cdot W^{-1}$)
Steel sheet	0.01	14.1 [36]	0.0007
Thermal resistance of the internal side of the constructive element			0.105
Thermal resistance of the external side of the constructive element			0.032
Rtotal			0.1377
U-value (slightly increased due to the metal frames of doors)			**7.26 W · m^{-2} · K^{-1}**

Table S3. PVC sheets U-value calculation	
Taken from commercial provider [37]	
U-value	**0.43 W· m^{-2} · K^{-1}**

Table S2. Double rolling windows U-value calculation			
Material	l (m)	k ($W \cdot m^{-1} \cdot K^{-1}$)	R ($m^2 \cdot K^{-1} \cdot W^{-1}$)
PVC window internal	0.01	0.16 [38]	0.063
Thermal resistance of the internal side of the constructive element			0.105
Thermal resistance of the external side of the constructive element			0.032
R_{total}			0.200
U-value			**4.99 W · m^{-2} · K^{-1}**