Supplementary materials: Appendix

Table S1 System parameters of EH-IES

| Equipment	Parameter
GT	$\eta^{\text{gt}} = 0.3$, $\lambda^{\text{gt}} = 1.5$, $\xi^{\text{gt}} = 0.1$, $Cap^{\text{gt}} = 1150$ kW, $P_{\max}^{\text{res}} = 240 / $kW, $c_{\text{m}}^{\text{gt}} = 0.01$ \$/(kW·h)
LBR	$\varepsilon^{\text{rec}} = 0.85$, $\eta^{\text{lbr}} = 1.2$, $c^{\text{lbr}} = 0.01$ \$/(kW·h)
HP	$\eta^{\text{hp}} = 0.9$, $Cap^{\text{hp}} = 1600$ kW, $c_{\text{m}}^{\text{hp}} = 0.01$ \$/(kW·h)
BT	$\gamma_{\text{loss}}^{\text{hs}} = 0.04$, $\eta^{\text{bt+}} = 0.95$, $\eta^{\text{bt-}} = 0.95$, $W^{\text{bt}} = 1500$ kW·h, $\xi^{\text{bt}} = 0.2$, $\tau^{\text{bt}} = 0.27$, $c_{\text{m}}^{\text{bt+}} = 0.05$ \$/(kW·h), $c_{\text{m}}^{\text{bt-}} = 0.03$ \$/(kW·h)
HS	$\gamma_{\text{loss}}^{\text{hs}} = 0.001$, $\eta^{\text{hs+}} = 0.95$, $\eta^{\text{hs-}} = 0.95$, $W^{\text{hs}} = 1200$ (kW·h), $\xi^{\text{hs}} = 0.2$, $\tau^{\text{hs}} = 0.2$, $c_{\text{m}}^{\text{hs}} = 0.06$ \$/(kW·h)
TT	$\gamma_{\text{loss}}^{\text{tt}} = 0.04$, $\eta^{\text{tt+}} = 0.95$, $\eta^{\text{tt-}} = 0.95$, $W^{\text{tt}} = 1500$ kW·h, $\xi^{\text{tt}} = 0.2$, $\tau^{\text{tt}} = 0.27$, $c_{\text{m}}^{\text{tt}} = 0.02$ \$/(kW·h)
ADN	$P_{\max}^{\text{grid}} = 1000$ kW
WT/PV	$P_{\max}^{\text{wt}} = 800$ kW, $P_{\max}^{\text{pv}} = 800$ kW, $v^{\text{in}} = 3$ m/s, $v^{\text{out}} = 25$ m/s, $v^{*} = 15$ m/s
Res	$P_{\max}^{\text{res}} = 400$ kW, $c_{\text{m}}^{\text{res}} = 0.04$ \$/(kW·h)
HE	$c_{\text{m}}^{\text{he}} = 0.07$ \$/(kW·h)
ED	$Cap^{\text{ed}} = 600$ kW, $\xi^{\text{ed}} = 0.5$, $T_{\min}^{\text{ed}} = 60$ °C, $T_{\max}^{\text{ed}} = 80$ °C, $C^{\text{ed}} = 625$ kJ/°C, $R^{\text{ed}} = 0.167$ °C/W, $a_1 = 0.62$, $a_2 = 0.28$, $b_1 = 0.50$, $b_2 = -0.49$, $c_{\text{m}}^{\text{ed}} = 0.6$ \$/(kW·h)
AC	$Cap^{\text{ac}} = 1500$ kW, $\eta^{\text{ac}} = 1.2$, $c_{\text{m}}^{\text{ac}} = 0.01$ \$/(kW·h)
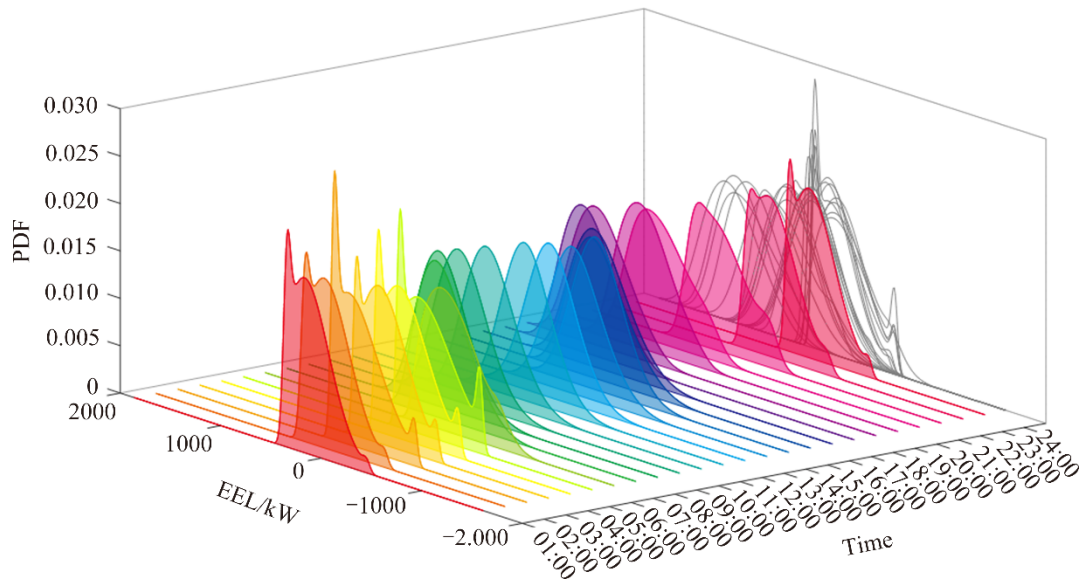
Figure S1 The probability distribution of EEL at each moment
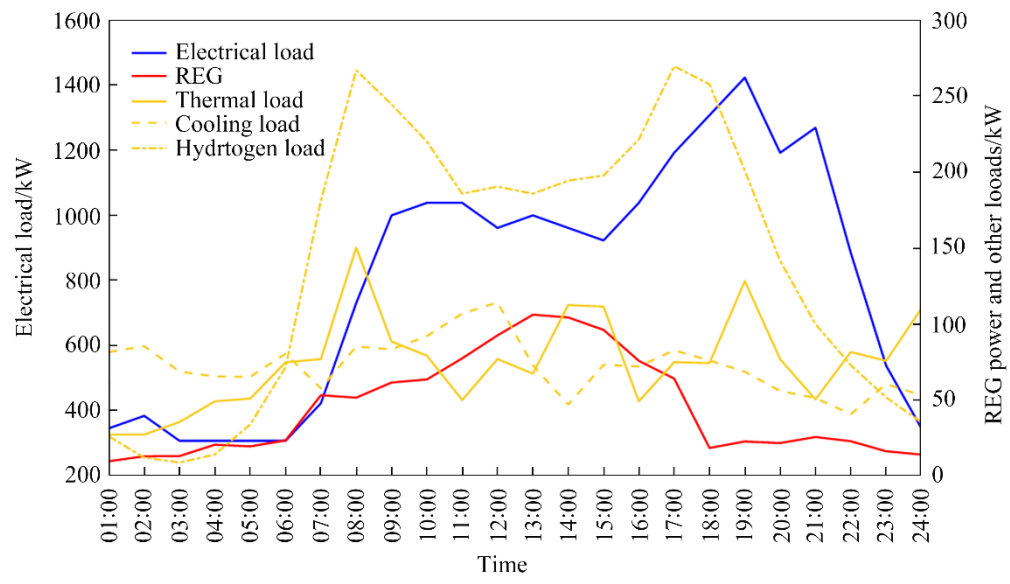
Figure S2 Expectation contours of multi-energy load, renewable energy PV and WT