SUPPLEMENTARY MATERIAL

Table SM-1. Electricity prices (in €/kWh) charged to the consumers by the retailer.

P$_1$ [1,420]	P$_2$ [421,660]	P$_3$ [661,840]	P$_4$ [841,1080]	P$_5$ [1081,1260]	P$_6$ [1261,1440]
0.0996	0.2739	0.2828	0.0817	0.1548	0.1438

Table SM-2. Power level prices (in €) charged to the consumers by the retailer.

Power level	Prices (€/day)	Max Power (kW)
1	0.2047	2.30
2	0.2206	3.45
3	0.2834	4.60
4	0.3492	5.75
5	0.4198	6.90
6	0.6280	10.35
7	0.8302	13.80
8	1.0324	17.25
9	1.2351	20.70

Table SM-3. Power requested to the grid (in W) in each unit of time $t \in$ T (expressed in intervals of time [initial time, final time]) by (non-controllable) base load.

Time intervals [earliest interval, latest interval]	Power (W)
[1,480]	165
[481,510]	700
[511,540]	170
[541,660]	85
[661,810]	160
[811,960]	130
[961,1200]	160
[1201,1215]	500
[1216,1245]	1600
[1246,1275]	750
[1276,1290]	250
[1291,1305]	450
[1306,1350]	280
[1351,1365]	1080
[1366,1440]	250

Table SM-4. Local PV energy generation (in Wh) in each unit of time $t \in$ T (expressed in intervals of time [initial time, final time]).

Time intervals [earliest interval, latest interval]	$P_t^{PV} \Delta t$ (Wh)
[1,465]	0
[466,495]	200
[496,525]	250
[526,585]	400
[586,645]	700
[646,705]	1000
[706,765]	1050
[766,825]	1100
[826,885]	1050
[886,945]	1000
[946,1005]	700
[1006,1020]	400
[1021,1050]	250
[1051,1080]	200
[1081,1440]	0

Table SM-5. Comfort time slots ($T_j = \left[T_{1_j}, T_{2_j}\right]$, $j \in \{1, \dots, J\}$) allowed for the operation of each shiftable load.

Shiftable Loads		
DW	LM	CD
[1,480]	[406,870]	[1126,1440]

Table SM-6. Operation cycles of the shiftable loads.

Appliance	Power required by the appliance at each stage of its operation cycle (W)						
	1-15	16-30	31-45	46-60	61-75	76-90	76-105
DW	1750	1250	120	1600	640	220	
LM	1840	980	160	220	300	340	120
CD	1660	1720	300	220			

Table SM-7. Parameters of the EWH load.

P_R	M	AU	c_p	τ^{net}	τ^{min}	τ^{max}	τ^{req}	t^{req}	τ_0	v_0	P_0^{losses}
1500	100	2.06	1.1419408	18	45ºC	85ºC	60ºC	11 min	55ºC	0	0

Table SM-8. Water withdrawal for consumption (in kg) in each unit of time $t \in$ T (expressed in intervals of time [initial time, final time]).

Time intervals [earliest interval, latest interval]	m_t (kg)
[0,479]	0
[480,490]	7.2
[491,509]	0
[510,520]	7.2
[521,1109]	0
[1110,1125]	7.2
[1126,1440]	0

Table SM-9. Ambient temperatures around the EWH for a period of 24h – T=1440 (expressed in intervals of time [initial time, final time]).

Time intervals [earliest interval, latest interval]	τ_t^{amb} (ºC)
[1,181]	19.6
[182,541]	18.5
[542,721]	22.4
[722,901]	23.2
[902,1081]	23.7
[1082,1261]	22.6
[1262,1440]	21

Table SM-10. Parameters of the thermostatic load.

θ^{max}	θ^{min}	θ_0^{in}	P_{AC}^{nom}	s_0	α	β	γ
24ºC	20ºC	20ºC	1400W	0	0.99046	0.00954	0.000185

Table SM-11. Outdoor temperatures for a period of 24h – T=1440 (expressed in intervals of time [initial time, final time]).

t	θ_t^{ext} (°C)	t	θ_t^{ext} (°C)	t	θ_t^{ext} (°C)
0	9.45				
[1,15]	9.45	[481,495]	8.96	[961,975]	12.92
[16,30]	9.40	[496,510]	8.92	[976,990]	12.79
[31,45]	9.35	[511,525]	8.92	[991,1005]	12.64
[46,60]	9.30	[526,540]	9.00	[1006,1020]	12.50
[61,75]	9.25	[541,555]	9.19	[1021,1035]	12.40
[76,90]	9.20	[556,570]	9.43	[1036,1050]	12.35
[91,105]	9.15	[571,585]	9.66	[1051,1065]	12.32
[106,120]	9.10	[586,600]	9.80	[1066,1080]	12.30
[121,135]	9.05	[601,615]	9.81	[1081,1095]	12.29

[136,150]	9.01	[616,630]	9.75	[1096,1110]	12.27
[151,165]	8.96	[631,645]	9.72	[1111,1125]	12.25
[166,180]	8.90	[646,660]	9.80	[1126,1140]	12.20
[181,195]	8.83	[661,675]	10.06	[1141,1155]	12.13
[196,210]	8.78	[676,690]	10.48	[1156,1170]	12.02
[211,225]	8.76	[691,705]	10.97	[1171,1185]	11.88
[226,240]	8.80	[706,720]	11.50	[1186,1200]	11.70
[241,255]	8.91	[721,735]	12.00	[1201,1215]	11.48
[256,270]	9.06	[736,750]	12.43	[1216,1230]	11.25
[271,285]	9.20	[751,765]	12.78	[1231,1245]	11.05
[286,300]	9.30	[766,780]	13.00	[1246,1260]	10.90
[301,315]	9.32	[781,795]	13.09	[1261,1275]	10.83
[316,330]	9.28	[796,810]	13.07	[1276,1290]	10.85
[331,345]	9.19	[811,825]	12.99	[1291,1305]	10.94
[346,360]	9.10	[826,840]	12.90	[1306,1320]	11.10
[361,375]	9.02	[841,855]	12.82	[1321,1335]	11.31
[376,390]	8.95	[856,870]	12.78	[1336,1350]	11.52
[391,405]	8.91	[871,885]	12.77	[1351,1365]	11.67
[406,420]	8.90	[886,900]	12.80	[1366,1380]	11.70
[421,435]	8.92	[901,915]	12.87	[1381,1395]	11.56
[436,450]	8.96	[916,930]	12.95	[1396,1410]	11.18
[451,465]	9.00	[931,945]	13.00	[1411,1425]	10.52
[466,480]	9.00	[946,960]	13.00	[1426,1440]	9.50

Table SM-12. Parameters of the static battery.

η_{ch}^B	η_{dch}^B	E_{min}^B	E_{max}^B	P_{max}^{Bch}	P_{max}^{Bdch}	E_0^B
0.95	0.95	0kWh	12kWh	6W	6W	2kwh

Table SM-13. Parameters of the EV.

η_{ch}^V	η_{dch}^V	E_{min}^V	E_{max}^V	E_{req}^V	P_{max}^{Bch}	P_{max}^{Bdch}	ta	td	E_{ta}^V
0.95	0.95	8kWh	40kWh	32kWh	6kW	6kW	466	1110	12kWh

Table SM-14. Maximum power allowed for exchanges with the grid.

P_{max}^G
6.9kW