Supplementary Data Tables

Table A1. Steps for the fixed term of the household energy bill from the Norwegian DSO [22]

Step	**Day's Peak Power** (kW)	**Add-on Cost for fixed Term (C^{pm})** (NOK/month)
Step 1	0-2	125
Step 2	2-5	200
Step 3	5-10	325
Step 4	10-15	450
Step 5	15-20	575
Step 6	20-25	700
Step 7	25-50	1,325
Step 8	50-75	1,950
Step 9	75-100	2,575
Step 10	Over 100	5,150

Table A2. Energy usage for shiftable and non-shiftable appliances

Type	**Appliance**	**Operation Hours** (h) **and Preferred Time Period** (*TP*)		**Energy Usage** (Wh) **per Day**
Non-shiftable	Lights	8h	(6-7 and 16-23)	400
	Fridge	24h	(1-24)	4,300
	Stove	3h	(7 and 19-20)	4,500
	TV	5h	(8 and 20-23)	500
	PC	2h	(18-19)	200
	Router	24h	(1-24)	150
	Microwave	1h	(17)	200
	Coffee Machine	1h	(7)	80
Shiftable	Dish Washer	1h		1,440
	Laundry Machine	2h		1,940
	Vacuum Cleaner	1h		420

Table A3. Necessary parameters and their values for the DSM model

Parameter	**Description**	**Value**
C^{gsc}	C^{gsc_d} : Add-on terms for grid supplier for day consumption	0.43 NOK/kWh
	C^{gsc_n} : Add-on terms for grid supplier for night consumption	0.37 NOK/kWh
C^{gsp}	Add-on terms for grid supplier for production	0.05 NOK/kWh
C^{es}	Add-on for energy supplier	0.06 NOK/kWh
C^{em}	Monthly add-on for energy supplier	39 NOK
BP	Billing period	30 days
VAT	Value Added Tax	0.25
$limit$	Fuse power limit (36 A)	7.5 kW
M^{small}	Appropriately small value for linearization	1000000
M^{big}	Appropriately big value for linearization	0.00001
d	Diameter of the tank	0.59 m
$hight$	Height of the tank	2.03 m
$mass^{upper}$	Volume of the tank in upper section of HPWH	224 m³
$mass^{lower}$	Volume of the tank in lower section of HPWH	136 m³
U_{upper}	Heat transfer from HPWH's upper section	1.1 W/m²·°C
U_{lower}	Heat transfer from HPWH's lower section	5.2 W/m²·°C
$U^{ind}*A^{ind}$	Thermal characteristic of a house as product of accumulated heat transfer coefficient and surface area.	100 Wh/°C
$P_{cap}^{HPWH,up}$	Power consumption rate of HPWH's upper section	0.75 kW (3 kWh)
$P_{cap}^{HPWH,low}$	Power consumption rate of HPWH's lower section	0.5 kW (2 kWh)
$Temp^{amb}$	Temperature of environment around HPWH	18 °C
$Temp^{ref}$	Cold water temperature entering HPWH	10 °C
$Temp^{target}$	Target temperature of HPWH's upper section	60 °C
$Temp_{\min}^{upper}$	Min. temperature in HPWH's upper section	55 °C
$Temp_{\max}^{upper}$	Max. temperature in HPWH's upper section	65 °C
$Temp_{\max,solr}^{upper}$	Max. temperature in HPWH's upper section with solar input	70 °C
$Temp_{\min,-5°C}^{lower}$	Min. temperature in HPWH's lower section at -5°C outdoor temperature	35 °C
$Temp_{\max,-5°C}^{lower}$	Max. temperature in HPWH's lower section at -5°C outdoor temperature	45 °C
$Temp_{\min,18°C}^{lower}$	Min. temperature in HPWH's lower section at 18°C outdoor temperature	20 °C
$Temp_{\max,18°C}^{lower}$	Max. temperature in HPWH's lower section at 18°C outdoor temperature	30 °C
$Temp_{\min}^{room}$	Min. preferred indoor temperature	21 °C
$Temp_{\max}^{lower}$	Max. preferred indoor temperature	22 °C
$Temp_{desired}^{ind}$	Desired temperature for indoor space	21.5 °C
$Temp_{desired}^{water}$	Desired temperature for hot water	60 °C
$Temp_{range}^{ind}$	Temperature range for indoor space	3 °C
$Temp_{range}^{water}$	Temperature range for hot water	20 °C
$dens^{air}$	Density of air	1.23 kg/m³
h^{upper}	Hight of the tank in the upper section	1.4 m
h^{lower}	Hight of the tank in the lower section	0.5 m
A^{upper}	Surface area of the tank in HPWH's upper section	1.06 m²
A^{lower}	Surface area of the tank in HPWH's lower section	2.73 m²
C^{water}	Heat capacity of water	1.16 Wh/kg.K
C^{air}	Heat capacity of air	0.28 Wh/kg.K