

Domestic Battery Power Management Strategies to Maximize the Profitability and Support the Network

This code contains three different management strategies for the residential behind the meter batteries (BESS) in order to maximize the customer's profitability and enhance the network performance. The three algorithms are briefly explained as:

- 1- Conventional Rule-Based Algorithm (CRBA): This is the conventional method of (dis)charging the BESS according to upper and lower thresholds that maximizes the customers profitability only through maximizing the PV self-consumption.
- 2- Proposed Day-Ahead Scheduling Algorithm (PDSA): This is an optimization-based algorithm aims to optimize the electricity bill and load variance using the WORHP solver. Optimizing the load variance supports the network through flattening the household net profile.
- 3- Proposed Rule-Based Algorithm (PRBA): This is a rule-based algorithm that does not require any optimizer however, it optimizes the electricity bill and load variance according to a set of inputs.

In order to run the code, the required inputs are detailed as follows:

- The household profiles should be entered in any data resolution in the file ([data.m](#)) in the following format:

Demand (kW) (first column)	PV (kW) (second column)	EV (kW) (third column)
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- These data can be copied directly from excel/CSV file.

- Use [BESSMA.m](#), to run the code. The inputs for the main program ([BESSMA.m](#)) are described in the following table:

Main Inputs	
Saver	To save the data in excel sheet: 1 will save in Results.xls , other values will not.
Prog	Selects the required algorithm. 1 for CRBA, 2 for PDSA, and 3 for PRBA
DataRes	Data resolution in minutes (10 for 10 minutes, 30 for 30 minutes, 60 for 1 hour)
BESS Inputs	
BESS	Actual Capacity [kWh]
DOD	Depth of discharge in fraction (0 to 1)
SOCMAX	Maximum state of charge (0 to 1)
BESSP	Maximum rating of the BESS [kW]
RE	BESS System efficiency = BESS Efficiency * Inverter/Charger Efficiency
Time of use tariff inputs (The algorithms are developed for the double tariff rates of UK)	
HR	High rate value (day rate) [p/kWh]
LR	Low rate value (night rate) [p/kWh]
TLS	Start hour of low rate tariff
TLE	End hour of low rate tariff
EX	Export tariff rate in [p/kWh]
TPR	Tariff daily profile, please insert the values of high rate (HR) and low rate (LR) at each hour according to your preference.
Network Details to calculate the losses and household voltage	
VT	Network Transformer voltage [V]
PF	Power factor
R	Resistance from the transformer to the household [Ohm]
X	Reactance from the transformer to the household [Ohm]
EX	Export tariff rate [p/kWh]
Program 1 (CRBA) Inputs	
PTHD	Upper threshold for discharging [kW]
PTHC	Lower threshold for charging [kW]
Program 3 (PRBA) Inputs	
EVS	EV charger rating [kW]
AVGD	Average daily consumption [kWh]
Season	The PV seasons (1 for high PV season / summer, 0 for low PV season / winter)
PTHDn	Normal upper threshold for discharging [kW]
EVA	Average EV charging hours
EVC	Electric vehicle status, if the EV will be charged next day EVC=1, otherwise, EVC=0
FPV	Forecasted PV daily generation

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PVL	Forecasted of number of PV hours calculated from the start time of PV (PVS) and the end time of PV (PVe)
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- To use the PDSA, the WORHP solver require to be installed in your machine. You can download the solver and request the License from this Link: <https://worhp.de/>. After the installation completes according to the WORHP guide, please copy the license file ([worhp.lic](#)) and the XML file ([worhp.xml](#)) to this folder or add it to the directory via MATLAB.
- More details on the work implemented in this code will be available soon through a published paper (see [1]).
- The main code content is obscured in the file ([MAINCODE.p](#)). After publication, this code will be revealed as an open source.
- This code can be used to generate the power dispatch of residential batteries (with any specifications) to minimize the household's electricity bill for any time period (single day to multiple years). The output is the net demand and electricity bill with and without the battery, in addition to the battery power dispatch, state of charge and degradation as well as the household's voltage and losses.

- If you will use this code in the production of a publication, please cite the following papers:

A. If you used any part of this code, please cite this paper:

[1]. A. A. R. Mohamed, R. J. Best, X. Liu, and D. J. Morrow, 'Domestic Battery Power Management Strategies to Maximize the Profitability and Support the Network', p. 5. [\(The exact Proceedings will be added soon\)](#)

B. If you used the optimization-based algorithm (PDSA), please cite the following paper in addition to paper number [1]:

[2]. C. Büskens and D. Wassel, 'The esa nlp solver worhp', in *Modeling and optimization in space engineering*, Springer, 2012, pp. 85–110.

C. If you used the BESS degradation results, please cite the following paper in addition to paper number [1]:

[3]. B. Xu, A. Oudalov, A. Ulbig, G. Andersson and D. S. Kirschen, "Modeling of Lithium-Ion Battery Degradation for Cell Life Assessment," in *IEEE Transactions on Smart Grid*, vol. 9, no. 2, pp. 1131-1140, March 2018, doi: 10.1109/TSG.2016.2578950.

