# EBR Distribution

Once `ebr-2.0.tgz` has been downloaded on a Linux machine, it is possible to unzip it by typing on a terminal the following command:

```
tar xfz ebr-2.0.tgz; cd ebr-2.0
```

This creates a new directory named `ebr-2.0`, with the following directories: `aux_files`, `example_files` and `src`. Moreover, an explanatory `README.txt` file is provided, together with a wrapper Bash script `launch.sh`.

In order to run Energy Bill Reduction (EBR), the main requirement is to have either CPLEX or GLPK installed on the machine (i.e., either the command `cplex` or the command `glpsol` must be available in the system or user `PATH`). Given this, the user may directly launch the Bash script:

```
bash launch.sh
```

This will launch EBR with default settings, which will run EBR on home 723 of Kalundborg test-bed. In order to customise the input, the `launch.sh` script accepts the following command line arguments (note they are all optional: when an argument is not given, the default is used).

`-h`: prints an help message with all arguments and defaults. Des not run EBR.

`-l` *h*: uses *h* as the number of hours to be forecasted for each charge/discharge action computation (default is 6).

`-d` *d*: uses *d* as the directory containing the input files needed by EBR, i.e., battery.csv, profiles.csv, and energy.csv (default is example_files/kalundborg/home_723)

`-pp` *pp*: uses *pp* as is the EBR input file for power profiles output by DAPP (needed only if -dapp is greater than 0, default is example_files/kalundborg/home_723/powerprofile.copy.1.npp_scen.3.csv)

`-pe` *pe*: uses *pe* as the EBR input file with PEV characteristics (default is example_files/kalundborg/home_723/pev.13.csv)

`-mr` *mr*: uses *mr* as the EBR input file with costs for energy and CO2 (default is example_files/market.csv)

`-co2` *co2*: uses *co2* as the coefficient for the CO2 costs in EBR objective function (default is 1)

`-en` *en*: uses *em* as the coefficient for the energy costs in EBR objective function (default is 1)

`-dapp` *dapp*: uses *dapp* as the coefficient for the transmission and distribution costs in EBR objective function (default is 8)

`-tsl` *tsl*: uses *tsl* as the duration (in minutes) of a time-slot, i.e., the periodicity of EBR invocations (default is 60)

`-p` $p$**:** uses $p$ as the number of days in the past to be used for forecast (default is 10).

`-pd` $p_d$**:** uses $p_d$ as the discounting factor for the days in the past. Format is $x_1$:...:$x_p$, and $\sum_{i=1}^{n} x_i = 1$ must hold (default is $\frac{1}{2}$:$\frac{1}{2^2}$:...:$\frac{1}{2^9}$:$\frac{1}{2^9}$).

`-ndmilps`**:** do not delete auxiliary files for Mixed-integer linear programming (MILP) problems.

Finally, the output of EBR is the log of the decided actions (for both the Energy Storage System (ESS) and the Plug-in Electric Vehicle (PEV)) and their effect on the resulting home demand. Such output is stored in the Comma Separated Value (CSV) file `results/`$\tilde{t}$`/output/results.csv`, being $\tilde{t}$ the time-stamp at which `launch.sh` was started. Namely, `results.csv` contains the following information, for each time-slot in the execution (note that EBR actually starts to compute charge/discharge actions only after $24p$ hours):

- starting time-stamps of the current time-slot $t$;
- overall home demand $d(t)$, shown both as energy and power (in kWh and kW, respecitvely) using EBR
- overall home demand $d(t)$, shown both as energy and power (in kWh and kW, respecitvely) using EBR, as computed by the EBR MILP
- overall home power demand $d(t)$, together with consumption only and production only (also in kW) without using EBR, i.e., without ESS and where PEV is not managed by EBR;
- ESS state of charge in $t$ (in kWh),
- ESS action $a_e(t)$ computed by EBR for $t$ (in kW),
- PEV state of charge in $t$ (in kWh),
- PEV action $a_p(t)$ computed by EBR for $t$ (in kW),
- PEV state of charge as a result of PEV action computed by EBR for $t$ (in kWh),
- required number of hours for the PEV to be fully charged,
- cost of energy due to CO2 emissions (in EUR/kWh);
- cost of energy (in EUR/kWh);
- control field, may be skipped;
- power below the DAPP power profile, if present (in kW)
- power above the DAPP power profile, if present (in kW)
- lower and upper bounds of DAPP power profile, if present (in kW)
- results for predicting future $h$ hours.