strLoadShape = 'New Loadshape.LoadShape npts =10 interval = 1 mult = [0.668 0.705 0.75 0.777 0.787 0.796 0.782 0.783 0.789 0.826]'

strLoadShapePV = 'New Loadshape.LoadShapePV npts =10 interval = 1 mult = [0.2 0.3 0.5 0.8 0.9 1 1 0.99 0.9 0.7]'

MPDOPF Verified for $T = 10, PV = 10\%, Batt = 15\%$

MPDOPF Simulation Results

P_{Loss} across the horizon for the system using Spatially-Distributed-OPF with 10% PVs and 15% Batter

OpenDSS Powerflow Results

```
------------------------------------------------------------
Machine ID: ETRL204-ARYAN
Horizon Duration: 10
    "Nature of Simulation: "    "Spatially-Distributed-OPF with 4 Areas."
GED Configuruation: pv_10_batt_15
----------------------------
```

```
----------------------------
Hour: Full 10 Hour Horizon
Horizon Line Loss: 160.2014 kW
Horizon Total Substation Power: 8782.6388 kW + 1737.9613 kVAr
Horizon Total Load: 8913.5786 kW + 4904.412 kVAr
Horizon Total Generation: 290.9676 kW + 3487.0291 kVAr
Horizon Total PV Generation: 255.1015 kW + 55.3285 kVAr
Horizon Total Battery Generation: 35.8661 kW + -68.2995 kVAr
Horizon Total Static Capacitor Reactive Power Generation: 3500 kVAr
Horizon Total Substation Power Cost: $ 283.3814
Horizon Total SCD Observed: -0.043 kW
Horizon-end Battery Energy Deviation from Reference: 40.1998 kWh
------------------------------------------------------------
Number of Macro-Iterations: 6
Simulation Time: 2154.9183 s
Time to solve with sequential (non-parallel) computation: 2084.2994 s
Time to solve if OPF computation parallelized: 1259.0284 s
------------------------------------------------------------
```
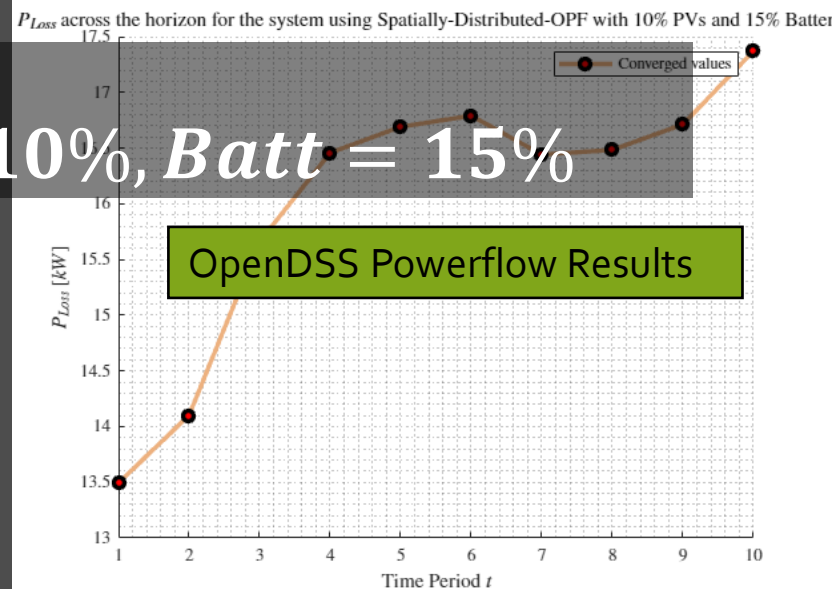
```
----------------------------
Hour: Full 10 Hour Horizon
Horizon Line Loss: 160.2869 kW
Horizon Total Substation Power: 8789.7515 kW + 1728.8044 kVAr
Horizon Total Load: 8913.5786 kW + 4904.412 kVAr
Horizon Total Generation: 283.9625 kW + 3487.0245 kVAr
Horizon Total PV Generation: 248.0996 kW + 55.3279 kVAr
Horizon Total Battery Generation: 35.863 kW + -68.3034 kVAr
Horizon Total Static Capacitor Reactive Power Generation: 3500 kVAr
Horizon Substation Power Cost: $ 283.5913
----------------------------
Horizon Period (hourly time-steps): 10 h
GED Penetration: 10% PVs + 15% Batteries
Maximum All Time Voltage Discrepancy: 0.00023693 pu
Maximum All Time Line Loss Discrepancy: 0.20972 kW
Maximum All Time Substation Borrowed Real Power Discrepancy: 8.0369 kW
Maximum All Time Substation Borrowed Reactive Power Discrepancy: 1.0127 kVAr
----------------------------
```

strLoadShape = 'New Loadshape.LoadShape npts =10 interval = 1 mult = [0.668 0.705 0.75 0.777 0.787 0.796 0.782 0.783 0.789 0.826]'

strLoadShapePV = 'New Loadshape.LoadShapePV npts =10 interval = 1 mult = [0.2 0.3 0.5 0.8 0.9 1 1 0.99 0.9 0.7]'

MPCOPF Verified for $T = 10, PV = 10\%, Batt = 15\%$

MPCOPF Simulation Results

P_{Loss} across the horizon for the system using Centralized-OPF with 10% PVs and 15% Batteries

OpenDSS Powerflow Results

```
--------------------------
Machine ID: ETRL204-ARYAN
Horizon Duration: 10
    "Nature of Simulation: "    "Centralized-OPF"
GED Configuruation: pv_10_batt_15
--------------------------
```

```
--------------------------
Hour: Full 10 Hour Horizon
Horizon Line Loss: 158.6123 kW
Horizon Total Substation Power: 8750.6369 kW + 1582.8217 kVAr
Horizon Total Load: 8913.5786 kW + 4904.412 kVAr
Horizon Total Generation: 321.554 kW + 3639.2332 kVAr
Horizon Total PV Generation: 255.1015 kW + 150.6201 kVAr
Horizon Total Battery Generation: 66.4525 kW + -11.3869 kVAr
Horizon Total Static Capacitor Reactive Power Generation: 3500 kVAr
Horizon Total Substation Power Cost: $ 282.5722
Horizon Total SCD Observed: -0.10186 kW
Horizon-end Battery Energy Deviation from Reference: 72.0729 kWh
----------------------------------------------------
Number of Macro-Iterations: 1
Simulation Time: 5271.9217 s
Time to solve with sequential (non-parallel) computation: 5224.7632 s
Time to solve if OPF computation parallelized: 5224.7632 s
----------------------------------------------------
```
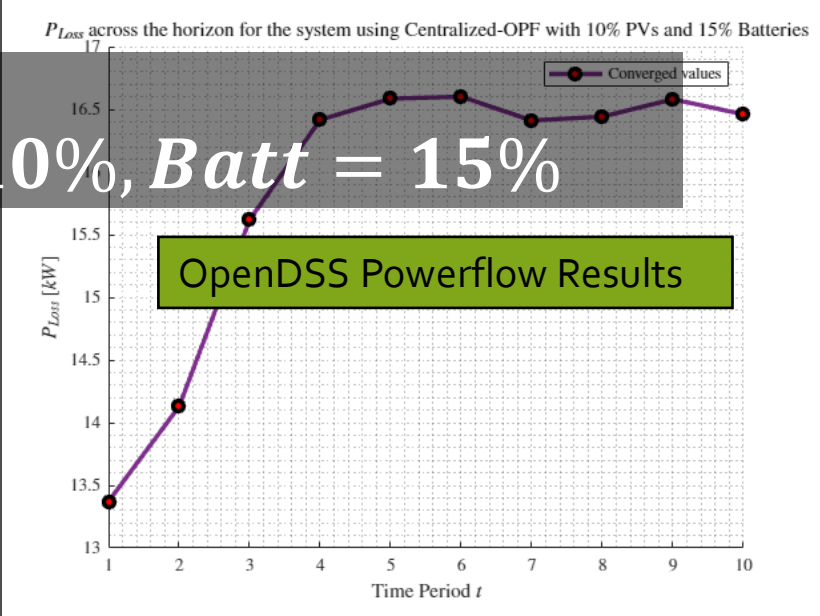
```
--------------------------
Hour: Full 10 Hour Horizon
Horizon Line Loss: 158.7039 kW
Horizon Total Substation Power: 8757.6423 kW + 1573.4026 kVAr
Horizon Total Load: 8913.5786 kW + 4904.412 kVAr
Horizon Total Generation: 314.5425 kW + 3639.2325 kVAr
Horizon Total PV Generation: 248.0925 kW + 150.6208 kVAr
Horizon Total Battery Generation: 66.4501 kW + -11.3883 kVAr
Horizon Total Static Capacitor Reactive Power Generation: 3500 kVAr
Horizon Substation Power Cost: $ 282.7737
--------------------------
Horizon Period (hourly time-steps): 10 h
GED Penetration: 10% PVs + 15% Batteries
Maximum All Time Voltage Discrepancy: 0.00015967 pu
Maximum All Time Line Loss Discrepancy: 0.19087 kW
Maximum All Time Substation Borrowed Real Power Discrepancy: 7.2284 kW
Maximum All Time Substation Borrowed Reactive Power Discrepancy: 1.0235 kVAr
--------------------------
```

strLoadShape = 'New Loadshape.LoadShape npts =10 interval = 1 mult = [0.668 0.705 0.75 0.777 0.787 0.796 0.782 0.783 0.789 0.826]'

strLoadShapePV = 'New Loadshape.LoadShapePV npts =10 interval = 1 mult = [0.2 0.3 0.5 0.8 0.9 1 1 0.99 0.9 0.7]'
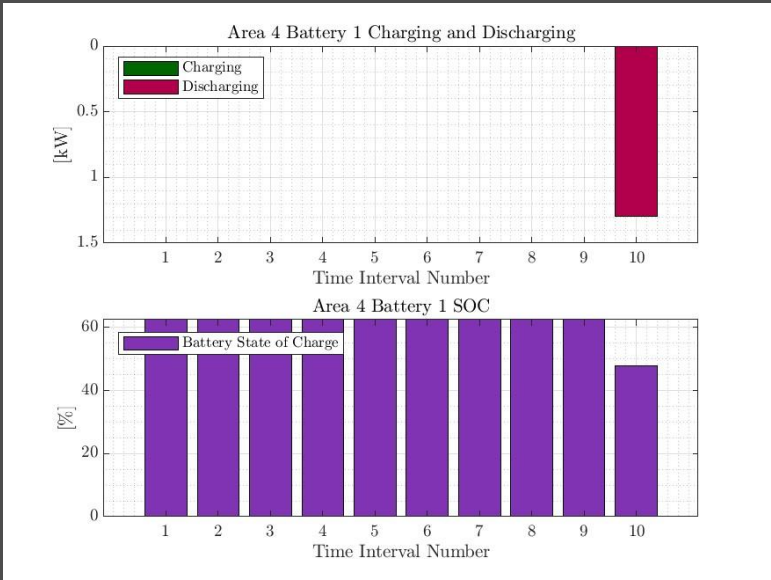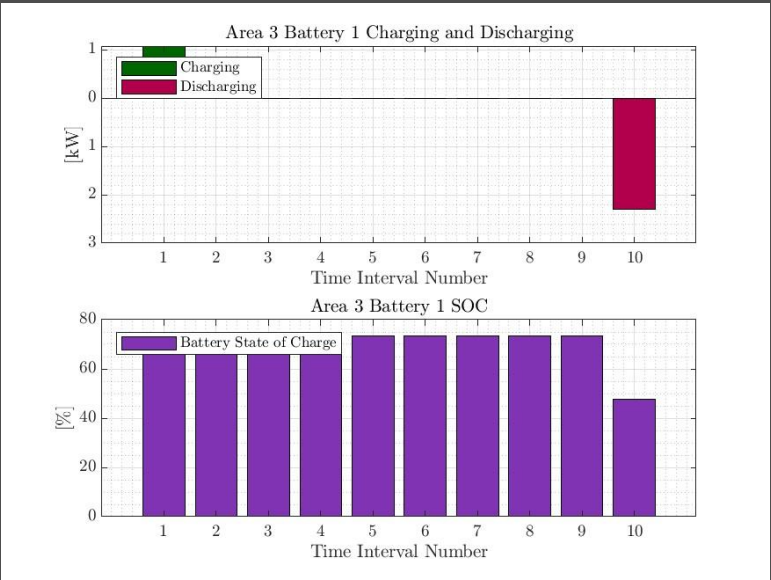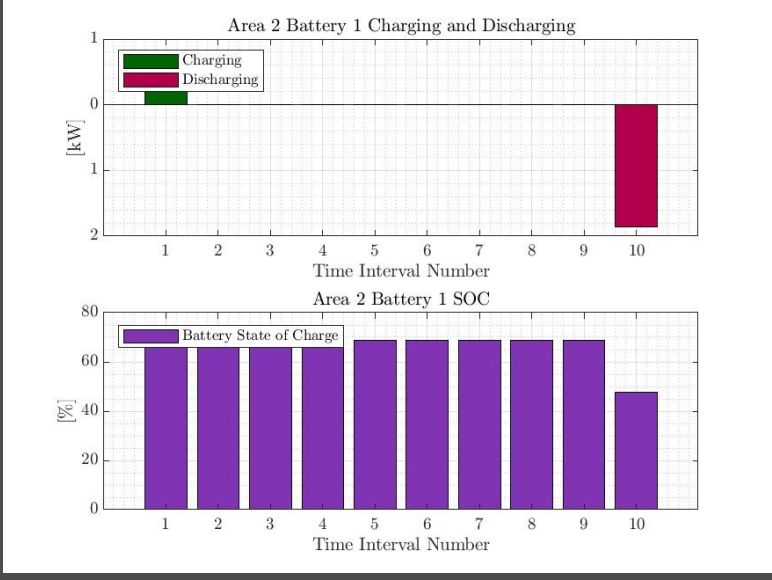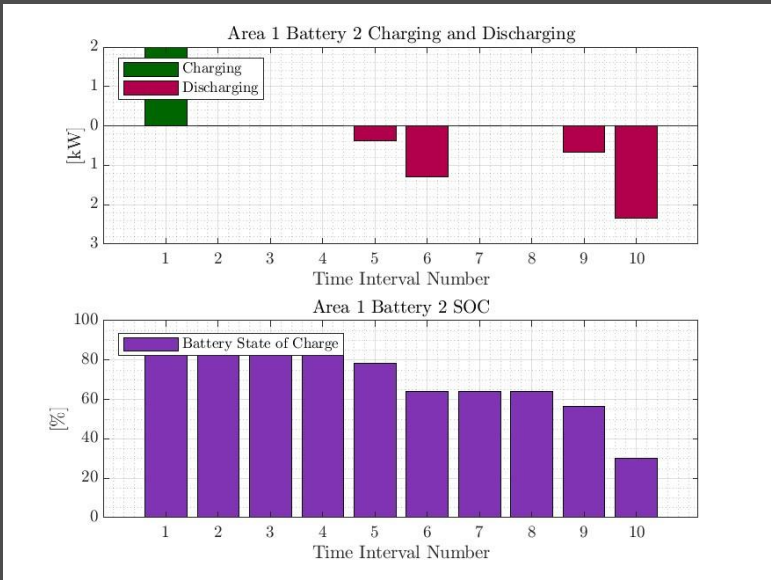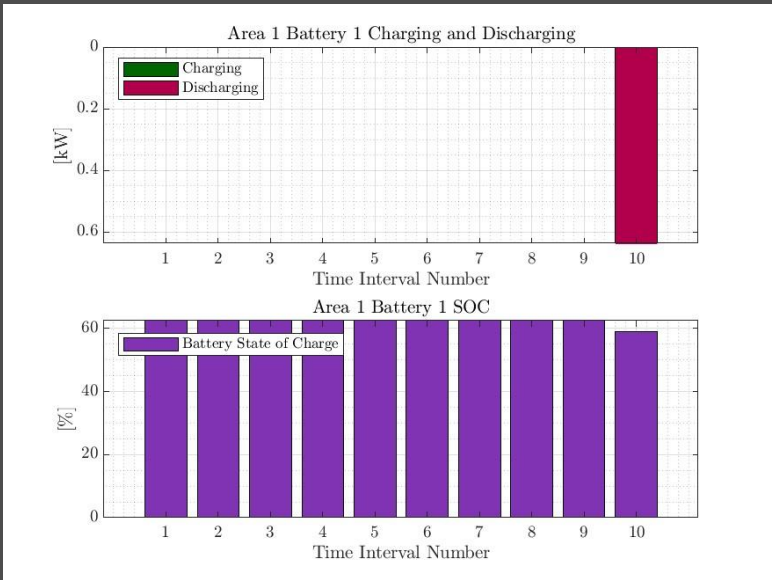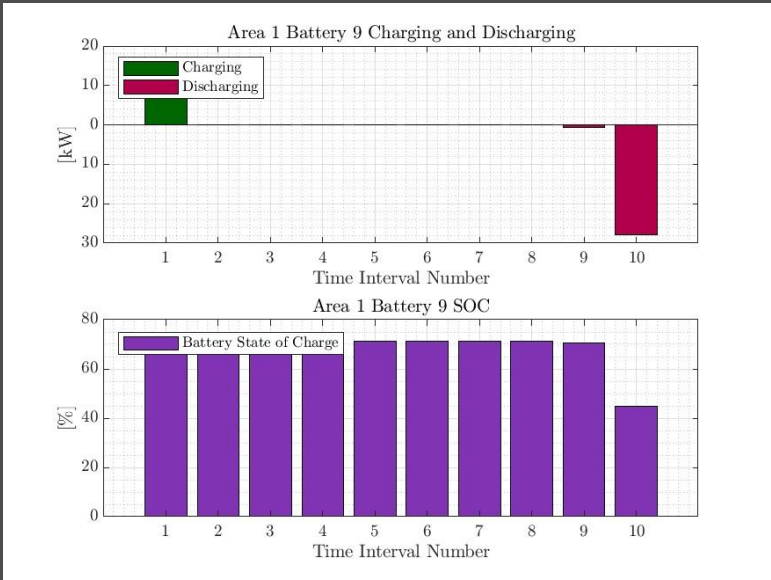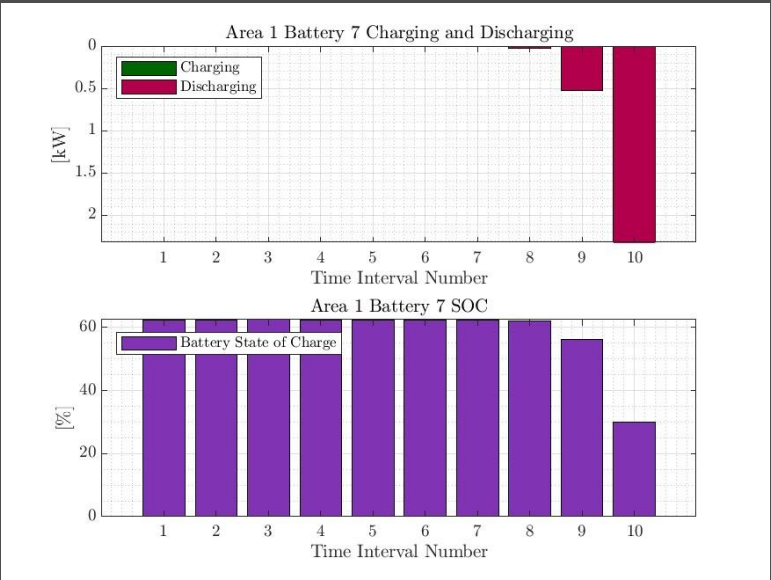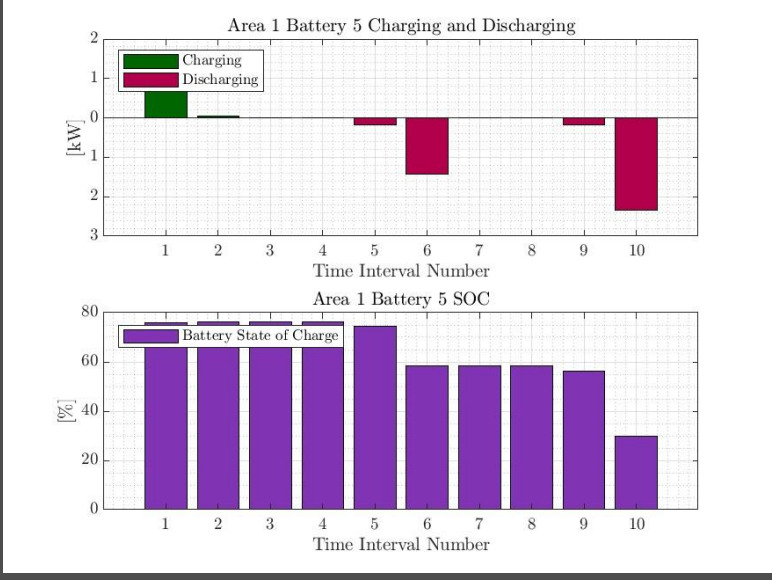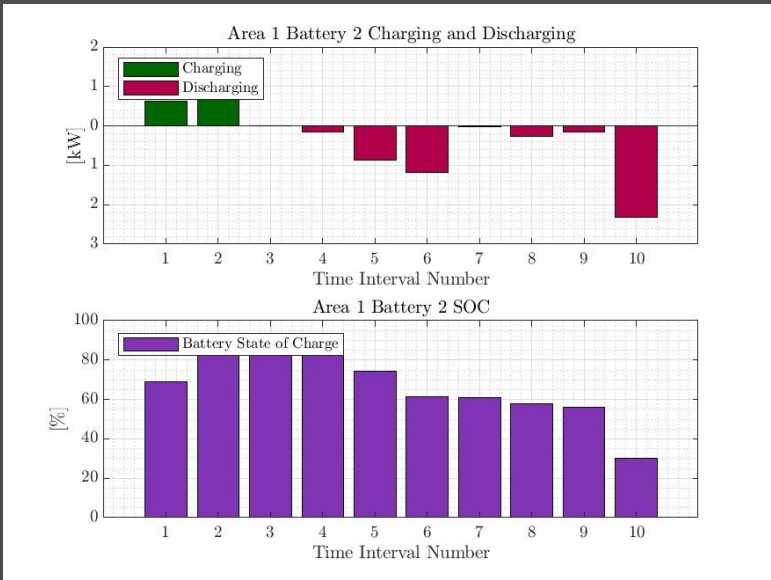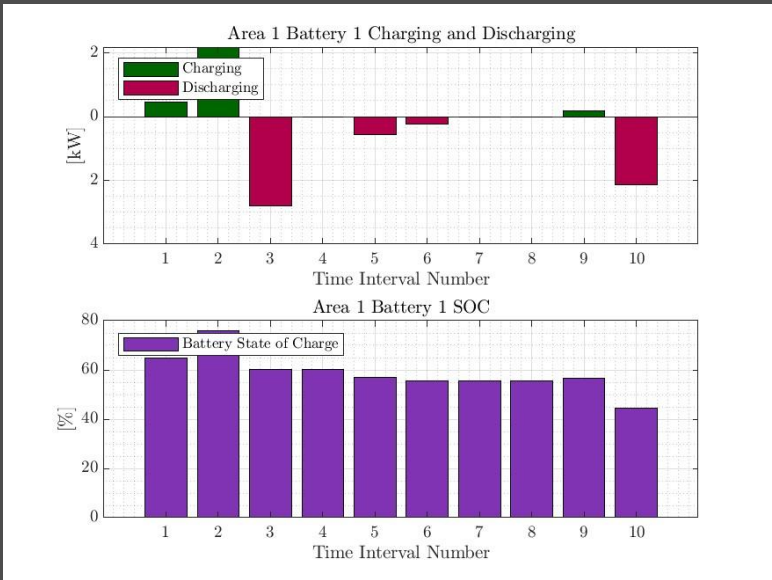
MP**D**OPF Verified for $T = 10, PV = 10\%, Batt = 15\%$

strLoadShape = 'New Loadshape.LoadShape npts =10 interval = 1 mult = [0.668 0.705 0.75 0.777 0.787 0.796 0.782 0.783 0.789 0.826]'
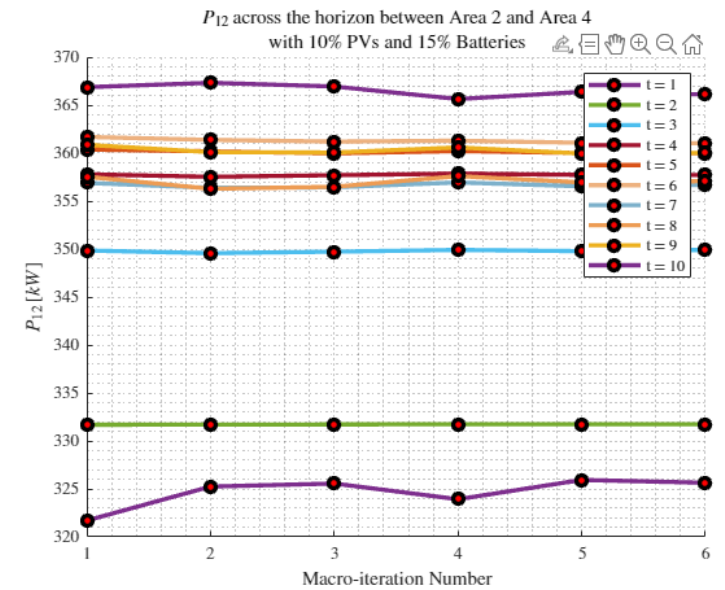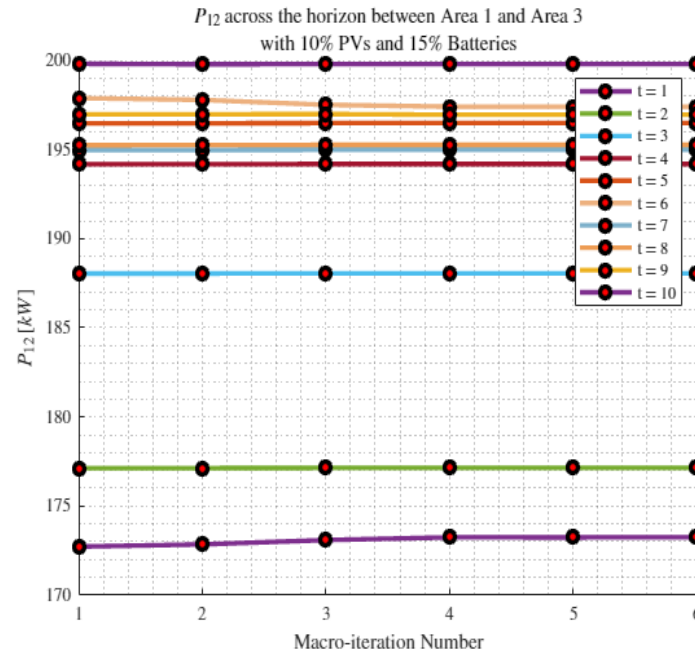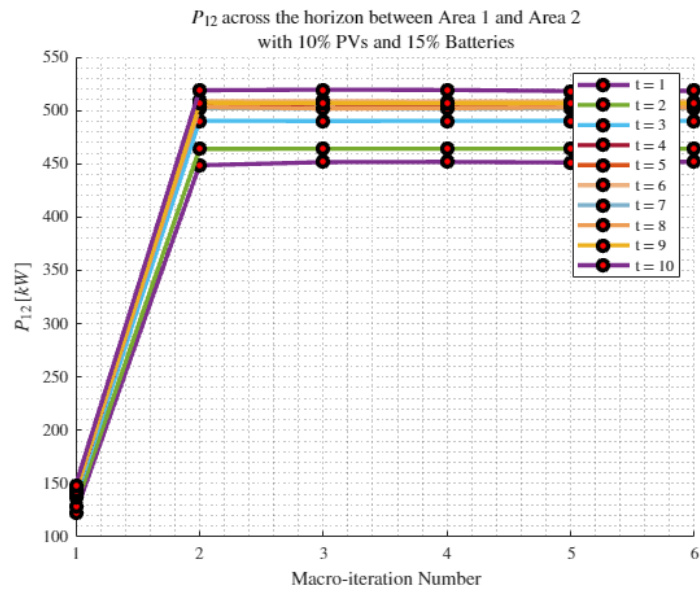
strLoadShapePV = 'New Loadshape.LoadShapePV npts =10 interval = 1 mult = [0.2 0.3 0.5 0.8 0.9 1 1 0.99 0.9 0.7]'

MPCOPF Verified for $T = 10, PV = 10\%, Batt = 15\%$

Boundary Complex Powers

Boundary Voltages