Energy Management System to Ensure Energy Continuity of Individuals in Emergency Situations

CURENT

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BACKGROUND AND MOTIVATION

- Microgrids, characterized by dynamic boundary structures, are expected to alleviate the energy continuity problem in emergency conditions.
- Limited resources within the microgrid boundaries can be shared among the consumers over the limited power to ensure energy continuity.
- Power limitation should be adjusted dynamically considering new consumption and generation units as the boundaries expanding or shrinking due to repairs of faulty lines by repair crews.
- This study investigates the effects of variable power limitations on individuals residing in the buildings located in the microgrid which have dynamic boundaries.

SYSTEM DESCRIPTION

- In this study, a detached home is used to analysis the effect of variable power limitation.
- The detached home includes roof-top PV serving as generation unit, electric vehicle serving as energy storage unit and various home appliances as loads.
- Roof-top PV is connected to the utility grid over on-grid inverter.
- Home appliances are categorized into five load levels based on their importance in emergency ranging from LL0 which includes only critical appliance to LL5 which includes all appliances.
- The detached home is located within a microgrid operating in islanded mode following an emergency.
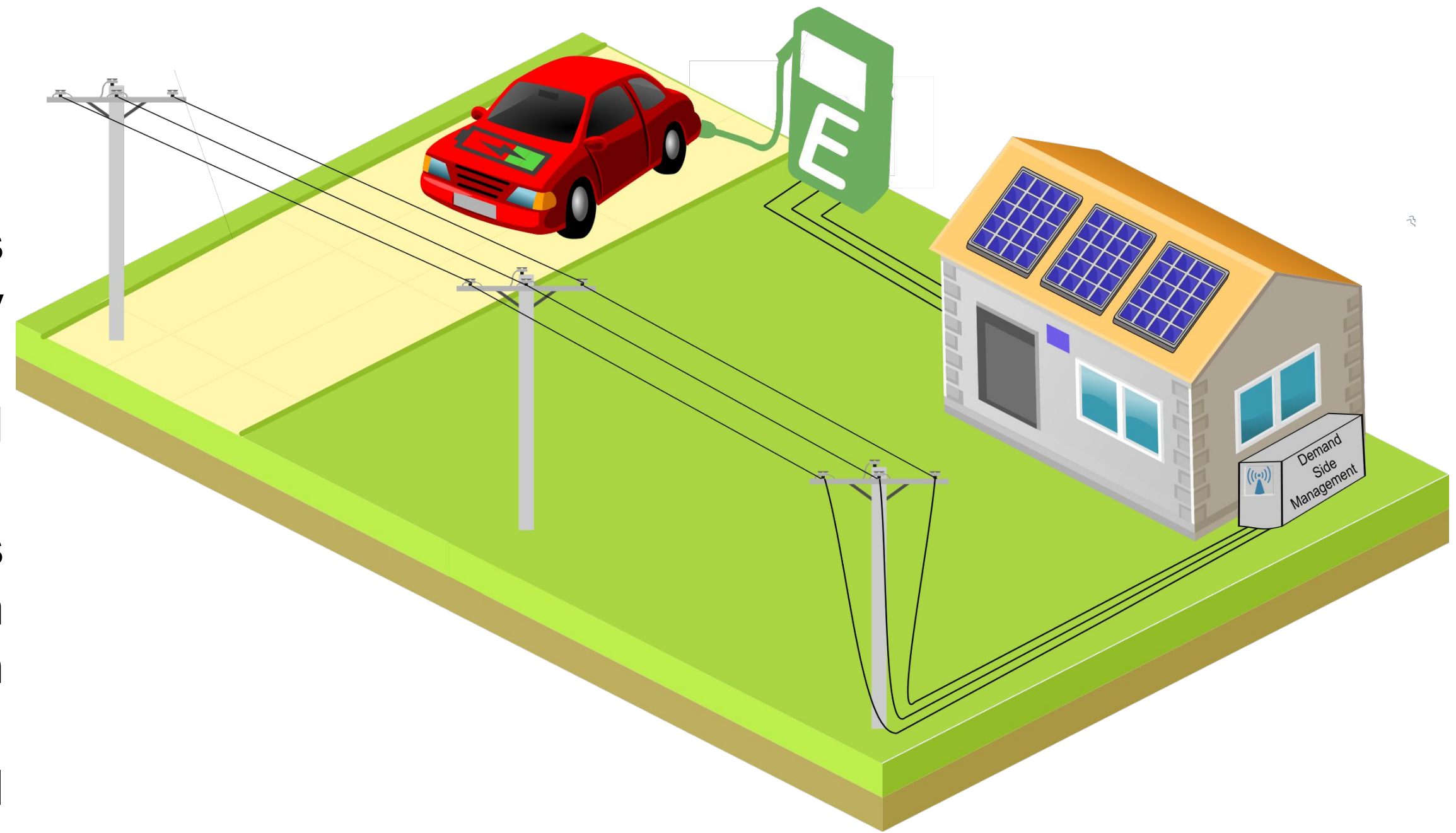
CASE STUDY

- Emergency period begins at 10:00 AM.
- Power limitation is applied to the detached home zero W between 10:00 AM – 18:00, 600 W between 18:00 PM – 03:00 AM and 350 W between 03:00 AM – 10:00 AM.
- Electric vehicle battery has a capacity of 52 kwh with the SOC of %25 at the beginning of emergency period.
- Roof-top PV has 3.5 kw rated power.

RESULTS
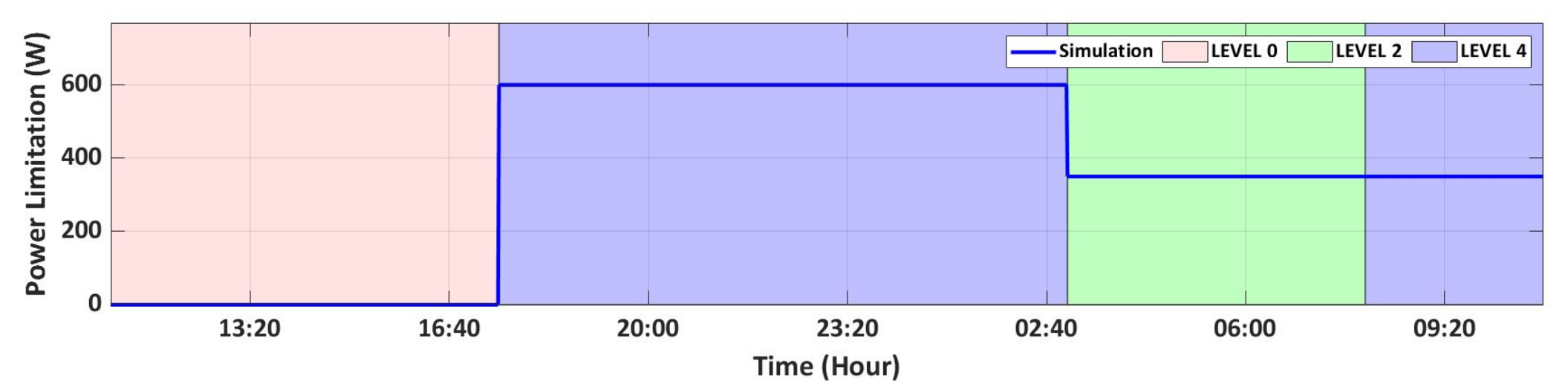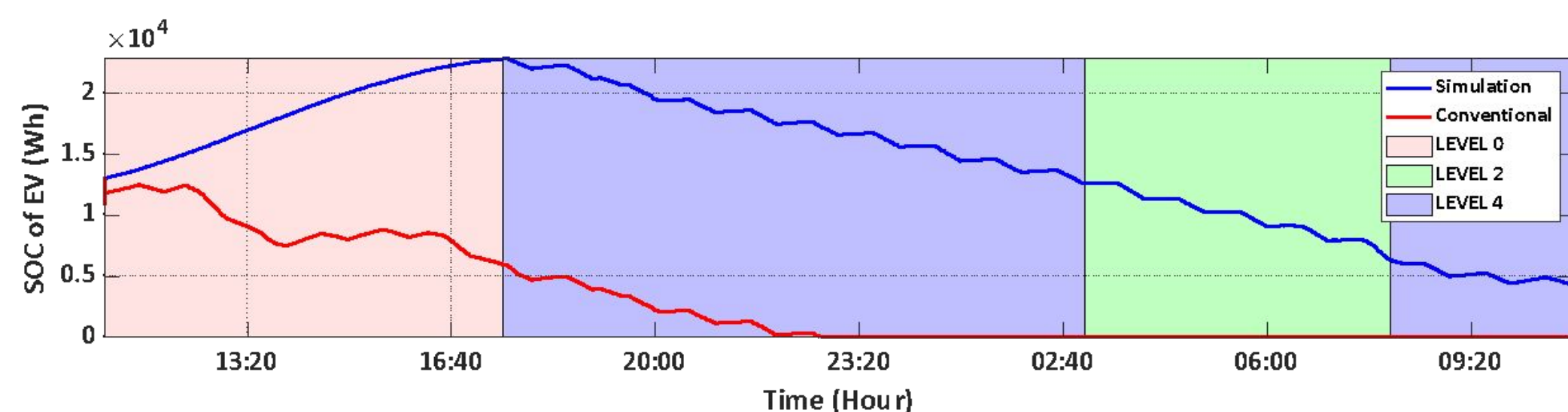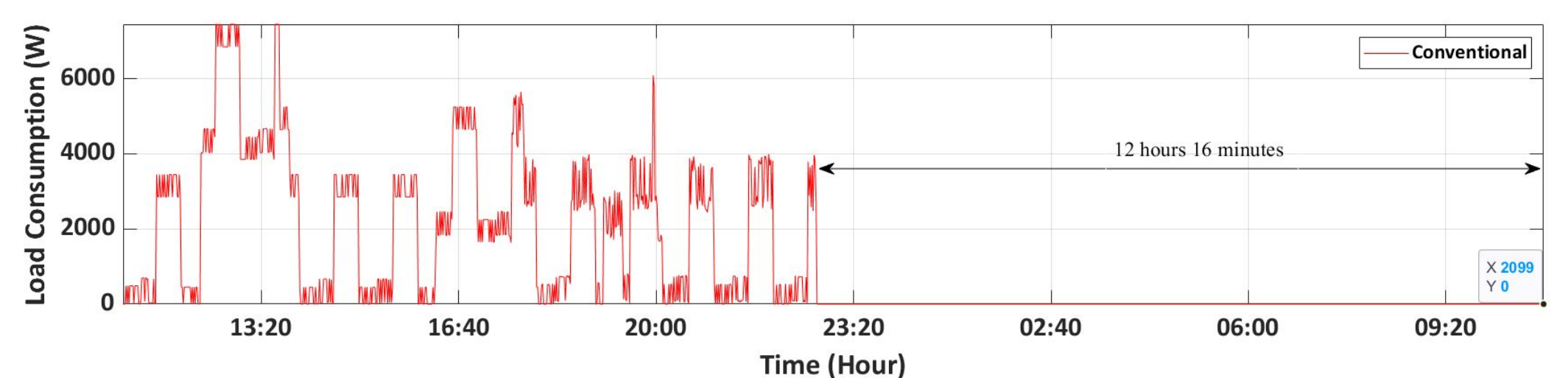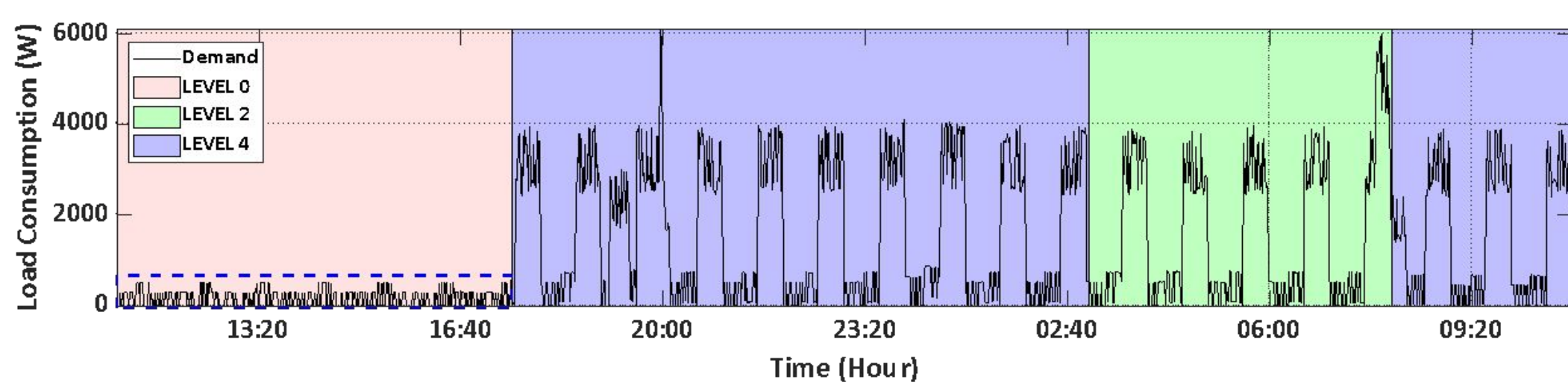
- Electric vehicle battery are depleted in 11 hour 44 minutes after the beginning of emergency period and cause power outage, while proposed algorithm can extend the energized %104.5, until the end of the emergency period.
- The energy management system demonstrated its ability to react to variable power limitations by adjusting the consumption of the individuals through changing the load levels.

CONCLUSION

- Conventional systems can lead to outage in emergency which is one of the most critical period in terms of the individuals' energy needs
- The proposed algorithm can ensure energy continuity of individuals in emergency situations under the variable power limitation resulting of dynamic microgrid boundaries.