Control and optimization scheduling within a meshed DC microgrid

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Research context

- Complex energy system modelling
- Power production, transmission and storage
- Load balancing and constrained optimization
- Fault mitigation and reconfiguration

Why meshed topology?

- Interconnection of many autonomous subsystems which operate both independently and cooperatively.
- Detection and avoidance of power losses and faults by changing the transmission line path.

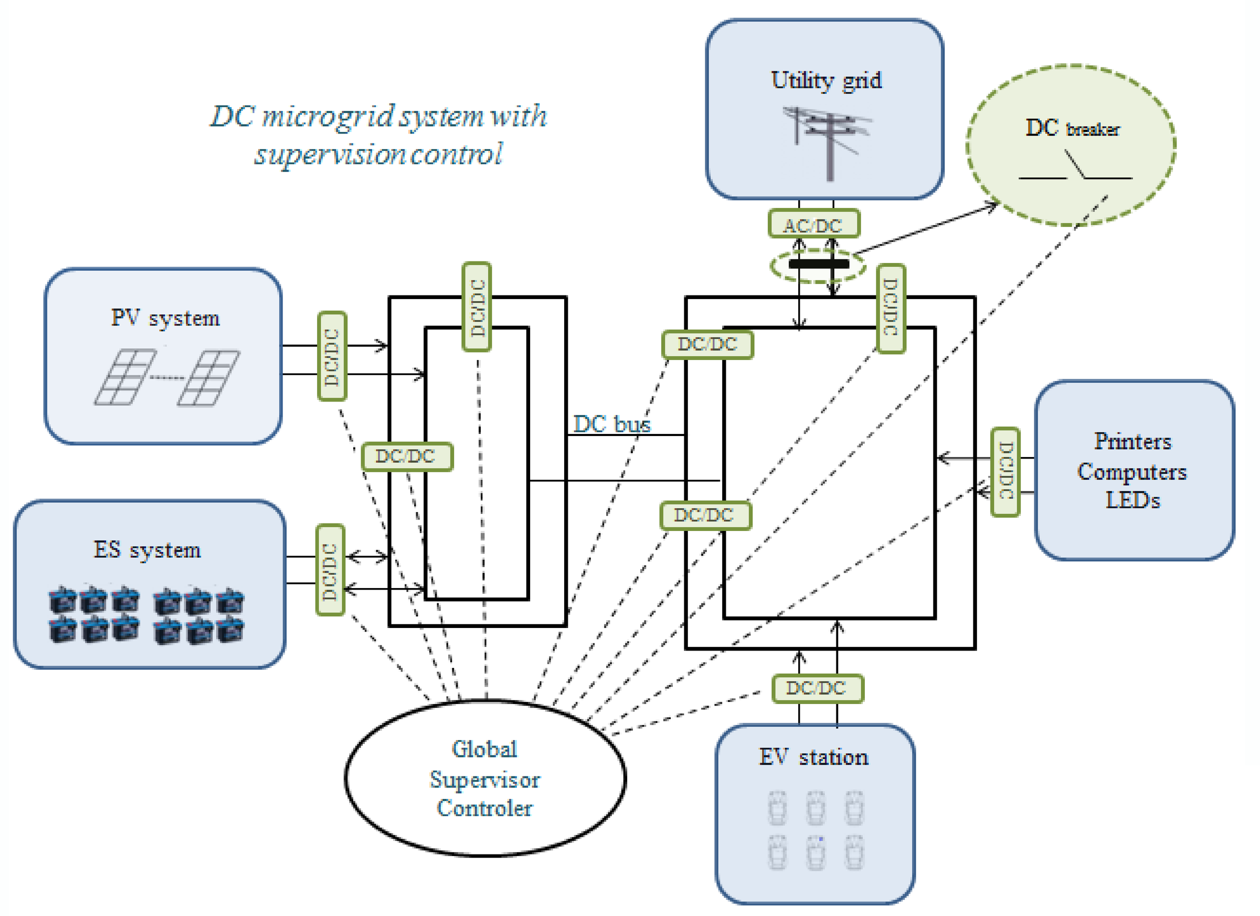
Control methods

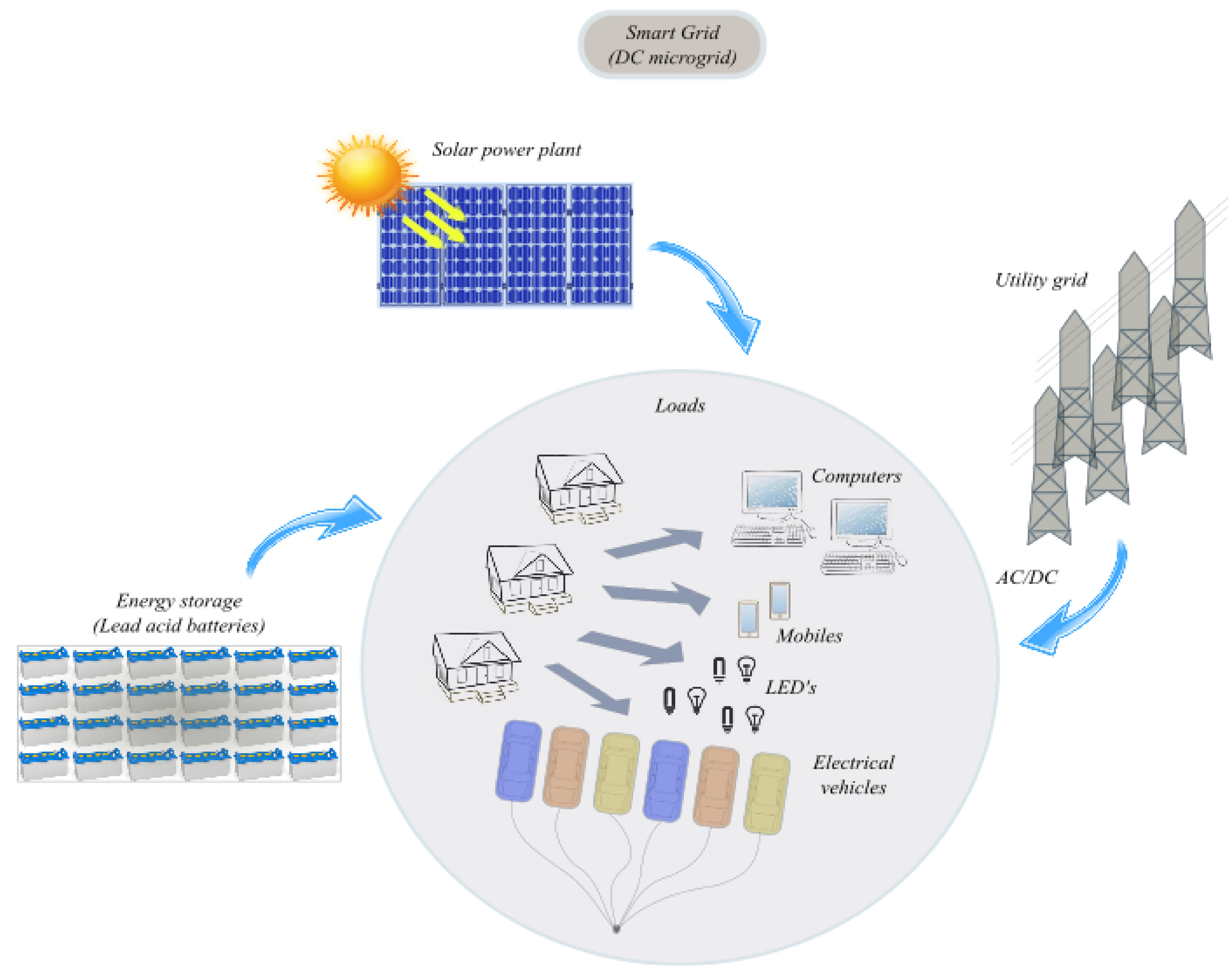
- Model Predictive Control for load balancing and cost minimization under operation constraints.
- Mixed-integer non linear programming techniques for discrete variable sets (on/off state of the converters)

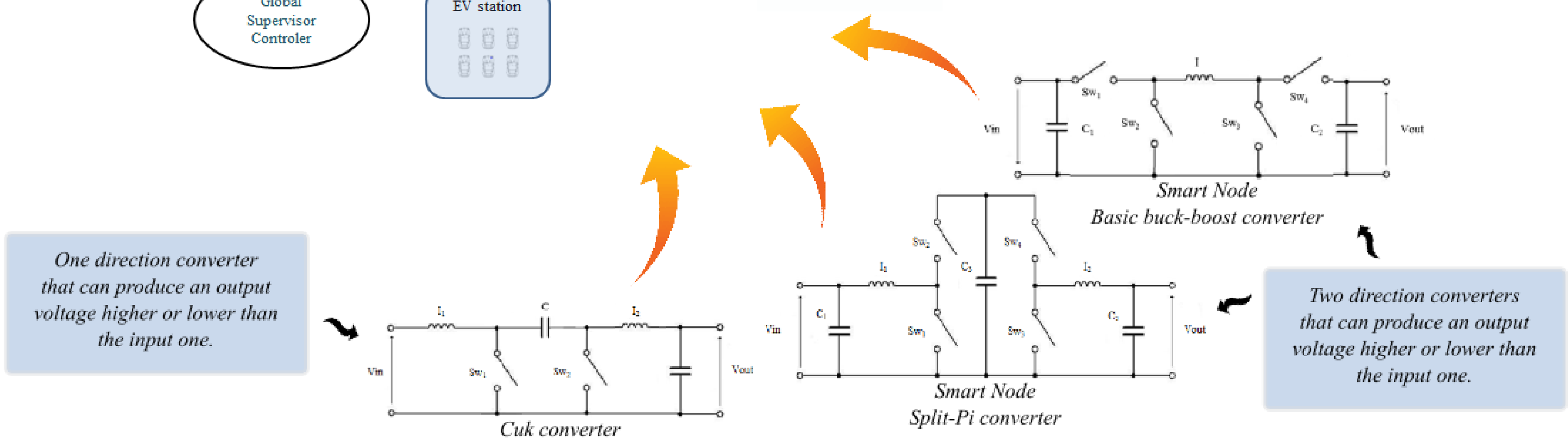
Architecture of the meshed DC microgrid

The DC microgrid considered in this research consists of the following physical components:

1. three-phase utility grid
2. renewable sources as solar panels
3. energy storage units
4. the transmission lines which are linked through the corresponding switching DC/DC converters







Modelling methodology:
Port- Hamiltonian model approach
for illustrating the dynamical system

Optimization objectives

Load balancing:

- Kirchoff's law verification: $\sum_{k=1}^{n} I_k = 0$ $\qquad$ $\sum_{k=1}^{n} V_k = 0$
- Difference between the provided load u and the required demand $d_k(t)$:

$$\sum_{k=1}^{n} d_k(t) - (u_{UG}(t) + u_1(t) + u_2(t) + ... + u_n(t)) > 0$$

Cost minimization:

- Difference between the selling cost C_{SC} and the buying cost C_{BC} : $\quad C_{SC} - C_{BC} \geq 0$
- State of charge (SoC) of the battery: $\quad SoC = 1 - D_B > 0$

Future work

Build a reliable and energy efficient controlled system, that will realize simultaneously the load balancing, the fault detection and the reconfiguration of the complex energy system.

Acknowledgements

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References

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