

DC microgrids, an opportunity?

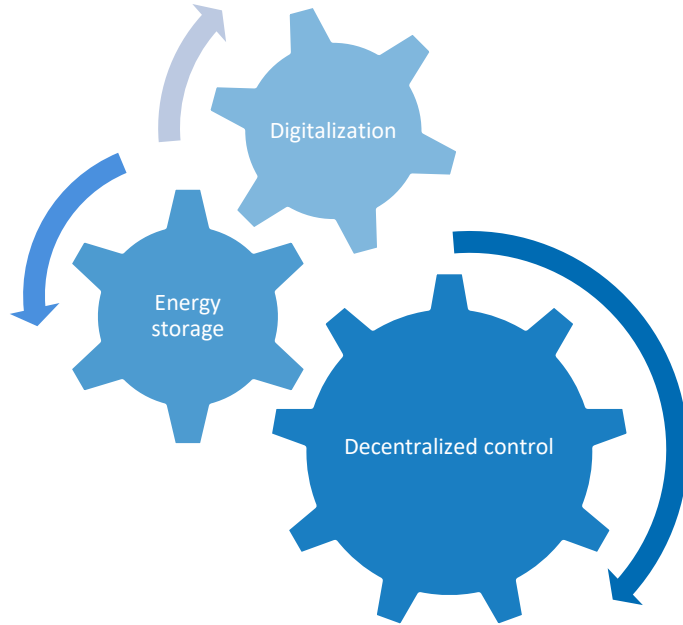
Andreas Hutter

Swiss-US Energy Innovation Days 2017

New York, 22. August 2017

Photovoltaic Research in Neuchâtel Switzerland

A competence center with 100 researchers



Energy Systems Research



- Applied research
- From lab to industry

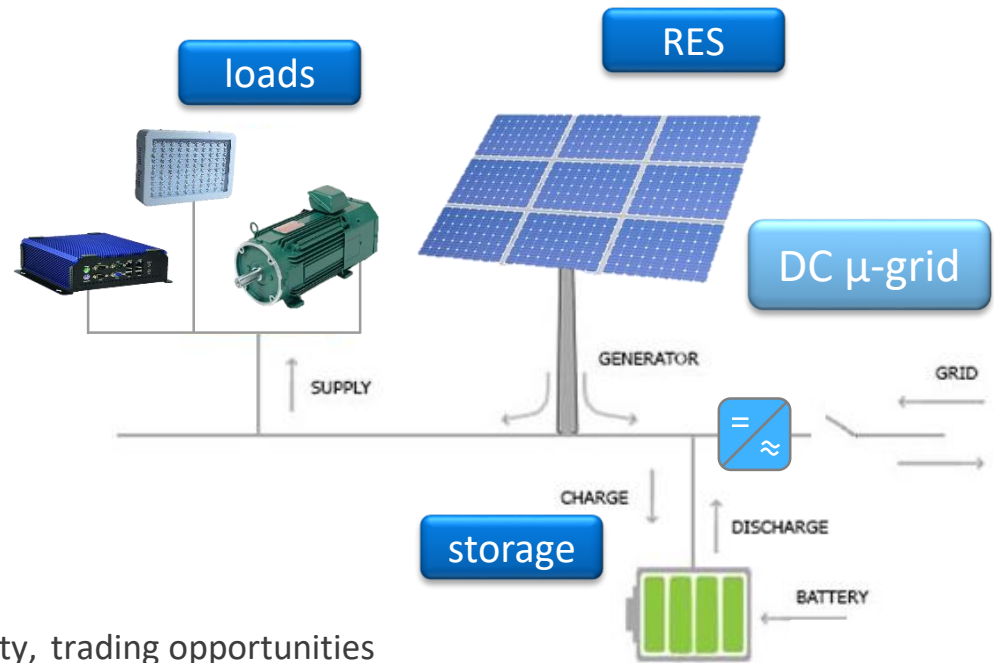
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DC microgrids, an opportunity?

microgrids: definitions

USDOE Definition :

A microgrid is a group of interconnected **loads** and distributed energy resources (**DERs**) within clearly defined **electrical boundaries** that acts as a single controllable entity with respect to the grid. A microgrid can connect and **disconnect** from the grid to enable it to operate in both grid-connected or island-mode.



benefits: system performance, supply security, trading opportunities

challenges: uncertainty, protection and control: bidirectional power flows, stability [\[1\]](#)

DC microgrid interface can result in significantly **simpler control** structure, **more energy efficient** distribution and higher current carrying capacity for the same line ratings. [\[2\]](#)[\[3\]](#)

DC microgrids, an opportunity?

DC microgrid in the industry

It *starts* as DC...

At present, most on-site renewable energy systems produce direct current (DC) electricity which is then inverted to alternating current (AC) and fed into the utility grid.



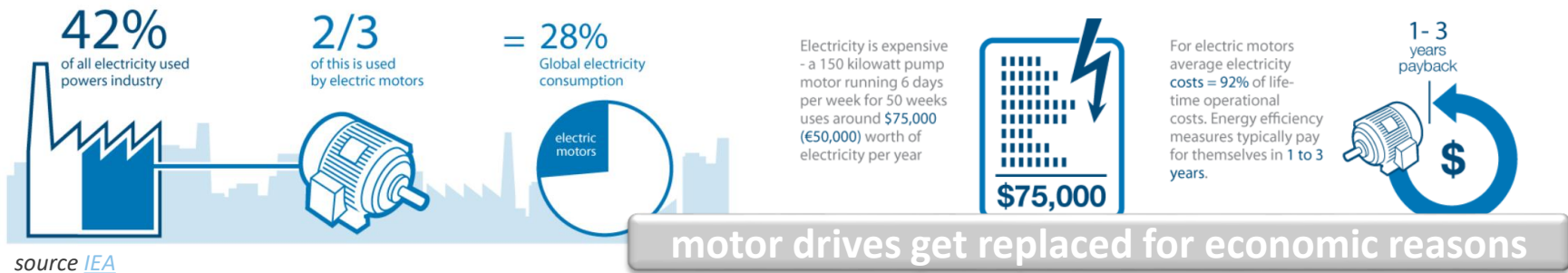
It *ends* as DC...

The AC power from the utility grid has to be converted to DC within the building to power the modern electrical loads such as fluorescent and LED lighting, IT equipment, energy efficient motors and pumps, etc.

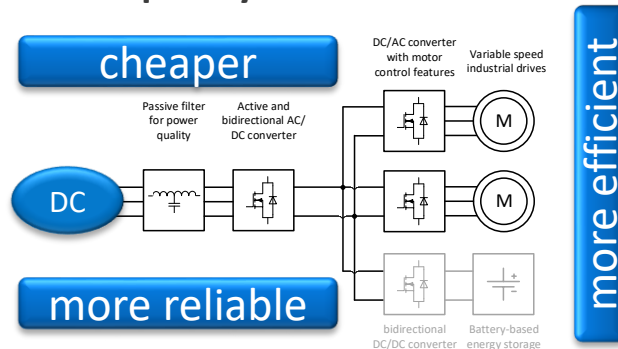
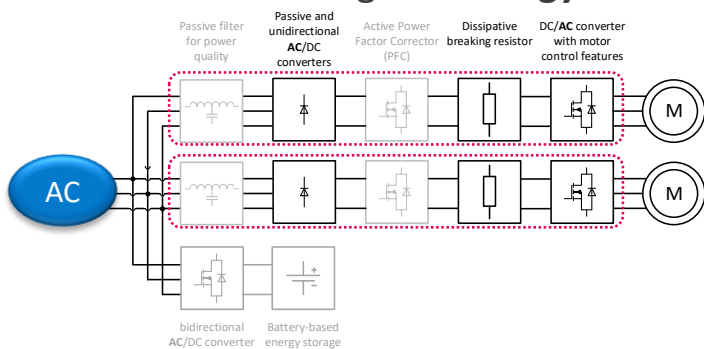
source [Bosch](#)

DC microgrids, an opportunity?

DC microgrid associated with motor control



DC microgrid integration can bring additional advantages due to exploited simplicity, e.g. for energy efficient motors with variable-frequency drives



DC microgrids, an opportunity?

big industry starts to embrace DC distribution systems

Components



source [Belimo](#)

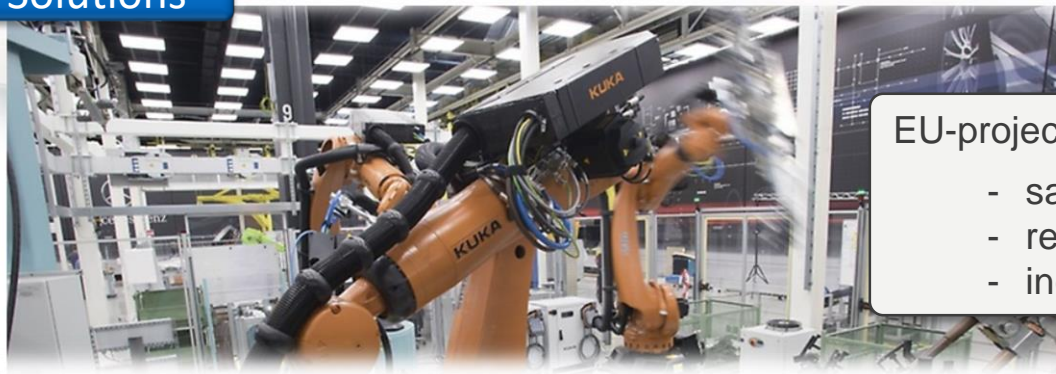


source [B&R](#)



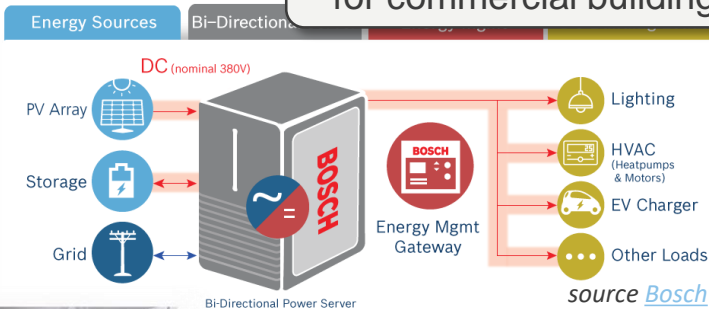
source [Siemens](#)

Solutions



Systems

7-10% efficiency increase for commercial buildings

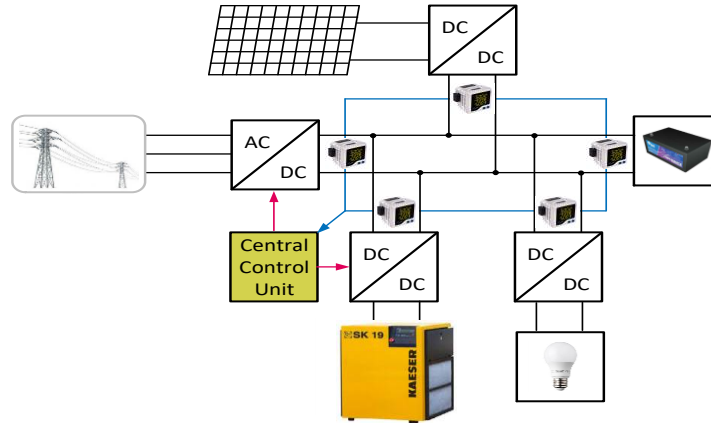


EU-project [AREUS](#): 600V DC microgrid

- safe energy
- reduce costs
- increase reliability

source [Daimler](#)

Join us to develop DC-microgrids for your industry ...



Thank you for your attention!

References

- [1] "[A Survey of Techniques for Designing and Managing Microgrids](#)",
IEEE PES GM 2015
- [2] *Dragičević, T.; Lu, X.; Vasquez, J. C.; Guerrero, J. M. (2016-07-01). "[DC Microgrids #x2014;Part I: A Review of Control Strategies and Stabilization Techniques](#)". IEEE Transactions on Power Electronics. **31** (7): 4876–4891. [ISSN 0885-8993](#). [doi:10.1109/TPEL.2015.2478859](#)*
- [3] *Dragičević, T.; Lu, X.; Vasquez, J. C.; Guerrero, J. M. (2016-05-01). "[DC Microgrids #x2014;Part II: A Review of Power Architectures, Applications, and Standardization Issues](#)". IEEE Transactions on Power Electronics. **31** (5): 3528–3549. [ISSN 0885-8993](#). [doi:10.1109/TPEL.2015.2464277](#)*