WEBINAR LVDC TECHNOLOGIES

SIMULATION TOOL FOR TECHNO-ECONOMIC ANALYSIS OF HYBRID AC/DC LOW VOLTAGE DISTRIBUTION GRIDS

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OUTLINE

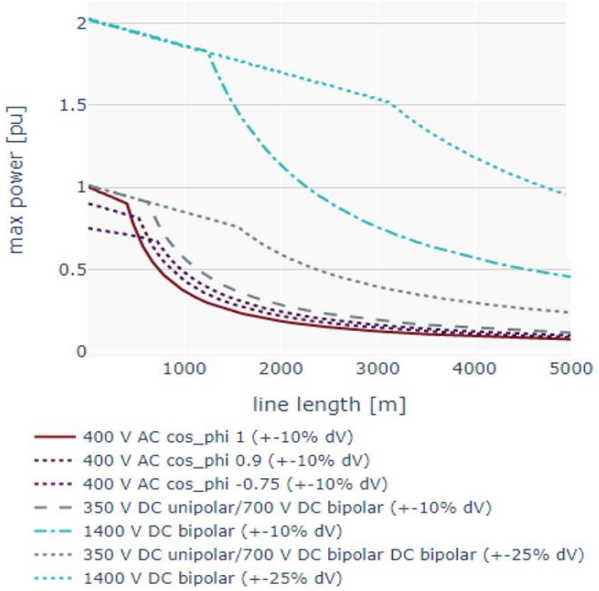
- Motivation
- Tool Preview
- Scenarios for LV AC/DC Hybrid Grids
- Presented Simulations
- Load Flow Simulation Results
- Economic Analysis Results
- Outlook

MOTIVATION

- Driven by international decarbonization goals, electric energy supply systems will have to go through fundamental changes in the next two decades:
  - Shift towards distributed energy generation (DEG)
  - Integration of more renewable energy sources (RES)
  - Electrification of transportation
- High increase in DC loads, sources and storages:
  - Devices of everyday use such as computers, cell phones, etc.
  - Electric vehicles (EV)
  - Light-emitting diodes (LED)
  - Photovoltaic systems (PV)
  - Battery energy storage system (BESS) and fuel cells

MOTIVATION

- Overall energy efficiency must be increased.
- New challenges such as changes in the energy flow direction or excessive loading and voltage fluctuation are to be solved.
- Converted from AC to DC, the already existing LV infrastructure, in particular the lines, can be further used with increased power transmission capacity, reduced losses and overcoming longer distances.
- The Techno-Economic Simulation Tool enables a grid planning perspective on DC in the LV grid.



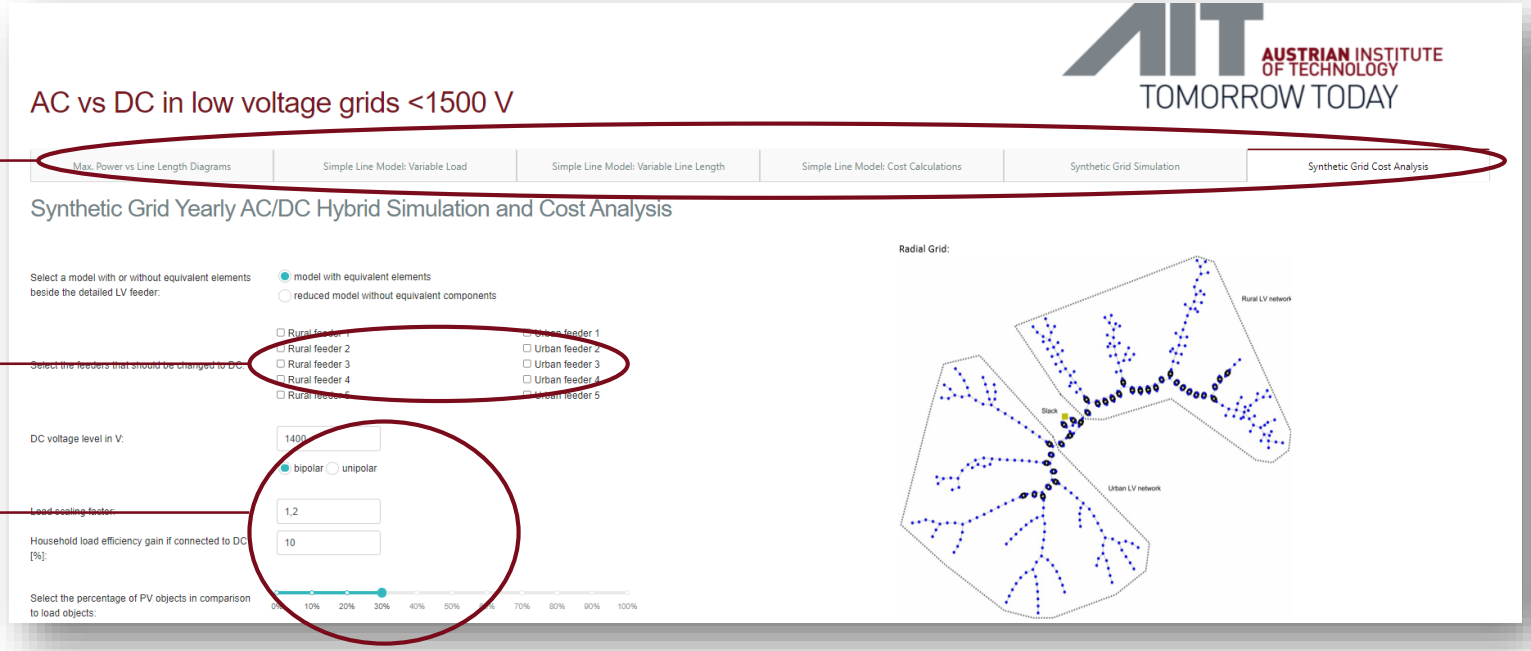
Maximum transmission power vs line length; cable type XAY2Y 4x150; max 1400 V_{DC} bipolar; p.u. of max. power at 1m line length 400 V_{AC} cos(ϕ) = 1.

TOOL PREVIEW

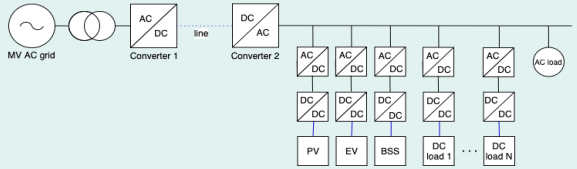
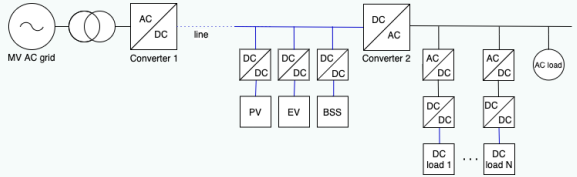
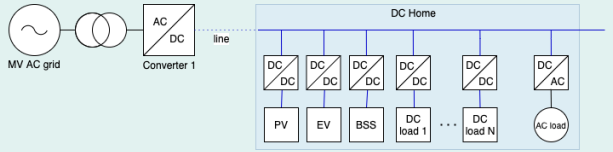
1. Simulation selection

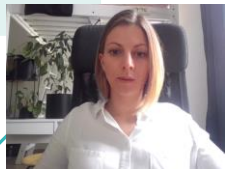
2. Feeder selection

3. Parameter definition



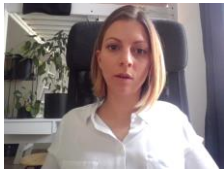
SCENARIOS FOR LV ACDC HYBRID GRIDS

DC Scenario	Description	Diagram
0	lossless conversion to DC	
1a	LVDC lines, AC customers	
1b	LVDC lines, AC customers, PV and EV connected to LVDC grid	
2	LVDC lines, DC customers	

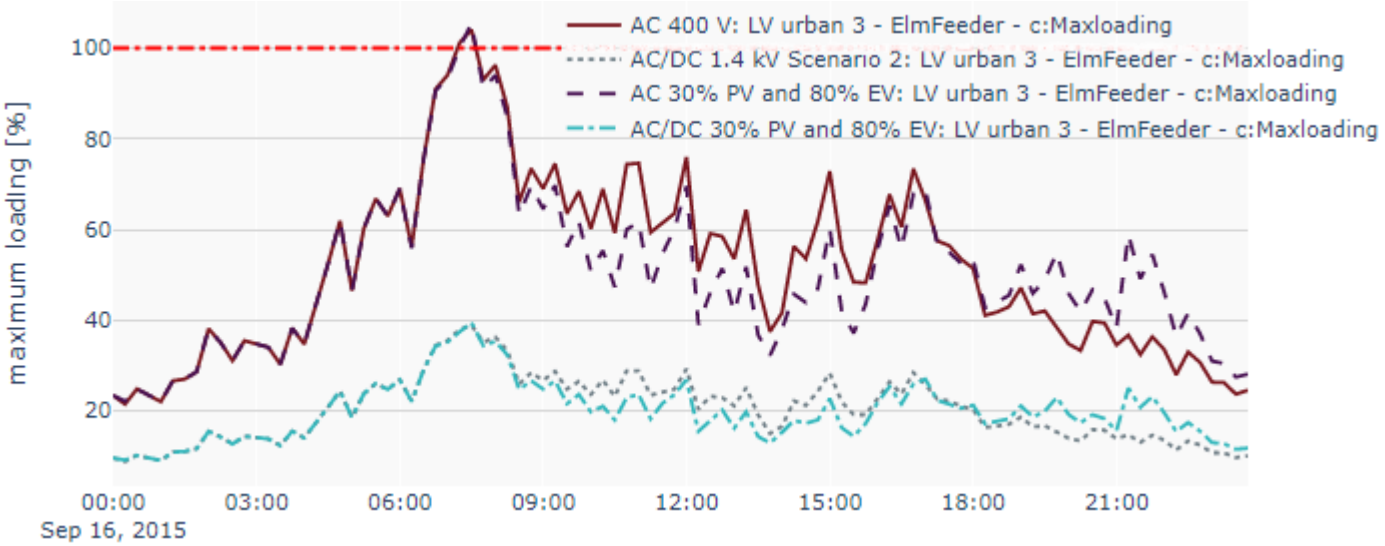


PRESENTED SIMULATIONS

- 400 V AC
- 1400 V DC, AC/DC hybrid scenario 2
- 400 V AC, 30% PV penetration, 80% EV penetration
- 1400 V DC, 30% PV penetration, 80% EV penetration, AC/DC hybrid scenario 2

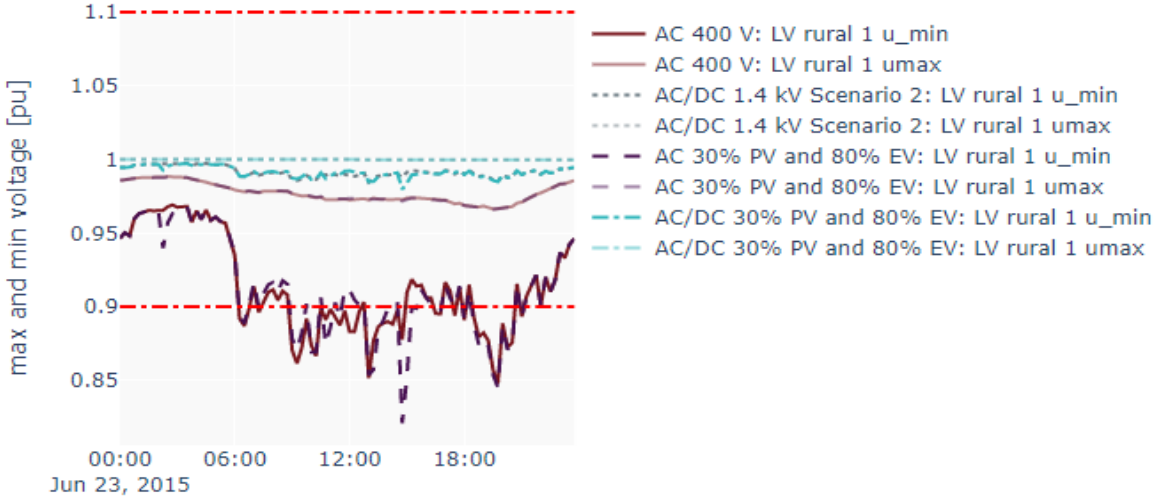


LOAD FLOW ANALYSIS – MAXIMUM LOADING

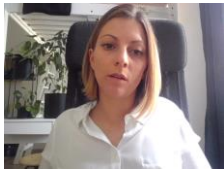


Daily loading profile of feeder LV urban 3 on an autumn day.

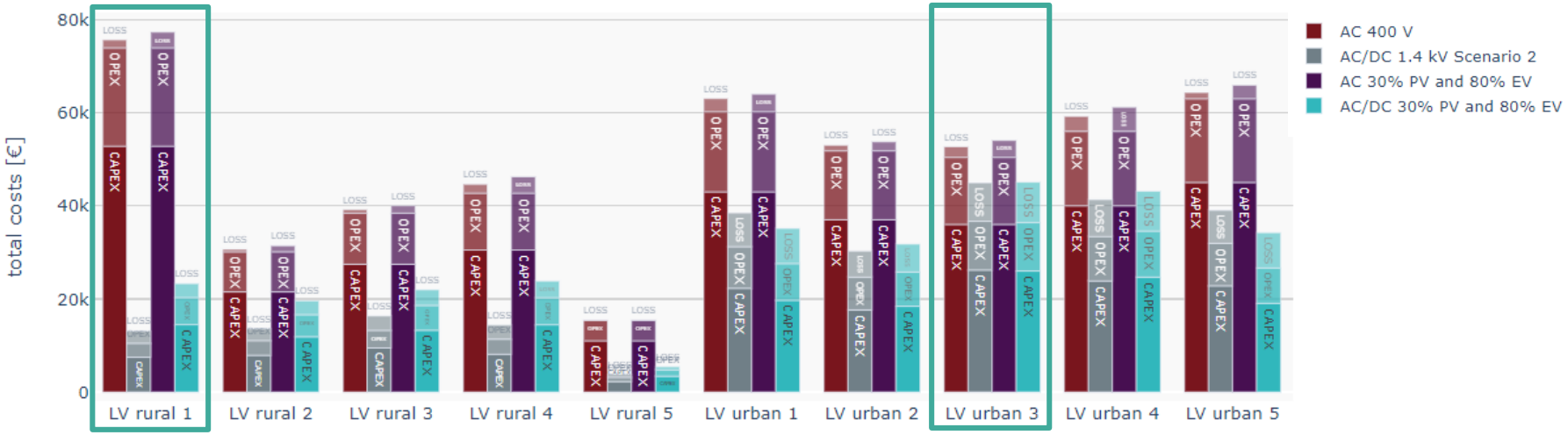
LOAD FLOW ANALYSIS – VOLTAGE VARIATION



Voltage profile of daily simulation (LV rural 1) on a summer day.



ECONOMIC ANALYSIS

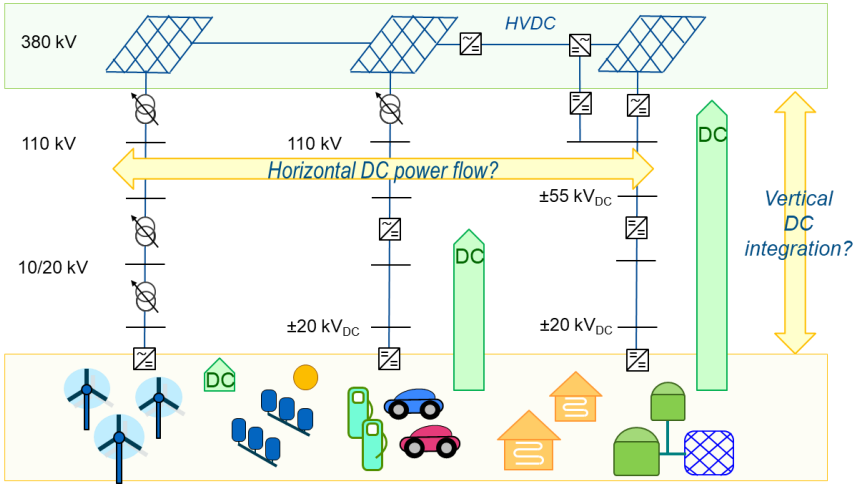


Comparison of TOTEX costs for AC grid reinforcement and conversion to DC for all LV feeders in test grid, TOTEX divided in CAPEX and OPEX (losses costs (LOSS) are indicated separately from the rest of OPEX costs) using calculation parameter from Table 5 in paper and yearly simulation results.

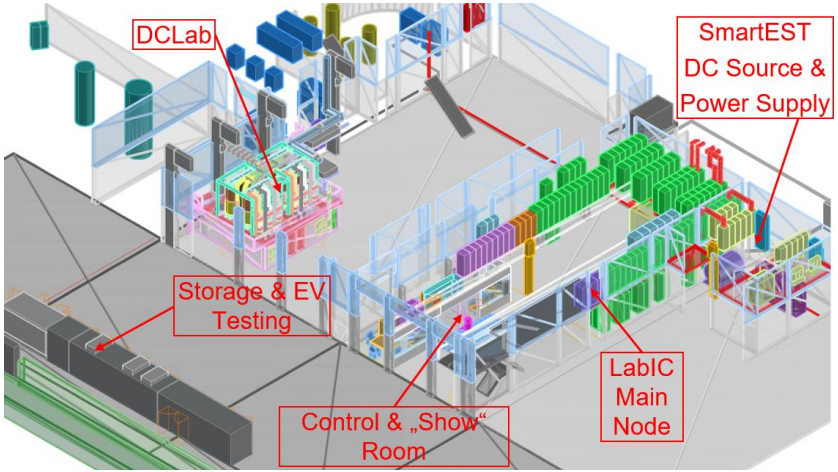
OUTLOOK

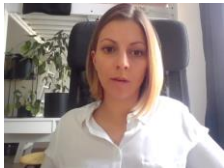
DC in power grids

HYPERRIDE
THE FUTURE OF POWER DISTRIBUTION



AIT DC Lab Extension





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THANK YOU!

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