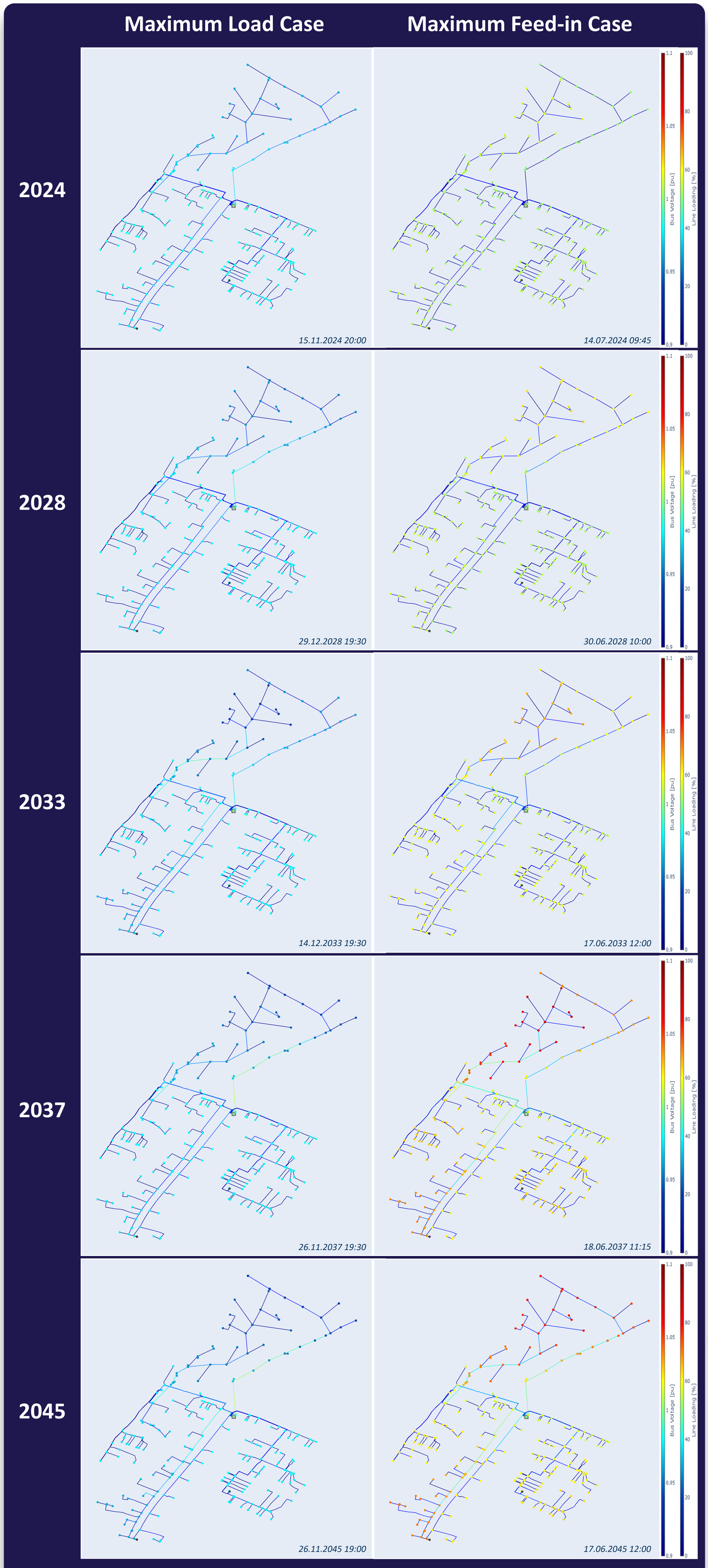
Temporal Development of Grid Congestions in a Real Low-Voltage Grid Through 2045

Evi Kasper, Álvaro Diaz, Michael Schmidt

Gr id-sensitive E nergy ommunity oordination



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Scenario Definition

How to determine penetration levels for semi-urban areas?

Demographic data from the *Landesentwicklungsplan* is combined with DSO planning (*Regionalszenario SÜDWEST*), which includes future numbers across all technology categories.

Scenario Year	PV	Battery	Heat Pump	Electric Vehicle
2024	36	22	21	4
2028	46	34	26	64
2033	68	47	33	114
2037	85	59	43	153
2045	101	67	52	186
Full electrification	131	131	131	346

Number of appliances for our case study – Subrural municipality

Limits in the Low-Voltage Grid

All constraints apply for each time step $t \in T$ within the simulation period:

- **Voltages** (based on DIN EN 50160)

$$0.97\ \text{p. u.} < \frac{U_{node,t}}{U_{\text{nenn}}} < 1.03\ \text{p. u.}$$

- **Transformer Loading**

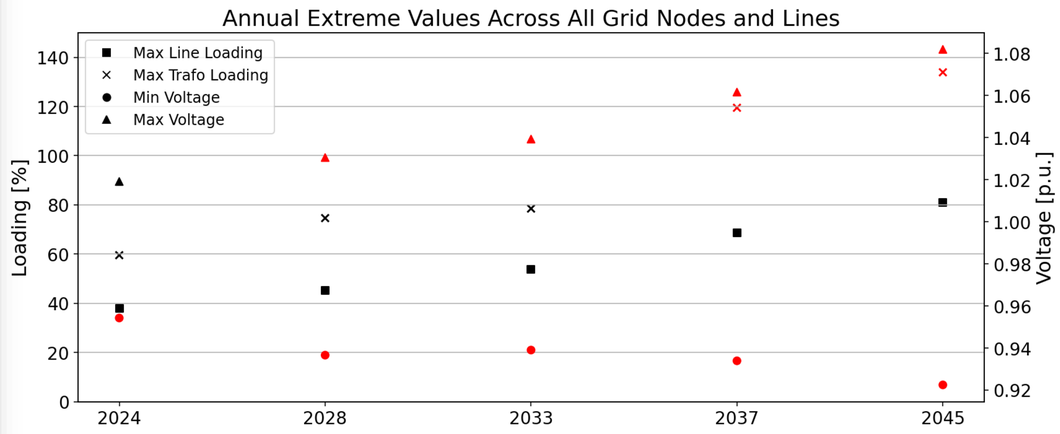
$$\frac{S_t}{S_{\text{nenn}}} \cdot 100 < 100\%$$

- **Line Loadings**

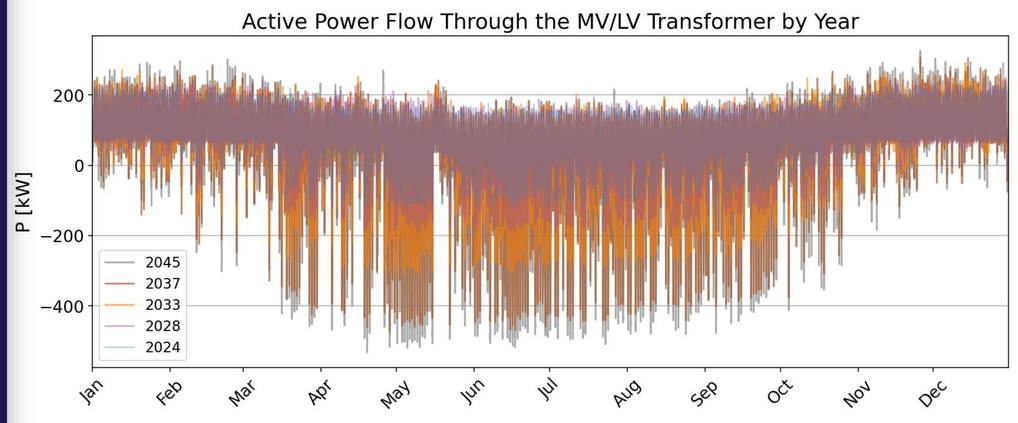
$$\frac{I_{line,t}}{I_{line,\max}} \cdot 100 < 100\%$$

p. u. – per unit; *U, S, I* – voltage, apparent power, current; nenn – nominal value; *line*,max – maximum thermal current

When Does Our Grid Exceed Its Limits?



→ Voltage limits are exceeded as early as 2028, well before the transformer overload occurs.



→ From 2037, high feed-ins into the medium-voltage grid are expected during the summer months.

Download the poster

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