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# New ways for evaluation and control concepts of distributed generation


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# DSO in Linz and 82 communities:

## Power Network

- 7,800 km power grid
- 26 transformer stations
- > 3.000 sub-stations

## Energy sales

- 275,000 customers
- 131,000 smart meters
- 400 MW Peak load
- 2,100 GWh energy transportation

# DG-Demonet

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- 8 Partners (2 Universities, 3 DSO´s, 3 Industry partners)
- Funded by Austrian Climate and Energy Fund (Total € 2.2 Mio)

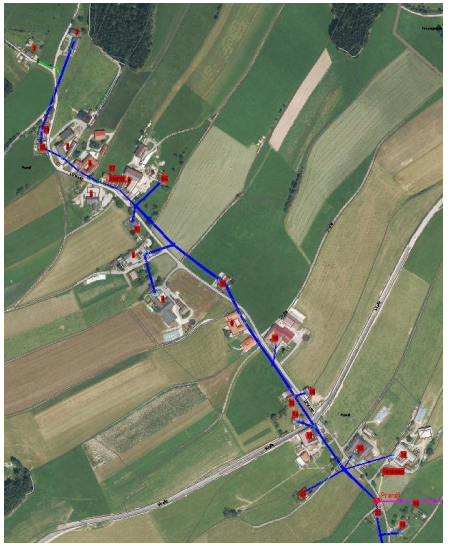
LINZ STROM Netz´ scope (Total costs 120,000 EUR, 65% granted):

- Develop new methods for network planning and evaluation in context with distributed generation
- Develop new control concepts for distributed generation
- Field test for evaluation of results

New methods: Probabilistic vs. conventional evaluation

Control concepts: Variation of reactive & active power

Field test: 16 PV-Plants with 140 kWp in rural area
connected to LV grid
(2 branches, overhead lines > 1,000 m length each)
Monitoring of voltage via Smart Meters



# Evaluation of PV-Plants

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**Conventional evaluation:**

- „Worst case“ estimation for feed in power and voltage
- No consideration of consumption
  ➔ maximum feed in power possible at any time
- estimated $\Delta U$ at field test plant +9% (limit +3%)

**Probabilistic evaluation:**

- Statistic distribution of voltage, consumption and feed in power regarded
  → more than 10,000 iterations with different values for voltage, feed in and consumption power (SMARTSIM)
- Develop a “reducing”-factor F for evaluation of $\Delta U$ in dependence of probability to meet voltage limit

# Control concepts(1)

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## Variation of reactive power:

## V1: Cos phi(P)-Control:

- P/Pn from 0 to 50%: power factor = 1
- P/Pn between 50% and 100%: linear increase of reactive power (Power factor between 1 and 0,9)

## V2: Q(U)-Control:

- U/Un from 100% to 104%: no reactive power consumed
- U/Un between 104% and 107%: linear increase of reactive power between cos phi 1 and 0,9

# Control concepts(2)

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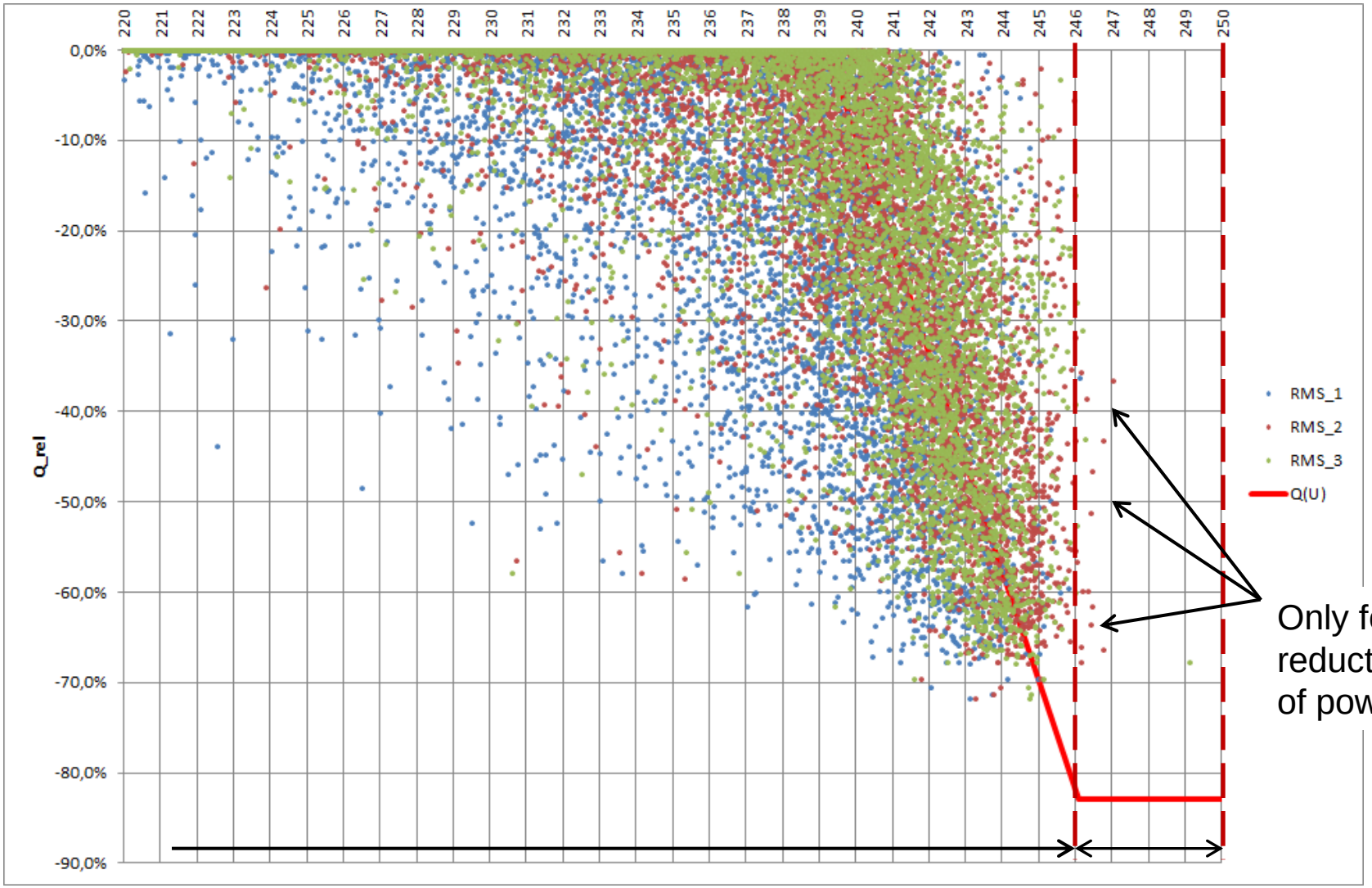
**Variation of active power:**

**P(U)-Control:**

- U/Un up to 107%: no reduction
- U/Un between 107% and 110%: linear reduction of feed in (active) power between 100% and 0%

# How did it work?



# Lessons learned

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**Evaluation**

- Probabilistic evaluation gives a very high correspondence between calculation and real data
- Higher number of plants can be connected to grid, when using “reduction” factor F
  (Field test region: installed capacity could be nearly doubled)

**Operation**

- Q(U)-Control better strategy than cos phi(P)
- P(U)-Control nearly not necessary
  (Field test region: energy not delivered ~1%)
- Single phase connection of DG leads to higher voltage increase and should be rejected by DSO
- Limits for energy not delivered have to be defined

# Thank you for attention!
# Questions?